



Department of  
Design and  
Construction

PROJECT ID:

PO002-116

THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

30-30 THOMSON AVENUE  
LONG ISLAND CITY, NEW YORK 11101-3045  
TELEPHONE (718) 391-1000  
WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

**LAW**

VOLUME 1 OF 3

# BID BOOKLET

FOR FURNISHING ALL LABOR AND MATERIALS  
NECESSARY AND REQUIRED FOR:

## New 116th Precinct Station House Rebid

LOCATION:  
BOROUGH:  
CITY OF NEW YORK

244-04 North Conduit Avenue  
Queens, NY 11422

CONTRACT NO. 1

GENERAL CONSTRUCTION WORK

New York City Police Department

Dattner Architects



Date:

August 29, 2019

**20-008**





**Department of  
Design and  
Construction**

Lorraine Grillo  
Commissioner

Jamie Torres-Springer  
First Deputy Commissioner

Justin Walter  
Chief Administrative Officer  
Administration

Nicholas Mendoza  
Agency Chief Contracting Officer

Lorraine Holley  
Deputy ACCO

March 04, 2020

**CERTIFIED MAIL - RETURN RECEIPT REQUEST**  
**CITNALTA CONSTRUCTION CORP.**  
**1601 LOCUST AVE.**  
**BOHEMIA, NY 11716**

**RE: FMS ID: PO002-116**  
**E-PIN: 85020B0004001**  
**DDC PIN: 8502020PD0001C**  
**NEW 116TH PRECINCT STATION HOUSE**  
**REBID-BOROUGH OF QUEENS**  
**NOTICE OF AWARD**

**Dear Contractor:**

You are hereby awarded the above referenced contract based upon your bid in the amount of \$77,971,962.00 submitted at the bid opening on October 11, 2019. Within ten (10) days of your receipt of this notice of award, you are required to take the actions set forth in Paragraphs (1) through (3) below. For your convenience, attached please find a copy of Schedule A of the General Conditions to the Contract, which sets forth the types and amounts of insurance coverage required for this contract.

- (1) Execute two copies of the Agreement in the Contracts Unit, 30-30 Thomson Avenue, 1<sup>st</sup> Floor, Long Island City, New York (IDCNY Building). A Commissioner of Deeds will be available to witness and notarize your signature. The Agreement must be signed by an officer of the corporation or a partner of the firm.
- (2) Submit to the Contracts Unit two properly executed performance and payment bonds. If required for this contract, copies of performance and payment bonds are attached.
- (3) Submit to the Contracts Unit the following insurance documentation: (a) original certificate of insurance for general liability in the amount required by Schedule A, and (b) original certificates of insurance or other proof of coverage for workers' compensation and disability benefits, as required by New York State Law. The insurance documentation specified in this paragraph is required for registration of the contract with the Comptroller's Office.



**Department of  
Design and  
Construction**

On or before the contract commencement date, you are required to submit all other certificates of insurance and/or policies in the types and amounts required by Schedule A. Such certificates of Insurance and/or policies must be submitted to the Agency Chief Contracting Office, Attention: Risk Manager, Fourth Floor at the above indicated department address.

Your attention is directed to the section of the Information for Bidders entitled "Failure to Execute Contract". As indicated in this section, in the event you fail to execute the contract and furnish the required bonds within the (10) days of your receipt of this notice of award, your bid security will be retained by the City and you will be liable for the difference between your bid price and the price for which the contract is subsequently awarded, less the amount of the bid security retained.

**As of August 16, 2019, please be advised that Contract Site Safety Plans for DDC projects must be submitted through DDC's online Site Safety Plan (SSP) application (available via our Agency Portal – DDC Anywhere).**

To create an account and begin your Site Safety Pan submission using SSP, click on the link below:

**DDC Portal** <https://ddcanywhere.nyc/Registration/Registration>

For questions regarding this web-based application, please contact DDC via email at: [appsupport@ddc.nyc.gov](mailto:appsupport@ddc.nyc.gov).

Sincerely,

A handwritten signature in black ink that reads "Lorraine Holley". The signature is fluid and cursive, with the first name and last name clearly distinguishable.

Lorraine Holley  
Deputy ACCO

# NOTICE TO BIDDERS

Please note that this Project includes to DDC's Expanded Work Allowance ("EWA") Pilot Program. The intent of this EWA Pilot Program is to limit change orders and expedite payments to contractors as part of DDC's overall strategy to improve its capital project delivery process. The EWA provides a funded, registered allowance for certain non-material changes in the work, as further explained in Specification 012200 in Volume 3 of 3.

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## **NOTICE TO BIDDERS:**

• **PROJECT LABOR AGREEMENT:** This contract is subject to a Project Labor Agreement ("PLA") entered into between the City and the Building and Construction Trades Council of Greater New York ("BCTC") affiliated Local Unions. By submitting a bid, the Contractor agrees that the PLA is binding on the Contractor and all subcontractors of all tiers. The bidder to be awarded the contract will be required to execute a "Letter of Assent" prior to award.

The Bidder is advised to review the following: (1) Notice regarding the PLA, (2) the PLA, and (3) the Letter of Assent, all of which are set forth at the beginning of Volume 2 of the Contract Documents.

• **SINGLE CONTRACT:** As stated above, this contract is subject to a PLA. The requirements of the Wicks Law for separate prime contractors DO NOT APPLY to any project that is covered by a PLA. Accordingly, the requirements of the Wicks Law for separate prime contractors do not apply to this Project. The Project consists of a single contract, the Contract for General Construction Work.

The Bidder is advised to review the Notice set forth at the beginning of Volume 2 of the Contract Documents. The Notice specifies revisions to the Contract Documents to provide that the Project consists of a single contract and to delete any and all references to separate prime contractors.

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## **PRE BID QUESTIONS (PBQs):**

Please be advised that PBQs should be submitted to the Agency Contact Person (CSB\_projectinquiries@ddc.nyc.gov) at least five (5) business days (by 5:00 PM EST) prior to the bid opening date as indicated in BID INFORMATION, and SCHEDULE B, VOLUME 1 OF 3 of this BID BOOKLET.

All PBQs must reference the Project ID. If a bidder has multiple PBQs for the same Project ID, the PBQs must be numbered sequentially, even if they are submitted separately.

## **NYC Contract Financing Loan Fund**

*Loans at a 3% annual interest rate to perform on New York City contracts*

If your business is working as a prime or subcontractor on a project with a City agency or City-funded entity, you may be eligible for a Contract Financing Loan from a participating lender coordinated with the NYC Department of Small Business Services (SBS). Loan repayment terms align with the contract payment schedule.

**Loans of up to \$500,000 at an annual interest rate of 3% are available to eligible\* businesses to perform on New York City contracts. Closing fees apply.**

\*To be eligible for a loan, you must:

- Have an operating business, AND
- Be applying for financing as a prime or sub-contractor to use toward a contract with a City agency or City-funded entity.
- Additional Eligibility requirements may also apply.

How it works:

Step 1: Fill out the Contract Financing inquiry form at [nyc.gov/contractfinancing](http://nyc.gov/contractfinancing)

Step 2: If Eligible, a participating lender will contact you within two business days.

Step 3: Begin the loan application process

For more information: Call 311 or visit [nyc.gov/contractfinancing](http://nyc.gov/contractfinancing)

**(NO FURTHER TEXT ON THIS PAGE)**

## **NYC Bond Collateral Assistance Fund**

If your business is bidding or planning to bid on a project as a prime or subcontractor with a City agency or the NYC Economic Development Corporation (NYCEDC) and the project requires surety bonding, you may be eligible\* to receive up to \$500,000 in Collateral Assistance to enhance your surety bond application from a participating bond service provider coordinated with the NYC Department of Small Business Services (SBS).

\*To be eligible, you must:

- Have an operating construction business, AND
- Be bidding or planning to bid as a prime or subcontractor on a contract with a City agency or NYCEDC that requires bonding
- Additional Eligibility requirements may apply.

How it works:

Step 1: Fill out the Bond Collateral Assistance Fund inquiry form at [nyc.gov/bondfund](http://nyc.gov/bondfund)

Step 2: If Eligible, the bond service provider will contact you within two business days

Step 3: Begin the bond application process

For more information: Call 311 or visit [nyc.gov/bondfund](http://nyc.gov/bondfund)

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**BID BOOKLET  
PART A**

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PROJECT ID: PO002-116

CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

BID BOOKLET

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**CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

**SPECIAL NOTICE TO BIDDERS**

**BID SUBMISSION REQUIREMENTS**

**THE BID SHALL CONSIST OF TWO (2) SEPARATE, SEALED  
ENVELOPES. THE DOCUMENTS THAT MUST BE COMPLETED AND  
INCLUDED IN EACH SEPARATE ENVELOPE ARE LISTED BELOW.**

**BID ENVELOPE #1:** Bid Envelope #1 shall contain the following items:

- Bid Form, including Affirmation
- Bid Security (if required, see page 22)
- Schedule B: M/WBE Utilization Plan (if participation goals have been established)

**BID ENVELOPE #2:** Bid Envelope #2 shall contain **ONLY** the following item:

- Bidder's Identification of Subcontractors (see pages 16 & 17)

**FAILURE TO SUBMIT THE FOUR ITEMS LISTED ABOVE  
WILL RESULT IN THE DISQUALIFICATION OF THE BID**

**BID ENVELOPE #1:** In addition to the items listed above, Bid Envelope #1 shall also contain the following items: DO NOT Include the items listed below in Bid Envelope #2.

- Bid Breakdown (if required, see page 21)
- Safety Questionnaire
- Construction Employment Report (if bid is \$1,000,000 or more)
- Bidder's Certification of Compliance with Iran Divestment Act
- Special Experience Requirements Qualification Form (if required, see pages 3, 4)
- Any Addenda issued prior to the receipt of bids

**FAILURE TO SUBMIT THE EIGHT ITEMS LISTED ABOVE  
MAY RESULT IN THE DISQUALIFICATION OF THE BID.**

- NOTES:**
- (1) All of the above referred to blank forms to be completed and submitted with the bid are included in the BID BOOKLET.
  - (2) If the bidder has any questions or requires additional information, please contact the Agency Contact Person noted on Attachment 1 of this Bid Booklet.
  - (3) **PASSPort Compliance:** The Bidder is advised that Vendex Questionnaires and procedures have been replaced by the PASSPort system. Compliance with PASSPort is mandatory for contract award. PASSPort details are set forth in Part B of this Bid Booklet.
  - (4) **SPECIAL EXPERIENCE REQUIREMENTS:** The Bidder is advised that Special Experience Requirements may apply to this contract. Such requirements are set forth on pages 3 and 4 of this Bid Booklet.
  - (5) **SPECIAL EXPERIENCE REQUIREMENTS FOR ASBESTOS:** The Bidder is advised that this contract contains strict requirements regarding the prior experience and licensing of the subcontractor who will perform any required asbestos abatement work. These special experience requirements are set forth in the section of the specifications which describes any required asbestos abatement work.

## Special Notice to Bidders – Proprietary Items

- A. General: A proprietary item required for the Project is specified below. The contractor is required to provide and install such proprietary item. The Contractor must provide the specified item from the designated manufacturer. Substitutions are not permissible and will not be approved. More detailed information regarding the item is set forth in the Specifications. Such information includes item description, as well as requirements for installation and related materials.
- B. Payment: For the required proprietary item, an allowance amount is indicated. The allowance provides a stipulated amount to reimburse the Contractor for the purchase of the proprietary item from the designated manufacturer. Payment from the allowance shall be limited to the purchase price of the specified proprietary item and shall exclude any costs above and beyond the purchase price. Payment from the allowance shall not include any of the following costs with respect to the specified proprietary item: (1) any mark-up for the Contractor's overhead and profit, (2) any costs for transportation, including delivery, shipping or special handling costs, (3) any costs for installation, and (4) any costs for related materials. Payment for the specified proprietary item shall be based on the invoice actually provided by the manufacturer.
- C. Bid Form: A total allowance amount for the purchase of all required proprietary items is set forth on the Bid Form. In preparing the lump sum portion of its bid, the Contractor shall:
- (1) Exclude from its bid any costs for the purchase of the proprietary items, and
  - (2) Include in its bid any costs above and beyond the purchase price, including without limitation, costs for transportation, delivery, installation, related materials and overhead.
- D. Required Proprietary Item(s):

### CONTRACT NO. 1:

1. Proprietary Item:

**CCTV Camera System**

*Camera Q3515-LV 9mm, Q3515-LVE 9mm, P3225-LV  
Mk II, Q6155-E 60Hz, Q-8414-LVS  
Camera Mounted recessed T94K01L  
Camera Ceiling Mount T91B63  
Camera Corner Bracket T91A64  
Camera Parapet Mount T91B62  
Camera Wall Mount T91D61*

Specification Section:

28 00 00 – Security Systems

Manufacturer:

Axis

Allowance Amount:

Not to Exceed \$ 96,384.00

2. Proprietary Item: **Card Reader System**  
*Network Intelligent Controller LNL-3300*  
*Duel Reader Interface Module LNL-1320*  
*Input Control Module LNL-1100*  
*Ethlan Micro board 10/10MBPS, LNL-ETHLAN-MICR On Board*  
*10/100MBPS Ethernet*  
*Cabinet w/ Power Supply LNL-600ULX-4CB*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Lenel  
Allowance Amount: Not to Exceed \$ 4,561.00
3. Proprietary Item: **Card Reader System**  
*Card Reader HID HP 40, HID RP*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: HID  
Allowance Amount: Not to Exceed \$ 4,240.00
4. Proprietary Item: **Card Reader System**  
*Request-to-Exit Motion Detector D5 150i*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Bosch  
Allowance Amount: Not to Exceed \$ 403.00
5. Proprietary Item: **Card Reader System**  
*Request-to-Exit Release Button TS2-2*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Alarm Control  
Allowance Amount: Not to Exceed \$ 1,209.00
6. Proprietary Item: **Card Reader System**  
*Cabinet w/ Relay Power Supply AL600ULACMCB8*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Alronix  
Allowance Amount: Not to Exceed \$ 290.00
7. Proprietary Item: **Card Reader System**  
*Door Contact Recessed 1076D-N (1078C)*  
*Magnet for Hollow Core Door 1840-N*  
*Door Contact surface Mount 1045T*  
*Door Contact Armored Cable 2507AD-L*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Interlogix United Technologies  
Allowance Amount: Not to Exceed \$ 50.00
8. Proprietary Item: **Card Reader System**  
*Overhead Door Contact ODC-59 Series*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Potter  
Allowance Amount: Not to Exceed \$ 7,254.00
9. Proprietary Item: **Card Reader System**  
*Battery N5P-12*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Yuasa Battery  
Allowance Amount: Not to Exceed \$ 800.00

10. Proprietary Item: **Card Reader System**  
*Access Control Flexible Cable (Plenum) AC251822BYE1000*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: West Penn  
Allowance Amount: Not to Exceed \$ 16,462.00
11. Proprietary Item: **Card Reader System**  
*Magnetic Lock V2M1200DB*  
*Magnetic Door Lock - Three Piece Bracket Z-V2M1200*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Securitron  
Allowance Amount: Not to Exceed \$ 3,676.00
12. Proprietary Item: **Card Reader System**  
*Magnetic Door Lock – Power Supply PS904*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Schlage  
Allowance Amount: Not to Exceed \$ 368.00
13. Proprietary Item: **Card Reader System**  
*Push Button 10250T597LRD2A-1X*  
Specification Section: 28 00 00 – Security Systems  
Manufacturer: Cutter Hammer  
Allowance Amount: Not to Exceed \$ 454.00
14. Proprietary Item: **Acoustically Rated Custom Security Door STC 54**  
*Flush Single Door and Frame 14 ga. "case open" Continuously welded mortar filled frame*  
*Flush Door 14 ga. flush door w/ 3/8" UC (proprietary Core)*  
Specification Section: 08 11 13 – Hollow Metal Doors and Frames  
Manufacturer: HMF Express  
Allowance Amount: Not to Exceed \$ 3,078.00
15. Proprietary Item: **Acoustically Rated Custom Security Door STC 54**  
*Door Hardware – Deadlock 1080A-2 – Keyed Both Sides*  
Specification Section: 08 70 00 – Finish Hardware  
Manufacturer: Southern Folger  
Allowance Amount: Not to Exceed \$ 661.00
16. Proprietary Item: **Acoustically Rated Custom Security Door STC 54**  
*Door Threshold – Rabbeted Threshold Zero- 566*  
*Cam Lift Hinges Zero-950*  
*Hardware Set – Head and Jambs Zero-770A*  
*Auto Door Bottom Zero-367*  
*Spring Bronze at Head and Jambs Zero-119W*  
Specification Section: 08 70 00 – Finish Hardware  
Manufacturer: Zero International by HMF  
Allowance Amount: Not to Exceed \$ 1,162.00
17. Proprietary Item: **Dry Chemical Extinguishing System**  
*Dry Chemical Extinguishing System*  
Specification Section: 21 24 00 – Dry Chemical Extinguishing System  
Manufacturer: Pyro-Chem  
Allowance Amount: Not to Exceed \$ 7,620.00

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## SPECIAL EXPERIENCE REQUIREMENTS

<b>Bidder(s):</b>	<b>General Construction Work</b>	<input checked="" type="checkbox"/> <b>YES</b>	<input type="checkbox"/> <b>NO</b>
<b>Specific Areas of Work:</b>	<b>General Construction Work</b>	<input checked="" type="checkbox"/> <b>YES</b>	<input type="checkbox"/> <b>NO</b>
	<b>HVAC Work</b>	<input checked="" type="checkbox"/> <b>YES</b>	<input type="checkbox"/> <b>NO</b>
	<b>Electrical Work</b>	<input checked="" type="checkbox"/> <b>YES</b>	<input type="checkbox"/> <b>NO</b>
<b>Manufacturer:</b>	<b>General Construction Work</b>	<input checked="" type="checkbox"/> <b>YES</b>	<input type="checkbox"/> <b>NO</b>
	<b>Electrical Work</b>	<input checked="" type="checkbox"/> <b>YES</b>	<input type="checkbox"/> <b>NO</b>

(A) **SPECIAL EXPERIENCE REQUIREMENTS FOR THE BIDDER IF APPLICABLE:** The special experience requirements set forth below apply to the bidder only if indicated above. Compliance with such special experience requirements will be determined solely by the City prior to an award of contract. Failure to comply with the special experience requirements will result in the rejection of the bid as non-responsive.

- The bidder must, within the last seven (7) years prior to the bid opening, have successfully completed in a timely fashion at least three (3) projects similar in scope, type, and size to the required work. Of the projects submitted:
  - a) include at least one (1) large construction project, involving the construction of a new building;
  - b) include at least one (1) construction project performed in a high-density urban/metropolitan environment; and
  - c) include at least one (1) large construction project involving a complex building type construction, such as a hospital, laboratory, airport, or a major institutional building.
- For the purposes of this solicitation, a "large construction project" shall mean a project with a construction cost of at least Forty Million (\$40,000,000) Dollars.

(B) **QUALIFICATION FORM:** For each project submitted to demonstrate compliance with the special experience requirements, the bidder(s) indicated above must complete the Qualification Form included in the Bid Booklet. The City will only evaluate a project if the following criteria are met: (1) the project is described on the Qualification Form, and (2) all information on the Qualification Form is provided. The City will not evaluate any project which does not comply with the criteria set forth herein, including any project which is referred to only on the resume of an individual.

(C) **CONDITIONS:** The City may, in determining compliance with the special experience requirements set forth above, consider prior projects completed by principal(s) or other employees of the bidder while affiliated with another entity, subject to the conditions set forth below.

- Any principal or other employee on whose prior experience the bidder is relying to demonstrate compliance with this special experience requirement must have held the following: (a) a significant management role in the prior entity with which he/she was affiliated, and (b) a significant management role in the entity submitting the bid for a period of six months or from the inception of the bidding entity. If the bidder is relying on the prior experience of a principal or employee, it must submit documentation confirming the position held by such principal or employee in the prior entity, as well as in the bidding entity.
- The bidder may not rely on the experience of its principals or other employees to demonstrate compliance with any other requirements, including without limitation, financial requirements or requirements for a specified minimum amount of annual gross revenues.

(D) **JOINT VENTURES:** In the event the bidder is a joint venture, at least one firm in the joint venture must meet the above described experience requirements.

(A) **SPECIAL EXPERIENCE REQUIREMENTS FOR SPECIFIC AREAS OF WORK:** The special experience requirements set forth below apply to the contractor or subcontractor that will perform specific areas of work. Compliance with such experience requirements will be evaluated after an award of contract. Within two (2) weeks of such award, the contractor will be required to submit the qualifications of the contractor or subcontractor that

will perform these specific areas of work. If the bidder intends to perform these specific areas of work with its own forces, it must demonstrate compliance with the special experience requirements. If the bidder intends to subcontract these specific areas of work, its proposed subcontractor(s) must demonstrate compliance with the special experience requirements. Once approved, no substitution will be permitted, unless the qualifications of the proposed replacement have been approved in writing in advance by the City. The bidder is advised to carefully review these special experience requirements prior to submitting its bid, as such experience requirements will be strictly enforced.

- (1) Special experience requirements apply to the contractor or subcontractor that will perform specific areas of work specified in the section(s) set forth below.

#### General Construction Work

- Section 033300: Architectural Concrete
- Section 034500: Precast Architectural Concrete
- Section 034800: Precast Concrete Specialties
- Section 051200: Structural Steel
- Section 057320: Decorative Metal Screens
- Section 071000: Foundation Waterproofing
- Section 075216: SBS Modified Bituminous Membrane Roofing
- Section 084413: Glazed Aluminum Curtain Walls
- Section 087000: Finish Hardware
- Section 096621: Resinous Matrix Terrazzo
- Section 131000: Vehicle Operable Barriers
- Section 142123: Traction Elevator
- Section 315000: Excavation Support and Protection
- Section 316800: Foundation Soil Anchor
- Section 323119: Decorative Metal Fences
- Section 329113: Planting Soils

#### HVAC Work:

- Section 212400: Dry Chemical Extinguishing System
- Section 230900: HVAC Instrumentation and Controls
- Section 231313: Underground Fuel Storage Tanks and Fuel

#### Electrical Work:

- Section 270000: Telecommunications Cabling Systems
- Section 280000: Security Systems

- (2) Special experience requirements applicable to the contractor or subcontractor who will perform specific areas of work are summarized below.

- The contractor or subcontractor performing the work of these sections (except 075216) must, within the last five (5) consecutive years prior to the bid opening, have successfully completed in a timely fashion at least three (3) projects similar in scope, size and type to the required work. In addition, for Sections 034800, 071000, 270000 and 280000, the contractor or subcontractor performing the work must be licensed or approved by the manufacturer.
- For Section 075216, the contractor or subcontractor performing the work of this section must be a company regularly engaged in performing roofing projects with its own workforce and have successfully completed in a timely fashion at least three (3) roofing projects similar in scope, size and type to the required work within the last three (3) consecutive years prior to the bid opening. At least one of those projects must have been performed within the last twelve (12) months. The three

(3) qualifying projects must have utilized one or more of the roofing systems specified for the project being bid herein, been installed by the contractor's or subcontractor's company utilizing its own workforce and must have qualified for, and have been issued, the warranty provided by the manufacturer of the roofing system. In addition, the contractor or subcontractor must be a certified or authorized installer for at least one of the manufacturer's roofing systems specified herein and shall submit proof of same.

(3) For each project submitted to demonstrate compliance with the special experience requirements for specific areas of work, the contractor or proposed subcontractor will be required to complete the Qualification Form included in the Bid Booklet.

a. The City will only evaluate a project if the following criteria are met: (1) the project is described on the Qualification Form, and (2) all information on the Qualification Form is provided. The City will not evaluate any project which does not comply with the criteria set forth herein, including any project which is referred to only on the resume of an individual.

b. For Section 075216, the contractor or subcontractor must specify, for each qualifying project submitted, the type of roofing system utilized and provide proof that the manufacturer's warranty for that project was issued. The City will only evaluate a project if the following criteria are met: (1) the project is described on the Qualification Form, and (2) all information required to be provided by the contractor or subcontractor on the Qualification Form is actually provided. The City will not evaluate any project which does not comply with the criteria set forth herein, including any project which is referred to only on the resume of an individual.

**(B) SPECIAL EXPERIENCE REQUIREMENTS FOR MANUFACTURER(S):** The special experience requirements set forth below apply to the manufacturer(s) that will supply or fabricate specific material or equipment. Compliance with such experience requirements will be evaluated after an award of contract. Within two (2) weeks of award, the contractor will be required to submit the qualifications of the proposed manufacturer(s). Once approved, no substitution will be permitted, unless the qualifications of the proposed replacement have been approved in writing in advance by the City.

(1) Special experience requirements apply to the manufacturer(s) of material and/or equipment specified in the section(s) set forth below.

#### General Construction Work

- Section 034500: Precast Architectural Concrete
- Section 034510: Thin Shell Precast Architectural Concrete
- Section 034800: Precast Concrete Specialties
- Section 034900: Glass-fiber Reinforced Concrete (GFRC)
- Section 074213: Insulated Metal Wall Panels
- Section 083463: Detention Doors and Frames
- Section 084333: Security Storefronts
- Section 096621: Resinous Matrix Terrazzo
- Section 131000: Vehicle Operable Barriers
- Section 142123: Traction Elevator
- Section 323119: Decorative Metal Fences
- Section 329113: Planting Soils

#### HVAC and Fire Suppression Work:

- Section 230900: HVAC Instrumentation and Controls
- Section 231313: Underground Fuel Storage Tanks and Fuel

## Electrical Work:

- Section 260943: Lighting Control System
- Section 265100: Interior Lighting
- Section 265600: Exterior Lighting

(2) Special experience requirements applicable to the manufacturer(s) of specified material or equipment are summarized below.

- The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.

## Qualification Form

Project ID: P0002-116

List previous projects completed to meet the special experience requirements for this contract. Please photocopy this form for submission of all required projects.

See attached project reference sheets

Name of Contractor: Citnalta Construction Corp.

Name of Project: PS 19 Queens

Location of Project: 40-10 99th Street, Queens, NY 11368

Owner or Owner's representative (Architect or Engineer) who is familiar with the work performed:

Name: Frank Szap

Title: Project Manager Phone Number: 718-472-8000

Brief description of work completed: New Addition & Existing Building Alterations

Was the work performed as a prime or a subcontractor: Prime

Amount of Contract: \$97,124,000.00

Date of Completion: 99% complete

\*\*\*\*\*

Name of Contractor: Citnalta Construction Corp.

Name of Project: PS 32 Brooklyn

Location of Project: 317 Hoyt Street, Brooklyn, NY 11231

Owner or Owner's representative (Architect or Engineer) who is familiar with the work performed:

Name: Edison Aguilar

Title: Project Manager Phone Number: 718-472-8000

Brief description of work completed: New Addition and Renovation to Existing Building

Was the work performed as a prime or a subcontractor: Prime

Amount of Contract: \$78,800,000.00

Date of Completion: 60% complete

## Qualification Form

Project ID: PO002-116

List previous projects completed to meet the special experience requirements for this contract. Please photocopy this form for submission of all required projects.

Name of Contractor: Citnalta Construction Corp.

Name of Project: PS 11 Queens

Location of Project: 54-25 Skillman Ave., Woodside, NY 11377

Owner or Owner's representative (Architect or Engineer) who is familiar with the work performed:

Name: Antonio Gentile

Title: Project Manager Phone Number: 718-472-8000

Brief description of work completed:

New Addition & Existing Building Upgrade

Was the work performed as a prime or a subcontractor: Prime

Amount of Contract: \$95,208,000.00

Date of Completion: 99% complete

\*\*\*\*\*

Name of Contractor: \_\_\_\_\_

Name of Project: \_\_\_\_\_

Location of Project: \_\_\_\_\_

Owner or Owner's representative (Architect or Engineer) who is familiar with the work performed:

Name: \_\_\_\_\_

Title: \_\_\_\_\_ Phone Number: \_\_\_\_\_

Brief description of work completed: \_\_\_\_\_

Was the work performed as a prime or a subcontractor: \_\_\_\_\_

Amount of Contract: \_\_\_\_\_

Date of Completion: \_\_\_\_\_

**CITNALTA CONSTRUCTION CORP.**

7/19

**Projects In Progress**

**PS 196 Queens**  
**New (4) Story Addition & Alterations**  
**Schedule Completion Date Jan 2022**  
**Contact: Lissa Pauld**  
**3030 Thomson Ave.**  
**LIC, NY 11101**  
**718-472-8000**

**Contract Amt: \$34,522,000.00**  
**Percent Complete: Just Underway**  
**Contract: C-15524**

**PS 361 Lease Conversion**  
**Construction of a new Elementary School**  
**Schedule Completion Date May 2020**  
**Contact: Bijan Radafshar**  
**14-07 20<sup>th</sup> Ave.**  
**Whitestone, NY 11356**  
**718-445-5295**

**Contract Amt: \$14,025,000.00**  
**Percent Complete: Just Underway**  
**Contract: C-14931**

**3K # 486Queens**  
**Construction of a new 3K @ PS 486Q**  
**Schedule Completion Date 8/2019**  
**Contact: Bijan Radafshar**  
**14-07 20<sup>th</sup> Ave.**  
**Whitestone, NY 11356**  
**718-445-5295**

**Contract Amt: \$5,490,000.00**  
**Percent Complete: 6%**  
**Contract: C-14931**

**PS 340 (Bronx)**  
**New Four Story Annex with Gymnasium**  
**Schedule Completion Date 9/2021**  
**Contact: Tanya Amusina**  
**30-30 Thomson Ave.**  
**Long Island City, NY 11101**  
**718-472-8000**

**Contract Amt: \$46,670,000**  
**Percent Complete: 1.5%**  
**Contract: C-15207**

**PS 97 (Brooklyn)**  
**New Four (4) Story Addition & Existing**  
**Building Alterations**  
**Schedule Completion Date 6/2021**  
**Contact: Marco Sutovic**  
**30-30 Thomson Ave.**  
**Long Island City, NY 11101**  
**718-472-8000**

**Contract Amt: \$48,892,000**  
**Percent Complete: 13%**  
**Contract: C-15033**

**ESI Pkg. #8 - 3 Stations**  
**Rehab of 145<sup>th</sup>, 167<sup>th</sup> & 174-175<sup>th</sup> Station**  
**Scheduled Completion Date 2018**  
**Contact: Frank Salvato**  
**2 Broadway**  
**New York, NY 10004**  
**646-252-6243**  
**Citnalta 50% partner on project**

**Contract Amt: \$93,175,000**  
**Percent Complete: 95%**  
**Contract: A-36622E**

**Design Build Services for LIRR ESI**  
**Rehab of 8 Long Island Railroad Stations**  
**Schedule Completion Date 2019**  
**Contact: Poonam Punj**  
**144-41 94<sup>th</sup> Avenue**  
**Jamaica, NY 11435**  
**516-369-6341**  
**Citnalta 50% partner on project**

**Contract Amt: \$81,748,000**  
**Percent Complete: 83%**  
**Contract: 6289**

**PS 32 (Brooklyn)**  
**New Addition and Renovation to**  
**Existing Building**  
**Scheduled Completion Date 2021**  
**Contact: Edison Aguilar**  
**30-30 Thomson Ave.**  
**L.I.C., NY 11101**  
**718-472-8000**

**Contract Amt: \$74,800,000**  
**Percent Complete: 50%**  
**Contract: C-14684**

**PS 19 (Queens)**  
**New Addition & Existing Bldg Alterations**  
**Schedule Completion Date 12/19**  
**Contact: Frank Szap**  
**NYC School Construction Authority**  
**30-30 Thomson Ave.**  
**L.I.C., NY 11101**  
**718-472-8000**

**Contract Amt: \$97,124,000**  
**Percent Complete: 97%**  
**Contract: C14379**



Hicksville Improvement  
North Track Siding Improvements  
Schedule Completion Date 5/2018  
Contact: Mrs. A. Natal  
MTA LIRR  
89 East 42<sup>nd</sup> Street  
New York, NY 10017  
718-725-2655

Citnalta 50% partner on project

Contract Amt: \$54,267,000  
Percent Complete: 99%  
Contract: 6202

PK 678 (Brooklyn)  
New Pre-K Center  
Schedule Completion Date 7/17  
Contact: Paul Ferrigno  
NYC School Construction Authority  
30-30 Thomson Ave  
L.I.C., New York 11101-3045  
718 472 8000

Contract Amt: \$26,633,000  
Percent Complete: 99%  
Contract: C14332

PS 77/IS 266 (Brooklyn)  
Exterior Masonry/Flood Elimination/  
Windows/Parapets & Roofs  
Scheduled Completion Date: 5/17  
Contact: Ronald Mezi  
NYC School Construction Authority  
30-30 Thomson Ave,  
L.I.C., New York 11101-3045  
718 472 8000

Contract Amt: \$39,668,000  
Percent Complete: 97%  
Contract: C13946

PS 11 (Queens)  
New Addition & Existing Building Upgrade  
Scheduled Completion Date: 2/14/19  
Contact: Antonio Gentile  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
718 472 8000

Contract Amt: \$95,208,000  
Percent Complete: 99%  
Contract: C13556

P.S. 35 Q  
New Building  
Scheduled Completion Date: 9/28/16  
Contact: Alonza Lloyd  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
718 472 8000

Contract Amt: \$46,620,000  
Percent Complete: 99%  
Contract: C13146

**PS 170 (Brooklyn)**  
**New Addition to Existing Building**  
**Scheduled Completion Date: 1/4/17**  
**Contact: George Wakin**  
**NYC School Construction Authority**  
**30-30 Thomson Ave.**  
**L.I.C., New York 11101-3045**  
**718 472 8000**

**Contract Amt: \$ 49,608,000**  
**Percent Complete: 99%**  
**Contract Amt: C13105**

**PS 313 (Queens)**  
**New Five Story School**  
**Scheduled Completion Date: 7/13**  
**Contact: Gordon Tung**  
**NYC School Construction Authority**  
**30-30 Thomson Ave.**  
**L.I.C., New York 11101-3045**  
**718 472 8000**

**Contract Amt: \$49,124,000**  
**Percent Complete: 99%**  
**Contract C12654**

**PS 70 (Queens)**  
**New Addition & ADA Upgrade to Existing School**  
**Scheduled Completion Date: 4/15**  
**Contact: Gordon Tung**  
**NYC School Construction Authority**  
**30-30 Thomson Ave.**  
**L.I.C., New York 11101-3045**  
**718 472 8000**

**Contract Amt: \$45,523,000**  
**Percent Complete: 99%**  
**Contract C12604**

**IS 297 (Queens)**  
**New Four (4) Story School & Playground**  
**Scheduled Completion Date: 8/18/14**  
**Contact: Aslam P. Qureshi**  
**NYC School Construction Authority**  
**30-30 Thomson Ave.**  
**L.I.C., New York 11101-3045**  
**718 472 8000**

**Contract Amt: \$23,737,000**  
**Percent Complete: 99%**  
**Contract C12465**

**CITNALTA CONSTRUCTION (Prime Contractor on all projects) 11 2455116**

**COMPLETED PROJECTS (PAST 10 YEARS)**

**ESI Pkg. #1 - 3 Stations  
Rehab of 53<sup>rd</sup> St, Bay Ridge, Prospect Stations  
Schedule Completion Date 11/2017  
Contact: Frank Salvato  
2 Broadway  
New York, NY 10004  
646-252-6243  
Citnalta 50% partner on project**

**Contract Amt: \$77,899,123**

**Contract: A-36622A**

**P.S. 292 (Bronx)  
New Four (4) Story Building  
Award Date: 6/23/10  
Scheduled Completion Date: 930 days  
Contact: Mario Sisca  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
718 472 8000**

**Contract Amt: \$33,023,364**

**Contract C11985**

**Pre-K Center at One Teleport Drive  
Scheduled Completion Date: 8/15  
Contact: Haks Engineering (CM)**

**Contract Amt: \$10,729,619**

**Contract: 13217**

**Repair of Brick Arch at 168<sup>th</sup> St.  
181<sup>st</sup> St. Station, B'way 7<sup>th</sup> Ave. Line  
Scheduled Completion Date: 8/15  
Contact: Olasupo Adewolu  
NYC Transit  
2 Broadway  
New York, New York 10004**

**Contract Amt: \$46,494,767**

**Contract A36193**

**P.S. 160 Annex (K)  
Design/Build New School & Existing  
Building Alteration**

**Award Date: 7/1/09**

**Schedule Completion Date: 3/17/13**

**Contact: Paul Ferrigno  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., NY 11101  
718-472-8000**

**Contract Amt: \$41,860,342  
Contract C-11643**

**Harlem RBI Dream  
Schedule Completion: 8/15  
Contact: Harlem Dream Partners, LLC  
c/o Civic GS LLC  
304 Hudson St., Suite 300  
New York, NY 10013  
212-571-7260**

**Contract Amt: \$22,352,684**

**South Beach Psychiatric Center  
Central Services Building  
Scheduled Completion Date: 5/28/14  
Owner: NYS Office of General Services  
Contact: Charles S. Ludlow,  
VP STV  
Construction Inc.  
225 Park Ave. South  
New York, New York 10003**

**Contract Amt: \$37,355,474  
Contract: SA065**

**Repair of Station Components at Five (5)  
Stations on the Broadway Line  
Award Date: 12/13  
Completion Date: 3/15**

**Contract Amt: \$10,716,728  
Contract: A36927**

**Improvements to Seven Stations, West End  
Line, Borough of Brooklyn  
Award Date: 8/3/09  
Substantial Completion 7/2/12  
Final Completion Date: 5/31/13  
Contact: Talib Lokhandwala  
NYC Transit  
2 Broadway  
New York, New York 10004  
\*Citnalta 50% partner on project**

**Contract Amt: \$92,814,566  
Contract #35797**

Rehab of the East 180<sup>th</sup> St. Station  
White Plains Rd. Line (IRT) in the  
Borough of the Bronx  
Award Date: 7/1/09  
Substantial Completion 5/31/12  
Final Completion Date: 4/19/13  
Contact: Abdul Muqtadir  
NYC Transit  
2 Broadway  
New York, New York 10004  
646 252 4668

Contract Amt: \$44,932,468  
Contract A35985/A35986

ECC 361 @ PS 94 (Bronx)  
A New Three Story School with a Full Cellar  
Award Date: June 29, 2007  
Completion Date: 11/30/12  
Contact: Lawrence Lee  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
718 472 8000

Contract Amt: \$35,563,812  
Contract C11032

CUNY School of Law Renovation  
Award Date: June 24, 2011  
Substantial Completion 4/20/12  
Final Completion 10/7/12  
Contact: Ron Barbaro  
Turner Construction Company (CM)  
375 Hudson St., 6<sup>th</sup> floor  
New York, New York 10014  
212 229 6210  
\*Citnalta 50% partner on project

Contract Amt: \$16,566,081\*  
Contract 1791800

PS 89 Brooklyn  
Design/Build a New 4 Story School  
With a Full Cellar  
Award Date: 11/14/08  
Substantial Completion 12/10  
Final Completion 6/12/13  
Contact: Michael Gonzalez/George Zhovna  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
917 295 0396/646 208 8408

Contract Amt: \$37,792,122  
Contract C11190

**Van Nest School  
New Building  
Award Date: June 11, 2008  
Completion Date: 4/2010  
Contact: Alejandro Triana – Civic Builders  
Broadway  
East Building, Suite 900  
New York, New York 10038  
212 571 7260**

**Contract Amt: \$60,171,814  
Contract C10289**

**Jay St./Lawrence Station Complex  
In the Borough of Brooklyn  
(JV with Schiavone Construction)  
Award Date: 3/26/07  
Completion Date: 7/2011  
Contact: Talib Lokhandwala  
NYC Transit  
2 Broadway  
New York, New York 10004  
646 252 4399**

**Contract Amt: \$109,580,437\*  
Contract A35913**

**Rehabilitation of 96<sup>th</sup> St. Station & ADA  
Broadway/7<sup>th</sup> Ave. Line (IRT) in the  
Borough of Manhattan  
Award Date: 5/15/07  
Substantial Completion 11/2010  
Final Completion Date: 10/31/2011  
Contact: Abdul Muqtadir  
NYC Transit  
2 Broadway – 16<sup>th</sup> floor  
New York, New York 10004**

**Contract Amount: \$65,926,213  
Contract A35822**

**Gregorio Luperon High School (Manhattan)  
New Four Story School and Full Cellar  
Award Date: 11/29/06  
Completion Date: 11/2008  
Contact: NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
718 472 8000**

**Contract Amt: \$37,778.151  
Contract C-10145**

Rehabilitation Fulton St. Station  
Clark St. Line "A" Div.- Manhattan  
Award Date: 12/20/04  
Substantial Completion 8/28/07  
Final Completion 5/31/08  
Surety: Travelers Casualty and Surety  
Contact: Talib Lokhandwala  
NYC Transit  
2 Broadway  
New York, New York 10004  
646 252 4399

Contract Amt: \$36,738,831  
Contract A-36024

Rehabilitation of Wall Street Station,  
Lexington Ave. Line (IRT) Borough of  
Manhattan  
Award Date: 12/28/05  
Substantial Completion 2/2008  
Final Completion 7/31/08  
Surety: Travelers Casualty and Surety  
Contact: Talib Lokhandwala  
NYC Transit 2 Broadway  
New York, New York 10004 646 252 4399

Contract Amt: \$22,176,415  
Contract A36023

New Building at Queens Gateway to Health  
Sciences Secondary School (Queens)  
Award Date: June 29, 2007  
Final Completion Date: 4/30/12  
Contact: Semen Vishnevsky  
NYC School Construction Authority  
30-30 Thomson Ave.  
L.I.C., New York 11101-3045  
718 472 8000

Contract Amt: \$78,772,123  
Contract C10542

Rehab Eastern Parkway/Five Stations  
103<sup>rd</sup>, 110<sup>th</sup>, 116<sup>th</sup> and 125<sup>th</sup> St. Stations  
Award Date: 12/30/02  
Substantial Completion 4/13/04  
Final Completion 8/31/04  
Contact: NYC Transit 646 252 4314

Contract Amt: \$61,126,527  
Architect: NYCT In-house  
Contract A35956,67,68,69,70  
Surety: Seaboard

**P.S. 254 Primary School**  
**Award Date: February 19, 2002**  
**Surety: Travelers Casualty and Surety**  
**Contact: Gordon Tung**  
**30-30 Thomson Ave.**  
**L.I.C., New York 11101-3045**  
**718 472 8000**

**Contract Amt: \$50,890,393**  
**Contract C8910**

**P.S. 268 Queens**  
**Design Build New Primary School**  
**Award Date: 6/20/01**  
**Completion Date: 11/1/03**  
**Contact: NYC SCA 718 472 8000**

**Contract Amt: \$45,010,568**  
**Architect: Anderson Larocca**  
**Anderson Haynes**  
**Contract C8798**

**General Contractor working with architect on design/build of new school.**

**P.S. 239 Queens**  
**Design/Build New 4 Story School**  
**Award Date: 12/22/00**  
**Date of Completion: 7/18/03**  
**Contact: NYC SCA 718 472 8000**

**Contract Amt: \$37,945,718**  
**Architect: John Ciardullo Assoc.**  
**Contract: C8599**

**General Contractor working with architect on design/build of new school.**

**Old Boys High School**  
**Owner: NYC School Construction Authority**  
**Start Date: 7/21/93**  
**Date of Completion: 1/31/99**  
**Surety: Seaboard Surety**  
**Contact: NYC SCA 718 472 8000**

**Contract Amt: \$26,025,168**  
**Architect: Ross & Bertolini**  
**Contract: C6423**

**General Contractor for interior modernization of historic school.**

**P.S. 262 Queens**  
**New Early Childhood Center**  
**Award Date: July 10, 2006**  
**Surety: Travelers Casualty and Surety**  
**Contact: Kenneth Faustmann**  
**NYC School Construction Authority**  
**30-30 Thomson Ave.**  
**L.I.C., New York 11101-3045**  
**718 472 8296**

**Contract Amt: \$21,930,738**  
**Contract C10016**



**P.S. 242 Queens**  
**Design Build/New Early Childhood School**  
**Award Date: 7/11/00**  
**Date of Completion: 9/26/01**  
**Surety: Seaboard Surety**  
**Contact: NYC SCA 781 472 8000**  
**General contractor working with architect on design/build of new school.**

**Contract Amt: \$20,000,000**  
**Architect: Anderson LaRocca**  
**Anderson Haynes**  
**Contract: C8459**

**Rehabilitation of 59<sup>th</sup> St. & Lexington Ave.**  
**Owner: NYC Transit**  
**Date of Award: 12/20/93**  
**Date of Completion: 12/31/97**  
**Surety: Seaboard Surety**  
**Contact: NYC Transit 212 632 7222**  
**General Contractor on rehabilitation of subway station.**

**Contract Amt: \$18,117,452**  
**Architect: In-house NYCTransit**  
**Contract: A-35718/A-35719**

**P.S. 228 Queens**  
**Design/Build Early Childhood Center**  
**Award Date: 5/2/00**  
**Date of Completion: 6/28/01**  
**Surety: Seaboard Surety**  
**Contact: NYC SCA 718 472 8000**  
**General Contractor working with architect on design/build of new school**

**Contract Amt: \$15,484,049**  
**Architect: R. Dattner & Partners**  
**Contract C8246**

**Upgrade of Kew Gardens/Union Turnpike**  
**Station for ADA Accessibility**  
**Award Date: 7/31/06**  
**Substantial Completion 7/18/08**  
**Final Completion 8/31/08**  
**Surety: Travelers Casualty and Surety**  
**Contact: Talib Lokhandwala**  
**NYC Transit**  
**2 Broadway**  
**New York, New York 10004**

**Contract Amt: \$14,877,110**  
**Contract A35919**

**57<sup>th</sup> St. & 7<sup>th</sup> Ave. Rehab**  
**Owner: NYC Transit**  
**Date of Completion: 10/9/96**  
**Surety: Seaboard Surety**  
**Contact: NYC Transit**  
**646 252 4399**

**Contract Amt: \$13,785,853**  
**Architect: NYC Transit In-House**  
**Contract A-35668/A-35669**

**P.S. 14 (Queens) Addition & Alteration**  
**Owner:** NYC School Construction Authority  
**Start Date:** 8/26/92  
**Date of Completion:** November 1995  
**Surety:** Fireman's Fund  
**Contact:** NYC SCA 718 472-8000  
**General Contractor on addition and interior alteration to existing school.**

**Contract Amount:** \$12,731,653  
**Architect:** Gran Sultan Assoc.  
**Contract C000005999**

**Rehabilitation of Canal Street Station**  
**Owner:** NYC Transit  
**Date of Completion:** 12/31/97  
**Surety:** Seaboard Surety  
**Contact:** NYC Transit 212 482 6518  
**General Contractor on rehabilitation of Canal Street.**

**Contract Amt:** \$12,520,686  
**Architect:** In-house NYC Transit  
**Contract:** A-35672R

**ADA Elevators and Station Entrance Canopy**  
**Bowling Green Station, Lexington Ave. Line**  
**(IRT) Borough of Manhattan**  
**Award Date:** 11/28/05  
**Substantial Completion** 5/28/07  
**Final Completion** 9/13/07  
**Surety:** Travelers Casualty  
**Contact:** Talilb Lokhandwala 646 252 4668  
**General contractor on station rehab including addition of handicap accessible elevators**

**Contract Amt.** \$11,719,568  
**Contract A36001/A36042**

**P.S. 135 Queens**  
**Design Build/Modular Addition**  
**Owner:** NYC School Construction Authority  
**Architect:** John Ciardullo Associates  
**Award Date:** 10/15/98  
**Date of Completion:** June 12, 1999 **Contact:** NYC SCA 718 472 8000  
**General Contractor working with architect on design/build of school and modular addition.**

**Contract Amt:** \$9,220,274  
**Contract C7705**

**P.S. 63 Queens**  
**Design/Build Modular/Stickbuilt**  
**Award Date:** 2/4/99  
**Date of Completion:** 10/00  
**Surety:** Seaboard Surety  
**Contact:** NYC SCA 718 472 8000  
**General Contractor working with architect on design/build to school.**

**Contract Amt:** \$8,950,102  
**Architect:** John Ciardullo Assoc.  
**Contract C7751**

**P.S. 107 Queens  
Design/Build Addition  
Award Date: 6/22/99**

**Date of Completion: 10/00**

**Surety: Seaboard Surety**

**Contact: NYC SCA 718 472 8000**

**General Contractor working with architect on design/build addition to school.**

**Contract Amt: \$8,889,434**

**Architect: Dindo Architect P.C.**

**Contract C7936**

**P.S. 123 (Queens)**

**Exterior Modernization, Boiler Conversion**

**Piping and Plumbing**

**Award Date: 10/21/97**

**Date of Completion: 12/9/99**

**Surety: Seaboard Surety**

**Contact: NYC SCA 718 472 8000**

**General Contractor on exterior modernization and boiler conversion.**

**Contract Amt: \$7,930,779**

**Architect: WASA**

**Contract C7384**

**Second Avenue Tunnel Rehabilitation**

**Owner: NYC Transit**

**Award Date: 12/26/96**

**Date of Completion: 5/26/00**

**Surety: Seaboard Surety**

**Contact: NYC Transit 212 373 5222**

**General Contractor on rehabilitation of tunnel.**

**Contract Amt: \$4,202,533**

**Architect: NYC Transit**

**Erasmus Hall High School**

**Phase II**

**Award Date: June 2, 2006**

**Date of Completion: November 2006**

**Contact: Robert Bowers**

**NYC School Construction Authority**

**30-30 Thomson Ave.**

**L.I.C, New York 11101-43045**

**718 472 8000**

**Contract Amt. \$4,618,459**

**Architect: NYC SCA**

**Contract C9862**

**Elderly/Handicapped Accessibility**

**Borough Hall Station -Rehab**

**Owner: NYC Transit**

**Start Date: 11/8/91**

**Date of Completion: January 1995**

**Surety: Fireman's Fund**

**Contact: Ray Zukauskas 212 482-6518**

**General Contractor on total Rehab to station with addition of handicap accessible elevator.**

**Contract Amount: \$2,882,475**

**Architect: NYC Transit In-house**

**Contract #A-35531**

**P.S. 12 Queens**  
**Early Childhood Center Addition**  
**(6,000 s.f.) and Misc. Work in Existing School**  
**Award Date: 2/12/04**  
**Date of Completion: 9/30/06**  
**Surety: Seaboard**  
**Contact: Julio Monroy 718 472 8000**  
**General contractor for addition to and work in existing school**

**Contract Amt. \$13,169,944**  
**Contract C9206**

**Improvements to H. Lee Dennison Building**  
**Owner: Suffolk County Dept. of Public Works**  
**Date of Completion: April 1998**  
**Start Date: June 28, 1996**  
**Surety: Seaboard Surety**  
**Contact: Mark Michaels 631 851 4000**  
**General Contractor on interior improvements to the H. Lee Dennison Bldg. in Suffolk.**

**Contract Amt: \$8,191,192**  
**Architect: Mark Michaels**

**Andrew Jackson High School**  
**Roof Upgrade/Window Replacement**  
**Owner: NYC School Construction Authority**  
**Start Date: 5/27/97**  
**Date of Completion: 11/27/98**  
**Surety: Seaboard Surety**  
**Contact: NYC SCA 718 472 8000**  
**General Contractor for roof upgrade and window replacement.**

**Contract Amt: \$6,377,701**  
**Architect: NYC SCA**  
**Contract: C7235**

## Qualification Form

Project ID: PO002-116

List previous projects completed to meet the special experience requirements for this contract. Please photocopy this form for submission of all required projects.

Name of Contractor: \_\_\_\_\_

Name of Project: \_\_\_\_\_

Location of Project: \_\_\_\_\_

Owner or Owner's representative (Architect or Engineer) who is familiar with the work performed:

Name: \_\_\_\_\_

Title: \_\_\_\_\_ Phone Number: \_\_\_\_\_

Brief description of work completed: \_\_\_\_\_

Was the work performed as a prime or a subcontractor: \_\_\_\_\_

Amount of Contract: \_\_\_\_\_

Date of Completion: \_\_\_\_\_

\*\*\*\*\*

Name of Contractor: \_\_\_\_\_

Name of Project: \_\_\_\_\_

Location of Project: \_\_\_\_\_

Owner or Owner's representative (Architect or Engineer) who is familiar with the work performed:

Name: \_\_\_\_\_

Title: \_\_\_\_\_ Phone Number: \_\_\_\_\_

Brief description of work completed: \_\_\_\_\_

Was the work performed as a prime or a subcontractor: \_\_\_\_\_

Amount of Contract: \_\_\_\_\_

Date of Completion: \_\_\_\_\_

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## MWBE PROGRAM

### M/WBE UTILIZATION PLAN

**M/WBE Program Requirements:** The requirements for the M/WBE Program are set forth on the following pages of this Bid Booklet, in the section entitled “Notice to All Prospective Contractors”.

**Schedule B: M/WBE Utilization Plan:** Schedule B: M/WBE Utilization Plan for this Contract is set forth in this Bid Booklet on the pages following the section entitled “Notice to All Prospective Contractors”. The M/WBE Utilization Plan (Part I) indicates whether Participation Goals have been established for this Contract. If Participation Goals have been established for this Contract, the bidder must submit an M/WBE Utilization Plan (Part II) with its bid.

**Waiver:** The bidder may seek a full or partial pre-award waiver of the Participation Goals in accordance with the “Notice to All Prospective Contractors” (See Part A, Section 10). The bidder’s request for a waiver must be submitted at least seven (7) calendar days prior to the bid date. Waiver requests submitted after the deadline will not be considered. The form for requesting a waiver of the Participation Goals is set forth in the M/WBE Utilization Plan (Part III).

**Rejection of the Bid:** The bidder must complete Schedule B: M/WBE Utilization Plan (Part II) set forth in this Bid Booklet on the pages following the section entitled “Notice to All Prospective Contractors”. A Schedule B submitted by the bidder which does not include the Vendor Certification and Required Affirmations (See Section V of Part II) will be deemed to be non-responsive, unless a full waiver of the Participation Goals is granted (Schedule B, Part III). In the event that the City determines that the bidder has submitted a Schedule B where the Vendor Certification and Required Affirmations are completed but other aspects of the Schedule B are not complete, or contain a copy or computation error that is at odds with the Vendor Certification and Required Affirmations, the bidder will be notified by the Agency and will be given four (4) calendar days from receipt of notification to cure the specified deficiencies and return a completed Schedule B to the Agency. Failure to do so will result in a determination that the Bid is non-responsive.

Receipt of notification is defined as the date notice is emailed or faxed (if the bidder has provided an email address or fax number), or no later than five (5) days from the date of mailing or upon delivery, if delivered.

**Impact on LBE Requirements:** If Participation Goals have been established for the participation of M/WBEs, the contractor is not required to comply with the Locally Based Enterprise Program (“LBE”). The LBE Program is set forth in Article 67 of the Contract.

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## NOTICE TO ALL PROSPECTIVE CONTRACTORS

### PARTICIPATION BY MINORITY-OWNED AND WOMEN-OWNED BUSINESS ENTERPRISES IN CITY PROCUREMENT

#### ARTICLE I. M/WBE PROGRAM

Local Law No. 129 of 2005 added and Local Law 1 of 2013 amended Section 6-129 of the Administrative Code of the City of New York (hereinafter "Section 6-129"). Section 6-129 establishes the program for participation in City procurement ("M/WBE Program") by minority-owned business enterprises ("MBEs") and women-owned business enterprises ("WBEs"), certified in accordance with Section 1304 of the New York City Charter. As stated in Section 6-129, the intent of the program is to address the impact of discrimination on the City's procurement process, and to promote the public interest in avoiding fraud and favoritism in the procurement process, increasing competition for City business, and lowering contract costs. The contract provisions contained herein are pursuant to Section 6-129, and the rules of the Department of Small Business Services ("DSBS") promulgated thereunder.

**If this Contract is subject to the M/WBE Program established by Section 6-129, the specific requirements of MBE and/or WBE participation for this Contract are set forth in Schedule B of the Contract (entitled the "M/WBE Utilization Plan"), and are detailed below. The Contractor must comply with all applicable MBE and WBE requirements for this Contract.**

All provisions of Section 6-129 are hereby incorporated in the Contract by reference and all terms used herein that are not defined herein shall have the meanings given such terms in Section 6-129. Article I, Part A, below, sets forth provisions related to the participation goals for construction, standard and professional services contracts. Article I, Part B, below, sets forth miscellaneous provisions related to the M/WBE Program.

#### PART A

#### PARTICIPATION GOALS FOR CONSTRUCTION, STANDARD AND PROFESSIONAL SERVICES CONTRACTS OR TASK ORDERS

1. The **MBE and/or WBE Participation Goals** established for this Contract or Task Orders issued pursuant to this Contract, ("Participation Goals"), as applicable, are set forth on Schedule B, Part I to this Contract (see Page 1, line 1 Total Participation Goals) or will be set forth on Schedule B, Part I to Task Orders issued pursuant to this Contract, as applicable.

The **Participation Goals** represent a percentage of the total dollar value of the Contract or Task Order, as applicable, that may be achieved by awarding subcontracts to firms certified with New York City Department of Small Business Services as MBEs and/or WBEs, and/or by crediting the participation of prime contractors and/or qualified joint ventures as provided in Section 3 below, unless the goals have been waived or modified by Agency in accordance with Section 6-129 and Part A, Sections 10 and 11 below, respectively.

2. If **Participation Goals** have been established for this Contract or Task Orders issued pursuant to this Contract, Contractor agrees or shall agree as a material term of the Contract that Contractor shall be subject to the **Participation Goals**, unless the goals are waived or modified by Agency in accordance with Section 6-129 and Part A, Sections 10 and 11 below, respectively.

3. If **Participation Goals** have been established for this Contract or Task Order issued pursuant to this Contract, a Contractor that is an MBE and/or WBE shall be permitted to count its own participation toward fulfillment of the relevant **Participation Goal**, provided that in accordance with Section 6-129 the value of Contractor's participation shall be determined by subtracting from the total value of the Contract or Task Order, as applicable, any amounts that the Contractor pays to direct subcontractors (as defined in Section 6-129(c)(13)), and provided further that a Contractor that is certified as both an MBE and a WBE may count its own participation either toward the goal for MBEs or the goal for WBEs, but not both.

A Contractor that is a qualified joint venture (as defined in Section 6-129(c)(30)) shall be permitted to count a percentage of its own participation toward fulfillment of the relevant **Participation Goal**. In accordance with Section 6-129, the value of Contractor's participation shall be determined by subtracting from the total value of the Contract or Task Order, as applicable, any amounts that Contractor pays to direct subcontractors, and then multiplying the remainder by the percentage to be applied to total profit to

determine the amount to which an MBE or WBE is entitled pursuant to the joint venture agreement, provided that where a participant in a joint venture is certified as both an MBE and a WBE, such amount shall be counted either toward the goal for MBEs or the goal for WBEs, but not both.

4. A. If **Participation Goals** have been established for this Contract, a prospective contractor shall be required to submit with its bid or proposal, as applicable, a completed Schedule B, M/WBE Utilization Plan, Part II (see Pages 2-4) indicating: (a) whether the contractor is an MBE or WBE, or qualified joint venture; (b) the percentage of work it intends to award to direct subcontractors; and (c) in cases where the contractor intends to award direct subcontracts, a description of the type and dollar value of work designated for participation by MBEs and/or WBEs, and the time frames in which such work is scheduled to begin and end. In the event that this M/WBE Utilization Plan indicates that the bidder or proposer, as applicable, does not intend to meet the **Participation Goals**, the bid or proposal, as applicable, shall be deemed non-responsive, unless Agency has granted the bidder or proposer, as applicable, a pre- award waiver of the Participation Goals in accordance with Section 6-129 and Part A, Section 10 below.

B. (i) If this Contract is for a master services agreement or other requirements type contract that will result in the issuance of Task Orders that will be individually registered ("Master Services Agreement") and is subject to M/WBE **Participation Goals**, a prospective contractor shall be required to submit with its bid or proposal, as applicable, a completed Schedule B, M/WBE Participation Requirements for Master Services Agreements That Will Require Individually Registered Task Orders, Part II (page 2) indicating the prospective contractor's certification and required affirmations to make all reasonable good faith efforts to meet participation goals established on each individual Task Order issued pursuant to this Contract, or if a partial waiver is obtained or such goals are modified by the Agency, to meet the modified **Participation Goals** by soliciting and obtaining the participation of certified MBE and/or WBE firms. In the event that the Schedule B indicates that the bidder or proposer, as applicable, does not intend to meet the **Participation Goals** that may be established on Task Orders issued pursuant to this Contract, the bid or proposal, as applicable, shall be deemed non-responsive.

(ii) **Participation Goals** on a Master Services Agreement will be established for individual Task Orders issued after the Master Services Agreement is awarded. If **Participation Goals** have been established on a Task Order, a contractor shall be required to submit a Schedule B – M/WBE Utilization Plan For Independently Registered Task Orders That Are Issued Pursuant to Master Services Agreements, Part II (see Pages 2-4) indicating: (a) whether the contractor is an MBE or WBE, or qualified joint venture; (b) the percentage of work it intends to award to direct subcontractors; and (c) in cases where the contractor intends to award direct subcontracts, a description of the type and dollar value of work designated for participation by MBEs and/or WBEs, and the time frames in which such work is scheduled to begin and end. The contractor must engage in good faith efforts to meet the **Participation Goals** as established for the Task Order unless Agency has granted the contractor a pre-award waiver of the Participation Goals in accordance with Section 6-129 and Part A, Section 10 below.

**C. THE BIDDER/PROPOSER MUST COMPLETE THE SCHEDULE B INCLUDED HEREIN (SCHEDULE B, PART II). A SCHEDULE B SUBMITTED BY THE BIDDER/PROPOSER WHICH DOES NOT INCLUDE THE VENDOR CERTIFICATION AND REQUIRED AFFIRMATIONS (SEE SECTION V OF PART II) WILL BE DEEMED TO BE NON-RESPONSIVE, UNLESS A FULL WAIVER OF THE PARTICIPATION GOALS IS GRANTED (SCHEDULE B, PART III). IN THE EVENT THAT THE CITY DETERMINES THAT THE BIDDER/PROPOSER HAS SUBMITTED A SCHEDULE B WHERE THE VENDOR CERTIFICATION AND REQUIRED AFFIRMATIONS ARE COMPLETED BUT OTHER ASPECTS OF THE SCHEDULE B ARE NOT COMPLETE, OR CONTAIN A COPY OR COMPUTATION ERROR THAT IS AT ODDS WITH THE VENDOR CERTIFICATION AND AFFIRMATIONS, THE BIDDER/PROPOSER WILL BE NOTIFIED BY THE AGENCY AND WILL BE GIVEN FOUR (4) CALENDAR DAYS FROM RECEIPT OF NOTIFICATION TO CURE THE SPECIFIED DEFICIENCIES AND RETURN A COMPLETED SCHEDULE B TO THE AGENCY. FAILURE TO DO SO WILL RESULT IN A DETERMINATION THAT THE BID/PROPOSAL IS NON-RESPONSIVE. RECEIPT OF NOTIFICATION IS DEFINED AS THE DATE NOTICE IS E-MAILED OR FAXED (IF THE BIDDER/PROPOSER HAS PROVIDED AN E-MAIL ADDRESS OR FAX NUMBER), OR NO LATER THAN FIVE (5) CALENDAR DAYS FROM THE DATE OF MAILING OR UPON DELIVERY, IF DELIVERED.**

5. Where an M/WBE Utilization Plan has been submitted, the Contractor shall, within 30 days of issuance by Agency of a notice to proceed, submit a list of proposed persons or entities to which it intends to award subcontracts within the subsequent 12 months. In the case of multi-year contracts, such list shall also be submitted every year thereafter. The Agency may also require the Contractor to report periodically about the contracts awarded by its direct subcontractors to indirect subcontractors (as defined in Section 6-129(c)(22)). **PLEASE NOTE: If this Contract is a public works project subject to GML §101(5) (i.e., a contract valued at or**

below \$3M for projects in New York City) or if the Contract is subject to a project labor agreement in accordance with Labor Law §222, and the bidder is required to identify at the time of bid submission its intended subcontractors for the Wicks trades (plumbing and gas fitting; steam heating, hot water heating, ventilating and air conditioning (HVAC); and electric wiring), the Contractor must identify all those to which it intends to award construction subcontracts for any portion of the Wicks trade work at the time of bid submission, regardless of what point in the life of the contract such subcontracts will occur. In identifying intended subcontractors in the bid submission, bidders may satisfy any Participation Goals established for this Contract by proposing one or more subcontractors that are MBEs and/or WBEs for any portion of the Wicks trade work. In the event that the Contractor's selection of a subcontractor is disapproved, the Contractor shall have a reasonable time to propose alternate subcontractors.

6. MBE and WBE firms must be certified by DSBS in order for the Contractor to credit such firms' participation toward the attainment of the **Participation Goals**. Such certification must occur prior to the firms' commencement of work. A list of MBE and WBE firms may be obtained from the DSBS website at [www.nyc.gov/buycertified](http://www.nyc.gov/buycertified), by emailing DSBS at [buyer@sbs.nyc.gov](mailto:buyer@sbs.nyc.gov), by calling (212) 513-6356, or by visiting or writing DSBS at 110 William St., New York, New York, 10038, 7th floor. Eligible firms that have not yet been certified may contact DSBS in order to seek certification by visiting [www.nyc.gov/getcertified](http://www.nyc.gov/getcertified), emailing [MWBE@sbs.nyc.gov](mailto:MWBE@sbs.nyc.gov), or calling the DSBS certification helpline at (212) 513-6311. A firm that is certified as both an MBE and a WBE may be counted either toward the goal for MBEs or the goal for WBEs, but not both. No credit shall be given for participation by a graduate MBE or graduate WBE, as defined in Section 6-129(c)(20).

7. Where an **M/WBE Utilization Plan** has been submitted, the Contractor shall, with each voucher for payment, and/or periodically as Agency may require, submit statements, certified under penalty of perjury, which shall include, but not be limited to: the total amount the Contractor paid to its direct subcontractors, and, where applicable pursuant to Section 6-129(j), the total amount direct subcontractors paid to indirect subcontractors; the names, addresses and contact numbers of each MBE or WBE hired as a subcontractor by the Contractor, and, where applicable, hired by any of the Contractor's direct subcontractors; and the dates and amounts paid to each MBE or WBE. The Contractor shall also submit, along with its voucher for final payment: the total amount it paid to subcontractors, and, where applicable pursuant to Section 6-129(j), the total amount its direct subcontractors paid directly to their indirect subcontractors; and a final list, certified under penalty of perjury, which shall include the name, address and contact information of each subcontractor that is an MBE or WBE, the work performed by, and the dates and amounts paid to each.

8. If payments made to, or work performed by, MBEs or WBEs are less than the amount specified in the Contractor's **M/WBE Utilization Plan**, Agency shall take appropriate action, in accordance with Section 6-129 and Article II below, unless the Contractor has obtained a modification of its **M/WBE Utilization Plan** in accordance with Section 6-129 and Part A, Section 11 below.

9. Where an **M/WBE Utilization Plan** has been submitted, and the Contractor requests a change order the value of which exceeds the greater of 10 percent of the Contract or Task Order, as applicable, or \$500,000, Agency shall review the scope of work for the Contract or Task Order, as applicable, and the scale and types of work involved in the change order, and determine whether the **Participation Goals** should be modified.

10. Pre-award waiver of the **Participation Goals**. (a) A bidder or proposer, or contractor with respect to a Task Order, may seek a pre-award full or partial waiver of the **Participation Goals** in accordance with Section 6-129, which requests that Agency change one or more **Participation Goals** on the grounds that the **Participation Goals** are unreasonable in light of the availability of certified firms to perform the services required, or by demonstrating that it has legitimate business reasons for proposing a lower level of subcontracting in its **M/WBE Utilization Plan**.

(b) To apply for a full or partial waiver of the **Participation Goals**, a bidder, proposer, or contractor, as applicable, must complete Part III (Page 5) of Schedule B and submit such request no later than seven (7) calendar days prior to the date and time the bids, proposals, or Task Orders are due, in writing to the Agency by email at [zhangji@ddc.nyc.gov](mailto:zhangji@ddc.nyc.gov) or via facsimile at (718) 391-1886. Bidders, proposers, or contractors, as applicable, who have submitted requests will receive an Agency response by no later than two (2) calendar days prior to the due date for bids, proposals, or Task Orders; provided, however, that if that date would fall on a weekend or holiday, an Agency response will be provided by close-of-business on the business day before such weekend or holiday date.

(c) If the Agency determines that the **Participation Goals** are unreasonable in light of the availability of certified firms to perform the services required, it shall revise the solicitation and extend the deadline for bids and proposals, or revise the Task Order, as applicable.

(d) Agency may grant a full or partial waiver of the Participation Goals to a bidder, proposer or contractor, as applicable, who demonstrates—before submission of the bid, proposal or Task Order, as applicable—that it has legitimate business reasons for proposing the level of subcontracting in its M/WBE Utilization Plan. In making its determination, Agency shall consider factors that shall include but not be limited to, whether the bidder, proposer or contractor, as applicable, has the capacity and the bona fide intention to perform Contract without any subcontracting, or to perform the Contract without awarding the amount of subcontracts represented by the Participation Goals. In making such determination, Agency may consider whether the M/WBE Utilization Plan is consistent with past subcontracting practices of the bidder, proposer or contractor, as applicable, whether the bidder, proposer or contractor, as applicable, has made efforts to form a joint venture with a certified firm, and whether the bidder, proposer, or contractor, as applicable, has made good faith efforts to identify other portions of the Contract that it intends to subcontract.

11. Modification of M/WBE Utilization Plan. (a) A Contractor may request a modification of its M/WBE Utilization Plan after award of this Contract. PLEASE NOTE: If this Contract is a public works project subject to GML §101(5) (i.e., a contract valued at or below \$3M for projects in New York City) or if the Contract is subject to a project labor agreement in accordance with Labor Law §222, and the bidder is required to identify at the time of bid submission its intended subcontractors for the Wicks trades (plumbing and gas fitting; steam heating, hot water heating, ventilating and air conditioning (HVAC); and electric wiring), the Contractor may request a Modification of its M/WBE Utilization Plan as part of its bid submission. The Agency may grant a request for Modification of a Contractor's M/WBE Utilization Plan if it determines that the Contractor has established, with appropriate documentary and other evidence, that it made reasonable, good faith efforts to meet the Participation Goals. In making such determination, Agency shall consider evidence of the following efforts, as applicable, along with any other relevant factors:

- (i) The Contractor advertised opportunities to participate in the Contract, where appropriate, in general circulation media, trade and professional association publications and small business media, and publications of minority and women's business organizations;
- (ii) The Contractor provided notice of specific opportunities to participate in the Contract, in a timely manner, to minority and women's business organizations;
- (iii) The Contractor sent written notices, by certified mail or facsimile, in a timely manner, to advise MBEs or WBEs that their interest in the Contract was solicited;
- (iv) The Contractor made efforts to identify portions of the work that could be substituted for portions originally designated for participation by MBEs and/or WBEs in the M/WBE Utilization Plan, and for which the Contractor claims an inability to retain MBEs or WBEs;
- (v) The Contractor held meetings with MBEs and/or WBEs prior to the date their bids or proposals were due, for the purpose of explaining in detail the scope and requirements of the work for which their bids or proposals were solicited;
- (vi) The Contractor made efforts to negotiate with MBEs and/or WBEs as relevant to perform specific subcontracts, or act as suppliers or service providers;
- (vii) Timely written requests for assistance made by the Contractor to Agency's M/WBE liaison officer and to DSBS;
- (viii) Description of how recommendations made by DSBS and Agency were acted upon and an explanation of why action upon such recommendations did not lead to the desired level of participation of MBEs and/or WBEs.

Agency's M/WBE officer shall provide written notice to the Contractor of the determination.

(b) The Agency may modify the **Participation Goals** when the scope of the work has been changed by the Agency in a manner that affects the scale and types of work that the Contractor indicated in its **M/WBE Utilization Plan** would be awarded to subcontractors.

12. If this Contract is for an indefinite quantity of construction, standard or professional services or is a requirements type contract and the Contractor has submitted an **M/WBE Utilization Plan** and has committed to subcontract work to MBEs and/or WBEs in order to meet the **Participation Goals**, the Contractor will not be deemed in violation of the M/WBE Program requirements for this Contract with regard to any work which was intended to be subcontracted to an MBE and/or WBE to the extent that the Agency has determined that such work is not needed.

13. If **Participation Goals** have been established for this Contract or a Task Order issued pursuant to this Contract, at least once annually during the term of the Contract or Task Order, as applicable, Agency shall review the Contractor's progress toward attainment of its M/WBE Utilization Plan, including but not limited to, by reviewing the percentage of work the Contractor has actually awarded to MBE and/or WBE subcontractors and the payments the Contractor made to such subcontractors.

14. If **Participation Goals** have been established for this Contract or a Task Order issued pursuant to this Contract, Agency shall evaluate and assess the Contractor's performance in meeting those goals, and such evaluation and assessment shall become part of the Contractor's overall contract performance evaluation.

## **PART B: MISCELLANEOUS**

1. The Contractor shall take notice that, if this solicitation requires the establishment of an **M/WBE** Utilization Plan, the resulting contract may be audited by DSBS to determine compliance with Section 6-129. See §6-129(e)(10). Furthermore, such resulting contract may also be examined by the City's Comptroller to assess compliance with the **M/WBE** Utilization Plan.
2. Pursuant to DSBS rules, construction contracts that include a requirement for an **M/WBE** Utilization Plan shall not be subject to the law governing Locally Based Enterprises set forth in Section 6-108.1 of the Administrative Code of the City of New York.
3. DSBS is available to assist contractors and potential contractors in determining the availability of MBEs and/or WBEs to participate as subcontractors, and in identifying opportunities that are appropriate for participation by MBEs and/or WBEs in contracts.
4. Prospective contractors are encouraged to enter into qualified joint venture agreements with MBEs and/or WBEs as defined by Section 6-129(c)(30).
5. By submitting a bid or proposal the Contractor hereby acknowledges its understanding of the M/WBE Program requirements set forth herein and the pertinent provisions of Section 6-129, and any rules promulgated thereunder, and if awarded this Contract, the Contractor hereby agrees to comply with the M/WBE Program requirements of this Contract and pertinent provisions of Section 6-129, and any rules promulgated thereunder, all of which shall be deemed to be material terms of this Contract. The Contractor hereby agrees to make all reasonable, good faith efforts to solicit and obtain the participation of MBEs and/or WBEs to meet the required **Participation Goals**.

## **ARTICLE II. ENFORCEMENT**

1. If Agency determines that a bidder or proposer, as applicable, has, in relation to this procurement, violated Section 6-129 or the DSBS rules promulgated pursuant to Section 6-129, Agency may disqualify such bidder or proposer, as applicable, from competing for this Contract and the Agency may revoke such bidder's or proposer's prequalification status, if applicable.
2. Whenever Agency believes that the Contractor or a subcontractor is not in compliance with Section 6-129 or the DSBS rules promulgated pursuant to Section 6-129, or any provision of this Contract that implements Section 6-129, including, but not limited to any **M/WBE** Utilization Plan, Agency shall send a written notice to the Contractor describing the alleged noncompliance and offering the Contractor an opportunity to be heard. Agency shall then conduct an investigation to determine whether such Contractor or subcontractor is in compliance.
3. In the event that the Contractor has been found to have violated Section 6-129, the DSBS rules promulgated pursuant to Section 6-129, or any provision of this Contract that implements Section 6-129, including, but not limited to, any **M/WBE** Utilization Plan, Agency may determine that one of the following actions should be taken:
  - (a) entering into an agreement with the Contractor allowing the Contractor to cure the violation;
  - (b) revoking the Contractor's pre-qualification to bid or make proposals for future contracts;
  - (c) making a finding that the Contractor is in default of the Contract;
  - (d) terminating the Contract;
  - (e) declaring the Contractor to be in breach of Contract;
  - (f) withholding payment or reimbursement;
  - (g) determining not to renew the Contract;
  - (h) assessing actual and consequential damages;

- (i) assessing liquidated damages or reducing fees, provided that liquidated damages may be based on amounts representing costs of delays in carrying out the purposes of the M/WBE Program, or in meeting the purposes of the Contract, the costs of meeting utilization goals through additional procurements, the administrative costs of investigation and enforcement, or other factors set forth in the Contract;
- (j) exercising rights under the Contract to procure goods, services or construction from another contractor and charge the cost of such contract to the Contractor that has been found to be in noncompliance; or
- (k) taking any other appropriate remedy.

4. If an **M/WBE** Utilization Plan has been submitted, and pursuant to this Article II, Section 3, the Contractor has been found to have failed to fulfill its **Participation Goals** contained in its **M/WBE** Utilization Plan or the **Participation Goals** as modified by Agency pursuant to Article I, Part A, Section 11, Agency may assess liquidated damages in the amount of ten percent (10%) of the difference between the dollar amount of work required to be awarded to MBE and/or WBE firms to meet the **Participation Goals** and the dollar amount the Contractor actually awarded and paid, and/or credited, to MBE and/or WBE firms. In view of the difficulty of accurately ascertaining the loss which the City will suffer by reason of Contractor's failure to meet the **Participation Goals**, the foregoing amount is hereby fixed and agreed as the liquidated damages that the City will suffer by reason of such failure, and not as a penalty. Agency may deduct and retain out of any monies which may become due under this Contract the amount of any such liquidated damages; and in case the amount which may become due under this Contract shall be less than the amount of liquidated damages suffered by the City, the Contractor shall be liable to pay the difference.

5. Whenever Agency has reason to believe that an MBE and/or WBE is not qualified for certification, or is participating in a contract in a manner that does not serve a commercially useful function (as defined in Section 6-129(c)(8)), or has violated any provision of Section 6-129, Agency shall notify the Commissioner of DSBS who shall determine whether the certification of such business enterprise should be revoked.

6. Statements made in any instrument submitted to Agency pursuant to Section 6-129 shall be submitted under penalty of perjury and any false or misleading statement or omission shall be grounds for the application of any applicable criminal and/or civil penalties for perjury. The making of a false or fraudulent statement by an MBE and/or WBE in any instrument submitted pursuant to Section 6-129 shall, in addition, be grounds for revocation of its certification.

7. The Contractor's record in implementing its **M/WBE** Utilization Plan shall be a factor in the evaluation of its performance. Whenever Agency determines that a Contractor's compliance with an **M/WBE** Utilization Plan has been unsatisfactory, Agency shall, after consultation with the City Chief Procurement Officer, file an advice of caution form for inclusion in VENDEX as caution data.

Tax ID #: 11-2455116

APT E-  
PIN#: 85020B0004

Contract # 1 - General Construction Work

**SCHEDULE B - MWBE Utilization Plan****Part I: MWBE Participation Goals**

Part I to be completed by contracting agency

**Contract Overview**

APT E-Pin # 85020B0004 FMS Project ID#: PO002-116  
 Project Title/Agency New 116th Precinct Station House Rebid  
 PIN # 8502020PD0001C  
 Bid/Proposal Response Date: October 9, 2019  
 Contracting Agency Department of Design and Construction  
 Agency Address 30-30 Thomson Avenue City Long Island City State NY Zip Code 11101  
 Contact Person Kristen Carroll Title MWBE Outreach & Compliance Analyst  
 Telephone # (718) 391-2404 Email Carrollkr2@ddc.nyc.gov

This Project consists of the 116th Precinct Station House. The new building will be sited adjacent to the existing 105th Precinct Annex, located on North Conduit Avenue between Francis Lewis Boulevard and 138th Avenue, in the Rosedale neighborhood of Queens.

The new building is 2 stories and includes a cellar level. Parking for the new facility will be provided in a surface lot behind the new building, as well as in a new surface lot in front of the existing 105th Precinct Annex. Fueling for the 116th precinct vehicles will be located at the rear parking lot of the new precinct.

An open space on axis with the LIRR entrance creates a new public open space. The main entrance to the new 2-story precinct station house opens off the new public open space. A secondary entrance, directly to the Community Room, is provided on North Conduit Avenue. The building is designed to be certified LEED Silver and will conform with Local Law 86.

**MWBE Participation Goals**

Enter the amount of each group of firms or services that you intend to use in this project. Please note that there are no goals for Black Americans or Hispanic Americans in this project.

Prime Contract Industry: Construction

Group	Percentage	
<u>Unspecified *</u>	<u>33</u>	<u>%</u>
OR		
<u>Black American</u>		<u>%</u>
<u>Hispanic American</u>		<u>%</u>
<u>Asian American</u>		<u>%</u>
<u>Women</u>		<u>%</u>
<b>Total Participation Goals</b>	<b>33</b>	<b>%</b>

Line 1

\* Note: For this procurement, individual ethnicity and gender goals are not specified. The Total Participation Goals for construction contracts may be met by using Black American, Hispanic American, Asian American or Women certified firms or any combination of such firms.

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Tax ID #: 11-2455116

APT E-

PIN#: 85020B0004

**SCHEDULE B - Part II: M/WBE Participation Plan**

Part II to be completed by the bidder/proposer:

Please note: For Non-M/WBE Prime Contractors who will NOT subcontract any services and will self-perform the entire contract, you must obtain a FULL waiver by completing the Waiver Application on pages 9 and 9a and timely submitting it to the contracting agency pursuant to the Notice to Prospective Contractors. Once a FULL WAIVER is granted, it must be included with your bid or proposal and you do not have to complete or submit this form with your bid or proposal.

**Section I: Prime Contractor Contact Information**

<b>Tax ID #</b>	11-2455116	<b>FMS Vendor ID #</b>	
<b>Business Name</b>	Citnalta Construction Corp.	<b>Contact Person</b>	Jay Dier
<b>Address</b>	1601 Locust Ave., Bohemia, NY 11716		
<b>Telephone #</b>	631-563-1110	<b>Email</b>	JDier@citnalta.com

**Section II: M/WBE Utilization: Goal Calculation: Check the applicable box and complete subsection.****PRIME CONTRACTOR ADOPTING AGENCY M/WBE PARTICIPATION GOALS**

<input checked="" type="checkbox"/> <b>For Prime Contractors (including Qualified Joint Ventures and M/WBE firms) adopting Agency M/WBE Participation Goals.</b>  Calculate the total dollar value of your total bid that you agree will be awarded to M/WBE subcontractors for services and/or credited to an M/WBE prime contractor or Qualified Joint Venture.  Please review the Notice to Prospective Contractors for more information on how to obtain credit for M/WBE participation.	<b>Total Bid/Proposal Value</b>  77,971,962  \$	<b>Agency Total Participation Goals (Line 1, Page 6)</b>  33 %  X	<b>Calculated M/WBE Participation Amount</b>  25,730,748  \$ Line 2
--	---	---	---

**PRIME CONTRACTOR OBTAINED PARTIAL WAIVER APPROVAL: ADOPTING MODIFIED M/WBE PARTICIPATION GOALS**

<input type="checkbox"/> <b>For Prime Contractors (including Qualified Joint Ventures and M/WBE firms) adopting Modified M/WBE Participation Goals.</b>  Calculate the total dollar value of your total bid that you agree will be awarded to M/WBE subcontractors for services and/or credited to an M/WBE prime contractor or Qualified Joint Venture.  Please review the Notice to Prospective Contractors for more information on how to obtain credit for M/WBE participation.	<b>Total Bid/Proposal Value</b>    \$	<b>Adjusted Participation Goal (From Partial Waiver)</b>    X	<b>Calculated M/WBE Participation Amount</b>    \$ Line 3
---	---	---	---

**Section III: M/WBE Utilization Plan: How Proposer/Bidder Will Fulfill M/WBE Participation Goals. Please review the Notice to Prospective Contractors for more information on how to obtain credit for M/WBE participation. Check applicable box. The Proposer or Bidder will fulfill the M/WBE Participation Goals:**

☐ As an M/WBE Prime Contractor that will self-perform and/or subcontract to other M/WBE firms a portion of the contract the value of which is at least the amount located on Lines 2 or 3 above, as applicable. The value of any work subcontracted to non-M/WBE firms will not be credited towards fulfillment of M/WBE Participation Goals. Please check all that apply to Prime Contractor:

☐ MBE ☐ WBE

☐ As a Qualified Joint Venture with an M/WBE partner, in which the value of the M/WBE partner's participation and/or the value of any work subcontracted to other M/WBE firms is at least the amount located on Lines 2 or 3 above, as applicable. The value of any work subcontracted to non M/WBE firms will not be credited towards fulfillment of M/WBE Participation Goals.

☐ As a non M/WBE Prime Contractor that will enter into subcontracts with M/WBE firms the value of which is at least the amount located on Lines 2 or 3 above, as applicable.

**Section IV: General Contract Information**

What is the expected percentage of the total contract dollar value that you expect to award in subcontracts for services, regardless of M/WBE status? % 56

*See Attached Sheet*

✓ **Scopes of Subcontract Work**

Precast Concrete

Structural Steel

Misc. Metal

Detention Enclosures

Arch Woodwork

Foundation Waterproofing

Metal Wall Panels

Roofing

Spray Fireproofing

Fire Stopping

Storefronts

Alum Curtain Wall

Glazing

Louvers

Gyp Board

Ceramic Tile

Terazzo

**Section V: Vendor Certification and Required Affirmations**

I hereby:

- 1) acknowledge my understanding of the M/WBE participation requirements as set forth herein and the pertinent provisions of Section 6-129 of the Administrative Code of the City of New York (Section 6-129), and the rules promulgated thereunder;
- 2) affirm that the information supplied in support of this M/WBE Utilization Plan is true and correct;
- 3) agree, if awarded this Contract, to comply with the M/WBE participation requirements of this Contract, the pertinent provisions of Section 6-129, and the rules promulgated thereunder, all of which shall be deemed to be material terms of this Contract
- 4) agree and affirm that it is a material term of this Contract that the Vendor will award the total dollar value of the M/WBE Participation Goals to certified MBEs and/or WBEs, unless a full waiver is obtained or such goals are modified by the Agency; and
- 5) agree and affirm, if awarded this Contract, to make all reasonable, good faith efforts to meet the M/WBE Participation Goals, or if a partial waiver is obtained or such goals are modified by the Agency, to meet the modified Participation Goals by soliciting and obtaining the participation of certified MBE and/or WBE firms.

Signature Jay Dier  
Print Name Jay Dier

Date 10/9/19  
Title VP

**Minority Plan 116th Police Precinct**

Trade	\$\$\$\$	MBE	WBE	Total M/WBE Allowed	Work Period
Precast Concrete	\$ 2,800,000				Month 10-12
Structural Steel	\$ 2,400,000	\$ 2,440,000		\$ 2,440,000	Month 6-10
Misc Metal	\$ 2,200,000	\$ 2,200,000		\$ 2,200,000	Month 8-24
Detention Enclosures	\$ 445,000			\$ -	Month 24-28
Arch Woodwork	\$ 300,000		\$ 306,000	\$ 306,000	Month 24-28
Foundation Waterproofing	\$ 400,000	\$ 376,490		\$ 376,490	Month 4-10
Metal Wall Panels	\$ 500,000			\$ -	Month 13-14
Roofing	\$ 800,000			\$ -	Month 13-15
Spray Fireproofing	\$ 250,000			\$ -	Month 14-15
Fire Stopping	\$ 300,000			\$ -	Month 15-24
Storefronts	\$ 2,000,000			\$ -	Month 20-24
Alum Curtain Wall	\$ 1,000,000			\$ -	Month 13-18
Glazing	\$ 690,000			\$ -	Month 16-24
Louvers	Incl			\$ -	Month 16-24
Gyp Board	\$ 1,900,000			\$ -	Month 14-22
Ceramic Tile	\$ 400,000	\$ 400,000		\$ 400,000	Month 20-24
Terrazzo	\$ 630,000	\$ 629,400		\$ 629,400	Month 20-24
Resinous Flooring	\$ 400,000	\$ 390,800		\$ 390,800	Month 20-24
Painting	\$ 180,000	\$ 180,000		\$ 180,000	Month 24-29
Signage	\$ 30,000	\$ 30,000		\$ 30,000	Month 27-29
Window Shades	\$ 11,000			\$ -	Month 29
Veh Barriers	\$ 225,000			\$ -	Month 22-24
Elevators	\$ 400,000			\$ -	Month 20-27
Sprinkler	\$ 500,000			\$ -	Month 10-28
Plumbing	\$ 1,800,000			\$ -	Month 6-28
HVAC	\$ 6,575,000	\$ 6,575,000		\$ 6,575,000	Month 6-28
Underground Fuel Syst	\$ 600,000			\$ -	Month 6-24
Electrical	\$ 10,150,000		\$ 10,150,000	\$ 10,150,000	Month 6-30
SOE Piles	\$ 485,000			\$ -	Month 2-3
Soil Anchors	\$ 200,000			\$ -	Month 3-4
Curbs Sidewalks/Paving	\$ 1,150,000		\$ 1,150,000	\$ 1,150,000	Month 28-30
Unit Pavers	\$ 260,000			\$ -	Month 28-29
Metal Fencing	\$ 350,000	\$ -		\$ -	Month 24-28
Landscaping	\$ 350,000			\$ -	Month 27-30
Site Utilities	\$ 2,725,000		\$ 2,725,000	\$ 2,725,000	Month 2-10
Total Subcontracted	\$ 43,946,000				
Total MBE		\$ 13,221,690			
Total WBE			\$ 14,331,000		
<b>Total Minority Participation</b>				<b>\$ 27,552,690</b>	

**SCHEDULE B - PART III - REQUEST FOR WAIVER OF M/WBE PARTICIPATION REQUIREMENT**

**Contract Overview**

Tax ID # \_\_\_\_\_ FMS Vendor ID # \_\_\_\_\_  
 Business Name \_\_\_\_\_  
 Contact Name \_\_\_\_\_ Telephone # \_\_\_\_\_ Email \_\_\_\_\_  
 Type of Procurement ☐ Competitive Sealed Bids ☐ Other Bid/Response Due Date \_\_\_\_\_

**M/WBE Participation Goals as described in bid/solicitation**

%

Agency M/WBE Participation Goal

%

of the total contract value anticipated in good faith by the bidder/proposer to be subcontracted for services and/or credited to an M/WBE Prime Contractor or Qualified Joint Venture.

**Basis for Waiver Request:** Check appropriate box & explain in detail below (attach additional pages if needed)

- ☐ Vendor does not subcontract services, and has the capacity and good faith intention to perform all such work itself with its own employees.
- ☐ Vendor subcontracts some of this type of work but at a lower % than bid/solicitation describes, and has the capacity and good faith intention to do so on this contract. (Attach subcontracting plan outlining services that the vendor will self-perform and subcontract to other vendors or consultants.)
- ☐ Vendor has other legitimate business reasons for proposing the M/WBE Participation Goal above. Explain under separate cover.

**References**

CONTRACT NO.	AGENCY	DATE COMPLETED
Total Contract Amount \$	Total Amount Subcontracted \$	
Item of Work Subcontracted and Value of subcontract	Item of Work Subcontracted and Value of subcontract	Item of Work Subcontracted and Value of subcontract
CONTRACT NO.	AGENCY	DATE COMPLETED
Total Contract Amount \$	Total Amount Subcontracted \$	
Item of Work Subcontracted and Value of subcontract	Item of Work Subcontracted and Value of subcontract	Item of Work Subcontracted and Value of subcontract
CONTRACT NO.	AGENCY	DATE COMPLETED
Total Contract Amount \$	Total Amount Subcontracted \$	
Item of Work Subcontracted and Value of subcontract	Item of Work Subcontracted and Value of subcontract	Item of Work Subcontracted and Value of subcontract



<b>TYPE OF Contract</b> _____	<b>ENTITY</b> _____	<b>DATE COMPLETED</b> _____
Manager at entity that hired vendor (Name/Phone No./Email) _____		
<b>Total Contract Amount</b> \$ _____	<b>Total Amount Subcontracted</b> \$ _____	_____
<b>Type of Work Subcontracted</b> _____	_____	_____

<b>TYPE OF Contract</b> _____	<b>AGENCY/ENTITY</b> _____	<b>DATE COMPLETED</b> _____
Manager at agency/entity that hired vendor (Name/Phone No./Email) _____		
<b>Total Contract Amount</b> \$ _____	<b>Total Amount Subcontracted</b> \$ _____	_____
<b>Item of Work Subcontracted and Value of subcontract</b> _____	<b>Item of Work Subcontracted and Value of subcontract</b> _____	<b>Item of Work Subcontracted and Value of subcontract</b> _____

<b>TYPE OF Contract</b> _____	<b>AGENCY/ENTITY</b> _____	<b>DATE COMPLETED</b> _____
Manager at entity that hired vendor (Name/Phone No./Email) _____		
<b>Total Contract Amount</b> \$ _____	<b>Total Amount Subcontracted</b> \$ _____	_____
<b>Item of Work Subcontracted and Value of subcontract</b> _____	<b>Item of Work Subcontracted and Value of subcontract</b> _____	<b>Item of Work Subcontracted and Value of subcontract</b> _____

**VENDOR CERTIFICATION:** I hereby affirm that the information supplied in support of this work is correct to the best of my knowledge and belief, and that this request is made in good faith.

<b>Signature:</b> _____	<b>Date:</b> _____
<b>Print Name:</b> _____	<b>Title:</b> _____



**BID FORM  
THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

**BID FOR FURNISHING ALL LABOR AND  
MATERIAL NECESSARY AND REQUIRED FOR:**

**PROJECT ID: PO002-116**

**New 116th Precinct Station House Rebid  
244-04 North Conduit Avenue  
Queens, NY 11422**

Name of Bidder: Citnalta Construction Corp.

Date of Bid Opening: 10/9/19

Bidder is: (Check one, whichever applies)    Individual ( )    Partnership ( )    Corporation (x)

Place of Business of Bidder: 1601 Locust Ave., Bohemia, NY 11716

Bidder's Telephone Number: 631-563-1110    Bidder's Fax Number: 631-563-3765

Bidder's Email Address: JDier@citnalta.com

Residence of Bidder (If Individual): \_\_\_\_\_

If Bidder is a Partnership, fill in the following blanks:

Names of Partners

Residence of Partners

_____	_____
_____	_____
_____	_____

If Bidder is a Corporation, fill in the following blanks:

Organized under the laws of the State of New York

Name and Home Address of President: \_\_\_\_\_  
Michael Gargiulo, St. James, NY

Name and Home Address of Secretary: \_\_\_\_\_  
Larry Sitbon, Northport, NY

Name and Home Address of Treasurer: \_\_\_\_\_  
Larry Sitbon, St. James, NY

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## BID FORM

The above-named Bidder affirms and declares:

1. The said bidder is of lawful age and the only one interested in this bid; and no person, firm or corporation other than hereinbefore named has any interest in this bid, or in the Contract proposed to be taken.
2. By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief: (1) the prices in this bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor; (2) unless otherwise required by law, the prices quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and (3) no attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.
3. No councilman or other officer or employee or person whose salary is payable in whole or in part from the City Treasury is directly or indirectly interested in this bid, or in the supplies, materials, equipment, work or labor to which it relates, or in any of the profits thereof.
4. The bidder is not in arrears to the City of New York upon debt or contract or taxes, and is not a defaulter, as surety or otherwise, upon any obligation of the City of New York, and has not been declared not responsible, or disqualified, by any agency of the City of New York or State of New York, nor is there any proceeding pending relating to the responsibility or qualification of the bidder to receive public contracts except as set forth on the Affirmation included as page 17 of this Bid Booklet.

The bidder hereby affirms that it has paid all applicable City income, excise and other taxes for all years it has conducted business activities in New York City.

5. The bidder, as an individual, or as a member, partner, director or officer of the bidder, if the same be a firm, partnership or corporation, executes this document expressly warranting and representing that should this bid be accepted by the City and the Contract awarded to him, he and his subcontractors engaged in the performance:  
(1) will comply with the provisions of Section 6-108 of the Administrative Code of the City of New York and the non-discrimination provisions of Section 220a of the New York State Labor Law, as more expressly and in detail set forth in the Agreement; (2) will comply with Section 6-109 of the Administrative Code of the City of New York in relation to minimum wages and other stipulations as more expressly and in detail set forth in the Agreement; (3) have complied with the provisions of the aforesaid laws since their respective effective dates, and (4) will post notices to be furnished by the City, setting forth the requirements of the aforesaid laws in prominent and conspicuous places in each and every plant, factory, building and structure where employees engaged in the performance of the Contract can readily view it, and will continue to keep such notices posted until the supplies, materials and equipment, or work labor and services required to be furnished or rendered by the Contractor have been finally accepted by the City. In the event of any breach or violation of the foregoing, the Contractor may be subject to damages, liquidated or otherwise, cancellation of the Contract and suspension as a bidder for a period of three years. (The words, "the bidder", "he", "his", and "him" where used shall mean the individual bidder, firm, partnership or corporation executing this bid).



6. Compliance Report

The bidder, as an individual, or as a member, partner, director, or officer of the bidder, if the same be a firm, partnership, or corporation, (1) represents that his attention has been specifically drawn to Executive Order No. 50, dated April 25, 1980, on Equal Employment Compliance of the contract, and (2) warrants that he will comply with the provisions of Executive Order No. 50. The Employment Report must be submitted as part of the bid.

The bidder, as an individual, or as a member, partner, director, or officer of the bidder, if the same be a firm, partnership, or corporation, executes this document expressly warranting that he will comply with: (1) the provision of the contract on providing records, Chapter 8.

7. By submission of this bid, the bidder certifies that it now has and will continue to have the financial capability to fully perform the work required for this contract. Any award of this contract will be made in reliance upon such certification. Upon request therefor, the bidder will submit written verification of such financial capability in a form that is acceptable to the department.

8. In accordance with Section 165 of the State Finance Law, the bidder agrees that tropical hardwoods, as defined in Section 165 of the State Finance Law, shall not be utilized in the performance of this Contract, except as the same are permitted by the foregoing provision of law.

9. The bidder has visited and examined the site of the work and has carefully examined the Contract in the form approved by the Corporation Counsel, and will execute the Contract and perform all its items, covenants and conditions, and will provide, furnish and deliver all the work, materials, supplies, tools and appliances for all labor and materials necessary or required for the hereinafter named work, all in strict conformity with the Contract, for the prices set forth in the Bid Schedule:

10. **M/WBE UTILIZATION PLAN:** By signing its bid, the bidder agrees to the Vendor Certification and Required Affirmations set forth below, unless a full waiver of the Participation Goals is granted. The Vendor Certification and Required Affirmations will be deemed to satisfy the requirement to complete Section V of Part II of Schedule B: M/WBE Utilization Plan.

**Section V: Vendor Certification and Required Affirmations:**

I hereby:

- 1) acknowledge my understanding of the M/WBE participation requirements as set forth in this Contract and the pertinent provisions of Section 6-129 of the Administrative Code of the City of New York and the rules promulgated thereunder;
- 2) affirm that the information supplied in support of the M/WBE Utilization Plan is true and correct;
- 3) agree, if awarded this Contract, to comply with the M/WBE participation requirements of this Contract, the pertinent provisions of Section 6-129, and the rules promulgated thereunder, all of which shall be deemed to be material terms of this Contract;
- 4) agree and affirm that it is a material term of this Contract that the Vendor will award the total dollar value of the M/WBE Participation Goals to certified MBEs and/or WBEs, unless a full waiver is obtained or such goals are modified by the Agency; and
- 5) agree and affirm, if awarded this Contract, to make all reasonable, good faith efforts to meet the M/WBE Participation Goals, or If a partial waiver is obtained or such goals are modified by the Agency, to meet the modified Participation Goals by soliciting and obtaining the participation of certified MBE and/or WBE firms.

**BID FORM**

**PROJECT ID: PO002-116**

**TOTAL BID PRICE:** In the space provided below, the Bidder shall indicate the total bid price in figures.

- A. **LUMP SUM PRICE** - Total price for all labor and material for all required work, excluding items (B), (C), (D), (E) and (F) set forth below. Total Price shall include all costs and expenses, i.e., labor and material, including overhead and profit for all the Work, described below and shown in the drawings and specifications.

Total Price For  
Labor

Total Price for Material Sold and  
Delivered

\$ 41,834,577 +

\$ 30,939,721

Total Price for Item A = \$ 72,824,298

- B. ALLOWANCE for Incidental Asbestos Abatement  
(Section 028013 of the Specifications) \$30,000.00
- C. AMOUNT for Proprietary Items (pages 2a-2c) \$148,672.00
- D. ALLOWANCE for Incentives  
(Section 012000 of the Specifications) \$1,000,000.00
- E. ALLOWANCE for Project Work Acceleration  
(Section 012100 of the Specifications) \$500,000.00
- F. ALLOWANCE for Expanded Work  
(Section 012200 of the Specifications) \$3,468,992.00

**TOTAL BID PRICE** (Add A + B + C + D + E + F)  
(a/k/a BID PROPOSAL)

\$77,971,962

BB 10/11/19

**BIDDER'S SIGNATURE AND AFFIDAVIT**

- \* **SUBCONTRACTOR IDENTIFICATION:** You **MUST** complete and submit the form entitled "Bidder's Identification of Subcontractors" (page 17) at the time you submit your bid. You must submit this form in a separate, sealed envelope (BID ENVELOPE #2). In the event an award of contract is not made to the Bidder, the Bidder hereby authorizes the Agency to shred the form entitled "Bidder's Identification of Subcontractors". ☒ Yes ☐ No

Bidder: Citnalta Construction Corp.

By: 

(Signature of Partner or corporate officer)

Attest:  
(Corporate Seal)

  
Secretary of Corporate Bidder

Affidavit on the following page should be subscribed and sworn to before a Notary Public

**THIS PAGE INTENTIONALLY LEFT BLANK**

**BID FORM (TO BE NOTARIZED)**

\*\*\*\*\*

**AFFIDAVIT WHERE BIDDERS IS AN INDIVIDUAL**

STATE OF NEW YORK, COUNTY OF \_\_\_\_\_ ss:

being duly sworn says:

I am the person described in and who executed the foregoing bid, and the several matters therein stated are in all respects true.

\_\_\_\_\_  
(Signature of the person who signed the Bid)

Subscribed and sworn to before me this  
\_\_\_\_ day of \_\_\_\_\_,

\_\_\_\_\_  
Notary Public

\*\*\*\*\*

**AFFIDAVIT WHERE BIDDERS IS A PARTNERSHIP**

STATE OF NEW YORK, COUNTY OF \_\_\_\_\_ ss:

being duly sworn says:

I am a member of \_\_\_\_\_ the firm described in and which executed the foregoing bid.  
subscribed the name of the firm thereto on behalf of the firm, and the several matters therein stated are in all respects true.

\_\_\_\_\_  
(Signature of Partner who signed the Bid)

Subscribed and sworn to before me this  
\_\_\_\_ day of \_\_\_\_\_,

\_\_\_\_\_  
Notary Public

\*\*\*\*\*

**AFFIDAVIT WHERE BIDDERS IS A CORPORATION**

STATE OF NEW YORK, COUNTY OF Suffolk ss:

Jay Dier

being duly sworn says:

I am the VP of the above named corporation whose name is subscribed to and which executed  
the foregoing bid. I reside at Nesconset, NY  
I have knowledge of the several matters therein stated, and they are in all respects true.

\_\_\_\_\_  
(Signature of Corporate Officer who signed the Bid)

Subscribed and sworn to before me this  
9th day of October 2019

Christina M. Lewis  
Notary Public

Christina M. Lewis  
NOTARY PUBLIC-STATE OF NEW YORK  
Registration 01LE6392847  
Qualified in Suffolk County  
Commission Expires 6/03/2023

## AFFIRMATION

The undersigned bidder affirms and declares that said bidder is not in arrears to the City of New York upon debt, contract or taxes and is not a defaulter, as surety or otherwise, upon obligation to the City of New York, and has not been declared not responsible, or disqualified, by any agency of the City of New York, nor is there any proceeding pending relating to the responsibility or qualification of the bidder to receive public contracts except None

(If none, the bidder shall insert the word "None" in the space provided above.)

Full Name of Bidder: Citnalta Construction Corp.

Address: 1601 Locust Ave.

City: Bohemia

State: NY

Zip Code: 11716

CHECK ONE BOX AND INCLUDE APPROPRIATE NUMBER:

☐

A - Individual or Sole Proprietorship \*  
SOCIAL SECURITY NUMBER

☐

B - Partnership, Joint Venture or other unincorporated organization  
EMPLOYER IDENTIFICATION NUMBER

☒

C - Corporation  
EMPLOYER IDENTIFICATION NUMBER

11-2455116

By: 

Signature:

Title:

Vice President

If a corporation, place seal here

This affirmation must be signed by an officer or duly authorized representative.

\* Under the Federal Privacy Act the furnishing of Social Security Numbers by bidders on City contracts is voluntary. Failure to provide a Social Security Number will not result in a bidder's disqualification. Social Security Numbers will be used to identify bidders, proposers or vendors to ensure their compliance with laws, to assist the City in enforcement of laws, as well as to provide the City a means of identifying of businesses which seek City contracts.

## **BIDDER'S IDENTIFICATION OF SUBCONTRACTORS**

### **NOTICE TO BIDDERS**

**SUBMISSION:** The Bidder must, at the time of the bid, submit the completed form on the next page ("BIDDER'S IDENTIFICATION OF SUBCONTRACTORS"). This form must be submitted in a separate, sealed envelope (BID ENVELOPE #2). Failure to do so will result in the disqualification of the bid as non-responsive.

\*\*\*\*\*

Please be advised that pursuant to GML § 101(5) the Bidder is required to submit with its bid the names of subcontractors it intends to use to perform the following work on this contract, as well as the agreed-upon amount to be paid to each:

- plumbing and gas fitting;
- steam heating, hot water heating, ventilating and air conditioning apparatus; and
- electric wiring and standard illuminating fixtures.

**NOTE:** This project may not involve all of the above listed subcontractors. Please see the form on the next page which indicates the subcontractors required for this Project.

All listed subcontractors must be used to perform the work identified on this form for the amount listed. The listed subcontractors are not alternatives to each other. The list of subcontractors is to be submitted in a separate sealed envelope by completing the form 'Bidders Identification of Subcontractors' for any subcontractors intended to be used in any of the three trades listed above. If bidder intends to use its own forces for any of the above listed work, bidder should complete this form using its own name.

Failure to submit the completed form on the next page ("Bidder's Identification of Subcontractors") that includes the names of subcontractors and the agreed upon amounts to be paid to such subcontractors will render the bid non-responsive.

PLEASE NOTE: for any contract that is subject to M/WBE Participation Goals under Local Law 129, if the bidder's intention to use its own forces to do any of the above-referenced work would result in Bidder's failure to attain the Target Subcontracting Percentage identified in Schedule B (Subcontractor Utilization Plan), the bid will be non-responsive unless the bidder requests and obtains a Waiver of Target Subcontracting Percentage (Schedule B, Part III) in advance of bid submission. Failure to submit the completed 'BIDDERS IDENTIFICATION OF SUBCONTRACTORS' form that includes the names of subcontractors and the agreed upon amounts to be paid to such subcontractors will render the bid non-responsive.

After the low bid is announced, the sealed list submitted by the low bidder will be opened and the names of the subcontractors will be announced. The sealed lists of subcontractors submitted by all other bidders shall be maintained by the Agency unopened unless such bidder shall become the low bidder (e.g., the initial low bidder is found non-responsive). All unopened lists of subcontractors shall be returned to the bidders unopened after contract award, unless the bidder has given the agency permission to shred the form.

After bid submission, any change of subcontractor or agreed-upon amount to be paid to each shall require approval of the Agency upon a showing of a legitimate construction need which shall include, but not be limited to, a change in project specifications, a change in project material costs, a change to subcontractor status as determined pursuant to §222 (2)(e) of the Labor Law, or if the subcontractor has become otherwise unwilling, unable or unavailable to perform the subcontract.

## BIDDER'S IDENTIFICATION OF SUBCONTRACTORS

Project ID: PO002-116

**SUBMISSION:** In addition to its Bid (Bid Envelope # 1), the Bidder must, at the time of the bid, complete and submit this form in a separate, sealed envelope (Bid Envelope # 2). To complete this form, the Bidder must identify the subcontractors it intends to use for the work listed below, as well as the dollar amount to be paid to each subcontractor. Failure to complete this form and submit it in a separate, sealed envelope will result in the disqualification of the bid as non-responsive.

The Bidder intends to use the following subcontractors. If the Bidder intends to do any of the work referenced below with its own forces, the Bidder should complete this form using its own name. If multiple subcontractors for any trade are proposed, Bidder may submit multiple copies of this form.

1. **PLUMBING CONTRACTOR:**

Description of Plumbing Work:

J M Botto  
(Print Name)

All Plumbing work

Agreed amount to be paid Subcontractor: \$ 1,777,000

2. **HVAC CONTRACTOR:**

Description of HVAC Work:

RAMS Mechanical  
(Print Name)

All HVAC work

Agreed amount to be paid Subcontractor: \$ 6,500,000

3. **ELECTRICAL CONTRACTOR:**

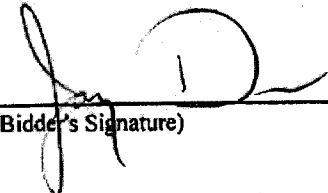
Description of Electrical Work:

Milud Contracting  
(Print Name)

All Electrical, Communications,  
Fire Alarm work ETC

Agreed amount to be paid Subcontractor: \$ 10,150,000

**BIDDER'S SIGNATURE:** The Bidder must sign and complete this form in the spaces provided below:



Jay Dier

(Bidder's Signature)

(Print Name)

1601 Locust Ave., Bohemia, NY 11716  
(Address)

<u>VP</u>	<u>631-563-1110</u>	<u>631-563-3765</u>	<u>10/9/19</u>
(Title)	(Phone #)	(Fax#)	(Date)





BID BOND I  
FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS. That we, \_\_\_\_\_

Citnalta Construction Corp.

1601 Locust Avenue, Bohemia, NY 11716

hereinafter referred to as the "Principal", and \_\_\_\_\_

Travelers Casualty and Surety Company of America

One Tower Square, Hartford, CT 06183

hereinafter referred to as the "Surety" are held and firmly bound to THE CITY OF NEW YORK, hereinafter referred to as the "CITY", or to its successors and assigns in the penal sum of \_\_\_\_\_

Ten Percent of Proposal Price

(\$ 10% of P.P. \_\_\_\_\_), Dollars lawful money of the United States, for the payment of which said sum of money well and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Whereas, the Principal is about to submit (or has submitted) to the City the accompanying proposal, hereby made a part hereof, to enter into a contract in writing for PO002-116

New 116th Precinct Station House, Borough of Queens

NOW, THEREFORE, the conditions of this obligation are such that if the Principal shall not withdraw said Proposal without the consent of the City for a period of forty-five (45) days after the opening of bids and in the event of acceptance of the Principal's Proposal by the City, if the Principal shall:

(a) Within ten (10) days after notification by the City, execute in quadruplicate and deliver to the City all the executed counterparts of the Contract in the form set forth in the Contract Documents, in accordance with the proposal as accepted, and

(b) Furnish a performance bond and separate payment bond, as may be required by the City, for the faithful performance and proper fulfillment of such Contract, which bonds shall be satisfactory in all respects to the City and shall be executed by good and sufficient sureties, and

(c) In all respects perform the agreement created by the acceptance of said Proposal as provided in the Information for Bidders, bound herewith and made a part hereof, or if the City shall reject the aforesaid Proposal, then this obligation shall be null and void; otherwise to remain in full force and effect.

## BID BOND 2

In the event that the Proposal of the Principal shall be accepted and the Contract be awarded to him the Surety hereunder agrees subject only to the payment by the Principal of the premium therefore, if requested by the City, to write the aforementioned performance and payment bonds in the form set forth in the Contract Documents.

It is expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

There shall be no liability under this bond if, in the event of the acceptance of the Principal's Proposal by the City, either a performance bond or payment bond, or both, shall not be required by the City on or before the 30th day after the date on which the City signs the Contract.

The surety, for the value received, hereby stipulates and agrees that the obligations of the Surety and its bond shall in no way be impaired or affected by any postponements of the date upon which the City will receive or open bids, or by any extensions of time within which the City may accept the Principal's Proposal, or by any waiver by the City of any of the requirements of the Information for Bidders, and the Surety hereby waives notice of any such postponements, extensions, or waivers.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers the 1st day of October, 2019.

(Seal)

Citnalta Construction Corp.

(L.S.)

Principal

By:

(Seal)

Travelers Casualty and Surety Company of America

Surety

By:

Susan Lupski, Attorney-In-Fact

BID BOND 3

ACKNOWLEDGEMENT OF PRINCIPAL, IF A CORPORATION

State of New York County of Suffolk ss:  
On this 1st day of Oct, 2017, before me personally came  
John Dico to me known, who, being by me duly sworn, did depose and say that he  
resides at Norcross St, NYC  
that he is the V.P. of Chas. J. Rella Construction Corp.  
the corporation described in and which executed the foregoing instrument; that he knows the seal of said  
corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the  
directors of said corporation, and that he signed his name thereto by like order.

Christina M. Lewis  
NOTARY PUBLIC-STATE OF NEW YORK  
Registration 01LE6392847  
Qualified in Suffolk County  
Commission Expires 8/03/2023

Christina M. Lewis  
Notary Public

ACKNOWLEDGEMENT OF PRINCIPAL, IF A PARTNERSHIP

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:  
On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, before me personally appeared  
\_\_\_\_\_ to me known and known to me to be one of the members of the firm of  
\_\_\_\_\_ described in and who executed the foregoing instrument, and he  
acknowledged to me that he executed the same as and for the act and deed of said firm.

\_\_\_\_\_  
Notary Public

ACKNOWLEDGEMENT OF PRINCIPAL, IF AN INDIVIDUAL

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:  
On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, before me personally appeared  
\_\_\_\_\_ to me known and known to me to be the person described in and who  
executed the foregoing instrument and acknowledged that he executed the same.

\_\_\_\_\_  
Notary Public

AFFIX ACKNOWLEDGEMENTS AND JUSTIFICATION OF SURETIES



**Travelers Casualty and Surety Company of America**  
**Travelers Casualty and Surety Company**  
**St. Paul Fire and Marine Insurance Company**

**POWER OF ATTORNEY**

**KNOW ALL MEN BY THESE PRESENTS:** That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Susan Lupski of Uniondale, New York**, their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.


**IN WITNESS WHEREOF**, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this 3rd day of February, 2017.



State of Connecticut

City of Hartford ss.

By:


  
Robert L. Raney, Senior Vice President

On this the 3rd day of February, 2017, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

**In Witness Whereof**, I hereunto set my hand and official seal.

My Commission expires the 30th day of June, 2021



  
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

**RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

**FURTHER RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

**FURTHER RESOLVED**, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

**FURTHER RESOLVED**, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this 1st day of October, 2019



  
Kevin E. Hughes, Assistant Secretary

**To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.**  
**Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.**

ACKNOWLEDGEMENT OF SURETY COMPANY

STATE OF NEW YORK

COUNTY OF NASSAU

On this October 1, 2019 before me personally came Susan Lupski to me known, who, being by me duly sworn, did depose and say; that he/she resides in Nassau County, State of New York, that he/she is the Attorney-In-Fact of the Travelers Casualty and Surety Company of America the corporation described in which executed the above instrument; that he/she knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by the Board of Directors of said corporation; and that he/she signed his/her name thereto by like order; and the affiant did further depose and say that the Superintendent of Insurance of the State of New York, has, pursuant to Section 1111 of the Insurance Law of the State of New York, issued to Travelers Casualty and Surety Company of America (Surety) his/her certificate of qualification evidencing the qualification of said Company and its sufficiency under any law of the State of New York as surety and guarantor, and the propriety of accepting and approving it as such; and that such Certificate has not been revoked.



Notary Public

**LAURAJEAN MURTAGH**  
Notary Public, State of New York  
Registration No. 01MU6319758  
Qualified in Nassau County  
Commission Expires 02/23/2023

## TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

HARTFORD, CONNECTICUT 06183

FINANCIAL STATEMENT AS OF DECEMBER 31, 2018

CAPITAL STOCK \$ 6,480,000

ASSETS		LIABILITIES & SURPLUS	
CASH AND INVESTED CASH	\$ 36,728,596	UNEARNED PREMIUMS	\$ 978,007,378
BONDS	3,507,432,239	LOSSES	750,995,504
STOCKS	294,199,598	LOSS ADJUSTMENT EXPENSES	166,873,871
INVESTMENT INCOME DUE AND ACCRUED	38,287,129	COMMISSIONS	45,888,584
OTHER INVESTED ASSETS	3,507,839	TAXES, LICENSES AND FEES	14,584,663
PREMIUM BALANCES	250,476,792	OTHER EXPENSES	43,858,534
NET DEFERRED TAX ASSET	48,781,239	CURRENT FEDERAL AND FOREIGN INCOME TAXES	10,143,037
REINSURANCE RECOVERABLE	29,278,755	REMITTANCES AND ITEMS NOT ALLOCATED	21,277,153
SECURITIES LENDING REINVESTED COLLATERAL ASSETS	14,277,262	AMOUNTS WITHHELD / RETAINED BY COMPANY FOR OTHERS	30,289,553
RECEIVABLES FROM PARENT, SUBSIDIARIES AND AFFILIATES	27,813,268	RETROACTIVE REINSURANCE RESERVE ASSUMED	810,360
ASSUMED REINSURANCE RECEIVABLE AND PAYABLE	626,488	POLICYHOLDER DIVIDENDS	10,410,755
OTHER ASSETS	4,936,229	PROVISION FOR REINSURANCE	7,641,358
		ADVANCE PREMIUM	1,608,777
		REINSURANCE PAYABLE ON PAID LOSSES & LOSS ADJ. EXPENSES	868,002
		PAYABLE FOR SECURITIES LENDING	14,277,262
		CEDED REINSURANCE NET PREMIUMS PAYABLE	48,469,976
		OTHER ACCRUED EXPENSES AND LIABILITIES	335,489
		TOTAL LIABILITIES	\$ 2,145,120,254
		CAPITAL STOCK	\$ 6,480,000
		PAID IN SURPLUS	433,803,760
		OTHER SURPLUS	1,670,943,418
		TOTAL SURPLUS TO POLICYHOLDERS	\$ 2,111,227,178
TOTAL ASSETS	\$ 4,258,347,432	TOTAL LIABILITIES & SURPLUS	\$ 4,258,347,432

STATE OF CONNECTICUT )  
COUNTY OF HARTFORD ) ss.  
CITY OF HARTFORD )

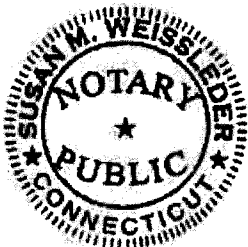
MICHAEL J. DOODY, BEING DULY SWORN, SAYS THAT HE IS SECOND VICE PRESIDENT, OF TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, AND THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT STATEMENT OF THE FINANCIAL CONDITION OF SAID COMPANY AS OF THE 31ST DAY OF DECEMBER, 2018.

*Michael J. Doody*  
VICE PRESIDENT, FINANCE

*Susan M. Weissleder*  
NOTARY PUBLIC

SUBSCRIBED AND SWORN TO BEFORE ME THIS  
28TH DAY OF MARCH, 2019

SUSAN M. WEISSELEDER  
Notary Public  
My Commission Expires November 30, 2022



## BID BREAKDOWN

**Submission:** Bidders are advised that the requirement to submit a Bid Breakdown applies to each contract for which an "X" is indicated before the word "Yes". If required, the bidder must submit, with its bid, a completed Bid Breakdown. Failure to provide a completed Bid Breakdown may result in rejection of the bid as non-responsive.

X                      YES                      NO

### Limitations on Use of Bid Breakdown:

Bidders are advised that the Bid Breakdown shall be used for bid analysis purposes only and shall not be binding for any other purposes under the Contract, including, without limitation, for payment purposes or in connection with a contractor claim for extra work. If the form for the Bid Breakdown does not include an item of work required by the Contract Documents, such omission shall have no effect whatsoever, nor shall it be used by the contractor in connection with a claim for extra work (i.e., work for which the contractor is entitled to a change order).

### Instructions for Preparing Bid Breakdown:

- (A) The Bid Breakdown is set forth on the following pages of this Bid Booklet and is in accordance with the Construction Specification Institute (CSI) format. For all items of work listed in the Bid Breakdown, the bidder must indicate the price for labor and the price for material, as well as the estimated quantities required.
- (B) In preparing its Bid Breakdown, the bidder shall submit prices that include all costs for overhead and profit. Overhead shall include, without limitation, all costs in connection with the following: administration, management, superintendence, small tools, insurance, bonds, and provision of services or items required by the General Conditions [except for Security/Fire Guard Services and Temporary Heat]. If the Project requires Security/Fire Guard Services and/or Temporary Heat, such service(s) will be included as separate line items in the Bid Breakdown.
- (C) If an item is set forth in the Bid Breakdown, but is not included in the Contract Documents (Drawings, Specifications, General Conditions, and/or Addenda), the bidder is advised to leave the item blank and exclude the cost of the item from its grand total. In an attachment to its Bid Breakdown, the bidder shall provide a list of all items left blank.
- (D) If an item is not set forth in the Bid Breakdown, but is included in the Contract Documents (Drawings, Specifications, General Conditions, and/or Addenda), the bidder is advised to add the item to its Bid Breakdown and include the cost of the item in its grand total. In an attachment to its Bid Breakdown, the bidder shall provide a list of all items added.

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Project: New 116th Precinct Station House Rebid  
 Location: 244-04 North Conduit Avenue, Queens, NY 11422  
 Bidder: CITNALTA CONSTRUCTION CORP.

DDC ID: PO002-116  
 Sponsor Agency: New York City Police Department

CSI Number	Description	Quantity	Unit	Unit Cost of Material	Total Cost of Material	Unit Cost of Labor	Total Cost of Labor	Total Cost: Materials and Labor
<b>CONTRACT 1 - GENERAL CONSTRUCTION WORK</b>								
<b>01 0000</b>	<b>GENERAL REQUIREMENTS</b>							
<b>01 0000</b>	<b>GENERAL REQUIREMENTS</b>							
	<b>TEMPORARY UTILITIES</b>							
	Temporary electric	1	sf	\$213,324	\$ 213,324	\$319,985	\$ 319,985.40	\$ 533,309
	Temporary heat	1	sf	\$308,271	\$ 308,271	\$462,407	\$ 462,406.64	\$ 770,678
	<b>VEHICULAR ACCESS AND PARKING</b>							
	Traffic control	1	ls	\$184,963	\$ 184,963	\$277,444	\$ 277,443.99	\$ 462,407
	Staging area	1	ls	\$61,654	\$ 61,654	\$92,481	\$ 92,481.33	\$ 154,136
	<b>TEMPORARY BARRIERS AND ENCLOSURES</b>							
	Construction fencing (noise control)	0	lf	\$289,775	\$ 289,775	\$434,662	\$ 434,662.24	\$ 724,437
	Construction gates with anti-tracking pad	0	pr	\$24,662	\$ 24,662	\$36,993	\$ 36,992.53	\$ 61,654
	Vehicle wash station	1	loc	\$30,827	\$ 30,827	\$46,241	\$ 46,240.66	\$ 77,068
	Sidewalk closure barrier signage	1	loc	\$6,165	\$ 6,165	\$9,248	\$ 9,248.13	\$ 15,414
	New pedestrian striping on pavement	1	loc	\$6,165	\$ 6,165	\$9,248	\$ 9,248.13	\$ 15,414
	Covered Walkway Complete w/Lighting	1	lf	\$135,639	\$ 135,639	\$203,459	\$ 203,458.92	\$ 339,098
	Temporary construction barrier for street work and bollards	1	lf	\$115,293	\$ 115,293	\$172,940	\$ 172,940.08	\$ 288,233
	<b>DUST CONTROL</b>							
	Dust control	1	ls	\$92,481	\$ 92,481	\$138,722	\$ 138,721.99	\$ 231,203
	Temporary air barriers	1	ls	\$0	\$ 0	\$0	\$ -	\$ -
	<b>TREE PROTECTION AND PRUNING</b>							
	Protect existing trees, det. 4/C152, C150-151	1	ea.	\$6,165	\$ 6,165	\$9,248	\$ 9,248.13	\$ 15,414
	Cut back foliage at easement area as needed	1	sf	\$24,662	\$ 24,662	\$36,993	\$ 36,992.53	\$ 61,654
	Security Guards	1	ls	\$499,399	\$ 499,399	\$749,099	\$ 749,098.76	\$ 1,248,498
	Mobilization	1	ls	\$1,972,935	\$ 1,972,935	\$2,959,403	\$ 2,959,402.51	\$ 4,932,338
	<b>Subtotal</b>				\$ 3,972,382		\$ 5,958,573	\$ 9,930,954
<b>01 3234</b>	<b>COMPUTER AIDED DESIGN COORDINATION</b>	1	ls	\$0.00	\$ 59,357	\$0.00	\$ 89,036	\$ 148,393
	<b>Subtotal</b>				\$ 59,357		\$ 89,036	\$ 148,393



DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

	BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS	1	Is	\$0.00	\$	4,566	\$0.00	\$	6,849	\$	11,415
	Subtotal				\$	4,566		\$	6,849	\$	11,415
01 9117	BUILDING ENCLOSURE FUNCTIONAL PERFORMANCE TEST PROTOCOL										
	Mock-ups	1	Is	\$34,244.64	\$	34,245	\$0.00	\$	-	\$	34,245
	Testing	1	Is	\$21,117.52	\$	21,118	\$0.00	\$	-	\$	21,118
	Subtotal				\$	55,362		\$	-	\$	55,362
03 0000	CONCRETE										
03 1000	CONCRETE FORMWORK (included w/ other Div. 3 sections)										
03 2000	CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES (included w/ other Div. 3 sections)										
03 3000	CAST-IN-PLACE CONCRETE										
	Foundations										
	Concrete spread footings	219	CY	\$612.14	\$	134,059	\$753.40	\$	164,994	\$	299,052
	Continuous concrete footings, below grade/wall footing	50	CY	\$612.14	\$	30,607	\$753.40	\$	37,670	\$	68,277
	Continuous concrete footings, at grade	14	CY	\$629.33	\$	8,811	\$780.79	\$	10,931	\$	19,742
	A381, 3'w. x 1'-4" h.	37	CY	\$612.14	\$	22,649	\$753.40	\$	27,876	\$	50,525
	Foundation Walls										
	Concrete foundation wall, 15" th. at cellar and 1st floor	452	CY	\$636.63	\$	287,755	\$1,431.45	\$	647,017	\$	934,772
	Concrete foundation wall, 8" th.x 3'-2" h. (Outdoor Bike Storage), A381	5	CY	\$612.14	\$	3,061	\$1,054.76	\$	5,274	\$	8,334
	Concrete piers	46	CY	\$881.48	\$	40,548	\$2,410.87	\$	110,900	\$	151,448
	Concrete grade beam, 18" h. x 24" d.		CY	\$0.00	\$	-	\$0.00	\$	-	\$	-
	Vehicle fuel dispensing station FS-104										
	Concrete pier, 7.33'h x 3' x 3' - complete, S-208	7	CY	\$857.00	\$	5,999	\$1,958.83	\$	13,712	\$	19,711
	Concrete elevator pit - complete Inc. Sump pit and grating	12	CY	\$1,469.14	\$	17,630	\$2,712.23	\$	32,547	\$	50,176
	Concrete ejector pit - complete, 4'-0" x 4'-0" x 8' d.	7	CY	\$1,469.14	\$	10,284	\$2,712.23	\$	18,986	\$	29,270
	Concrete CORBEL, S-210, including concrete curb 7 cy	34	Lf	\$122.43	\$	4,214	\$150.68	\$	5,186	\$	9,400
	Concrete foundations for flag pole, 2/L606 (3' - 0" dia) 1.3 CY ea)	2	ea.	\$612.14	\$	1,224	\$1,506.79	\$	3,014	\$	4,238



Project: New 116th Precinct Station House Rebid  
 Location: 244-04 North Conduit Avenue, Queens, NY 11422  
 Bidder: CITNALT CONSTRUCTION CORP.

DDC ID: PO002-116  
 Sponsor Agency: New York City Police Department

Concrete foundations for bottle filling station, 3/L606	1	ea.	\$306.07	\$	306	\$1,130.09	\$	1,130	\$	1,436
Concrete foundations for bicycle rack, 1/L606	1	ea.	\$612.14	\$	612	\$3,766.98	\$	3,767	\$	4,379
Bleacher - Concrete foundations, L604 12 cy	167	sf	\$61.21	\$	10,223	\$150.68	\$	25,163	\$	35,386
Backless Bench - Concrete foundations, L603 8 CY	32	lf	\$91.82	\$	2,962	\$662.99	\$	21,388	\$	24,350
Backless Bench - Concrete foundations, L605 17 CY	65	lf	\$91.82	\$	5,983	\$662.99	\$	43,200	\$	49,183
Backless Bench - Concrete foundations, L603 CY	32	lf	\$91.82	\$	2,938	\$662.99	\$	21,216	\$	24,154
Concrete footings at rising beam barrier (no details)	10	cy	\$612.14	\$	6,121	\$904.08	\$	9,041	\$	15,162
<b>SLAB ON GRADE</b>										
Concrete slab on grade, 12" thick, two-way slab, reinforced with #6 bars at 12" o.c. each way top and bottom with structural synthetic macrofiber reinforcing 497 cy	13,420	sf	\$17.14	\$	230,018	\$21.10	\$	283,096	\$	513,114
Concrete slab on grade, 5" thick with structural synthetic macrofiber reinforcing at 1st floor 28 CY	1,677	sf	\$14.69	\$	24,637	\$15.98	\$	26,798	\$	51,436
Additional reinforcing bars at slab on grade		lbs.	\$0.00	\$	-	\$0.00	\$	-	\$	-
Vapor barrier	13,420	sf	\$1.22	\$	16,430	\$3.01	\$	40,442	\$	56,872
12" th. gravel bed below slab on grade at 1st floor only	62	cy	\$48.97	\$	3,036	\$120.54	\$	7,474	\$	10,510
<b>MUD SLAB</b>										
3" th. concrete mud slab 125 CY	13,420	sf	\$2.45	\$	32,860	\$15.07	\$	202,212	\$	235,071
MISC. CONC. EQUIPMENT PADS, CURBS			\$0.00	\$	-	\$0.00	\$	-	\$	-
4" concrete pad at fire 4.9 cy reserve tank, DWG S-111	400	sf	\$2.45	\$	979	\$19.59	\$	7,835	\$	8,815
4" concrete pad at fuel oil tank extend pad 12" typical beyond the tank footprint, DWG S-111 1.6 cy	130	sf	\$3.67	\$	477	\$19.59	\$	2,546	\$	3,024
6" concrete pad at generator 1.5 cy	84	sf	\$4.90	\$	411	\$19.59	\$	1,645	\$	2,057
Concrete fill on metal deck - floor slabs, #4 bars 12" o.c. ea. way, additional top bars over beams parallel to steel deck, total slab thickness of 5-1/2" w/WWF 159 CY	13,420	sf	\$4.90	\$	65,719	\$9.04	\$	121,327	\$	187,046
Concrete fill on metal deck - roof slabs, #4 bars 12" o.c. ea. way, additional top bars over beams parallel to steel deck, total slab thickness of 5-1/2" w/WWF 217 cy	18,366	sf	\$4.90	\$	89,941	\$9.04	\$	166,043	\$	255,983
<b>Service ramp at roof S118, S119, Det.3,4/S520</b>										
Concrete fill on metal deck - service ramp at roof, #4 bars 12" o.c. ea. way, additional top bars over beams parallel to steel deck, total slab thickness of 5-1/2" w/WWF 212 CY	17,852	sf	\$4.90	\$	87,423	\$9.04	\$	161,396	\$	248,819
Styrofoam 268 cy	7,213	cf	\$3.11	\$	22,430	\$7.53	\$	54,342	\$	76,773
4" concrete curb at built-up service ramp at roof @ 10'-0" O.C. det. DWG S-118, 119 9 CY	726	sf	\$6.12	\$	4,444	\$25.62	\$	18,597	\$	23,041
8" CIP concrete curb at built-up service ramp at roof 54 CY	2,117	sf	\$7.35	\$	15,551	\$21.10	\$	44,658	\$	60,209
Concrete curb 8" w/ 26" h, Det.4/S518, at Lightwell Det. 5/S522, 3/A334	543	sf	\$6.85	\$	3,720	\$15.98	\$	8,677	\$	12,397



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	5" concrete curb below curtain wall at 2nd floor det. Dwg 5/A-553 (1 cy)	86	If	\$7.35	\$	632	\$21.10	\$	1,814	\$	2,446
	Concrete curb 4"x4" at Mechanical rooms at edge of slab	-	If	\$0.00	\$	1,000	\$0.00	\$	3,000	\$	4,000
	Concrete with hardener at Cooling Tower 200A 2 (CY)	56	Sf	\$0.00	\$	1,000	\$0.00	\$	3,000	\$	4,000
	Concrete curb at roof 5 cy	209	Sf	\$12.24	\$	2,559	\$60.27	\$	12,597	\$	15,156
	Cast in place concrete column enclosure at overhang (11 cy)	4	Ea.	\$5,000.00	\$	20,000	\$15,000.00	\$	60,000	\$	80,000
	Isolated concrete footing, 7' x 7' x 2.33'h. - complete, S-208		Cy	\$0.00	\$	2,500	\$0.00	\$	7,500	\$	10,000
	<b>FUEL STORAGE TANKS - General Construction</b>										
	Tank support concrete pad on below grade, 12" th., FS103, #5's 12" o.c. each way 29 CY	768	Sf	\$12.24	\$	9,402	\$54.24	\$	41,660	\$	51,062
	Tank support concrete pad on grade level, 10" th., FS103, assume #5's 12" o.c. each way 24 CY	768	Sf	\$9.79	\$	7,522	\$54.24	\$	41,660	\$	49,182
	Dispenser concrete pad on grade level, 10" th., FS103 6 CY	180	Sf	\$9.79	\$	1,763	\$54.24	\$	9,764	\$	11,527
	Fuel tank dispenser island, FS104, 1'-6"th. on pea gravel with steel faced curb 4 CY	72	Sf	\$19.59	\$	1,410	\$67.81	\$	4,882	\$	6,292
	<b>SITE IMPROVEMENTS - AT COMPACTOR</b>										
	Concrete footing 15 CY	65	If	\$85.70	\$	5,570	\$241.09	\$	15,671	\$	21,241
	Concrete foundation wall 5 CY	65	If	\$85.70	\$	5,570	\$241.09	\$	15,671	\$	21,241
	Concrete slab on grade at Refuse Building A-063 27 CY	892	Sf	\$12.24	\$	10,921	\$25.62	\$	22,849	\$	33,770
	Concrete pad for compactor 6 CY	184	Sf	\$12.24	\$	2,253	\$25.62	\$	4,713	\$	6,966
	<b>Subtotal</b>				\$	<b>1,266,165</b>		\$	<b>2,594,880</b>	\$	<b>3,661,045</b>
<b>03 3300</b>	<b>ARCHITECTURAL CONCRETE</b>										
	<b>RETAINING WALLS</b>										
	Raised planter wall 12" w. with footing, 3' h.exposed face, 4' minimum footing depth, det.2/L601, L100, 101 31 CY	83	If	\$235.11	\$	19,396	\$473.82	\$	39,090	\$	58,486
	Type 3 Concrete security wall with 3'h. fence, 1'-8" w. with footing, 3' h.exposed face, 4'-0" minimum footing depth, 1/B105, B102, L100 (along NYDOT Lot at east side) 147 CY	185	If	\$470.22	\$	86,990	\$947.63	\$	175,312	\$	262,302
	Concrete security wall with 3'h. fence, 1'-0" w. with footing, 3' h.exposed face, 4'-0" minimum footing depth, 1/L601, 1/L602, L101 (along Conduit Ave.) fig 34 cy wall 68 CY 307 If	102	Cy	\$352.66	\$	35,972	\$1,184.54	\$	120,823	\$	156,795
	Type 3 Concrete security/planter wall, 1'-8" w. with footing, 3' h.exposed face, 4'-0" minimum footing depth, 1/B105, B102, L101 (at raised plant bed) 33 CY	42	If	\$352.66	\$	14,812	\$829.18	\$	34,825	\$	49,637
	Rising beam barrier concrete foundations (no details)	10	Cy	\$587.77	\$	5,878	\$710.72	\$	7,107	\$	12,985
	<b>ARCHITECTURAL CONCRETE (formliner surface finish)</b>										
	Dispenser canopy column cover, architectural concrete S-522 3 cy	3	CY	\$470.22	\$	1,411	\$1,421.45	\$	4,264	\$	5,675



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	Type 1 (B1) shallow foundation for fixed bollard, det. 1/B103, 1&3/B104 67 CY	290	If	\$70.53	\$	20,454	\$201.37	\$	58,398	\$	78,852
	Type 2 (B2) deep foundation for removable bollard, det. 2/B103, 2&5/B104 17 CY	30	If	\$141.07	\$	4,232	\$414.59	\$	12,438	\$	16,670
	<b>Subtotal</b>				\$	<b>189,145</b>		\$	<b>452,257</b>	\$	<b>641,402</b>
<b>03 4500</b>	<b>PRECAST ARCHITECTURAL CONCRETE</b>										
	P1 - Thin brick-faced precast concrete (9" precast sandwich panel with thin brick exterior face) mounted to steel structure, det. DWG 1/A-300	6596	sf	\$70.39	\$	464,294	\$119.75	\$	789,860	\$	1,254,154
	P2 - Precast concrete (12" precast sandwich panel with 3" recesses at exterior face) mounted to steel structure	8621	sf	\$87.99	\$	758,542	\$124.13	\$	1,070,113	\$	1,828,655
	P2 Wall Screen - Precast concrete (12" precast sandwich panel with 3" recesses at exterior face) mounted to steel structure	1000	sf	\$87.99	\$	87,988	\$124.13	\$	124,129	\$	212,116
	<b>Subtotal</b>	<b>16844</b>			\$	<b>1,310,824</b>		\$	<b>1,984,101</b>	\$	<b>3,294,925</b>
<b>03 4510</b>	<b>THIN SHELL PRECAST ARCHITECTURAL CONCRETE</b>										
	P3 Thin-brick faced thin cast panel (1" Thin-cast concrete w/brick veneer mounted on J-clips) mounted to steel structure, det. DWG 2/A-300	2769	sf	\$0.00	\$	\$0.00	\$0.00	\$	\$0.00	\$	INCL 03 4500
	<b>Subtotal</b>	<b>19613</b>			\$	<b>0</b>		\$		\$	
<b>03 4800</b>	<b>PRECAST CONCRETE SPECIALTIES</b>										
	Bleacher - Precast concrete, L604	113	If	\$213.08	\$	24,079	\$316.96	\$	35,816	\$	59,895
	Backless Bench, Type A - Precast concrete, L603	13	If	\$437.87	\$	5,692	\$761.17	\$	9,895	\$	15,588
	Backless Bench - Precast concrete, L605	66	If	\$588.65	\$	38,851	\$816.93	\$	53,917	\$	92,768
	Backless Bench, Type C - Precast concrete, L603	31	If	\$398.07	\$	12,340	\$703.65	\$	21,813	\$	34,153
	<b>Subtotal</b>	<b>223</b>			\$	<b>80,962</b>		\$	<b>121,442</b>	\$	<b>202,404</b>
<b>03 4900</b>	<b>GLASS-FIBER-REINFORCED CONCRETE (GFRC)</b>										
	Glass-fiber-reinforced concrete fins used as vertical Sunshade devices	1004	If	\$105.64	\$	106,067	\$93.08	\$	93,448	\$	199,515



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						\$	106,067	\$	93,448	\$	199,515	
04 0000	MASONRY	Subtotal										
04 2000	UNIT MASONRY											
	Concrete masonry units											
	Extra cost for glazed masonry face at wall type J, J1, J2, J3, JS, M, M1, M2, M3	40,847 sf		\$18.20		\$	743,302.73	\$	1,546,402	\$	2,289,705	
	FUEL STORAGE TANKS - General Construction	15,551 sf		\$32.35		\$	503,084.99	\$	252,315	\$	755,400	
	Loading bearing cmu support pier, 12" x 16" (21 ea. @10'-0"h. )	21 ea.		\$353.84		\$	7,430.54		\$1,027.59	\$	29,010	
	Install only HM frames, grout	109 leafs		\$60.66		\$	6,611.66		\$627.37	\$	74,995	
	Install only lintels at door openings	N/A ea.							\$0.00			
	Bleacher - cmu, L604	160 sf		\$24.26		\$	3,882.08		\$48.68	\$	11,670	
	Subtotal					\$	1,264,312		\$	1,896,468	\$	3,160,780
05 0000	METALS											
05 1200	STRUCTURAL STEEL											
	STRUCTURAL STEEL											
	Structural steel framing including beams, columns, bracing, roof platform, dunnage etc.	471.0 tons		\$2,345.20		\$	1,104,589		\$3,517.80	\$	2,761,473	
	Structural steel - plate girders	tons		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Moment connections	104 ea.		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Column base plates	35 ea.		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Miscellaneous steel details, beam cut-outs etc.	ls		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Support framing for MTL-3 Architectural metal screen at Roof	615 lf		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Fuel Station Canopy Framing , Fuel station steel	4.1 ln		\$2,345.20		\$	9,503		\$3,517.80	\$	23,757	
	Column base plate, 21" x 21", S-208 including grouting (vehicle dispensing station)	ea.		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Subtotal					\$	1,114,092		\$	1,671,138	\$	2,785,230
05 3000	STEEL DECK											
	Metal deck at floor slabs	sf		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Metal deck at roof slabs	sf		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Metal deck at Service ramp	sf		\$0.00		\$	-		\$0.00	\$	INCL 051200	
	Shear studs	ea.		\$0.00		\$	-		\$0.00	\$	INCL 051200	



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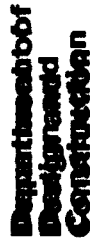
		Subtotal		\$	-	\$	-	\$	-	\$
05 4000	COLD-FORMED METAL FRAMING (Included w/ other Div. 5 sections)									
05 5000	METAL FABRICATIONS									
	Furnish only steel lintels	-	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Elevator pit ladder	1	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Metal cover over elevator sump pit	1	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Elevator hoist beam	1	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Stainless steel wire mesh enclosure to underside of Stair A & B and at General Storage 122	780	sf	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Metal bollards									
	B1 - M50/K12 fixed bollard, 10-3/4" o.d., sched.140	58	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	B2 - M50/K12 REMOVABLE bollard, 10-3/4" o.d., sched.140	6	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	B3 site bollard, 8" o.d. sched 80 pipe	14	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Signage bollard, 8" o.d. sched 40 pipe, det 3.5/6/C212	2	ea.	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	General miscellaneous iron	-	sf	\$0.00	\$	-	-	\$0.00	\$	INCL 05 5113
	Subtotal			\$		-	-	\$		
05 5113	METAL PAN STAIRS									
	Stair A - cellar level to 2nd floor, 46 treads @ 11"	1	ls	\$880,493.00	\$	880,493		\$390,234.37	\$	1,270,727
	Stair B - cellar level to 2nd floor, 4' w, 50 treads @ 11"	1	ls	\$46,860.00	\$	46,860		\$452,524.75	\$	499,385
	Stair at 2nd floor from Corridor to Cooling Tower, 5' w, 2 treads @ 11", landing 6'-0" x 7'-10". S/S wall mounted handrail L=9lf. 1/A522, 3/A404	1	ls	\$10,000.00	\$	10,000		\$136,445.58	\$	22,500
	Aluminum Access ladder mounted to curb at roof det. A-117, A-335, incl. non-alip alum. Platform 12" x 2'0", rail extension (both sides) 3'6" H, 1'2" W, alum. Tube ladder rung 3	1	ea.	\$4,000.00	\$	4,000		\$53,391.75	\$	57,392
	Aluminum Access ladder mounted to curb at roof det. A-117, A-335 incl. non-alip alum. Platform 12" x 2'0", rail extension (both sides) 3'6" H, 1'2" W, alum. Tube ladder rung 2	1	ea.	\$4,000.00	\$	4,000		\$53,391.75	\$	57,392
	Aluminum Access ladder mounted to curb at roof det. A-117, A-335 incl. non-alip alum. Platform 12" x 2'0", rail extension (both sides) 3'6" H, 1'2" W, alum. Tube ladder rung 1	1	ea.	\$4,000.00	\$	4,000		\$53,391.75	\$	57,392
	1-1/2" S/S Pipe guardrail at Cooling Towers	250	lf	\$183.00	\$	45,750		\$1,222.08	\$	351,269
	Metal access stair, include S/S handrail at cooling tower roof area 3' W	2	lf	\$10,000.00	\$	20,000		\$100,851.08	\$	221,702
	Subtotal			\$		1,015,103		\$1,522,656	\$	2,537,759



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[illegible]



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	PLAM2 10" W hat shelf with 60" H PLAM2 back wall Det. 11/A596; Det. 4.13/A597	10	If	\$	320.23	\$	3,202	\$	649.81	\$	6,498.07	\$	9,700
	PLAM2 bench Det. 11/A596, Det.4.13/A597	7	If	\$	228.73	\$	1,601	\$	407.15	\$	2,850.08	\$	4,451
	<b>Kitchen at Community room A-593</b>												
	Base cabinet w/ SS-2 countertop 2'1" w. 2'10 H	10	If	\$	88.95	\$	890	\$	158.34	\$	1,583.36	\$	2,473
	Open shelves (2 row)	10	If	\$	88.95	\$	890	\$	158.34	\$	1,583.36	\$	2,473
	Millwork double door (2)2'2"x7'6"	2	pr	\$	1,025.51	\$	2,051	\$	1,900.03	\$	3,800.06	\$	5,851
	Millwork fixed panels (total 8'x7'6")	10	ls	\$	88.95	\$	890	\$	158.34	\$	1,583.36	\$	2,473
	<b>Muster room A595</b>												
	SS-2 Countertop Workstation 1'8" W 2'10" H with drawer with PLAM-2 divider Det. 4/A595	18	If	\$	148.25	\$	2,669	\$	263.89	\$	4,750.08	\$	7,419
	PLAM-2 shelf with divider Det. 4/A595	18	If	\$	346.60	\$	6,239	\$	633.34	\$	11,400.18	\$	17,639
	PLAM-2 floating bench Det. 1/A595	35	If	\$	284.65	\$	9,963	\$	506.67	\$	17,733.62	\$	27,696
	PLAM-2 Hat shelf Det. 2/A595	24	If	\$	148.25	\$	3,558	\$	263.89	\$	6,333.44	\$	9,892
	<b>Conference rm Det.4/A596</b>												
	PLAM 2 base cabinet w/SS-2 countertop Det.4/A596	12	If	\$	355.81	\$	4,270	\$	633.34	\$	7,600.12	\$	11,870
	PLAM 2 base cabinet w/SS-2 countertop and backsplash Det.5/A596 at Lactation rm	8	If	\$	355.81	\$	2,846	\$	633.34	\$	5,066.75	\$	7,913
	<b>Detective Suite A525</b>												
	PLAM-2 Wall and PLAM-2 base cabinets w/SS-2 countertop Det. 7/A596 at Detective Suite	12	If	\$	512.76	\$	6,153	\$	950.02	\$	11,400.18	\$	17,553
	Recessed visual display cabinet w/ sliding glass door 4'-0" x 4'-0" L. Dwg 6/A-612, 14/A-511	1	EA	\$	-	\$	2,000	\$	1,000.00	\$	1,000.00	\$	3,000
	<b>Subtotal</b>			\$		\$	139,718	\$		\$	209,577	\$	349,295
<b>07 0000</b>	<b>THERMAL AND MOISTURE PROTECTION</b>												
<b>07 1000</b>	<b>FOUNDATION WATERPROOFING</b>												
	Waterproofing (and vapor barrier) at slab and walls	13420	sf		\$11.22	\$	150,528		\$16.91	\$	226,910	\$	377,438
	Waterproofing at plaza type slab (enclosed cellar space below)	1670	sf		\$12.80	\$	21,376		18.53	\$	30,945	\$	52,321
	Elevator pit metallic waterproofing, 3" Rigid insulation and drainage mat	500	sf		\$9.13	\$	4,566		\$17.12	\$	8,561	\$	13,127
	<b>Subtotal</b>			\$		\$	176,469	\$		\$	266,416	\$	442,886
<b>07 2100</b>	<b>THERMAL INSULATION</b>												
	2" continuous rigid insulation at 1st floor slab on grade	13420	sf		\$3.03	\$	40,675		\$5.57	\$	74,721	\$	115,396



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	3" rigid insulation on Z-furring channels at CMU type L,L1,L2,L3, M, M1,M2,M3 at Mechanical Rm, Emergency Generator Rm & Evidence Vehicles	4830	sf	\$5.05	\$	24,399	\$5.57	\$	26,893	\$	51,292
	6" rigid insulation below cantilevered arches	650	sf	\$6.06	\$	3,940	\$5.57	\$	3,619	\$	7,559
	6" rigid insulation below plaza type arches over enclosed space	1670	sf	\$6.06	\$	10,123	\$5.57	\$	9,298	\$	19,422
	Wall Insulation, Rigid, expanded polystyrene, 2" thick, R7.5 @ Basement	12204	sf	\$3.03	\$	36,989	\$5.57	\$	67,951	\$	104,940
	Wall Insulation, Rigid, extruded polystyrene, 3" thick, R15 @ Masonry Backup	4128	sf	\$5.05	\$	20,853	\$5.57	\$	22,984	\$	43,837
	<b>Subtotal</b>				\$	<b>136,979</b>		\$	<b>205,468</b>	\$	<b>342,446</b>
<b>07 2119</b>	<b>FOAMED-IN-PLACE INSULATION</b>										
	Closed-cell spray polyurethane foam, det. Dwg 1/2/A-301	2702	lf	\$4.00	\$	10,808	\$6.00	\$	16,211	\$	27,019
	<b>Subtotal</b>				\$	<b>10,808</b>		\$	<b>16,211</b>	\$	<b>27,019</b>
<b>07 2726</b>	<b>FLUID-APPLIED MEMBRANE AIR BARRIERS</b>										
	Vapor retarder at masonry exterior wall	3425	sf	\$4.00	\$	13,698	\$6.00	\$	20,547	\$	34,245
	<b>Subtotal</b>				\$	<b>13,698</b>		\$	<b>20,547</b>	\$	<b>34,245</b>
<b>07 4213</b>	<b>INSULATED METAL WALL PANELS</b>										
	MP-1, MP-2 - insulated metal panel beam fascia and soffit, Det. DWG. A-231/232	451	sf	\$60.91	\$	27,472	\$97.61	\$	44,020	\$	71,492
	3" insulated metal panel siding on CMU at Bulkhead, det. DWG 9,10,11,12/A-205	289	sf	\$60.91	\$	17,604	\$97.61	\$	28,208	\$	45,812
	3" insulated metal panel siding at CMU at Cooling Tower, det. DWG 3/A-205	904	sf	\$60.91	\$	55,066	\$97.61	\$	88,235	\$	143,301
	<b>Lightwell Exterior, A205</b>										
	3" insulated metal panel siding	1130	sf	\$60.00	\$	67,800	\$105.00	\$	118,650	\$	186,450
	MTL-2 metal panel fascia (at lightwell)		sf		\$	85,000		\$	109,500	\$	194,500
	Dispenser canopy above station, architectural cladding S-522		sf		\$	46,000		\$	59,800	\$	105,800
	<b>Subtotal</b>				\$	<b>298,942</b>		\$	<b>448,413</b>	\$	<b>747,355</b>
<b>07 5216</b>	<b>SBS MODIFIED BITUMINOUS MEMBRANE ROOFING</b>										
	SBS modified bituminous membrane roofing system w/ 1/2" Glass mat gypsum cover board and vapor barrier	21000	sf	\$12.90	\$	271,001	\$18.48	\$	388,142	\$	659,143



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	Additional geofoam at edge of roof, approx. 2h.	2500	sf	\$2.92	\$	7,307	\$4.84	\$	12,089	\$	19,396
	Tapered edge strip at additional geofoam	1	#LS	\$3,440.92	\$	3,441	\$5,238.63	\$	5,239	\$	8,680
	Misc. Flashing at Roof Penetrations at Mounted Panel Supports	1	#LS	\$20,459.66	\$	20,460	\$33,849.61	\$	33,850	\$	54,309
	Walkway Pad/ Splash Pads/Protection Pads	1	#LS	\$121.78	\$	122	\$201.49	\$	201	\$	323
	2'8" x 2'8" Walkway pad, typ	2500	sf	\$2.44	\$	6,089	\$4.24	\$	10,612	\$	16,701
	4" adhered rubber roof paver tile w/ interlocking arm, A2/A333, 2/A301	2500	sf	\$28.01	\$	70,026	\$47.01	\$	117,533	\$	187,559
	<b>Subtotal</b>				\$	<b>378,444</b>		\$	<b>567,666</b>	\$	<b>946,111</b>
<b>07 6200</b>	<b>SHEET METAL FLASHING AND TRIM</b>										
	MTL-2 aluminum metal coping at roof	800	lf	\$0.00	\$	-	\$0.00	\$	-		INCL 07 5216
	Base of wall flashing and drip edge with flashing, 2/A301	150	lf	\$0.00	\$	-	\$0.00	\$	-		INCL 07 5216
	Alum flashing, leaders, misc. accessories	1	#LS	\$0.00	\$	-	\$0.00	\$	-		INCL 07 5216
	Lightwell Exterior, A204										
	Metal roof edge fascia, 1'h.	180	sf	\$0.00	\$	-	\$0.00	\$	-		INCL 07 5216
	<b>Subtotal</b>				\$	-		\$	-	\$	-
<b>07 7200</b>	<b>ROOF ACCESSORIES</b>										
	Fire rated governor access panel at Bulkhead	1	ea.	\$1,995.00	\$	1,995	750	\$	750	\$	2,745
	36" x 12" Elevator smoke vent horizontal louver with actuated damper	1	ea.	\$3,566.00	\$	3,566	2,708	\$	2,708	\$	6,274
	18" x 18" Automatic smoke vent w/ integral guard	1	ea.	\$1,995.00	\$	1,995	750	\$	750	\$	2,745
	36" x 36" Automatic smoke vent w/ integral guard	2	ea.	\$2,500.00	\$	5,000	750	\$	1,500	\$	6,500
	<b>Subtotal</b>				\$	<b>12,556</b>		\$	<b>5,707</b>	\$	<b>18,264</b>
<b>07 8100</b>	<b>APPLIED FIREPROOFING</b>										
	Spray-on fireproofing to metal decking, structural steel beams, and columns based on metal deck area	42107	sf	\$2.92	\$	122,824	\$4.37	\$	184,236	\$	307,060
	<b>Subtotal</b>				\$	<b>122,824</b>		\$	<b>184,236</b>	\$	<b>307,060</b>
<b>07 8410</b>	<b>FIRESTOPPING</b>										
	Fire safing and firestopping at edge of slab	5120	sf	\$12.48	\$	63,139	\$18.50	\$	94,709	\$	157,848



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		Subtotal			\$	63,139	\$	94,709	\$	157,848
07 9200	JOINT SEALANTS									
	Misc. caulking - façade jt sealants, primary & secondary seals	2500	sf		\$25.58	63,944	\$38.35	95,878	\$	159,821
	Misc. sealants - façade, spray foam	2500	sf		\$10.95	27,376	\$16.44	41,101	\$	68,477
	Subtotal					91,319		136,979	\$	228,298
08 0000	OPENINGS									
08 1113	HOLLOW METAL DOORS AND FRAMES									
	3'-0" x 7'-0" single door	47	ea.		\$627.37	29,486	\$1,329.88	62,504	\$	91,991
	Acoustically Rated Custom Security door (Door 212C-Proprietary Item #14). Flush single Door and Frame 14ga. "case open" Continuously welded mortar filled frame. Flush Door 14ga. Flush door w/3/8" UC	1	ea.							
	3'-0" x 7'-0" Solid core single door	41	ea.		\$627.37	25,722	\$1,329.88	54,525	\$	80,247
	3'-0" x 7'-0" HM single door w/ mesh infill	3	ea.		\$627.37	1,882	\$1,329.88	3,990	\$	5,872
	6'-0" x 7'-0" double door	1	pr		\$627.37	627	\$1,329.88	1,330	\$	1,957
	6'-0" x 7'-0"Solid core double door	3	pr		\$627.37	1,882	\$1,329.88	3,990	\$	5,872
	3'-0" x 7'-0" single dutch door with shelf	2	ea.		\$627.37	1,255	\$1,329.88	2,660	\$	3,915
	3'-0" x 7'-0" Exterior solid core single door and HM frames at Evidence Vehicles & MCC Closet	2	ea.		\$627.37	1,255	\$1,329.88	2,660	\$	3,915
	3'-8" x 7'-0" Exterior single door and frames (from Cooling Tower to Corridor)	1	ea.		\$627.37	627	\$1,329.88	1,330	\$	1,957
	Premium for:									
	Fire rated									
	45-mins	9	lvs		\$150.00	1,350	\$0.00	-	\$	1,349
	90-mins	22	lvs		\$250.00	5,500	\$0.00	-	\$	5,500
	180-mins	2	lvs		\$350.00	700	\$0.00	-	\$	700
	1'-0" x 1'-0" 1 1/4" lam. security glass vision panel (type door CS)	2	ea.		\$1,200.00	2,400	\$0.00	-	\$	2,400
	8" x 4'-0" 1 1/4" lam. security glass vision panel (type door BS, BS1)	5	ea.		\$2,400.00	12,000	\$0.00	-	\$	12,000
	2'-0" x 5'-4" 9/16" lam. Tempered glass vision panel (type door E)	1	ea.		\$250.00	250	\$0.00	-	\$	250
	3" x 2'-9" 9/16" lam. Tempered glass vision panel (type door B)	18	ea.		\$250.00	4,500	\$0.00	-	\$	4,500
	STEEL DOORS AND FRAMES									
	Custom 14 Gauge type 316 Stainless steel exterior door and HM frames, single	2	ea.		\$941.00	1,882	\$1,995.00	3,990	\$	5,872



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Project: New 116th Precinct Station House Rebid  
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	Lightwell Exterior, A205	137	sf	\$650.00	\$	89,050	\$400.00	\$	54,800	\$	143,850
	GF-3 Curtain wall 2-3/8" 90 min. fire rated insulated glazing unit										
	<b>Subtotal</b>					<b>161,353</b>			<b>\$ 107,569</b>		<b>\$ 268,922</b>
<b>08 4333</b>	<b>SECURITY STOREFRONTS</b>										
	Glazed entry doors - Exterior (storefront), Fall Safe, Power door operator (ballistic and forced entry resistant)	3	pr	\$8,000.00	\$	24,000	\$3,500.00	\$	10,500	\$	34,500
	Glazed entry doors - Interior (storefront), Power door operator (ballistic and forced entry resistant)	3	pr	\$8,000.00	\$	24,000	\$3,500.00	\$	10,500	\$	34,500
	G-1 bulletproofing fixed aluminum window W1 w/ MTL-1 frame at 1st floor, level 3 in accordance with UL 752	556	sf	\$877.77	\$	488,042	\$604.97	\$	336,361	\$	824,403
	<b>Subtotal</b>					<b>536,042</b>			<b>\$ 357,361</b>		<b>\$ 893,403</b>
<b>08 4413</b>	<b>GLAZED ALUMINUM CURTAIN WALLS</b>										
	G-2 glazing: aluminum window standard 1'3/4" triple-glazed IGU with operable sash at 2nd floor	278	sf	\$425.00	\$	118,150	\$248.60	\$	69,111	\$	187,261
	G-3 Shadowbox assembly: 1" IGU w/ insulated glazing unit	2150	sf	\$334.68	\$	719,569	\$248.60	\$	534,490	\$	1,254,059
	IG-3 Glazing: 1'3/4" insulated vision panel w/ tempered interior pane (safety) det. 2/A-351	963	sf	\$445.00	\$	428,535	\$248.60	\$	239,402	\$	667,936
	1'-3" x 7'-0" Exterior sidelight/storefront dwg 1/A-201	1	ea.	\$2,500.00	\$	2,500	\$1,500.00	\$	1,500	\$	4,000
	Led panel at Storefront 100.1, A203	16	sf	\$325.00	\$	5,200	\$300.00	\$	4,800	\$	10,000
	<b>Subtotal</b>					<b>1,273,954</b>			<b>\$ 849,303</b>		<b>\$ 2,123,256</b>
<b>08 7000</b>	<b>FINISH HARDWARE</b>										
	Hardware locksets, furnish and install		sets	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Deadlock for Acoustically Rated Custom Security door (Door 212C - Proprietary Item #15)			\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Door hardware - Deadlock 1080A-2 - Keyed Both Sides, Manufacturer: Southern Folger		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Finish hardware for Acoustically Rated Custom Security door (Door 212C - Proprietary Item #16)			\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Door Threshold - Rabbed Threshold Zero-566		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Cam Lift Hinges Zero-950		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Hardware Set - head and Jamb Zero-770A		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Auto Door Bottom Zero-367		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113
	Spring Bronze at Head and Jamb Zero-119W		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 08 1113



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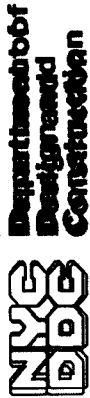
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**Sponsor Agency:** New York City Police Department

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Project: New 116th Precinct Station House Rebid  
 Location: 244-04 North Conduit Avenue, Queens, NY 11422  
 Bidder: CITNALTA CONSTRUCTION CORP.

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	ACT3 - Acoustical ceiling tile w/ perforated metal finish, 2x2 typical at Vestibule, Community Room, Lobby		sf	\$0.00	\$	-	\$0.00	\$	INCL 09 2900
	<b>Subtotal</b>				\$	-	\$		
<b>09 6500</b>	<b>RESILIENT FLOORING AND BASE</b>								
	RF-1 - Rubber floor mat at Stress Reduction Room	530	sf	\$10.00	\$	5,300	\$15.00	\$	13,251
	RB-1 & RB-2 Rubber base	96	lf	\$20.26	\$	1,945	\$30.39	\$	4,862
	<b>Subtotal</b>				\$	7,245		\$	18,113
<b>09 6621</b>	<b>RESINOUS MATRIX TERRAZZO</b>								
	T-1 - Resin terrazzo	8260	sf	\$20.00	\$	165,225	\$30.00	\$	413,025
	TB-1 - Epoxy resin terrazzo base	2637	sf	\$13.63	\$	35,942	\$20.46	\$	89,892
	Precast terrazzo treads and risers at Stairs A, B	368	lf	\$234.28	\$	86,214	\$351.42	\$	215,535
	<b>Subtotal</b>				\$	287,381		\$	718,452
<b>09 6723</b>	<b>RESINOUS FLOORING</b>								
	EP-1 - Broadcast epoxy resin	19670	sf	\$5.48	\$	107,849	\$8.16	\$	268,361
	EP-2 - Pure epoxy resin	8508	sf	\$5.00	\$	42,540	\$6.00	\$	93,588
	EB-1 - Epoxy resin base	7012	lf	\$4.00	\$	28,048	\$8.00	\$	84,144
	<b>Subtotal</b>				\$	178,437		\$	446,093
<b>09 6900</b>	<b>ACCESS FLOORING</b>								
	Raised access flooring (cementitious), +6" aff at Main Desk Area including ramp	756	sf	\$8.15	\$	6,164	\$12.23	\$	15,410
	<b>Subtotal</b>				\$	6,164		\$	15,410
<b>09 9100</b>	<b>PAINTING</b>								
	Paint hollow metal doors and frames	131	leaf	\$50.00	\$	6,550	\$221.26	\$	35,535
	Paint partition	73000	sf	\$0.95	\$	69,350	\$1.20	\$	156,950
	Gypsum Board Finish Level 2 at Staff Lounge	1100	sf	\$0.95	\$	1,045	\$1.20	\$	2,365
	Paint gwb ceilings / Paint Ceiling Types GWB-1 and GWB-2	5125	sf	\$1.55	\$	7,923	\$2.10	\$	18,685



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Project: New 116th Precinct Station House Rebid  
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	Paper towel dispenser and waste receptacle	12	ea.	\$175.00	\$	2,100	\$0.00	\$	-	\$	2,100
	Stainless steel toilet tissue and seat cover dispenser, surface mounted	26	ea.	\$175.00	\$	4,550	\$0.00	\$	-	\$	4,550
	Coat hook	28	ea.	\$25.00	\$	700	\$0.00	\$	-	\$	700
	Mop utility shelf/ broom holder	2	ea.	\$25.00	\$	50	\$0.00	\$	-	\$	50
	Medicine cabinet (CO's toilet room)	1	ea.	\$200.00	\$	200	\$0.00	\$	-	\$	200
	Foldable shower seat	9	ea.	\$175.00	\$	1,575	\$0.00	\$	-	\$	1,575
	Grab bars	25	ea.	\$150.00	\$	3,750	\$0.00	\$	-	\$	3,750
	Shower curtain and rod (locker room)	9	ea.	\$75.00	\$	675	\$0.00	\$	-	\$	675
	Electric hand dryer	14	ea.	\$372.29	\$	5,212	\$0.00	\$	-	\$	5,212
	Sanitary napkin disposal unit	15	ea.	\$225.00	\$	3,375	\$0.00	\$	-	\$	3,375
	Baby changing station at Bathroom 102	1	ea.	\$350.00	\$	350	\$0.00	\$	-	\$	350
	Stainless steel shelf over sink at Restrooms 5" wide x 24" long, 18 gauge	12	lf	\$175.00	\$	2,100	\$0.00	\$	-	\$	2,100
	Wall mounted Mirror at Stress Reduction Rm 03	286	sf	\$10.00	\$	2,860	\$0.00	\$	-	\$	2,860
	<b>Subtotal</b>				\$	<b>30,947</b>		\$	-	\$	<b>30,947</b>
<b>10 2813</b>	<b>DETENTION TOILET ACCESSORIES</b>										
	Grab bars	6	ea.	\$570.60	\$	3,424	\$856.16	\$	5,137	\$	8,561
	<b>Subtotal</b>				\$	<b>3,424</b>		\$	<b>5,137</b>	\$	<b>8,561</b>
<b>10 4413</b>	<b>FIRE PROTECTION CABINETS</b>										
	Fire extinguisher and cabinet, cold-rolled steel	11	ea.	\$1,498.45	\$	16,483	\$0.00	\$	-	\$	16,483
	<b>Subtotal</b>				\$	<b>16,483</b>		\$	-	\$	<b>16,483</b>
<b>10 5113</b>	<b>METAL LOCKERS</b>										
	Type L1 - 24" x 37-1/8" x 84" powered single door locker bank (with seat)	372	ea.	\$573.27	\$	213,256	\$860.68	\$	320,173	\$	533,429
	Type L1a - 24" x 37-1/8" x 84" accessible powered single door locker bank	8	ea.	\$572.59	\$	4,581	\$861.34	\$	6,891	\$	11,471
	Type L3 - 18" x 24" x 36" typical double- tier locker	15	ea.	\$572.59	\$	8,589	\$861.34	\$	12,920	\$	21,509
	Type L2 -18" x 24" x 72" typical single door locker bank	63	ea.	\$572.59	\$	36,073	\$861.34	\$	54,264	\$	90,338
	Locker benches	1	ea.	\$500.00	\$	500	\$250.00	\$	250	\$	750



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Project: New 116th Precinct Station House Rebid  
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Bidder: CITI/ALTA CONSTRUCTION CORP.

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	Bicycle rack, aluminum casting, 1/L606	10	ea.	\$228.30	\$2,282.98	\$2,282.98	\$365.28	\$3,653	\$5,936
	Litter and recycling receptacles	2	ea.	\$2,282.98	\$4,565.95	\$3,652.76	\$7,306	\$11,871	
Incl Above	RPL bleacher on precast concrete base, L604			\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	Bleacher - RPL, metal support frame rails, metal cover between slats, L604		sf	\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	RPL benches on precast concrete base, type A, det.1/L603			\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	Backless Bench - RPL, metal support frame rails, metal cover between slats, L603		lf	\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	RPL benches on precast concrete base, type B, L605			\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	Backless Bench - RPL, metal support frame rails, metal cover between slats, L605		lf	\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	RPL benches on precast concrete base, type C, det.1/L603			\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	Backless Bench - RPL, metal support frame rails, metal cover between slats, L603		lf	\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	B1 - M50/K12 stainless steel bollard cover, 2/A-061	58	ea.	\$0.00	-	\$0.00	-	-	Incl in 03 4800
Incl Above	B2 - M50/K12 stainless steel bollard cover, 2/A-061	6	ea.	\$0.00	-	\$0.00	-	-	Incl in 03 4800
	<b>Subtotal</b>				<b>\$ 14,839</b>		<b>\$ 10,958</b>	<b>\$ 25,798</b>	
<b>13 0000</b>	<b>SPECIAL CONSTRUCTION</b>								
<b>13 1000</b>	<b>VEHICLE OPERABLE BARRIERS</b>								
	Rising beam barrier, B-101	1	ea.	\$102,734.00	\$102,734.00	\$154,101.00	\$154,101	\$256,835	
	<b>Subtotal</b>				<b>\$ 102,734</b>		<b>\$ 154,101</b>	<b>\$ 256,835</b>	
<b>14 0000</b>	<b>CONVEYING SYSTEMS</b>								
<b>14 2123</b>	<b>TRACTION ELEVATOR</b>								
	Elevator PE1 passenger and building service type, machine room-less (MRL) traction elevator, serving the cellar, 1st and 2nd floors, 200 fpm, 3,500# capacity, 30'-0" run, 3'-6" w. automatic single speed side opening door, sized for 84" NYC code stretcher requirement.	1	ea.	\$159,351.21	159,351	\$239,028.39	\$239,028	\$398,380	
	Elevator cab fit-out	1	ea.	\$1,369.79	1,370	\$55,704.61	\$55,705	\$57,074	
	<b>Subtotal</b>				<b>\$ 160,721</b>		<b>\$ 294,732</b>	<b>\$ 455,454</b>	
<b>21 0000</b>	<b>FIRE SUPPRESSION</b>								
<b>21 0000</b>	<b>COMMON WORK RESULTS FOR FIRE PROTECTION</b>								





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2" Pipe Size	120	If	\$7.78	\$	933	\$17.00	\$	2,040	\$	2,973
<b>Riser Valve</b>										
Roof Manifold 3" size w/3 fire Hose Valve Standpipe connect 1 1/2", wall w/plugs & chains, brass, 2-1/2" x 2-1/2"x 4"	3	ea.	\$2,750.00	\$	8,250	\$5,000.00	\$	15,000	\$	23,250
<b>FIRE SUPPRESSION HOSE VALVES</b>										
Fire Hose Valve 2 1/2"	9	ea.	\$1,500.00	\$	13,500	\$2,000.00	\$	18,000	\$	31,500
Sprinkler System Gate Valve, 4" size, w flow & tamper alarm connections	20	ea.	\$750.00	\$	15,000	\$1,000.00	\$	20,000	\$	35,000
Sprinkler System Gate Valve, 6" size, w flow & tamper alarm connections	10	ea.	\$850.00	\$	8,500	\$1,200.00	\$	12,000	\$	20,500
<b>Subtotal</b>				\$	<b>50,433</b>		\$	<b>75,649</b>	\$	<b>126,082</b>
<b>21 1313 WET-PIPE SPRINKLER SYSTEMS</b>										
Sprinkler System Riser Detail 6"	3	ea.	\$400.00	\$	1,200	\$400.00	\$	1,200	\$	2,400
<b>Main &amp; Riser Piping CS Sch 40 Welded</b>										
6" pipe	70	lf	\$10.00	\$	700	\$11.00	\$	770	\$	1,470
3" - 4" Pipe Size	120	lf	\$8.00	\$	960	\$8.80	\$	1,056	\$	2,016
2" - 2-1/2" Pipe Size	210	lf	\$6.00	\$	1,260	\$6.60	\$	1,386	\$	2,646
1-1/2" - 1-1/4" Pipe Size	380	lf	\$4.00	\$	1,520	\$4.40	\$	1,672	\$	3,192
1" Pipe Size	598	lf	\$3.00	\$	1,793	\$3.30	\$	1,972	\$	3,765
Heads in General	200	ea.	\$200.00	\$	40,000	\$327.96	\$	65,593	\$	105,593
Floor Control Assembly w FHVC	2	ea.	\$1,500.00	\$	3,000	\$1,000.00	\$	2,000	\$	5,000
<b>Subtotal</b>				\$	<b>50,433</b>		\$	<b>75,649</b>	\$	<b>126,082</b>
<b>21 1316 DRY-PIPE SPRINKLER SYSTEMS</b>										
Dry Heads - Canopy area	14	ea.	\$551.14	\$	7,716	\$951.79	\$	13,325	\$	21,041
Control Assembly Dry System	1	ea.	\$10,000.00	\$	10,000	\$14,000.00	\$	14,000	\$	24,000
Compressor	1	ea.	\$7,500.00	\$	7,500	\$10,500.00	\$	10,500	\$	18,000
<b>Subtotal</b>				\$	<b>25,216</b>		\$	<b>37,825</b>	\$	<b>63,041</b>
<b>21 2400 DRY CHEMICAL EXTINGUISHING SYSTEM</b>										
Proprietary #17: Pyro-Chem Dry Chemical Extinguishing System for Vehicle Fueling Area										
40BC Fire Extinguisher		ea.								
80 lb. Sodium Bicarbonate extinguishing System		ea.								
<b>Piping</b>										
1" Black Steel Sch 40		lf								

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

[illegible]



Project: New 116th Precinct Station House Rebid  
Location: 244-04 North Conduit Avenue, Queens, NY 11422  
Bidder: CITNALT CONSTRUCTION CORP.

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

	Link seal (or equal) 6" Sanitary	1	ea.	\$3,000.00	\$	3,000	\$4,500.00	\$	4,500	\$	7,500
	Link seal (or equal) 10" Storm	1	ea.	\$6,000.00	\$	6,000	\$9,000.00	\$	9,000	\$	15,000
	Dorm. Wtr + Waste & Vent, Fire Safe & Seal Pipe Penetrations	261	ls	\$38.64	\$	10,085	\$57.96	\$	15,128	\$	25,213
	Subtotal				\$	37,220		\$	55,830	\$	93,050
22 0518	ESCUTCHEONS FOR PLUMBING PIPING	62	ls	\$120.06	\$	7,444	\$180.10	\$	11,166	\$	18,610
	Subtotal				\$	7,444		\$	11,166	\$	18,610
22 0519	METERS AND GAGES FOR PLUMBING PIPING	12	ls		\$	37,220		\$	55,830	\$	93,050
	Subtotal				\$	37,220		\$	55,830	\$	93,050
22 0523	GENERAL-DUTY VALVES FOR PLUMBING PIPING										
	Master Domestic Thermostatic mixing valve		ea.								
	Thermostatic mixing valve, automatic water tempering, 1-1/2" - 2" size	25	ea.	\$38.57	\$	964	\$39.71	\$	993	\$	1,957
	1 per MW BathRm Group, bronze	9	ea.	\$295.03	\$	2,655	\$186.20	\$	1,676	\$	4,331
	Wall Hydrant- Freeze Proof Type size 3/4"	2	ea.	\$18.65	\$	37	\$39.64	\$	79	\$	117
	HB-1 Hose Bib 3/4", washroom	103	ls	\$36.77	\$	3,787	\$81.73	\$	8,418	\$	12,205
	Valves and fittings in General				\$	7,444		\$	11,166	\$	18,610
	Subtotal										
22 0529	ING PIPING AND EQUIPMENT (included w/ other Div. 22 sections)										
22 0533	HEAT TRACING FOR PLUMBING PIPING										
	Heat Tracing	675	lf	\$17.04	\$	11,502	\$0.00	\$	-	\$	11,502
	Plumbing Pipe Seismic Restraint, NYC Code Risk IV / Class C	1	sf	\$25,718.00	\$	25,718	\$55,830.00	\$	55,830	\$	81,548
	Subtotal				\$	37,220		\$	55,830	\$	93,050
22 0548	VIBRATION ISOLATION, SEISMIC, WIND AND FLOOD LOAD RESTRAINTS FOR PLUMBING COMPONENTS										
	Vibration And Seismic Controls For Plumbing Piping And Equip	1	LS	\$14,538.00	\$	14,538	\$21,632.00	\$	21,632	\$	36,170
	Seismic bracing supports, vibration absorber hanger type, neoprene flex, 10-120 lb. capacity - 2 per In Line FZP Pumps (4 ea.), details	4	ea.	\$50.00	\$	200	\$100.00	\$	400	\$	600
	Seismic bracing supports, vibration absorber hanger type, neoprene flex, 10-120 lb. capacity - 2 per In Line HW Boiler Pumps (2 ea.), details	2	ea.	\$50.00	\$	100	\$100.00	\$	200	\$	300
	Seismic bracing supports, vibration absorber hanger type, neoprene flex, 10-120 lb. capacity - 4 per HV-2-1 Unit (1 ea.), details	1	ea.	\$50.00	\$	50	\$100.00	\$	100	\$	150



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						\$	14,888	\$			\$	22,332	\$	37,220
22 0553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT													
	Plumbing System Pipe ID, Valve Tag and charts	438	Is	\$2.00			876	\$5.00				2,190	\$	3,066
	Paint Fuel Piping		If				6,568					8,976	\$	15,544
	Subtotal						7,444					11,166	\$	18,610
22 0719	PLUMBING PIPING INSULATION													
	Domestic Water Pipe Insulation													
	6" size / Pipe, copper tubing	-	If	\$0.00			-	\$0.00				-	\$	-
	4" size / Pipe, copper tubing	56	If	\$3.25			182	\$3.95				221	\$	403
	3" size / Pipe, copper tubing	245	If	\$3.25			796	\$3.95				968	\$	1,764
	2-1/2" size / Pipe, copper tubing	11	If	\$3.25			36	\$3.95				43	\$	79
	2" size / Pipe, coppe, tubing	540	If	\$3.00			1,620	\$3.50				1,890	\$	3,510
	1-1/2" size / Pipe, copper tubing	383	If	\$2.25			862	\$3.50				1,341	\$	2,202
	1-1/4" size / Pipe, copper tubing	33	If	\$2.25			74	\$3.50				116	\$	190
	1" size / Pipe, copper, tubing solder	979	If	\$2.25			2,203	\$3.50				3,427	\$	5,629
	3/4" size / Pipe, copper, tubing solder	2,419	If	\$2.00			4,838	\$3.50				8,467	\$	13,305
	1/2" size / Pipe, copper tubing	4,663	If	\$1.84			8,566	\$3.44				16,059	\$	24,625
	Storm Piping Insulation													
	10" size	14	If	\$18.00			252	\$20.00				280	\$	532
	8" size	263	If	\$17.00			4,471	\$20.00				5,260	\$	9,731
	4" size	888	If	\$15.00			13,320	\$20.00				17,760	\$	31,080
	Subtotal						37,220					55,830	\$	93,050
22 0800	COMMISSIONING OF PLUMBING													
	COMMISSIONING OF PLUMBING Assistance	1	Is	\$7,444.00			7,444	\$11,166.00				11,166	\$	18,610
	Subtotal						7,444					11,166	\$	18,610
22 1113	FACILITY WATER DISTRIBUTION PIPING													
	Back Flow Preventer RPZ -6" W/ Water Meter for Fire System Water, Double Check, flanged with bypass and isolation valves	1	ea.	\$15,894.34			15,894	\$26,275.34				26,275	\$	42,170
	Back Flow Preventer RPZ -4" W/ Water Meter for Fire System Water, Double Check, flanged with bypass and isolation valves	1	ea.	\$21,325.66			21,326	\$29,554.66				29,555	\$	50,880
	Subtotal						37,220					55,830	\$	93,050
22 1114	FACILITY NATURAL GAS PIPING													
	Gas Meter 4" size, Nat Gas Meter, turbine type, flanged, 4" diameter - Bldg. entry area / 6"	1	ea.	\$1,978.17			1,978	\$14,755.87				14,756	\$	16,734



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[illegible]



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DDC ID: PO002-116  
 Sponsor Agency: New York City Police Department

22 1124	Circulation Pump w Pipe Hk-up, @ Dom Wtr Htrs / HW Circ pump - CP- 1 - 4; 0.75hp	2	ea.	\$6,609.00	\$	13,218	\$8,285.25	\$	16,571	\$	29,789
	Check Valve Non Slam 4"		ea.		\$	435		\$	1,501	\$	1,936
	Gate Valve 4"		ea.		\$	435		\$	1,501	\$	1,936
	Ball Valve 4"		ea.		\$	405		\$	1,397	\$	1,802
	Pressure Reducing Valve 4"		ea.		\$	395		\$	1,363	\$	1,758
	<b>Subtotal</b>				\$	<b>14,888</b>		\$	<b>22,332</b>	\$	<b>37,220</b>
22 1124	<b>DOMESTIC WATER PACKAGED BOOSTER PUMPS</b>										
	Duplex Dom Water Booster Pump w Controls, up to 50' head, 80 gpm, 5 HP each	1	ea.	\$14,888.00	\$	14,888	\$22,332.00	\$	22,332	\$	37,220
	<b>Subtotal</b>				\$	<b>14,888</b>		\$	<b>22,332</b>	\$	<b>37,220</b>
22 1223	<b>FACILITY INDOOR WATER STORAGE TANKS</b>										
	22,500 gal Ground Suction Storage Tank	1	ea.	\$51,000.00	\$	51,000	\$77,000.00	\$	77,000	\$	128,000
	Fire Reserve Tank float assembly with relay head for alarm/level control	1	ea.	\$1,108.00	\$	1,108	\$1,162.00	\$	1,162	\$	2,270
	<b>Subtotal</b>				\$	<b>52,108</b>		\$	<b>78,162</b>	\$	<b>130,270</b>
22 1316	<b>SANITARY WASTE AND VENT PIPING</b>										
	Sanitary Piping										
	CI Pipe Hub and Spigot										
	4" size	308	If	\$16.41	\$	5,054	\$24.62	\$	7,582	\$	12,636
	3" size	117	If	\$14.77	\$	1,728	\$22.15	\$	2,592	\$	4,320
	2" size	287	If	\$8.21	\$	2,355	\$12.31	\$	3,532	\$	5,887
	1-1/2" size	-	If	\$0.00	\$	-	\$0.00	\$	-	\$	-
	CI Pipe No Hub and Spigot										
	6" size	-	If	\$0.00	\$	-	\$0.00	\$	-	\$	-
	4" size	697	If	\$14.77	\$	10,294	\$22.15	\$	15,441	\$	25,735
	3" size	182	If	\$13.13	\$	2,389	\$19.69	\$	3,584	\$	5,973
	2-1/2" size	-	If	\$0.00	\$	-	\$0.00	\$	-	\$	-
	2" size	2,142	If	\$6.56	\$	14,060	\$9.85	\$	21,090	\$	35,151
	1-1/2" size	-	If	\$0.00	\$	-	\$0.00	\$	-	\$	-
	1-1/4" size	-	If	\$0.00	\$	-	\$0.00	\$	-	\$	-
	<b>Pumped Drain</b>										
	3" size	24	If	\$16.41	\$	394	\$24.62	\$	591	\$	985
	2" size	64	If	\$14.77	\$	945	\$22.15	\$	1,418	\$	2,363
	<b>Subtotal</b>				\$	<b>37,220</b>		\$	<b>55,830</b>	\$	<b>93,050</b>



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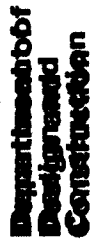






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				ea.	\$0.00	\$	-	\$0.00	\$	-	INCL 22 1423
	Storm Drain House Trap - 10"										
	Roof Drains:										
	Roof drain - 6" dia RD	10	ea.		\$432.00	\$	4,320	\$720.00	\$	7,200	\$ 11,520
	Overflow drain - 6" dia OD	9	ea.		\$432.00	\$	3,888	\$720.00	\$	6,480	\$ 10,368
	Subtotal					\$	37,220		\$	55,630	\$ 93,050
22 3500	DOMESTIC WATER HEATERS										
	Dual Fuel Domestic Hot Water Heater	2	ea.		\$7,444.00	\$	14,888	\$11,166.00	\$	22,332	\$ 37,220
	Flue 4" dia (SS 10 Ga) (Hot water heater)		If			\$	-		\$	-	INCL 22 3500
	Subtotal					\$	14,888		\$	22,332	\$ 37,220
22 4300	PLUMBING FIXTURES										
	Water Closet, vit china, Wall hung, seat, supply w stop and Carrier	23	ea.		\$358.00	\$	8,234	\$550.57	\$	12,663	\$ 20,897
	Lavatory, Wall Hung, porcelain, white, 19" x 17", incl trim w Carrier - Sm Men/ Women Restrooms	25	ea.		\$348.00	\$	8,700	\$556.00	\$	13,900	\$ 22,600
	Pantry sink, Wall Mtd, porcelain, sgl bowl, 24"x21" w faucet & drn - at Lactation Rm	2	ea.		\$228.00	\$	456	\$385.00	\$	770	\$ 1,226
	Mop Service Sink, molded stone w rim, 3 sides, 24x36 w faucet, accessy	3	ea.		\$228.00	\$	684	\$285.00	\$	855	\$ 1,539
	Shower Base only	15	ea.		\$200.00	\$	3,000	\$250.00	\$	3,750	\$ 6,750
	Urinal	6	ea.		\$209.67	\$	1,258	\$260.00	\$	1,560	\$ 2,818
	Add for Sensors		ea.		\$0.00	\$	-	\$0.00	\$	-	INCL 22 4300
	Subtotal					\$	22,332		\$	33,498	\$ 55,830
22 4500	EMERGENCY PLUMBING FIXTURES										
	Emergency Shower	1	ea.		\$7,444.00	\$	7,444	\$11,166.00	\$	11,166	\$ 18,610
	Subtotal					\$	7,444		\$	11,166	\$ 18,610
22 4600	SECURITY PLUMBING FIXTURES										
	Combination water closet/ lavatory	2	ea.		\$1,900.00	\$	3,800	\$2,750.00	\$	5,500	\$ 9,300
	In Line Macerator	2	ea.		\$1,822.00	\$	3,644	\$2,833.00	\$	5,666	\$ 9,310
	Subtotal					\$	7,444		\$	11,166	\$ 18,610
22 4700	ELECTRIC WATER COOLERS										
	Electric Water Cooler (Added 2 for First Floor) / Electric Water Cooler, wall mtd, non-recess, dual height, 8.2 GPH	7	ea.		\$965.21	\$	6,757	\$995.00	\$	6,965	\$ 13,722
	Exterior Bottle Filler	1	ea.		\$50.00	\$	50	\$100.00	\$	100	\$ 150
	Roughing of plumbing fixtures	85	ea.		\$7.50	\$	638	\$48.25	\$	4,101	\$ 4,739
	Subtotal					\$	7,444		\$	11,166	\$ 18,610



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	Valves, iron body, Butterfly 4" - Boiler	4	ea.	\$1,004.96	\$	4,020	\$264.17	\$	1,057	\$	5,077
	Valves, iron body, 6" - Summer Winter Valve	3	ea.	\$1,339.94	\$	4,020	\$234.82	\$	704	\$	4,724
	Cab Unit Heater Coil Connection - CUH-1	5	ea.	\$293.11	\$	1,466	\$845.36	\$	4,227	\$	5,692
	Unit Heater Coil Connection	6	ea.	\$293.11	\$	1,759	\$821.87	\$	4,931	\$	6,690
	AD-1 Unit 1" Htg Coil Connection	1	ea.	\$251.24	\$	251	\$704.46	\$	704	\$	956
	CRAC Unit 1" Chill Coil Connection - CRAC C-1, 1-1 & 2-1	2	ea.	\$293.11	\$	586	\$880.58	\$	1,761	\$	2,347
	CRAC Unit 1 1/4" to 1 1/2" Chill Coil Connection - CRAC C-2	2	ea.	\$293.11	\$	586	\$880.58	\$	1,761	\$	2,347
	HV Unit 1 1/4" to 1 1/2" Htg HW Coil Connection - HV-2-1	1	ea.	\$418.73	\$	419	\$704.46	\$	704	\$	1,123
	FTR Zone Connection	73	ea.	\$293.11	\$	21,397	\$627.26	\$	45,790	\$	67,187
	VAV Box Connection	65	ea.	\$293.11	\$	19,052	\$623.18	\$	40,507	\$	59,559
	Subtotal				\$	136,800		\$	157,800	\$	294,600
23 0533	HEAT TRACING FOR HVAC PIPING	2280	lf	\$15.00	\$	34,200	\$17.30	\$	39,450	\$	73,650
	Subtotal				\$	34,200		\$	39,450	\$	73,650
23 0548	VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS VIBRATION CONTROLS FOR MECHANICAL/ELECTRICAL SYSTEMS (NON-SEISMIC):	1	ls	\$13,888.30	\$	13,888	\$24,483.60	\$	24,484	\$	38,372
	Cooling Tower Vibration Isolators	2	ea.	\$6,944.15	\$	13,888	\$5,894.20	\$	11,788	\$	25,677
	Chiller	1	ea.	\$13,888.30	\$	13,888	\$4,534.00	\$	4,534	\$	18,422
	AHU	9	ea.	\$3,090.15	\$	27,811	\$3,022.67	\$	27,204	\$	55,015
	Pumps	15	ea.	\$1,874.92	\$	28,124	\$3,022.67	\$	45,340	\$	73,464
	Ductwork 50' out for HVAC units	ALL	ea.		\$	5,000		\$	5,000	\$	10,000
	Subtotal				\$	102,600		\$	118,350	\$	220,950
23 0553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	1	ls		\$	4,200		\$	3,450	\$	7,650
	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	3000	lf	\$5.00	\$	15,000	\$6.00	\$	18,000	\$	33,000
	Paint Fuel Piping; Generator	3000	lf	\$5.00	\$	15,000	\$6.00	\$	18,000	\$	33,000
	Paint Fuel Piping; Fueling Station				\$	34,200		\$	39,450	\$	73,650
	Subtotal				\$	34,200		\$	39,450	\$	73,650
23 0593	TESTING, ADJUSTING AND BALANCING										
	Mech Subcontractor Assist 3rd Party - HVAC Balancing Air & Water	ALL	day		\$	34,200		\$	39,450	\$	73,650
	Subtotal				\$	34,200		\$	39,450	\$	73,650



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	HVAC INSULATION	ALL	Is	\$	17,425						
	HVAC INSULATION	ALL	Sf	\$	60,990						
	Duct Insulation	ALL	Sf	\$	5,230						
	Acoustical Lining 2" for Ductwork	ALL	Is	\$	870						
	HVAC Equipment Insulation	ALL	Is	\$							
	HVAC Piping Insulation	ALL	If	\$	8,715						
	6" size	ALL	If	\$	8,715						
	4" size	ALL	If	\$	8,715						
	3" size	ALL	If	\$	8,715						
	2-1/2"-2" size	ALL	If	\$	8,715						
	1-1/2" - 1" size	ALL	If	\$	8,715						
	3/4" size	ALL	If	\$	8,710						
	HVAC Piping, Fire Safe & Seal Pipe Penetrations	ALL	Is	\$	-	\$0.00					
	Subtotal			\$	136,800						
23 0800	COMMISSIONING OF HVAC										
	COMMISSIONING OF HVAC	1	Is	\$	7,435						
	Mech subcontractor Commissioning Support - Assist 3rd Party (2 men, 3 days), HVAC Pipe Testing, Chill + Htg Water	1	Is	\$	5,948						
	HVAC Pipe Testing, Chill + Htg Water	1	Is	\$	11,896						
	HVAC Duct Leakage Testing, both SA & RA Duct, (lb. Basis) - Base Cost	1	Is	\$	4,461						
	Pipe Flushing & Chemical Cleaning (2 men 6 days) - Chill & Htg water	1	Is	\$	4,461						
	Subtotal			\$	34,200						
23 0900	HVAC INSTRUMENTATION AND CONTROLS	1	Is	\$	34,200						
	Subtotal			\$	34,200						
23 0905	SEQUENCE OF OPERATIONS FOR HVAC CONTROLS (included w/ 230900)										
23 1113	FACILITY FUEL-OIL PIPING										
	Piping 6"Containment w/1-1/2", FOS 2 FOR 1-1/2"	35	If	\$	265.37						
	3" FO Pipe	150	If	\$	\$53.07						
	2" FO Pipe	160	If	\$	\$29.03						
	1-1/2" FO Pipe	175	If	\$	\$18.96						
	1" FO Pipe	30	If	\$	\$22.11						
	3"Vent Pipe	45	If	\$	\$44.23						



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	3" Fill Pipe	45	If	\$44.23	\$	1,990	\$197.93	\$	8,907	\$	10,897
	Valving and specialties										
	Curb Box										
	Fuel oil specialties, Duplex fuel oil pump skid, 0.5 HP, 150gph - Tag FOSP1 & FOSP-2	2	ea.	\$26,537.34	\$	53,075	\$742.24	\$	1,484	\$	54,559
	Fuel oil specialties, Duplex fuel oil filtration pump skid, to 0.25 HP, up to 180gph - Tag FOF-B-3/ FOF-B-4	2	ea.	\$26,537.34	\$	53,075	\$742.24	\$	1,484	\$	54,559
	Duplex Strainers	2	ea.	\$398.06	\$	796	\$222.67	\$	445	\$	1,241
	Subtotal				\$	136,800		\$	157,800	\$	294,600
23 1313	UNDERGROUND FUEL STORAGE TANKS AND FUEL SYSTEMS										
	Vehicle fuel dispensing station, dual pumps, FS-104		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	FUEL STORAGE TANKS - General Construction										
	Watertight tank manholes, FS105 including collar extension riser		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	18" manholes, tank observation sump, FS105		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Fuel Oil Tanks										
	Gasoline System										
	6,000 gal Fiberglass double wall tank		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Sump Pump 2hp		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Filtration		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Alarm System		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Veeder Root Meter		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Fill Box and overflow		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Leak Detection System		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Vapor Recovery		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Sump Sensor		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Flex Piping		ls	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Piping										
	3" Containment Pipe with 2" Carrier Pipe		If	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	2" Black Steel Sch 40		If	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	1" Black Steel Sch 40		If	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	2" Fiberglass Vent Pipe		If	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	1" Black Steel Sch 40		If	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	PVC Piping										
	6" PVC Pipe observation sump		If	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313
	Diesel System										
	4,000 gal Fiberglass double wall tank		ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 23 1313



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Bidder: CITNALTA CONSTRUCTION CORP.

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Sponsor Agency: New York City Police Department

	Sump Pump 2hp		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Diesel Filtration System										
	Filtration		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Alarm System		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Veeder Root Meter		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Fill Box and overflow		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Leak Detection System		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Vapor Recovery		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Sump Sensor		ea.	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Flex Piping		ls	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	Piping										
	3" Containment Pipe with 2" Carrier Pipe		lf	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	2" Containment Pipe with 1" Carrier Pipe		lf	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	2" Black Steel Sch 40		lf	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	1" Black Steel Sch 40		lf	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	2" Fiberglass Vent Pipe		lf	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
	PVC Piping										
	6" PVC Pipe observation sump		lf	\$0.00	\$	\$0.00	\$	-	\$0.00	\$	INCL 23 1313
		Subtotal			\$			136,800		\$ 157,800	\$ 294,600
23 2113	HVAC PIPING										
	CHW&CW Pipe Black Steel Sch-40										
	6" size	850	lf	\$41.74	\$	\$32.33	\$	35,477	\$27.481	\$	62,958
	4" size	25	lf	\$23.65	\$	\$25.45	\$	591	\$636	\$	1,227
	3" size	165	lf	\$16.29	\$	\$16.96	\$	2,688	\$2,799	\$	5,487
	2-1/2" size	17	lf	\$15.81	\$	\$14.97	\$	269	\$254	\$	523
	2" size	25	lf	\$10.75	\$	\$12.72	\$	269	\$318	\$	587
	1-1/2" size	222	lf	\$7.26	\$	\$12.04	\$	1,613	\$2,672	\$	4,284
	1" size	455	lf	\$5.91	\$	\$11.18	\$	2,688	\$5,089	\$	7,777
	3/4" size	420	lf	\$5.76	\$	\$8.78	\$	2,419	\$3,690	\$	6,108
	Condensate Water Drain Pipe Copper Type L										
	1-1/4" size	70	lf	\$8.45	\$	\$11.81	\$	591	\$827	\$	1,418
	1" size	70	lf	\$7.68	\$	\$11.45	\$	538	\$802	\$	1,339
	3/4" size	235	lf	\$5.26	\$	\$8.66	\$	1,236	\$2,036	\$	3,272
	HW Pipe Black Steel Sch-40										
	6" size	275	lf	\$43.00	\$	\$32.39	\$	11,826	\$8,906	\$	20,731
	4" size	350	lf	\$24.57	\$	\$25.45	\$	8,600	\$8,906	\$	17,506



Project: New 116th Precinct Station House Rebid  
Location: 244-04 North Conduit Avenue, Queens, NY 11422  
Bidder: CITNALTA CONSTRUCTION CORP.

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

	3" size	200	lf	\$17.47	\$	3,494	\$17.18	\$	3,435	\$	6,929
	2-1/2" size	180	lf	\$14.93	\$	2,688	\$14.14	\$	2,545	\$	5,232
	2" size	1,720	lf	\$10.94	\$	18,813	\$12.57	\$	21,629	\$	40,442
	1-1/2" size	480	lf	\$8.40	\$	4,031	\$12.19	\$	5,852	\$	9,884
	1-1/4" size	344	lf	\$8.59	\$	2,956	\$11.84	\$	4,071	\$	7,028
	1" size	3,070	lf	\$6.48	\$	19,888	\$11.23	\$	34,479	\$	54,367
	3/4" size	2,430	lf	\$5.31	\$	12,901	\$8.74	\$	21,247	\$	34,148
	Flow Meter Cooling systems	2	ea.	\$268.76	\$	538	\$31.81	\$	64	\$	601
	Flow Meter Boiler make up	1	ea.	\$2,687.62	\$	2,688	\$63.61	\$	64	\$	2,751
	Backflow Preventer, Double Check, 1" - Boiler Make-up water		ea.	\$0.00	\$	-	\$0.00	\$	-	\$	INCL 23 2113
	Backflow Preventer, Double Check, 1" - Chilled Make-up water		ea.	\$0.00	\$	-	\$0.00	\$	-	\$	INCL 23 2113
	Subtotal				\$	136,800		\$	157,800	\$	294,600
23 2123	HVAC PUMPS										
	CWP-1,2 Condenser Water Pump 360gpm, 95TDH, 15hp	1	ea.	\$24,212.39	\$	24,212	\$16,967.74	\$	16,968	\$	41,180
	CHWP-1,2 Chilled Water Pump 305gpm, 90TDH, 10hp	1	ea.	\$24,212.39	\$	24,212	\$16,967.74	\$	16,968	\$	41,180
	HWP-1,2 AHU Hot Water Pump; 150gpm, 45TDH 3 hp	1	ea.	\$18,159.29	\$	18,159	\$16,967.74	\$	16,968	\$	35,127
	HWP-3,4 Perimeter AHU Hot Water Pump; 30gpm, 25TDH, 1 hp	1	ea.	\$12,106.19	\$	12,106	\$16,967.74	\$	16,968	\$	29,074
	BHWP-1,2 Boiler Hot Water Pump; 40gpm, 25TDH, 1 hp	2	ea.	\$6,053.10	\$	12,106	\$8,483.87	\$	16,968	\$	29,074
	Freeze Protection Pump; 25gpm, 0.4 hp	1	ea.	\$605.31	\$	605	\$3,393.55	\$	3,394	\$	3,999
	HRRP-1,2 AHU Hot Water Pump; 150gpm, 45TDH 3 hp	2	ea.	\$12,106.19	\$	24,212	\$8,483.87	\$	16,968	\$	41,180
	Suction Diffusers, Triple Duty Valves, Flex Connectors and Check Valves	15	ea.	\$605.31	\$	9,080	\$1,696.77	\$	25,452	\$	34,531
	Expansion Tank; 21.7 gal, ET -1, 4	2	ea.	\$1,210.62	\$	2,421	\$3,393.55	\$	6,787	\$	9,208
	Expansion Tank; 68 gal, ET -2, 3	2	ea.	\$1,210.62	\$	2,421	\$3,393.55	\$	6,787	\$	9,208
	Air Separator; 300gpm, 4F, AS-1	1	ea.	\$2,421.24	\$	2,421	\$3,393.55	\$	3,394	\$	5,815
	Air Separator; 850gpm, 6F, AS-2, 3	2	ea.	\$1,210.62	\$	2,421	\$3,393.55	\$	6,787	\$	9,208
	Air Separator; 190gpm, 3F, AS-4	1	ea.	\$2,421.24	\$	2,421	\$3,393.55	\$	3,394	\$	5,815
	Subtotal				\$	136,800		\$	157,800	\$	294,600
23 2500	HVAC WATER TREATMENT										
	Water treatment for open loop hydronic systems	1	ea.	\$34,200.00	\$	34,200	\$39,450.00	\$	39,450	\$	73,650
	Water treatment for closed loop hydronic systems	1	ea.	\$34,200.00	\$	34,200	\$39,450.00	\$	39,450	\$	73,650
	Subtotal				\$	68,400		\$	78,900	\$	147,300
23 2510	HVAC WATER FILTRATION SYSTEM										
	Side Stream Filtration System Skid Mounted Pump and Back Wash Tank; 15gpm; 208V, 1Hp;	1	ea.	\$68,400.00	\$	68,400	\$78,900.00	\$	78,900	\$	147,300





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23 3113	METAL DUCTS	Subtotal	1	ea.	\$	68,400	\$	78,900	\$	147,300
	Galvanized Ductwork		72000	lb.	\$1.31	94,154	\$2.03	146,372	\$	240,526
	Metal Duct Fittings		ALL	ls		35,000		50,000	\$	85,000
	Duct Sound Traps Generator Room, 15,000cfm; SA-2-1; SA-2-2		2	ls	\$15,692.31	31,385	\$292.74	585	\$	31,970
	Duct Sound Traps Generator Room, 30,000cfm; SA-2-3		1	ls	\$10,461.54	10,462	\$292.74	293	\$	10,754
	Duct Sound Attenuators VAV boxes		0	ea.		-				
	Subtotal				\$	171,000	\$	197,250	\$	368,250
23 3120	FIRE RESISTIVE DUCT-PIPE INSULATION AND ENCLOSURE (included w/ 231313)									
23 3310	DAMPERS									
	Smoke Dampers		ALL	sf		18,200		\$22,500.00	\$	40,700
	Fire/ Smoke Dampers (SF Basis) - approx. 28 ea., all floors		ALL	sf		18,200		\$22,500.00	\$	40,700
	Balance Dampers & Turning Vanes (SF Basis)		ALL	sf		8,000		\$10,650.00	\$	18,650
	ALD Automatic Louvered Damper		ALL	sf		19,000		\$21,000.00	\$	40,000
	Back Draft Damper 180x84"		ALL	sf		5,000		\$2,250.00	\$	7,250
	Subtotal				\$	68,400	\$	78,900	\$	147,300
23 3311	HVAC SOUND ATTENUATION (included w/ 230700)									
23 3313	ACOUSTICAL DUCT LINING (included w/ other Div. 23 sections)									
23 3416	HVAC FANS									
	TX-R-1; 1,550cfm, 1hp		1	ea.	\$9,000.00	9,000	\$10,800.00	10,800	\$	19,800
	TX-R-2; 1,000cfm, 1hp		1	ea.	\$9,000.00	9,000	\$10,800.00	10,800	\$	19,800
	GX-R-1; 1,000cfm, 1/2hp		1	ea.	\$8,000.00	8,000	\$9,600.00	9,600	\$	17,600
	GX-R-2; 1,000/500cfm, 2hp		1	ea.	\$10,500.00	10,500	\$12,600.00	12,600	\$	23,100
	GX-R-3; 1,300cfm, 1hp		1	ea.	\$9,000.00	9,000	\$10,800.00	10,800	\$	19,800
	GX-R-4; 500cfm, 2hp		1	ea.	\$9,000.00	9,000	\$10,800.00	10,800	\$	19,800
	GX-R-5; 9200cfm, 2hp		1	ea.	\$8,000.00	8,000	\$9,600.00	9,600	\$	17,600
	Roof Curb		7	ea.	\$10,500.00	73,500	\$12,600.00	88,200	\$	161,700
	Motorized Damper		ALL	ea.	\$0.00	15,000	\$0.00	15,050	\$	30,050
	Back Draft Dampers		ALL	ea.	\$0.00	20,000	\$0.00	19,000	\$	39,000
	Subtotal				\$	171,000	\$	197,250	\$	368,250

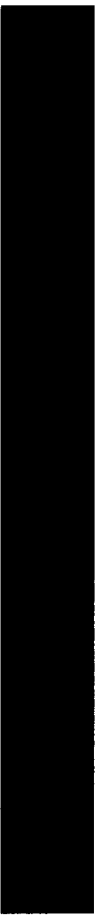


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23 3433	AIR CURTAINS		1	ea.	\$34,200.00	\$	34,200	\$39,450.00	\$	39,450	\$	73,650
	Air Door Unit; 2,518cfm 1/2hp 9' Wide , 12'high, 12'wd, incl motor starters - Tag AD-1											
		Subtotal					34,200		\$	39,450	\$	73,650
23 3600	AIR TERMINAL UNITS											
	VAV Boxes											
	VAV Box, up to 300 CFM; HW Coil & pipe Hk-up		23	ea.	\$2,162.85	\$	49,745	\$2,744.35	\$	63,120	\$	112,865
	VAV Box, 300 to 600 CFM; HW Coil & pipe Hk-up		18	ea.	\$2,303.03	\$	41,455	\$2,454.67	\$	44,184	\$	85,639
	VAV Box, 600 to 1,000 CFM; HW Coil & pipe Hk-up		18	ea.	\$2,303.03	\$	41,455	\$2,454.67	\$	44,184	\$	85,639
	VAV Box, 1,000 to 1,500 CFM; HW Coil & pipe Hk-up		1	ea.	\$4,145.45	\$	4,145	\$6,312.00	\$	6,312	\$	10,457
		Subtotal				\$	136,800		\$	157,800	\$	294,600
23 3713	DIFFUSERS, REGISTERS, AND GRILLES											
	Ceiling Diffusers		181	ea.	\$238.67	\$	43,200	\$509.84	\$	92,281	\$	135,481
	Transfer Grille		12	ea.	\$400.00	\$	4,800	\$461.40	\$	5,537	\$	10,337
	Ceiling Registers		59	ea.	\$325.42	\$	19,200	\$469.22	\$	27,684	\$	46,884
	Ceiling Diffusers - Security Type		12	ea.	\$2,000.00	\$	24,000	\$576.75	\$	6,921	\$	30,921
	Ceiling Registers - Security Type		12	ea.	\$2,000.00	\$	24,000	\$576.75	\$	6,921	\$	30,921
	Continuous Linear Diffusers		30	ea.	\$400.00	\$	12,000	\$307.60	\$	9,228	\$	21,228
	Continuous Linear Returns		22	ea.	\$436.36	\$	9,600	\$419.46	\$	9,228	\$	18,828
		Subtotal				\$	136,800		\$	157,800	\$	294,600
23 4100	AIR FILTERS											
	Air Filter Change		1	ls	\$34,200.00	\$	34,200	\$39,450.00	\$	39,450	\$	73,650
		Subtotal				\$	34,200		\$	39,450	\$	73,650
23 5100	BREECHINGS, CHIMNEYS, AND STACKS											
	Emergency Generator Flue 10" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	Combustion Air Intake 10" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	Combustion Air Intake 6" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	Combustion Air Intake 8" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	Boiler Flue 6" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	Boiler Flue 9" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	GH-1 Unit Heater Flue 4" diam		ALL	lf		\$	4,275		\$	4,930	\$	9,205
	Domestic Water Heater Flue 10" diam		ALL	lf		\$	4,275		\$	4,940	\$	9,215
		Subtotal				\$	34,200		\$	39,450	\$	73,650

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23 7103	UVC GERMICIDAL TREATMENT SYSTEM	1	ls	\$34,200.00	\$	34,200	\$39,450.00	\$	39,450	\$	73,650
	Subtotal				\$	34,200		\$	39,450	\$	73,650
23 7313	SEMI-CUSTOM AIR HANDLING UNITS										
	AHU- 1-2; 2,000 CFM, Supply and Return Fans; Labor Only		ea	\$0.00	\$	102,600	\$0.00	\$	118,350	\$	220,950
23 7315	FACTORY FABRICATED CUSTOM AIR HANDLING UNITS										
	AHU-C-1, 1-1, 2-1 & 1-2 Material Only	4	ls	\$42,750.00	\$	171,000	\$0.00	\$	-	\$	171,000
	AHU-C-1; 9,000 CFM, Supply and Return Fans; Labor Only	0	ea.	\$0.00	\$	-	\$0.00	\$	65,750	\$	65,750
	AHU-1-1; 11,000 CFM, Supply and Return Fan; Labor Only	0	ea.	\$0.00	\$	-	\$0.00	\$	65,750	\$	65,750
	AHU- 2-1; 10,500 CFM, Supply and Return Fan; Labor Only	0	ea.	\$0.00	\$	-	\$0.00	\$	65,750	\$	65,750
	Subtotal				\$	171,000		\$	197,250	\$	368,250
23 7339	PACKAGED, INDOOR HEATING AND VENTILATING UNITS										
	GAS FIRED UNIT HEATER										
	GH-1 Gas Fired Unit Heater; 60MBH; 770cfm, Hydronic heating, unit heater, propeller, horizontal, 115 V, Nat Gas, 60Deg.F entering air, UNIT VENTILATORS	1	ea.	\$37,600.00	\$	37,600	\$63,250.00	\$	63,250	\$	100,850
	Unit Ventilator 2,300cfm, 170MBH	1	ea.	\$65,000.00	\$	65,000	\$55,100.00	\$	55,100	\$	120,100
	Subtotal				\$	102,600		\$	118,350	\$	220,950
23 7733	FACTORY FABRICATED DOUBLE WALL ABOVE GROUND FUEL OIL STORAGE TANK										
	55 Gallon overflow drum, rupture tank foot valve and alarm	1	ea.	\$8,000.00	\$	8,000	\$10,000.00	\$	10,000	\$	18,000
	4,000 Gallon Indoor Fuel Oil Tank, horizontal, Carbon steel, above ground, double wall, incl. cradles - for emergency generator	1	ea.	\$60,400.00	\$	60,400	\$68,900.00	\$	68,900	\$	129,300
	Subtotal				\$	68,400		\$	78,900	\$	147,300
23 8123	COMPUTER ROOM AIR-CONDITIONING UNITS (CRAC UNITS)										
	CRAC units (3) 1 ton and (1) 2 ton Units Material Only	4	ls	\$7,500.00	\$	30,000	\$0.00	\$	-	\$	30,000
	CRAC One ton Unit, Labor Only	3	ea.	\$0.00	\$	-	\$10,000.00	\$	30,000	\$	30,000
	CRAC Two ton Unit, Labor Only	1	ea.	\$0.00	\$	-	\$9,450.00	\$	9,450	\$	9,450
	Drain Pan and Condensate Pump	4	ea.	\$1,050.00	\$	4,200	\$0.00	\$	-	\$	4,200
	Subtotal				\$	34,200		\$	39,450	\$	73,650
23 8233	HVAC HEATING RADIATORS AND CONVECTORS										
	Finned-Tube Radiation	500	lf	\$136.80	\$	68,400	\$157.80	\$	78,900	\$	147,300



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	#3 WIRE	-	If	\$0.00 \$	-	\$0.00 \$	-	\$ -
	#2 WIRE	2,400	If	\$2.27 \$	5,449	\$2.21 \$	5,298	\$ 10,747
	#2 WIRE, grounding	850	If	\$2.27 \$	1,930	\$2.21 \$	1,876	\$ 3,806
	#1 WIRE	2,300	If	\$2.41 \$	5,548	\$2.29 \$	5,272	\$ 10,821
	#1/0 WIRE	3,000	If	\$2.70 \$	8,088	\$2.46 \$	7,386	\$ 15,475
	#2/0 WIRE	6,000	If	\$2.98 \$	17,880	\$2.63 \$	15,792	\$ 33,671
	#3/0 WIRE	-	If	\$0.00 \$	-	\$0.00 \$	-	\$ -
	#4/0 WIRE	7,200	If	\$3.41 \$	24,521	\$2.89 \$	20,784	\$ 45,304
	#350 MCM	2,800	If	\$3.69 \$	10,330	\$3.06 \$	8,558	\$ 18,888
	#500 MCM	2,400	If	\$3.97 \$	9,536	\$3.23 \$	7,743	\$ 17,279
	#600 MCM	12,400	If	\$4.26 \$	52,787	\$3.40 \$	42,111	\$ 94,898
	Wiring for mechanical equipment	1	Is	\$7,095.08 \$	7,095	\$8,590.07 \$	8,590	\$ 15,685
	Wiring for Fire Alarm system	1	Is	\$8,514.09 \$	8,514	\$7,641.06 \$	7,641	\$ 16,155
	Subtotal			\$	317,902	\$	375,637	\$ 693,539
26 0526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS							
	Grounding & Bonding	1	Is	\$3,750.00 \$	3,750	\$18,229.17 \$	18,229	\$ 21,979
	Ground bar	5	ea.	\$1,000.00 \$	5,000	\$1,041.67 \$	5,208	\$ 10,208
	Grounding busbar assembly	1	ea.	\$1,250.00 \$	1,250	\$1,562.50 \$	1,563	\$ 2,813
	Subtotal			\$	10,000	\$	25,000	\$ 35,000
	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS							
26 0529	(Included w/ 260533)							
26 0533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS							
	Property end box, 4.5' x 3.5' x 4'	1	ea.	\$52,369.61 \$	52,370	\$3,751.40 \$	3,751	\$ 56,121
	FEEDERS AND BRANCH CIRCUITRY							
	4" RGS	2,000	If	\$36.66 \$	73,317	\$37.51 \$	75,028	\$ 148,346
	3 1/2" PVC SCH80	360	If	\$10.47 \$	3,771	\$18.76 \$	6,753	\$ 10,523
	1 1/4" RGS, compactor	150	If	\$9.16 \$	1,375	\$18.76 \$	2,814	\$ 4,188
	1 1/4" PVC SCH80, empty	450	If	\$3.93 \$	1,767	\$9.38 \$	4,220	\$ 5,988
	1 1/2" RGS, fuel system	-	If	\$0.00 \$	-	\$0.00 \$	-	\$ -
	1" RGS, fuel system	-	If	\$0.00 \$	-	\$0.00 \$	-	\$ -
	1" PVC SCH80, empty for security	200	If	\$3.67 \$	733	\$9.00 \$	1,801	\$ 2,534
	3/4 RGS, fuel system	-	If	\$0.00 \$	-	\$0.00 \$	-	\$ -
	3 1/2" EMT	2,000	If	\$15.71 \$	31,422	\$28.14 \$	56,271	\$ 87,693
	2 1/2" EMT	2,000	If	\$10.47 \$	20,948	\$24.38 \$	48,768	\$ 69,716
	2" EMT	1,250	If	\$9.82 \$	12,274	\$23.45 \$	29,308	\$ 41,582



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	2" EMT, grounding	100	If	\$9.82	\$	982	\$23.45	\$	2,345	\$	3,327
	1 1/2" EMT	100	If	\$9.16	\$	916	\$21.57	\$	2,157	\$	3,074
	1 1/4" EMT	600	If	\$8.51	\$	5,106	\$19.69	\$	11,817	\$	16,923
	1" EMT, telcom	400	If	\$5.24	\$	2,095	\$15.01	\$	6,002	\$	8,097
	3/4 EMT, grounding	1,000	If	\$4.58	\$	4,582	\$11.25	\$	11,254	\$	15,837
	3/4 EMT, lighting	8,000	If	\$4.58	\$	36,659	\$11.25	\$	90,034	\$	126,692
	3/4 EMT, wiring devices	11,000	If	\$4.58	\$	50,406	\$11.25	\$	123,796	\$	174,202
	Conduit for mechanical equipment	1	Is	\$26,184.80	\$	26,185	\$11,254.21	\$	11,254	\$	37,439
	Conduit for Fire Alarm system	1	Is	\$13,092.40	\$	13,092	\$5,627.10	\$	5,627	\$	18,720
	<b>Subtotal</b>				\$	<b>338,000</b>		\$	<b>493,000</b>	\$	<b>831,000</b>
26 0543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS (included w/ 260533)										
26 0544	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAY AND CABLING (included w/ 260533)										
26 0548	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS	1	Is	\$5,000.00	\$	5,000	\$10,000.00	\$	10,000	\$	15,000
	<b>Subtotal</b>				\$	<b>5,000</b>		\$	<b>10,000</b>	\$	<b>15,000</b>
26 0553	IDENTIFICATION FOR ELECTRICAL SYSTEMS AND CABLING (included w/ 260500)										
26 0572	OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY (included w/ 260500)										
26 0573	OVERCURRENT DEVICE COORDINATION STUDY (included w/ 260500)										
26 0574	OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY (included w/ 260500)										
26 0800	COMMISSIONING OF ELECTRICAL SYSTEMS Provide Testing & Commissioning	1	Is	\$50,000.00	\$	50,000	\$50,000.00	\$	50,000	\$	100,000
	<b>Subtotal</b>				\$	<b>50,000</b>		\$	<b>50,000</b>	\$	<b>100,000</b>
26 0943	LIGHTING CONTROL SYSTEM 1-channel toggle switch 1-channel toggle switch w/ dimming	27 - ea. ea.	ea. ea.	\$424.18 \$0.00	\$ \$	11,453 -	\$533.19 \$0.00	\$ \$	14,396 -	\$ \$	25,849 -



**Project:** New 116th Precinct Station House Rebid  
**Location:** 244-04 North Conduit Avenue, Queens, NY 11422  
**Bidder:** CITNALT A CONSTRUCTION CORP.

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

	2-channel toggle switch w/ dimming	-	ea.	\$0.00	\$	-	\$	\$	\$	\$	-	\$	-	\$
	Toggle switch w/ dimming	80	ea.	\$424.18	\$	33,934	\$	\$533.19	\$	42,655	\$	\$	76,590	\$
	2-preset level controller	3	ea.	\$565.57	\$	1,697	\$	\$666.49	\$	1,999	\$	\$	3,696	\$
	360 deg sensor in photocell & dimming, wireless	20	ea.	\$565.57	\$	11,311	\$	\$666.49	\$	13,330	\$	\$	24,641	\$
	Photocell sensor w/ dimming, wireless	2	ea.	\$424.18	\$	848	\$	\$533.19	\$	1,066	\$	\$	1,915	\$
	360 deg sensor w/ RJ-45 port, ceiling mtd	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	360 deg sensor, ceiling mtd	156	ea.	\$282.79	\$	44,115	\$	\$266.60	\$	41,589	\$	\$	85,703	\$
	4-channel toggle switch w/ dimming	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	AV interface	3	ea.	\$282.79	\$	848	\$	\$533.19	\$	1,600	\$	\$	2,448	\$
	Beam infrared sensor	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Contact closure input device	2	ea.	\$1,413.93	\$	2,828	\$	\$1,066.38	\$	2,133	\$	\$	4,961	\$
	Easy RB station 7-button	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Lighting scene control touchscreen	1	ea.	\$1,413.93	\$	1,414	\$	\$1,332.98	\$	1,333	\$	\$	2,747	\$
	Mini power pack	25	ea.	\$353.48	\$	8,837	\$	\$533.19	\$	13,330	\$	\$	22,167	\$
	Power/relay pack w/ dimmer	160	ea.	\$353.48	\$	56,557	\$	\$533.19	\$	85,311	\$	\$	141,868	\$
	Power/relay pack w/ dimmer, emergency	11	ea.	\$353.48	\$	3,888	\$	\$533.19	\$	5,865	\$	\$	9,753	\$
	Switch decorator sensor w/ dim control, wall mtd	30	ea.	\$353.48	\$	10,604	\$	\$399.89	\$	11,997	\$	\$	22,601	\$
	3-way switch	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Daylight sensor, ceiling mtd	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Dimmer switch	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Low voltage switch	30	ea.	\$353.48	\$	10,604	\$	\$399.89	\$	11,997	\$	\$	22,601	\$
	Occupancy sensor, ceiling mtd	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Occupancy sensor, wall mtd	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Single pole switch	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Timer switch	3	ea.	\$353.48	\$	1,060	\$	\$466.54	\$	1,400	\$	\$	2,460	\$
	Vacancy sensor, ceiling mtd	-	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Vacancy sensor, wall mtd	0	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Subtotal			\$	\$	200,000	\$	\$	\$	250,000	\$	\$	450,000	\$
26 2413	SWITCHBOARDS													
	2000A, 208V switchboard	1	ea.	\$76,923.08	\$	76,923	\$	\$57,142.86	\$	57,143	\$	\$	134,066	\$
	2000A, 208V emergency switchboard	1	ea.	\$76,923.08	\$	76,923	\$	\$57,142.86	\$	57,143	\$	\$	134,066	\$
	1200A, 208V switchboard, MCC-2A	1	ea.	\$48,076.92	\$	48,077	\$	\$42,857.14	\$	42,857	\$	\$	90,934	\$
	1200A, 208V panelboard, MCC-2B/2C	2	ea.	\$48,076.92	\$	96,154	\$	\$42,857.14	\$	85,714	\$	\$	181,868	\$
	200A, 208V panelboard, MCC-FS	0	ea.	\$0.00	\$	-	\$	\$0.00	\$	-	\$	\$	-	\$
	Service Cabinet and 2000A Breakers	1	ea.	\$76,923.08	\$	76,923	\$	\$57,142.86	\$	57,143	\$	\$	134,066	\$
	Subtotal			\$	\$	375,000	\$	\$	\$	300,000	\$	\$	675,000	\$





Project: New 116th Precinct Station House Rebid  
Location: 244-04 North Conduit Avenue, Queens, NY 11422  
Bidder: CITNALIA CONSTRUCTION CORP.

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

[illegible]



**Project:** New 116th Precinct Station House Rebid  
**Location:** 244-04 North Conduit Avenue, Queens, NY 11422  
**Bidder:** CITNALTA CONSTRUCTION CORP.

DDC ID: PO002-116  
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[illegible]



DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

	VFDs		ea.		\$		\$	50,000	\$	50,000	
		Subtotal									
26 3100	PHOTOVOLTAIC COLLECTORS										
	PV inverter, 9KW	11	ea.	\$11,841.10	\$	130,252	\$4,215.46	\$	46,370	\$	176,622
	Pull boxes, WP	11	ea.	\$3,552.33	\$	39,076	\$2,810.30	\$	30,913	\$	69,989
	PV AC panel, 265W, 39" x 65"	277	ea.	\$473.64	\$	131,199	\$702.58	\$	194,614	\$	325,813
	Optimizers, P600	1	ea.	\$9,472.88	\$	9,473	\$14,051.52	\$	14,052	\$	23,524
	Conduit	1	ls	\$0.00	\$	-	\$0.00	\$	-		INCL 26 3100
	Wiring	1	ls	\$0.00	\$	-	\$0.00	\$	-		INCL 26 3100
	Testing & integration	1	ls	\$0.00	\$	-	\$14,051.52	\$	14,052	\$	14,052
	Subtotal				\$	310,000		\$	300,000	\$	610,000
26 3213	ENGINE GENERATORS										
	600kW Emergency Generator (no Sound Attenuated Enclosure) Including battery, charger, muffler & day tank, remote annunciator, load bank, control panel	1	ea.	\$341,000.00	\$	341,000	\$230,000.00	\$	230,000	\$	571,000
	Roll-up generator (FBO), (includes conduit, wiring, duct bank)	1	ea.	\$10,000.00	\$	10,000	\$20,000.00	\$	20,000	\$	30,000
	Silencer/ Muffler, Noise control for air flow, pipe Generator Vent - Emerg Generator	1	ea.	\$0.00	\$	-		\$	-		INCL 26 3213
	Subtotal				\$	351,000		\$	250,000	\$	601,000
26 3600	TRANSFER SWITCHES										
	Automatic transfer switches, enclosed, 3 pole, 120/208 volt, 1600 amp	3	ea.				\$9,000.00	\$	27,000	\$	27,000
	Automatic transfer switches, enclosed, 3 pole, 120/208 volt, 400 amp	1	ea.				\$2,500.00	\$	2,500	\$	2,500
	Automatic transfer switches, enclosed, 3 pole, 480 volt, 60 amp	1	ea.				\$2,500.00	\$	2,500	\$	2,500
	Subtotal				\$	-		\$	32,000	\$	32,000
26 4113	LIGHTNING PROTECTION FOR STRUCTURE										
	10" ground rod	17	ea.	\$1,187.65	\$	20,190	\$923.08	\$	15,692	\$	35,882
	12" air terminal	62	ea.	\$475.06	\$	29,454	\$692.31	\$	42,923	\$	72,377
	48" air terminal	4	ea.	\$712.59	\$	2,850	\$923.08	\$	3,692	\$	6,543
	Lightning protection cable	2500	lf	\$9.50	\$	23,753	\$27.69	\$	69,231	\$	92,984
	Testing & integration	1	ls	\$23,752.97	\$	23,753	\$18,461.54	\$	18,462	\$	42,215
	Subtotal				\$	100,000		\$	150,000	\$	250,000



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[illegible]



Project: New 116th Precinct Station House Rebid  
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DDC ID: PO002-116  
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	Lighting fixture type X2a	4	ea.	\$562.57	\$	2,250	\$2,723.61	\$	10,894	\$	13,145
	Lighting fixture type X3	7	ea.	\$562.57	\$	3,938	\$453.93	\$	3,178	\$	7,116
	Lighting fixture type X5	5	ea.	\$562.57	\$	2,813	\$544.72	\$	2,724	\$	5,536
	Lighting fixture type X7	12	ea.	\$562.57	\$	6,751	\$544.72	\$	6,537	\$	13,288
	Lighting fixture type X8	65	ea.	\$562.57	\$	36,567	\$1,815.74	\$	118,023	\$	154,590
	Lighting fixture type X9	16	ea.	\$562.57	\$	9,001	\$544.72	\$	8,716	\$	17,717
	Lighting fixture type X10	6	ea.	\$562.57	\$	3,375	\$726.30	\$	4,358	\$	7,733
	Lighting fixture type X11	9	ea.	\$562.57	\$	5,063	\$544.72	\$	4,902	\$	9,966
	Lighting fixture type X12	1	ea.	\$562.57	\$	563	\$453.93	\$	454	\$	1,017
	<b>Subtotal</b>				\$	<b>522,000</b>		\$	<b>500,000</b>	\$	<b>1,022,000</b>
<b>26 5600</b>	<b>EXTERIOR LIGHTING</b>										
	Lighting poles	33	ea.	\$469.70	\$	15,500	\$2,818.18	\$	93,000	\$	108,500
	Lighting pole concrete base	0	ea.		\$	-		\$	-		INCL 26 5600
	Gas station lighting fixtures	0	ea.		\$	-		\$	-		INCL 26 5600
	<b>Subtotal</b>				\$	<b>15,500</b>		\$	<b>93,000</b>	\$	<b>108,500</b>
<b>GENERAL ELECTRICITY</b>											
<b>27 0000</b>	<b>COMMUNICATIONS</b>										
<b>27 0000</b>	<b>TELECOMMUNICATIONS CABLING SYSTEM</b>										
	Head end equipment	1	ls	\$6,441.22	\$	6,441	\$6,045.95	\$	6,046	\$	12,487
	Network switch	4	ea.	\$483.09	\$	1,932	\$241.84	\$	967	\$	2,900
	Data/phone outlet	451	ea.	\$24.15	\$	10,894	\$60.46	\$	27,267	\$	38,161
	Data/phone outlet, floor mtd	3	ea.	\$32.21	\$	97	\$60.46	\$	181	\$	278
	Equipment rack	4	ea.	\$483.09	\$	1,932	\$1,209.19	\$	4,837	\$	6,769
	Cable tray, basket type, galvanized steel, 12" W	30	lf	\$4.03	\$	121	\$15.11	\$	453	\$	574
	Cable tray, basket type, galvanized steel, 18" W	800	lf	\$4.03	\$	3,221	\$15.11	\$	12,092	\$	15,313
	Fuel system cabling	-	lf	\$0.00	\$	-	\$0.00	\$	-		INCL 27 0000
	<b>PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS</b>										
	Head end equipment	1	ls	\$11,272.14	\$	11,272	\$9,068.92	\$	9,069	\$	20,341
	Speaker, ceiling mtd	62	ea.	\$80.52	\$	4,992	\$151.15	\$	9,371	\$	14,363
	Main desk mic	1	ea.	\$1,610.31	\$	1,610	\$241.84	\$	242	\$	1,852
	Audio speakers, ceiling mtd	18	ea.	\$80.52	\$	1,449	\$151.15	\$	2,721	\$	4,170
	1" EMT	250	lf	\$0.64	\$	161	\$15.11	\$	3,779	\$	3,940
	1"-1/2 EMT	500	lf	\$1.13	\$	564	\$30.23	\$	15,115	\$	15,678
	#18 wire	3,000	lf	\$0.16	\$	483	\$0.60	\$	1,814	\$	2,297



DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

[illegible]





Project: New 116th Precinct Station House Rebid  
 Location: 244-04 North Conduit Avenue, Queens, NY 11422  
 Bidder: CITNALTA CONSTRUCTION CORP.

DDC ID: PO002-116  
 Sponsor Agency: New York City Police Department

	Area Smoke/CO detector	64	ea.	\$1,008.53	\$	64,546	\$1,347.22	\$	86,222	\$	150,768
	Duct smoke detectors	35	ea.	\$2,017.06	\$	70,597	\$2,694.44	\$	94,305	\$	164,903
	Elevator smoke detectors		ea.	\$0.00	\$	-	\$0.00	\$	-	\$	-
	Fire smoke damper	32	ea.	\$1,008.53	\$	32,273	\$842.01	\$	26,944	\$	59,217
	Heat detectors	13	ea.	\$1,008.53	\$	13,111	\$1,178.82	\$	15,325	\$	28,436
	Heat/ carbon monoxide detector combo	7	ea.	\$1,411.94	\$	9,884	\$1,347.22	\$	9,431	\$	19,314
	Horn/ strobe combo	75	ea.	\$1,008.53	\$	75,640	\$1,178.82	\$	88,411	\$	164,051
	Pull station	9	ea.	\$1,008.53	\$	9,077	\$1,347.22	\$	12,125	\$	21,202
	Relays	51	ea.	\$605.12	\$	30,861	\$1,178.82	\$	60,120	\$	90,981
	Strobe lights	41	ea.	\$1,008.53	\$	41,350	\$1,010.42	\$	41,427	\$	82,777
	Tamper switch	10	ea.	\$504.27	\$	5,043	\$1,010.42	\$	10,104	\$	15,147
	Water flow switch	3	ea.	\$605.12	\$	1,815	\$1,010.42	\$	3,031	\$	4,847
	Wiring for Fire Alarm system	1	ls	\$20,170.60	\$	20,171	\$117,881.78	\$	117,882	\$	138,052
	Fire Alarm Programming and Testing & commissioning	1	ls	\$10,085.30	\$	10,085	\$50,520.76	\$	50,521	\$	60,606
	Detection system, CO, detector, - car entry	1	ls		\$	582,984		\$	589,016	\$	1,172,000
	<b>Subtotal</b>				\$	<b>1,044,084</b>		\$	<b>1,278,877</b>	\$	<b>2,322,961</b>
	<b>ELECTRONIC SAFETY AND SECURITY SUBTOTAL</b>				\$	<b>1,192,339</b>		\$	<b>1,788,877</b>	\$	<b>2,981,461</b>
<b>31 0000</b>	<b>EARTHWORK</b>										
<b>31 0000</b>	<b>EARTHWORK</b>										
	<b>FUEL STORAGE TANKS - General Construction</b>										
	Excavation, FS105	427	cy	\$11.41	\$	4,874	\$68.49	\$	29,245	\$	34,119
	Dispose of excess, FS105	475	cy	\$11.41	\$	5,422	\$79.90	\$	37,954	\$	43,377
	Filter fabric, FS105	2,336	sf	\$3.42	\$	8,000	\$5.71	\$	13,333	\$	21,332
	Fill with pea gravel, FS105	368	cy	\$68.49	\$	25,204	\$68.49	\$	25,204	\$	50,408
	<b>EXCAVATION OF CONTAMINATED SOILS</b>										
	Premium for treatment of contaminated soil		cy	\$0.00	\$	-	\$0.00	\$	-		INCL 31 0000
	Dewatering for foundation work	1	ls	\$596,998.14	\$	596,998	\$599,281.11	\$	599,281	\$	1,196,279
	Dewatering, local, rainwater only	1	ls	\$0.00	\$	-	\$0.00	\$	-		INCL 31 0000
	<b>Subtotal</b>				\$	<b>640,498</b>		\$	<b>705,017</b>	\$	<b>1,345,515</b>
<b>31 1000</b>	<b>SITE CLEARING, REMOVALS, AND PREPARATION</b>										
	Remove existing flagpoles - complete, C102	2	ea.	\$0.00	\$	-	\$0.00	\$	-		INCL 31 10000





Project: New 116th Precinct Station House Rebid  
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 Bidder: CITNALT CONSTRUCTION CORP.

DDC ID: PO002-116  
 Sponsor Agency: New York City Police Department

	Removal of existing lighting poles	6	ea.	\$1,228.31	\$	7,370	\$3,026.28	\$	18,158	\$	25,528
	Remove existing trees, C101, C102	27	ea.	\$245.66	\$	6,633	\$726.31	\$	19,610	\$	26,243
	Remove existing fence, foundations and curb, C101	265	lf	\$12.28	\$	3,255	\$60.53	\$	16,039	\$	19,294
	Remove existing sodded area	13,275	sf	\$1.23	\$	16,306	\$1.21	\$	16,070	\$	32,375
	Demolition for existing sewer system										
	Remove existing 10' diameter drywells for new storm structures, C101, C102	2	ea.	\$614.15	\$	1,228	\$1,815.77	\$	3,632	\$	4,860
	Remove existing storm drainage piping, C101, C102	600	lf	\$12.28	\$	7,370	\$24.21	\$	14,526	\$	21,896
	Remove existing catch basins, C101, C102	10	ea.	\$1,228.31	\$	12,283	\$2,421.02	\$	24,210	\$	36,493
	Remove storm manhole, C102	22	ea.	\$1,228.31	\$	27,023	\$2,421.02	\$	53,263	\$	80,285
	Protect and maintain existing downspouts	4	loc	\$92.12	\$	368	\$151.31	\$	605	\$	974
	Remove existing sidewalk and curb at street, C101-102, C200-201	7,200	sf	\$1.23	\$	8,844	\$3.63	\$	26,147	\$	34,991
	Remove existing concrete curbs, C101-102	724	lf	\$6.14	\$	4,446	\$12.11	\$	8,764	\$	13,211
	Remove existing asphalt paving at street, 1'-0" w. including sawcutting, C101-102, C200-201	720	lf	\$1.23	\$	884	\$3.63	\$	2,615	\$	3,499
	Clear existing site of asphalt parking paving	30,000	sf	\$2.46	\$	73,698	\$2.42	\$	72,631	\$	146,329
	Remove existing light poles, bases, conduits, and foundations C101-102	6	ea.	\$1,228.31	\$	7,370	\$3,026.28	\$	18,158	\$	25,528
	Remove existing signs, C102	4	ea.	\$12.28	\$	49	\$121.05	\$	484	\$	533
	Remove existing concrete sidewalk leading up to existing police precinct, C102 29 Cy	788	sf	\$1.23	\$	968	\$3.63	\$	2,862	\$	3,830
	Remove existing curbs around annex, including sawcutting, C102 (as shown)	265	lf	\$6.14	\$	1,628	\$12.11	\$	3,208	\$	4,835
	Fine Grading at Asphalt, Sidewalks, Curbs & Pavers offsite city sidewalks curbs	16,247	sf	\$2.46	\$	39,913	\$2.42	\$	39,334	\$	79,247
	<b>Subtotal</b>				\$	<b>219,636</b>		\$	<b>340,315</b>	\$	<b>559,951</b>
<b>31 2500</b>	<b>SOIL EROSION AND SEDIMENT CONTROL</b>										
	Install temporary inlet protection at drywells/catch basins, C150, C152, det.2/C152	2	loc	\$285.37	\$	571	\$428.06	\$	856	\$	1,427
	Stabilized construction entrance, including piping and sediment device, det.2/C152, C150	480	sf	\$11.41	\$	5,479	\$17.12	\$	8,219	\$	13,698
	Silt fence for stockpile, det.5/C152	300	lf	\$5.71	\$	1,712	\$8.56	\$	2,568	\$	4,281
	Silt fence at site perimeter including wire mesh and posts every 10', C150-151, det.1/C152	1740	lf	\$8.61	\$	14,990	\$13.35	\$	23,234	\$	38,224
	Miscellaneous erosion and sedimentation control	300	sf	\$3.00	\$	900	\$2.00	\$	600	\$	1,500



DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

[illegible]



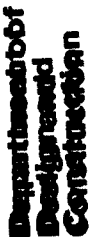
**Project: New 116th Precinct Station House Rebid**

Location: 244-04 North Conduit Avenue, Queens, NY 11422

DDC ID: PO002-116

**Sponsor Agency:** New York City Police Department

	Subtotal		\$	1,636,973	\$	1,551,830	\$	3,188,803
31 6100 FOOTINGS (Included w/ Div. 3 sections)								
31 6800 FOUNDATION SOIL ANCHOR Rock anchors RA-1, 50kips: 1" th., 25' bonded zone and 10' unbonded zone	14 ea.		\$4,500.00	63,000	\$5,987.64	\$83,827	\$	146,827
Rock anchors RA-2, 100 kips: 1.375" th., 35' bonded zone and 10' unbonded zone	10 ea.		\$3,288.50	32,885	\$6,000.00	\$60,000	\$	92,885
Subtotal			\$	95,885		\$143,827	\$	239,712
32 0000 EXTERIOR IMPROVEMENTS								
32 0516 AGGREGATE MATERIALS (included w/ Div. 3 sections)								
32 1216 ASPHALTIC PAVING New asphalt street restoration (mill and repave), 17.5' beyond curb line, C200-201 (5' past centerline of road) New asphalt paving adjacent to new street curb, full depth, 1'w., C200-201	1225 sf 720 sf		\$0.00 \$ \$0.00 \$	- -	\$0.00 \$ \$0.00 \$	- -	INCL 32 1315 INCL 32 1315	
New asphalt parking lot paving (at proposed new building). L100 New asphalt parking lot paving (at existing annex building)	20200 sf 16960 sf		\$0.00 \$ \$0.00 \$	- -	\$0.00 \$ \$0.00 \$	- -	INCL 32 1315 INCL 32 1315	
Subtotal			\$	-		\$	-	
32 1315 CONCRETE CURBS AND PAVEMENT								
Concrete sidewalk paving including aggregate base, C200-201, 4" th.	6,370 sf		\$34.00	216,573	\$29.25	\$186,296	\$	402,869
Concrete sidewalk paving including aggregate base, C200-201, 7" th. New handicap curb cut/ramp, C200-201	830 sf 3 ea.		\$40.93 \$ \$1,705.59 \$	33,975 5,117	\$34.12 \$ \$4,874.31 \$	\$28,320 \$ \$14,623 \$	\$	\$62,295
Concrete sidewalk paving within property line, L100, 4"	425 sf		\$40.93 \$	17,397	\$34.12 \$	\$14,501	\$	19,740
Concrete sidewalk paving within property line, L100, L101, 7" <b>Concrete curbs</b>	490 sf		\$40.93 \$	20,058	\$34.12 \$	\$16,719	\$	31,898
New steel faced concrete curb, C200-201	720 lf		\$112.57	81,050	\$255.90	\$184,249	\$	265,299
New concrete curbs on site at parking, C200-201	2,057 lf		\$44.35	91,219	\$158.41	\$325,860	\$	417,078



Project: New 116th Precinct Station House Rebid  
Location: 244-04 North Conduit Avenue, Queens, NY 11422  
Bidder: CITNALT A CONSTRUCTION CORP.

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

				\$0.00 \$	-	\$0.00 \$	-	INCL 32 1315
New 1x1 unilock concrete paver border at building facade at proposed landscape areas, C200, det.4/L600 including 1/4" x 6" painted steel edge and stakes, C200-201	-	sf		\$0.00 \$	-	\$0.00 \$	-	INCL 32 1315
New concrete curbs on site at proposed 116th precinct landscape areas, L101, det.5/L600	-	lf		\$0.00 \$	-	\$243.72 \$	17,060 \$	76,756
Concrete wheel stops, det.6/C211	70	ea.		\$852.80 \$	59,696			
<b>Subtotal</b>				<b>\$</b>	<b>525,084</b>	<b>\$</b>	<b>787,627 \$</b>	<b>1,312,711</b>
<b>32 1413 PRECAST CONCRETE UNIT PAVING</b>								
Precast concrete unit pavers on stone dust, L100, L700, 1/L700	6,520	sf		\$18.21 \$	118,738	\$27.32 \$	178,106 \$	296,844
<b>Subtotal</b>				<b>\$</b>	<b>118,738</b>	<b>\$</b>	<b>178,106 \$</b>	<b>296,844</b>
<b>32 1723 WHITE PAVEMENT MARKINGS</b>								
Parking Stalls Marking - regular, C200-201	82	ea.		\$25.00 \$	2,050	\$70.00 \$	5,740 \$	7,790
Parking Stalls Marking - HC, C200-201	4	ea.		\$35.00 \$	140	\$75.00 \$	300 \$	440
Other pavement markings	0	gsf		\$0.00 \$	1,997	\$0.00 \$	240 \$	2,237
ADA parking sign, 3/C212		ea.		\$0.00 \$	-	\$0.00 \$	-	INCL 321723
Other Parking lot signs (EV, GV, Yield), C212, C200, C201		ea.		\$0.00 \$	-	\$0.00 \$	-	INCL 321723
Street pavement markings	0	lf		\$0.00 \$	-	\$0.00 \$	-	INCL 321723
<b>Subtotal</b>				<b>\$</b>	<b>4,187</b>	<b>\$</b>	<b>6,280 \$</b>	<b>10,467</b>
<b>32 3119 DECORATIVE METAL FENCES</b>								
Aluminum fence, 3'h at concrete security wall, L1/L601, 1/L602, L101 (along Conduit Ave.)	302	lf		\$188.35 \$	56,880	\$280.81 \$	84,803 \$	141,684
3'h. aluminum fence on top of CIP concrete wall and CIP concrete security wall		sf		\$0.00 \$	-	\$0.00 \$	-	INCL 323119
Aluminum fence at compactor, A061 (4'-5"h. / 7'-8"h. / 12'-10"h.)	628	sf		\$65.06 \$	40,861	\$97.03 \$	60,933 \$	101,793
Aluminum fence, 3'h. at concrete security wall, 4/L701, L100 (along NYDOT Lot at east side)	125	lf		\$188.35 \$	23,543	\$280.81 \$	35,101 \$	58,644
<b>METAL FENCES &amp; GATES</b>								
Aluminum swing gate for compactor enclosure, 16'-4" w. x 7'-8" h.	1	pr		\$9,152.36 \$	9,152	\$14,818.58 \$	14,819 \$	23,971
Fence at Outdoor Bike Storage, A064 12'-10" h	52	lf		\$684.89 \$	35,614	\$1,027.34 \$	53,422 \$	89,036
<b>Subtotal</b>				<b>\$</b>	<b>166,051</b>	<b>\$</b>	<b>249,077 \$</b>	<b>415,128</b>



DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

[illegible]





DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

[illegible]



Project: New 116th Precinct Station House Rebid  
Location: 244-04 North Conduit Avenue, Queens, NY 11422  
Bidder: CITNALTA CONSTRUCTION CORP.

DDC ID: PO002-116  
Sponsor Agency: New York City Police Department

33 4910	OTHER UTILITIES	25	If	\$75.00	\$	1,875	\$150.00	\$	3,750	\$	5,625
	New 6" gas service (assume polyethylene)	1	ea.	\$300.00	\$	300	\$600.00	\$	600	\$	900
	Associated valve	1	ls	\$2,500.00	\$	2,500	\$1,200.00	\$	1,200	\$	3,700
	Tie-in to existing 8" gas line in street	1	ls	\$4,721.00	\$	4,721	\$3,656.00	\$	3,656	\$	8,377
	Traffic protection, plating, flagmen	30	If	\$100.00	\$	3,000	\$422.90	\$	12,687	\$	15,687
	Trenching and backfill, hand excavation, temp supports										
	OTHER UTILITIES										
	Disconnect existing lighting service, C101	6	loc	\$2,500.00	\$	15,000	\$3,200.00	\$	19,200	\$	34,200
	Subtotal				\$	27,396		\$	41,093	\$	68,489
	TOTAL CONTRACT 1 - GENERAL CONSTRUCTION WORK				\$	30,939,721		\$	41,884,577	\$	72,824,298



## ATTACHMENT 1 – BID INFORMATION

PROJECT ID: PO002-116

### DESCRIPTION AND LOCATION OF WORK:

New 116th Precinct Station House Rebid

244-04 North Conduit Avenue

Queens, NY 11422

DDC PIN: 8502020PD0001C

EPIN: 85020B0004

### DOCUMENTS AVAILABLE AT:

Department of Design and Construction, Contract Section  
30-30 Thomson Avenue - First Floor, Long Island City, NY 11101

### SUBMISSION OF BIDS BEFORE BID OPENING:

#### TIME TO SUBMIT:

On or Before:	October 9, 2019
---------------	-----------------

**BIDS MUST BE CLOCKED IN PRIOR TO BID OPENING**

#### PLACE TO SUBMIT:

Department of Design and Construction, Contract Section  
30-30 Thomson Avenue - First Floor, Long Island City, NY 11101

### PRE BID QUESTIONS (PBQs):

Please be advised that PBQs must be submitted to the Agency Contact Person at least five (5) business days (by 5:00 P.M. EST) prior to the bid opening date. Email PBQ(s) -  
CSB\_projectinquiries@ddc.nyc.gov

### BID OPENING:

PLACE OF BID OPENING:	Department of Design and Construction, Contract Section
	30-30 Thomson Avenue - First Floor
	Long Island City, NY 11101
DATE AND HOUR:	October 9, 2019 @ 2:00 PM

**LATE BIDS WILL NOT BE ACCEPTED**

### PRE-BID CONFERENCE:

PLACE:	244-04 North Conduit Avenue Queens, NY 11422
DATE AND HOUR:	September 25, 2019 @ 10:00 AM
MANDATORY OR OPTIONAL:	Optional

### BID SECURITY:

Bid Security is required in the amount set forth below; provided, however, bid security is not required if the TOTAL BID PRICE set forth on the Bid Form is less than \$1,000,000.00.

- (1) Bond in an amount not less than 10% of the TOTAL BID PRICE set forth on the Bid Form, OR
- (2) Certified Check in an amount not less than 2% of the TOTAL BID PRICE set forth on the Bid Form.

### PERFORMANCE AND PAYMENT SECURITY:

Required for Contracts in the amount of \$1,000,000.00 or more. Performance and Payment Security shall each be in amount equal to 100% of the Contract Price.

### AGENCY CONTACT PERSON:

Lorraine Holley, 30-30 Thomson Avenue - First Floor, Long Island City, Queens, 11101

Telephone (718) 391-1041

Email: CSB\_projectinquiries@ddc.nyc.gov



For questions about site accessibility, please contact our disability services facilitator at (718) 391-2815 or via email at accessibility@ddc.nyc.gov.

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**BID BOOKLET  
PART B**

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## SAFETY QUESTIONNAIRE

The Bidder must include, with its bid, all information requested on this Safety Questionnaire. Failure to provide a completed and signed Safety Questionnaire at the time of bid opening may result in disqualification of the bid as non-responsive. This Safety Questionnaire will be reviewed as per Section V of the Safety Requirements for Construction Contracts, found in Volume 2 of the Contract.

### 1. Bidder Information:

Company Name: Citnalta Construction Corp.

DDC Project Number: PO002-116

Company Size: ☐ Ten (10) employees or less

☒ Greater than ten (10) employees

Company has previously worked for DDC: ☐ YES ☒ NO

### 2. Type(s) of Construction Work:

Identify the types of work that the Bidder has performed in the last three years, and the types of work that are part of this Contract.

TYPE OF WORK	LAST 3 YEARS	THIS PROJECT
General Building Construction	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Residential Building Construction	<input type="checkbox"/>	<input type="checkbox"/>
Nonresidential Building Construction	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Heavy Construction, except building	<input type="checkbox"/>	<input type="checkbox"/>
Highway and Street Construction	<input type="checkbox"/>	<input type="checkbox"/>
Heavy Construction, except highways	<input type="checkbox"/>	<input type="checkbox"/>
Plumbing, Heating, HVAC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Painting and Paper Hanging	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Electrical Work	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Masonry, Stonework and Plastering	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Carpentry and Floor Work	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Roofing, Siding, and Sheet Metal	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Concrete Work	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Specialty Trade Contracting	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Asbestos Abatement		
Other (specify) _____	<input type="checkbox"/>	<input type="checkbox"/>

### 3. Experience Modification Rate:

The Experience Modification Rate (EMR) is a rating generated by the National Council of Compensation Insurance (NCCI). This rating is used to determine the contractor's premium for worker's compensation insurance. The Bidder / Contractor may obtain its EMR by contacting its insurance broker or the NCCI. If the Bidder cannot obtain its EMR, it must submit a written explanation as to why.

The Bidder must indicate its Intrastate and Interstate EMR for the past three years. [Note: For contractors with less than three years of experience, the EMR will be considered to be 1.00].

YEAR	INTRASTATE RATE	INTERSTATE RATE
2019	.71	
2018	.71	
2017	.77	

If the Intrastate and/or Interstate EMR for any of the past three years is greater than 1.00, the Bidder / Contractor must attach, to this questionnaire, a written explanation for the rating and identify what corrective action was taken to correct the situation resulting in that rating.

#### 4. OSHA Information:

☐ YES ☒ NO Contractor has received a willful violation issued by OSHA or a New York City Department of Buildings (NYCDOB) construction-related violation within the last three years.

☐ YES ☒ NO Contractor has had an incident requiring OSHA notification within 8 hours (all work-related fatalities) or an incident requiring OSHA notification within 24 hours (work-related in-patient hospitalization, amputation and all loss of an eye).

The OSHA Form 300 "Log of Work-Related Injuries and Illnesses" and OSHA Form 300A "Summary of Work-Related Injuries and Illnesses" must be submitted for the last three years for Contractors with more than ten employees.

The Bidder / Contractor must indicate the total number of hours worked by its employees, as reflected in payroll records for the past three (3) years.

The Bidder / Contractor must submit the Incident Rate for Lost Time Injuries (the Incident Rate) for the past three (3) years. The Incident Rate is calculated in accordance with the formula set forth below. For each given year, the total number of incidents is the total number of non-fatal injuries and illnesses reported on the OSHA Form 300 and OSHA Form 300A. The 200,000 hours represents the equivalent of 100 employees working forty hours a week, fifty (50) weeks per year.

Incident Rate = 
$$\frac{\text{Total Number of Incidents} \times 200,000}{\text{Total Number of Hours Worked by Employees}}$$

YEAR	TOTAL NUMBERS OF HOURS WORKED BY EMPLOYEES	INCIDENT RATE
2019	278,337	6.47
2018	330,371	5.45
2017	363,780	2.20

If the Bidder's / Contractor's Incident Rate for any of the past three years is one point higher than the Incident Rate for the type of construction it performs (listed below), the Bidder / Contractor must attach, to this questionnaire, a written explanation for the relatively high rate.

General Building Construction .....	8.5
Residential Building Construction .....	7.0
Nonresidential Building Construction .....	10.2
Heavy Construction, except building .....	8.7
Highway and Street Construction .....	9.7
Heavy Construction, except highways .....	8.3
Plumbing, Heating, HVAC .....	11.3
Painting and Paper Hanging .....	6.9
Electrical Work .....	9.5
Masonry, Stonework and Plastering .....	10.5
Carpentry and Floor Work .....	12.2
Roofing, Siding, and Sheet Metal .....	10.3
Concrete Work .....	8.6
Specialty Trade Contracting .....	8.6

5. Safety Performance on Previous DDC Project(s) N/A

☐ YES    ☒ NO    Fatality or an incident requiring OSHA notification within 24 hours (work-related in-patient hospitalization, amputation and all loss of an eye) on DDC Project(s) within the last three (3) years.

DDC Project Number(s): \_\_\_\_\_

The Bidder hereby affirms that all the information provided in this Safety Questionnaire and all additional pages and/or attachments, if applicable, consist of accurate representations.

Date: 1/17/2020

By:   
(Signature of Bidder: Owner, Partner, Corporate Officer)

Title: Jay Dier, VP

## Pre-Award Process

The bidder is advised that as part of the pre-award review of its bid, it may be required to submit the information described in Sections (A) through (D) below. If required, the bidder must submit such information within five (5) business days following receipt of notification from DDC that it is among the low bidders. Such notification from DDC will be by facsimile or in writing and will specify the types of information which must be submitted.

**In the event the bidder fails to submit the required information within the specified time frame, its bid may be rejected as nonresponsive.**

\*\*\*\*\*

- (A) **Project Reference Form:** If required, the bidder must complete and submit the Project Reference Form set forth on pages 28 through 30 of this Bid Booklet. The Project Reference Form consists of 3 parts: (1) Contracts Completed by the Bidder, (2) Contracts Currently Under Construction by the Bidder, and (3) Pending Contracts Not Yet Started by the Bidder.
- (B) **Copy of License:** If required, the bidder must submit a copy of the license under which the bidder will be performing the work. Such license must clearly show the following: (1) Name of the Licensee, (2) License Number, and (3) Expiration date of the License. A copy of the license will be required from bidders for the following contracts: Plumbing Work, Electrical Work and Asbestos Abatement.
- (C) **Financial Information:** If required, the bidder must submit the financial information described below:
- (1) **Audited Financial Statements:** Financial statements (Balance Sheet and Income Statement) of the entity submitting the bid, as audited by an independent auditor licensed to practice as a certified public accountant (CPA). Audited financial statements for the three most recent fiscal years must be submitted. Each such financial statement must include the auditor's standard report.
- If the bidder does not have audited financial statements, it must submit an affidavit attesting to the fact that the bidder does not have such statements. In addition, the bidder must submit the following documentation covering the three most recent fiscal years: signed federal tax returns, unaudited financial statements, and a "certified review letter" from a certified public accountant (CPA) verifying the unaudited financial statements.
- Unless the most recent audited or unaudited financial statement was issued within ninety (90) days, the bidder must submit interim financial information that includes data on financial position and results of operation (income data) for the current fiscal year. Such information may be summarized on a monthly or quarterly basis or at other intervals.
- (2) **Schedule of Aged Accounts Receivable,** including portion due within ninety (90) days.
- (D) **Project Specific Information:** If required, the bidder must submit the project specific information described below:
- (1) Statement indicating the number of years of experience the bidder has had and in what type of construction.
- (2) Resumes of all key personnel to be involved in the project, including the proposed project superintendent.
- (3) List of significant pieces of equipment expected to be used for the contract, and whether such equipment is owned or leased.



- (4) Description of work expected to be subcontracted, and to what firms, if known.
- (5) List of key material suppliers.
- (6) Preliminary bar chart time schedule
- (7) Contractor's expected means of financing the project. This should be based on the assumption that the contractor is required to finance 2X average monthly billings throughout the contract period.
- (8) Any other issues the contractor sees as impacting his ability to complete the project according to the contract.

In addition to the information described in Sections (A) through (D) above, the bidder shall submit such additional information as the Commissioner may require, including without limitation, an explanation or justification for specific unit price items.

The bidder is further advised that it may be required to attend a pre-award meeting with DDC representatives. If such a meeting is convened, the bidder will be advised as to any additional material to be provided.

**A. PROJECT REFERENCES – CONTRACTS COMPLETED BY THE BIDDER**

List all contracts substantially completed within the last 4 years, up to a maximum of 10, in descending order of date of substantial completion.

Project & Location	Contract Type	Contract Amount (\$000)	Date Completed	Owner Reference & Tel. No.	Architect/Engineer Reference & Tel. No. if different from owner
LIRR ESI 8 Stations Long Island, NY	General Construction	81,748,000.00	2019	Poonam Punj 516-369-6341	
PS 19 Queens, NY	General Construction	97,124,000.00	2019	Gordon Tung 718-472-8000	
PS 11 Queens, NY	General Construction	95,208,000.00	2019	Gordon Tung 718-472-8000	
ESI Pkg. #8 - 3 Stations 145th, 167th & 174-175th St Stations	General Construction	93,175,000.00	2018	Frank Salvato 646-252-6243	
Hicksville Improvement Long Island, NY	General Construction	54,267,000.00	2018	A.Natal 718-725-2655	
ESI Pkg. #1 - 3 Stations 53rd St, Bay Ridge, Prospect Stations	General Construction	77,899,123.00	2017	Frank Salvato 646-252-6243	
PK 678 Brooklyn, NY	General Construction	26,633,000.00	2017	Gordon Tung 718-472-8000	

Managing  
Partner of  
JV

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**A. PROJECT REFERENCES - CONTRACTS COMPLETED BY THE BIDDER**

List all contracts substantially completed within the last 4 years, up to a maximum of 10, in descending order of date of substantial completion.

Project & Location	Contract Type	Contract Amount (\$000)	Date Completed	Owner Reference & Tel. No.	Architect/Engineer Reference & Tel. No. if different from owner
PS 77/IS 266 Brooklyn, NY	General Construction	39,668,000.00	2017	Gordon Tung 718-472-8000	
PS 170 Brooklyn, NY	General Construction	49,608,000.00	2017	Gordon Tung 718-472-8000	
PS 35 Queens, NY	General Construction	46,620,000.00	2016	Gordon Tung 718-472-8000	

**B. PROJECT REFERENCES – CONTRACTS CURRENTLY UNDER CONSTRUCTION BY THE BIDDER**

List all contracts currently under construction even if they are not similar to the contract being awarded.

Project & Location	Contract Type	Contract Amount (\$000)	Subcontracted to Others (\$000)	Uncompleted Portion (\$000)	Date Scheduled to Complete	Owner Reference & Tel. No.	Architect/Engineer Reference & Tel. No. if different from owner
Relocation of Offices @ 345 Adams St Brooklyn	General Construction	96,721,000.00	72,580,000	88,000,000	Oct 2021	NYC DCAS Anthony Crane 212-386-0672 NYC SCA	
PS 196 Queens, NY	General Construction	34,522,000.00	19,190,000	30,500,000	Jan 2022	Gordon Tung 718-472-8000	
PS 361 Queens, NY	General Construction	14,025,000.00	10,387,000	11,600,000	May 2020	LiRo for NYCSCA Bijan Radafshar 718-445-5295 NYC SCA	
PS 340 Bronx, NY	General Construction	46,670,000	28,000,000	37,350,000	Sept 2021	Gordon Tung 718-472-8000 NYC SCA	
PS 97 Brooklyn, NY	General Construction	48,892,000	31,930,000	30,400,000	June 2021	Gordon Tung 718-472-8000 NYC SCA	
PS 32 Brooklyn, NY	General Construction	74,800,000	46,350,000	24,000,000	July 2021	NYC SCA Gordon Tung 718-472-8000	

**C. PROJECT REFERENCES – PENDING CONTRACTS NOT YET STARTED BY THE BIDDER**

List all contracts awarded to or won by the bidder but not yet started. N/A

Project & Location	Contract Type	Contract Amount (\$000)	Date Scheduled to Start	Owner Reference & Tel. No.	Architect/Engineer Reference & Tel. No. if different from owner

## PASSPort COMPLIANCE

All vendors that intend to do business with the City of New York must complete a disclosure process in order to be considered for a contract. This disclosure process was formerly completed using Vendor Information Exchange System (VENDEX) paper-based forms. The City of New York has moved collection of vendor disclosure information online. In early August 2017, the New York City Mayor's Office of Contract Services (MOCS) launched the **Procurement and Sourcing Solutions Portal (PASSPort)**, a new online procurement system that replaced the paper-VENDEX process. In anticipation of awards, all bidders must create online accounts in the new PASSPort system, and file all disclosure information using PASSPort. **Paper submissions, including certifications of no changes to existing VENDEX packages, will not be accepted in lieu of complete online filings using PASSPort.**

All vendors that intend to do business with the City, but specifically those that fall into any of the following categories, are required to enroll:

- Have a pending award with a City Agency; or
- Hold a current contract with a City Agency and have either an expiring VENDEX or expiring Certificate of No Change.

The Department of Design and Construction (DDC) and MOCS hereby notifies all proposers that the PASSPort system is available, and that disclosure filing completion is required prior to any award through this competitive bid.

To enroll in PASSPort and to access the PASSPort website (including online training), please visit [www.nyc.gov/passport](http://www.nyc.gov/passport). Contact MOCS at [passport@mocs.nyc.gov](mailto:passport@mocs.nyc.gov) for additional information and technical support.

## CONSTRUCTION EMPLOYMENT REPORT

All bidders will be required to submit either a Construction Employment Report (CER) if the bid amount is \$1,000,000 or greater.

The CER template form is available online at:

[https://www1.nyc.gov/assets/sbs/downloads/pdf/businesses/DLS\\_Constru\\_Employ\\_Rpt.pdf](https://www1.nyc.gov/assets/sbs/downloads/pdf/businesses/DLS_Constru_Employ_Rpt.pdf)

Instructions for completing the Construction Employment Report are available online at:

[https://www1.nyc.gov/assets/sbs/downloads/pdf/businesses/DLS\\_Cons\\_Employ\\_Rpt\\_Inst.pdf](https://www1.nyc.gov/assets/sbs/downloads/pdf/businesses/DLS_Cons_Employ_Rpt_Inst.pdf)

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**IRAN DIVESTMENT ACT COMPLIANCE RIDER**  
**FOR NEW YORK CITY CONTRACTORS**

The Iran Divestment Act of 2012, effective as of April 12, 2012, is codified at State Finance Law ("SFL") §165-a and General Municipal Law ("GML") §103-g. The Iran Divestment Act, with certain exceptions, prohibits municipalities, including the City, from entering into contracts with persons engaged in investment activities in the energy sector of Iran. Pursuant to the terms set forth in SFL §165-a and GML §103-g, a person engages in investment activities in the energy sector of Iran if:

- (a) The person provides goods or services of twenty million dollars or more in the energy sector of Iran, including a person that provides oil or liquefied natural gas tankers, or products used to construct or maintain pipelines used to transport oil or liquefied natural gas, for the energy sector of Iran; or
- (b) The person is a financial institution that extends twenty million dollars or more in credit to another person, for forty-five days or more, if that person will use the credit to provide goods or services in the energy sector in Iran and is identified on a list created pursuant to paragraph (b) of subdivision three of Section 165-a of the State Finance Law and maintained by the Commissioner of the Office of General Services.

A bid or proposal shall not be considered for award nor shall any award be made where the bidder or proposer fails to submit a signed and verified bidder's certification.

Each bidder or proposer must certify that it is not on the list of entities engaged in investment activities in Iran created pursuant to paragraph (b) of subdivision 3 of Section 165-a of the State Finance Law. In any case where the bidder or proposer cannot certify that they are not on such list, the bidder or proposer shall so state and shall furnish with the bid or proposal a signed statement which sets forth in detail the reasons why such statement cannot be made. The City of New York may award a bid to a bidder who cannot make the certification on a case by case basis if:

- (1) The investment activities in Iran were made before the effective date of this section (i.e., April 12, 2012), the investment activities in Iran have not been expanded or renewed after the effective date of this section and the person has adopted, publicized and is implementing a formal plan to cease the investment activities in Iran and to refrain from engaging in any new investments in Iran; or
- (2) The City makes a determination that the goods or services are necessary for the City to perform its functions and that, absent such an exemption, the City would be unable to obtain the goods or services for which the contract is offered. Such determination shall be made in writing and shall be a public document.



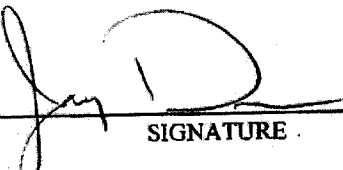
**BIDDER'S CERTIFICATION OF COMPLIANCE WITH  
IRAN DIVESTMENT ACT**

Pursuant to General Municipal Law Section 103-g, which generally prohibits the City from entering into contracts with persons engaged in investment activities in the energy sector of Iran, the bidder/proposer submits the following certification:

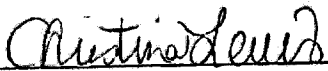
[Please Check One]

**BIDDER'S CERTIFICATION**

- ☒ By submission of this bid or proposal, each bidder/proposer and each person signing on behalf of any bidder/proposer certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief, that each bidder/proposer is not on the list created pursuant to paragraph (b) of subdivision 3 of Section 165-a of the State Finance Law.
- ☐ I am unable to certify that my name and the name of the bidder/proposer does not appear on the list created pursuant to paragraph (b) of subdivision 3 of Section 165-a of the State Finance Law. I have attached a signed statement setting forth in detail why I cannot so certify.

  
\_\_\_\_\_  
SIGNATURE  
  
Jay Dier  
\_\_\_\_\_  
PRINTED NAME  
  
VP  
\_\_\_\_\_  
TITLE

Sworn to before me this  
9th day of Oct, 2019

  
\_\_\_\_\_  
Notary Public

Dated: 10/9/19

Christina M. Lewis  
NOTARY PUBLIC-STATE OF NEW YORK  
Registration 01LE6392847  
Qualified In Suffolk County  
Commission Expires 6/03/2023

# ADDENDA CONTROL SHEET

TITLE: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE REBID

**GENERAL  
COUNSEL**

[illegible]

THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

September 11, 2019

**ADDENDUM No. # 1**

FOR FURNISHING ALL LABOR AND MATERIAL NECESSARY AND REQUIRED FOR:

PO002-116

NEW 116<sup>TH</sup> PRECINCT STATION HOUSE REBID

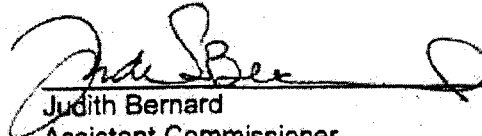
This addendum is issued for the purpose of amending the requirements of the Bid and Contract Documents and is hereby made a part of said Bid and Contract Documents to the same extent as though it were originally included therein.

The bidder is advised that the items listed below apply to the project:

1. **Revisions to Volume 3:**  
Delete Volume 3 of the Bid Documents in its entirety, and replace with updated Volume 3, included with this Addendum.

**THIS ADDENDUM MUST BE SIGNED BY ALL BIDDERS AND ATTACHED TO THEIR BIDS.**

If additional information is required, please contact the Department of Design and Construction, Contract Section at (718) 391-1016, by email at [CSB\\_projectinquiries@ddc.nyc.gov](mailto:CSB_projectinquiries@ddc.nyc.gov) or by fax at (718) 391-2627.

  
Judith Bernard  
Assistant Commissioner  
Courts/ Correction / Fire and Police  
Programs

Citnalta Construction Corp.

Name of Bidder

By: 

# ADDENDA CONTROL SHEET

TITLE: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE REBID

**GENERAL  
COUNSEL**

[illegible]

THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

October 10, 2019

**ADDENDUM No. # 2**

FOR FURNISHING ALL LABOR AND MATERIAL NECESSARY AND REQUIRED FOR:

PO002-116

NEW 116<sup>TH</sup> PRECINCT STATION HOUSE REBID


This addendum is issued for the purpose of amending the requirements of the Bid and Contract Documents and is hereby made a part of said Bid and Contract Documents to the same extent as though it were originally included therein.

The bidder is advised that the items listed below apply to the project:

1. The Bid Opening for the contract described below scheduled for October 9, 2019, at 2:00 pm is rescheduled to October 10, at 2:00 pm.  
Contract #1 – General Construction Work
2. Bidders Questions and Responses to Questions:  
See Attachment A.
3. Revisions to the Addendum to the General Conditions:  
See Attachment B.
4. Revisions to the Drawings:  
See Attachment C.
5. Revisions to the Specifications:  
See Attachment D.

**THIS ADDENDUM MUST BE SIGNED BY ALL BIDDERS AND ATTACHED TO THEIR BIDS.**

If additional information is required, please contact the Department of Design and Construction, Contract Section at (718) 391-1016, by email at [CSB\\_projectinquiries@ddc.nyc.gov](mailto:CSB_projectinquiries@ddc.nyc.gov) or by fax at (718) 391-2627.

  
Judith Bernard  
Assistant Commissioner  
Courts/ Correction / Fire and Police  
Programs

Citnalta Construction Corp.  
Name of Bidder

By: 

**DDC PROJECT #: PO002-116**

**PROJECT NAME: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE**

**ATTACHMENT A - BIDDERS QUESTIONS AND DDC RESPONSES**

No.	Bidders Questions	DDC Responses
1	On the original bid of this project it was requested and granted by NYCDDC to only require totals for each specification division as opposed to the 150 + page breakdown issued with the documents. We ask that the same request be granted on this bid. Should this breakdown be required we believe that it should only be required of the successful bidder at some point following the award of the project.	The totals must be provided for each specification section. The successful low bidder will be required to provide the full breakdown.
2	Section 05 59 63 Detention Enclosures paragraph 2.2.A specifies 7/8" diameter steel bars for the cell front construction. Details on Sheets A541 and A543.00 show 7/8" diameter double-ribbed, tool-resisting bars for cell front construction. (Note that only double-ribbed bars are capable of being interlocked as specified in paragraph 055963.2.2.B.) Please confirm that the bars for the cell front construction are to be 7/8" diameter, double-ribbed, tool-resisting steel bars.	Confirmed. Steel bars at cell enclosures are to be 7/8" diameter, double-ribbed tool-resisting bars.
3	Detail 5/A563.00 shows the Security Steel Plate (SSP) Ceiling to be 3/16" Security Steel Plate. Sheet A611 Finish Legend shows Ceiling Type SSP-1 Steel Plate Security Ceiling to be 14 gauge. Please confirm that the Security Steel Plate ceiling is to be constructed of 3/16" steel plate with angles and tees as shown in detail 5/A563.	Drawing A-611 has been revised to remove the note regarding 14-gauge panels; the 3/16" thickness per Drawing A-563 shall remain. See Attachment C – Revisions to the Drawings.
4	<p>1. What are the goals of BIM in this project? Is this only for coordination and clash detection, or the BIM will be utilized for as-built drawing production and facilities management?</p> <p>2. What is the required LOD (Level of Development) in this project?</p> <p>3. Is the design developed in Revit or another BIM platform, or the drawings were developed in 2D (CAD) environment? - and, if there are available models for the design phase, are those models reliable and can they be used in coordination (clash</p>	<p>1. Refer to specification section 01 32 34 "Computer Aided Design Coordination" for a description of the BIM modeling to be provided for this project.</p> <p>2. Specification section 01 32 34 "Computer Aided Design Coordination" identified modeling requirements in addition to LOD levels to be provided for specific requirements.</p> <p>3. The design was developed using Revit and Navisworks. The contractor should not rely on the design intent model. The Design Intent model can be used for reference only and all dimensions must be retrieved from hard copy drawings and verified.</p>

	<p>detection) phase during construction or they need to be verified with 2D drawings first?</p> <p>4. Can you please share the most updated NYCDDC's BIM Implementation Plan?</p> <p>5. Is there laser scanning requirement for as-built condition verification during construction, or, conventional measuring and surveying is enough?</p> <p>6. Are the models need to be georeferenced?</p>	<p>4. The most updated NYCDDC BIM Implementation Plan can be found on DDC's website under Resources/Publications.</p> <p>5. Laser scanning is not required but can be used.</p> <p>6. The models do not need to be georeferenced.</p>
5	<p>There were many questions asked and answered in Addenda 1 through 6 in the initial Bid Phase that apply to this rebid. Please clarify if the responses to these questions have been incorporated into the Contract Documents for this Bid Phase or do we need to resubmit them for review a second time for those who did not originally bid this project? Several instances we checked have not been incorporated. See Addendum #2 QA 15 for example; the response to this question indicates that Spec Section 10 11 00 Visual Display Boards was revised to include acoustical wall panel information. The Specification Section revisions were noted in the addendum and the Specification was not revised and re-issued in its entirety. The new re-bid package includes the same original, unrevised specification. If you don't have access to the original Addenda you do not get that clarification.</p>	<p>Yes, the bid addenda from the first solicitation were incorporated into this revised re-solicitation package. However, bidders must rely on the documents and drawings included in this solicitation ONLY when preparing their bids, and not any documents, drawings, answers, or addenda issued with any prior solicitations.</p> <p>Technical Specifications were revised to include Fabric-Wrapped Panels under new specification section 09 77 23 to address the revisions made in the first solicitation for the acoustical wall panels.</p>
6	<p>Please confirm if all drawings which were revised and reissued through Addenda in the original Bid Phase have been incorporated into this Bid Package?</p>	<p>Yes, the bid addenda from the first solicitation were incorporated into this revised re-solicitation package, including revised drawings. However, bidders must rely on the documents and drawings included in this solicitation ONLY when preparing their bids, and not any documents, drawings, answers, or addenda issued with any prior solicitations.</p>
7	<p>Drawing TAC-105: Note #2 suggests cameras are provided and installed by NYPD as well as cameras CAM-SP-01, 0,2 &amp; 0,3. Please confirm.</p>	<p>Note header reads, "Room 212C &amp; 212D Notes" – only cameras indicated in these areas (CAM-SP-01, 02, 03) are provided and installed by NYPD. All other cameras are to be provided and installed by the Contractor. See sheet TAC-405 Security Camera Schedule, and Proprietary Items special notice as indicated in the Bid Booklet page 2a.</p>

8	Drawing TAC-403: Please confirm if the mounting for cameras are also provided and installed by NYPD. Please confirm.	All camera mounts, except for CAM-SP-01, 02, and 03, are to be provided and installed by the Contractor, as listed in sheet TAC-405 Security Camera Schedule.
9	Drawing TAC-113: "Security Door Hardware schedule" shows (2) Strobe Siren, however, only (1) showing on the drawings. Please confirm the real count.	Drawing TAC-113 shows two (2) strobes.
10	Section 2.1.F.2 of Spec. Section 28 00 00: Please confirm if the Cisco switches are to be furnished by us in this contract as no further information has been provided in the spec nor in the contract drawings	Cisco switches are not in contract. Switches to be provided by NYPD after construction.
11	Drawing TC-306: Please confirm if the antenna is being furnished in this contract.	One (1) antenna is to be provided, as clearly indicated on detail C on sheet TC-306.
12	Section 28 00 00: There is no mention of the level of integration between the prisoner cell alarm system, door alarm system, emergency door alarm system, card access system, CCTV system and the intercom system in the spec. Please specify explicitly the level of integration to be furnished by us in this contract.	These standalone systems are to operate independent of each other per NYPD direction.
13	Section 2.1.C of the Spec. Section 27 41 00: Please confirm the no. of TVs that are being furnished in the Room 115 as there are two the drawing TAV-101 shows only two TVs in the room while four TVs are shown in the same room as per the drawing TAV-300.	Two (2) TVs to be furnished – see also sheet TAV-301.
14	Section 2.5.B of the Spec. Section 28 00 00: Please confirm if the LE-SS/A intercoms are to be provided at all external location as shown in TAC-110.	Confirmed.
15	Section 2.5.B of the Spec. Section 28 00 00: Please confirm if the intercoms are to be provided in the Prisoner Processing Room 107 as shown in the contract drawing TAC-110 as it is not shown in the layout drawing while 1 is shown in the Security Door Hardware Schedule	All interior and exterior intercoms in the project are audio intercoms.
16	Section 2.1.I of the Spec. Section 27 41 00: There are no induction loop amplifiers shown in the room.103 in the drawing TAV-103 which is contradicting the information shown in the Section 3.16.P equipment list table that shows 1 TVs to be furnished in the same room. Please confirm the real count	Room 103 is indicated on Drawing TAV-102, which references Drawing TAV-302. Induction loop equipment is clearly indicated on Drawings TAV-302 and TAV-303.
17	Section 1.8 of the Spec. Section 28 00 00: Please confirm the count of the Security Management and Facilities operators who are being trained by the professional	Refer to Specification Section 28 00 00 Security Systems, Part 1.8-A, which refers to a minimum of six (6) operators for system operation.



	engineers as no explicit count has been mentioned in the spec.	
18	Section 1.8 of the Spec. Section 28 00 00 of the Spec. Section 28 00 00: Please confirm if 40hrs total training is to be provided for Operator and Management or 40hrs each is to be provided each is to be provided for Operator and Management	Refer to Specification Section 28 00 00 Security Systems, part 1.8-A-3, which refers to two (2) distinct instruction sessions with minimum 40 hours each.
19	Section 2.6.F of the Spec. Section 28 00 00: Please note that no CCTV PC have been shown in the drawings while they have been mentioned in the specs. Please provide the counts of each item in this section that is to be furnished in this project.	For the 'CCTV PC' items, as noted in specification section 28 00 00 Security Systems, Item 2.6-F, one (1) CCTV PC shall be furnished.
20	Section 1.2.B.F of the Spec. Section 28 00 00: Please confirm the exterior and interior cameras are deployed in the same VMS system or separate VMS systems.	All interior and exterior security cameras are associated with Genetec VMS. Specific interior cameras (CAM-SP-01, 02, and 03) are associated with mission-specific investigatory functions, and thus are not associated with the Genetec VMS. See general note #3 on Drawing TAC-405 Security Camera Schedule.
21	Section 1.2.B.F of the Spec. Section 28 00 00: Please provide the recording parameters of the VMs Systems such as the resolution, frame, %-recording time, retention period and other details of the VMS system/(s)	NYPD to configure the Genetec recording parameters for the installed cameras.
22	Drawing TAV-104: Please confirm if any TVs are to be furnished in the room 212 as none are shown in the contract drawing	There are no TVs shown in room 212 as per drawing TAV-104.
23	We could not find a section in the bid pig referencing ARCS (auxiliary radio communication system). Please advise. ARCS (for FDNY) is a city building code requirement.	In accordance with the New York City Building Code 907.2.13.2 (Fire Department Communication System), the ARCS is required for all high-rise buildings, and it does not apply to this project

**DDC PROJECT #: PO002-116**

**PROJECT NAME: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE**

**ATTACHMENT B – REVISIONS TO THE ADDENDUM TO THE GENERAL CONDITIONS**

**REFER TO SCHEDULE B – GUARANTEES AND WARRANTIES**

Delete:

23 51 01	1.10.A.2	Boiler Draft Control System	Components of draft inducer fans	Ten (10) years from the date of Substantial Completion
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DDC PROJECT #: PO002-116

PROJECT NAME: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE

ATTACHMENT C – REVISIONS TO THE DRAWINGS

REFER TO DRAWING A-611:

1. Interior Finish Legend: Description for SSP-1 Steel Plate Security Ceiling clarified.

**DDC PROJECT #: PO002-116**

**PROJECT NAME: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE**

**ATTACHMENT D – REVISIONS TO THE SPECIFICATIONS**

The following Sections have been modified:

- 12 24 13 – Roller Window Shades (Revised as per below):

Revise: PART 2.2 MANUALLY OPERATED SHADES, Item F

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Extruded aluminum.

Delete: PART 2.4 Shadeband Materials, Item C





CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

## ADDENDA CONTROL SHEET

BID OPENING DATE: October 11, 2019

PROJECT No. : PO002-116

TITLE: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE REBID

		APPROVED BY:		
ADDENDA ISSUED	NO. OF DWG	DATE	ARCHITECTURE/ ENGINEERING	GENERAL COUNSEL
#1 Revisions to Volume 3		9/11/2019		
#2 Revised Bid Opening Date; Questions from Bidders and Responses to Questions; Revisions to the Addendum to the General Conditions; Revisions to the Drawings; Revisions to the Specifications		10/2/2019		
#3 Revised Bid Opening Date; Questions from Bidders and Responses to Questions; Revisions to the Bid Booklet; Revisions to Volume 2.		10/8/2019		

THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

October 8, 2019

**ADDENDUM No. # 3**

FOR FURNISHING ALL LABOR AND MATERIAL NECESSARY AND REQUIRED FOR:

PO002-116

NEW 116<sup>TH</sup> PRECINCT STATION HOUSE REBID


This addendum is issued for the purpose of amending the requirements of the Bid and Contract Documents and is hereby made a part of said Bid and Contract Documents to the same extent as though it were originally included therein.

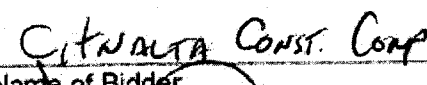
The bidder is advised that the items listed below apply to the project:

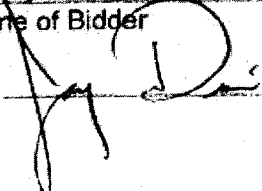
1. **The Bid Opening for the contract described below scheduled for October 10, 2019, at 2:00 pm is rescheduled to October 11, at 2:00 pm.**  
Contract #1 – General Construction Work
2. **Bidders Questions and Responses to Questions:**  
See Attachment A.
3. **Revisions to the Bid Booklet:**  
See Attachment B.
4. **Revisions to Volume 2:**  
See Attachment C.

**THIS ADDENDUM MUST BE SIGNED BY ALL BIDDERS AND ATTACHED TO THEIR BIDS.**

If additional information is required, please contact the Department of Design and Construction, Contract Section at (718) 391-1016, by email at [CSB\\_projectinquiries@ddc.nyc.gov](mailto:CSB_projectinquiries@ddc.nyc.gov) or by fax at (718) 391-2627

  
Judith Bernard  
Assistant Commissioner  
Courts/ Correction / Fire and Police  
Programs

  
Name of Bidder

By: 

**DDC PROJECT #:** PO002-116

**PROJECT NAME:** NEW 116<sup>TH</sup> PRECINCT STATION HOUSE

**ATTACHMENT A - BIDDERS QUESTIONS AND DDC RESPONSES**

No.	Bidders Questions	DDC Responses
1.	The Jewish High Holy Day of Yom Kippur begins at sundown on October 8, 2019 and runs until sundown on October 9, 2019. As currently scheduled, bids for the New 116 <sup>th</sup> Station House are due on October 9, 2019 at 2PM. We respectfully ask for a bid extension to accommodate those observing the holiday.	New Bid Date: October 11, 2019
2.	Please provide the Bid Breakdown sheet in Excel version to aid in preparing our bids. Please advise if the Bid Breakdown sheet can be submitted with the Subtotals only for each CSI number at the time of bid? The full itemized breakdown would be submitted post bid if we were the successful low bidder. Due to the magnitude of the items in the breakdown, it would be difficult to receive this information from our subcontractors and process it on the day of the bid.	Please see Attachment B. Yes, subtotals for each CSI number can be submitted for the bid.
3.	Please provide run lengths and quantities for those lighting products listed under Schedule No. P9, P23, and X12. Our lighting suppliers cannot find this information and need it to complete their quotes.	P9, P23, and X12 fixtures are indicated on the Electrical Lighting Plans (Drawings E-110 series).
4.	Wall Base in Stress Reduction Room 113; Drawing A-611.00 does not indicate, Drawing A-503.00 Details 2, 4, 6, 8 do not indicate, Section 096500 does not indicate, please clarify.	<p>Stress Reduction Room is Room 003.</p> <p>Detail 8/Sheet A-503 indicates a 4" RB-1 wall base, typical throughout the Stress Reduction Room. Room finish tag for the Stress Reduction Room on 5/A-161, indicates RB-1 wall base. RB-1 Wall Base is indicated on the Interior Finish Schedule, sheet A-611, as follows:</p> <ul style="list-style-type: none"> <li>• Type – RB-1</li> <li>• Item – Rubber Wall Base</li> <li>• Basis of Design (Manufacturer) – Johnsonite Baseworks Thermoset Rubber Wall Base</li> <li>• Color – 28 Medium Grey</li> <li>• Specification – 09 65 00 / part 2.2</li> </ul>



DDC PROJECT #: **PO002-116**

PROJECT NAME: **NEW 116<sup>TH</sup> PRECINCT STATION HOUSE**

**ATTACHMENT B – REVISIONS TO THE BID BOOKLET**

Electronic version of the Bid Breakdown is included with this Addendum.

**DDC PROJECT #: PO002-116**

**PROJECT NAME: NEW 116<sup>TH</sup> PRECINCT STATION HOUSE**

**ATTACHMENT C – REVISIONS TO VOLUME 2**

Revised Project Labor Agreement (PLA) Notice:

The PLA has been extended thru October 31, 2019. Refer to Notice to Bidders, included with this Addendum.



FMS ID: PO002-116



Department of  
Design and  
Construction

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**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

30-30 THOMSON AVENUE LONG ISLAND CITY, NEW YORK 11101-3045  
TELEPHONE (718) 391-1000 WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

---

**Contract for Furnishing all Labor and Material Necessary and Required for:**

**CONTRACT NO. 1 GENERAL CONSTRUCTION WORK**

**New 116th Precinct Station House  
Rebid**

**LOCATION: 244-04 North Conduit Avenue  
BOROUGH: Queens, NY 11422  
CITY OF NEW YORK**

---

Contractor \_\_\_\_\_

Dated \_\_\_\_\_, 20\_\_\_\_

---

Entered in the Comptroller's Office \_\_\_\_\_

First Assistant Bookkeeper \_\_\_\_\_

Dated \_\_\_\_\_, 20\_\_\_\_





Department of  
Design and  
Construction

PROJECT ID:

PO002-116

**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

30-30 THOMSON AVENUE  
LONG ISLAND CITY, NEW YORK 11101-3045  
TELEPHONE (718) 391-1000  
WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

**VOLUME 2 OF 3**

**PROJECT LABOR AGREEMENT  
INFORMATION FOR BIDDERS  
CONTRACT  
PERFORMANCE AND PAYMENT BONDS  
SCHEDULE OF PREVAILING WAGES  
GENERAL CONDITIONS**

FOR FURNISHING ALL LABOR AND MATERIALS  
NECESSARY AND REQUIRED FOR THE PROJECT

**New 116th Precinct Station House  
Rebid**

LOCATION:  
BOROUGH:  
CITY OF NEW YORK

244-04 North Conduit Avenue  
Queens, NY 11422

CONTRACT NO. 1

GENERAL CONSTRUCTION WORK

New York City Police Department

Dattner Architects

Date:

August 29, 2019



20-008



**Department of  
Design and  
Construction**

**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

30-30 THOMSON AVENUE  
LONG ISLAND CITY, NEW YORK 11101-3045  
TELEPHONE (718) 391-1000  
WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

**VOLUME 2 OF 3**

**PROJECT LABOR AGREEMENT  
INFORMATION FOR BIDDERS  
CONTRACT  
PERFORMANCE AND PAYMENT BONDS  
SCHEDULE OF PREVAILING WAGES  
GENERAL CONDITIONS**

**FOR FURNISHING ALL LABOR AND MATERIALS  
NECESSARY AND REQUIRED FOR THE PROJECT**



# **NOTICE TO BIDDERS**

Please be advised the Project Labor Agreement (PLA) attached and incorporated in this Invitation for Bids has been extended to apply to contracts let prior to October 31, 2019, including this contract. Other than extending the expiration date, all other terms of the PLA continue to apply in full force and effect.





# **2015 “New Construction” Project Labor Agreement**

## **NOTICE: THIS CONTRACT IS SUBJECT TO A NEW PROJECT LABOR AGREEMENT EXECUTED IN 2015**

**This contract is subject to the attached Project Labor Agreement (“PLA”) entered into between the City and the Building and Construction Trades Council of Greater New York (“BCTC”) affiliated Local Unions. By submitting a bid, the Contractor agrees that if awarded the Contract the PLA is binding on the Contractor and all subcontractors of all tiers. The bidder to be awarded the contract will be required to execute the attached Letter of Assent prior to award. Contractor shall include in any subcontract a requirement that the subcontractor, and sub-subcontractors of all tiers, become signatory to and bound to the PLA with respect to the subcontracted work. Contractor will also be required to have all subcontractors of all tiers execute the attached Letter of Assent prior to such subcontractors performing any work on the Project. Bidders are advised that the City of New York and City agencies have entered into multiple PLAs. The terms of individual PLAs, while similar, are not identical. All bidders should carefully read the entire PLA that governs this Contract.**

**In addition, please note that there are significant differences between the 2015 PLA attached to this bid and the Citywide Renovation PLA as well as previous new construction PLAs. The Contractor is urged to review the entire PLA. Significant changes include:**

- **Grievances:** The grievance procedure governing disputes under the PLA has been clarified. See PLA Article 9, Section 1.
- **Delinquent Contractors:** Contractors and Subcontractors who do not make required payments to union funds on a timely basis are subject to requirements to submit cancelled checks or another form of proof of payment in addition to certified payroll reports when requesting payment. See PLA Article 11, Section 2.
- **Payment to Union Funds for Non-Union Workers:** Non-union Contractors with bona fide private benefit plans that satisfy the requirements of Labor Law 220 will not be required to pay into union benefit funds for “core” non-union employees (working pursuant to Article 4, Section 2 of the PLA) who are already covered under such bona fide private benefit plans. See PLA Article 11, Section 2.
- **Veterans Day:** Veterans Day has been added to the list of standard holidays. See Article 12, Section 4.
- **Reporting Pay for Weather Events:** The usual reporting pay requirement of two hours for employees who report to their work location pursuant to their regular schedule does not apply when the National Weather Service issues a Weather Advisory and the Contractor speaks to the employee at least four hours before his/her shift starting time. See Article 12, Section 6.

To the extent that the terms of the PLA conflict with any other terms of the invitation for bids, including the Standard Construction Contract, the terms of the PLA shall govern. Where, however, the invitation for bids, including the Standard Construction Contract, requires the approval of the City/Department, the PLA does not supersede or eliminate that requirement.

In addition to the various provisions regarding work rules, Contractors should take special note of the requirement that Contractors and Subcontractors make payments to designated employee benefit funds. See PLA Article 11, Section 2. The PLA also contains provisions for what occurs when a Contractor or a subcontractor fails to make required payments into the benefit funds, including potentially the direct payment by the City to the benefit fund of monies owed and corresponding withholding of payments to the Contractor. See PLA Article 11, Section 2. The City strongly advises Contractors to read these provisions carefully and to include appropriate provisions in subcontracts addressing these possibilities.

This Contract is subject to the apprenticeship requirements of Labor Law §222 and to apprenticeship requirements established by the Department pursuant to Labor Law §816-b. Please be advised that the involved trades have apprenticeship programs that meet the statutory requirements of Labor Law 222(e) and the requirements set by the Department pursuant to Labor Law §816-b, Contractors and subcontractors who agree to perform the Work pursuant to the PLA are participating in such apprenticeship programs within the meaning of Labor Law §222(e) and the Department's directive.

If this Contract is subject to the Minority-Owned and Women-Owned Business Enterprise ("M/WBE") program implemented pursuant to New York City Administrative Code §6-129, the specific requirements of M/WBE participation for this Contract are set forth in Schedule B entitled the "Subcontractor Utilization Plan," and are detailed in a separate Notice to Prospective Contractors included with this bid package. If such requirements are included with this Contract, the City strongly advises Contractors to read those provisions, as well as PLA Article 4, Section 2(C), carefully. A list of certified M/WBE firms may be obtained from the Department of Small Business Services (DSBS) website at [www.nyc.gov/getcertified](http://www.nyc.gov/getcertified), by emailing DSBS at [MWBE@sbs.nyc.gov](mailto:MWBE@sbs.nyc.gov), by calling the DSBS certification hotline at (212) 513-6311, or by visiting or writing DSBS at 110 William St., 7<sup>th</sup> floor, New York, New York, 10038.

The local collective bargaining agreements (CBAs) that are incorporated into the PLA as PLA Schedule A Agreements are available on computer disk from the Department's Contract Officer upon the request of any prospective bidder. Please note that the "PLA Schedule A" is distinct from the Department's Schedule A that is a part of this invitation for bids.

A contact list for the participating unions is set forth after the FAQs.

Below are answers to frequently asked questions (FAQs) about this PLA:

1. **Q.** Does a Contractor need to be signatory with the unions in the NYC Building and Construction Trades Council in order to bid on projects under the PLA?

- A. No, any contractor may bid by signing and agreeing to the terms of the PLA. The contractor need not be signatory with these unions by any other labor agreement or for any other project.
2. Q. Does a Contractor agreeing to the PLA and signing the Letter of Assent create a labor agreement with these unions outside of the project covered by the PLA?
- A. No, the PLA applies only to those projects that the Contractor agrees to perform under the PLA and makes no labor agreement beyond those projects.
3. Q. Do the provisions of the PLA apply equally to subcontractors as well as contractors and how does the PLA affect the subcontractors that a bidder may utilize on the project?
- A. Yes, the PLA applies to subcontractors and all subcontractors must agree to become party to the PLA. See PLA Art. 2, Sec. 8. Subject to the Department's approval of subcontractors pursuant to Article 17 of the Standard Construction Contract, a Contractor may use any subcontractor, union or non-union, as long as the subcontractor signs and agrees to the terms of the PLA.
4. Q. Are bidders required to submit Letters of Assent signed by proposed subcontractors with their bid in order to be found responsive?
- A. No, bidders do not have to submit signed Letters of Assent from their subcontractors with their bid. Subcontractors, however, will be required to sign the Letter of Assent prior to being approved by the Department.
5. Q. May a Contractor or subcontractor use any of its existing employees to perform this work?
- A. Generally labor will be referred to the Contractor from the respective signatory local unions. See PLA Article 4. However, Contractors and subcontractors may continue to use up to 12% of their existing, qualifying labor force for this work, in accordance with the terms of PLA Article 4, Section 2B.
6. Q. Must the City set M/WBE participation goals for the particular project or contract in order for a certified M/WBE to utilize the provisions of PLA Article 4, Section 2C?
- A. No. PLA Article 4, Section 2(C) specifies what categories of M/WBEs are eligible to take advantage of this provision (i.e., those M/WBEs for which the City is authorized to set participation goals under §6-129). For purposes of section 2(C), it is not necessary for the project to be subject to §6-129 or for the City to have actually set participation goals for the particular contract or project. The result is the same where a project receives State funding and therefore is subject to the requirements of Article 15-A of the Executive Law.
7. Q. May a Contractor bring in union members from locals that are not signatory unions?
- A. Referrals will be from the respective signatory locals and/or locals listed in Schedule A of the PLA. Contractors may utilize 'traveler provisions' contained in the

local collective bargaining agreements (local CBAs) where such provisions exist and/or in accordance with the provisions of PLA Article 4, Section 2.

8. **Q.** Does a non-union employee working under the PLA automatically become a union member?

**A.** No, the non-union employee does not automatically become a union member by working on a project covered by the PLA. Non-union employees working under the PLA are subject to the union security provisions (i.e., union dues/agency shop fees) of the local CBAs while on the project. These employees will be enrolled in the appropriate benefit plans and earn credit toward various union benefit programs except in certain circumstances as set forth in the PLA. See PLA Article 4, Section 6 and Article 11.

9. **Q.** When will the agency shop dues payer affiliate workers become eligible for union benefits?

**A.** Union benefit plans have their own plan documents that determine eligibility and workers will become eligible for certain benefits at different points in time. Contractors who will have agency shop dues payer affiliate workers should speak with the respective union(s) as to benefit eligibility thresholds.

10. **Q.** Are all Contractors and subcontractors working under the PLA, including non-union Contractors and Contractors signatory to collective bargaining agreements with locals other than those that are signatories to the PLA, required to make contributions to designated employee benefit funds?

**A.** Except in certain circumstances, as described in the following paragraph, Contractors and subcontractors working under the PLA will be required to contribute on behalf of all employees covered by the PLA to established jointly trustee employee benefit funds designated in the Schedule A CBAs and required to be paid on public works under any applicable prevailing wage law. See PLA Article 11, Section 2. The Agency may withhold from amounts due to the Contractor any amounts required to be paid, but not actually paid into any such fund by the Contractor or a subcontractor. See PLA Article 11, Section 2 D.

Non-union Contractors with bona fide private benefit plans that satisfy the requirements of Labor Law 220 will not be required to pay into union benefit funds for their employees working pursuant to Article 4, Section 2 (B) and (C) ("core" employees) who are already covered under their bona fide private benefit plans. Supplemental benefit funds in excess of the annualized value of the private benefit plans will be paid to workers as additional wages in compliance with Labor Law 220. At the time of contract award, the Contractor shall make available to the contracting Agency a complete set of plan documents for each private benefit plan into which contributions will be made and/or coverage provided. The Contractor shall also provide certification from a certified public accountant as to the annualized hourly value of such benefits consistent with the requirements of Section 220. See PLA Article 11, Section 2.

11. **Q.** What happens if a Contractor or subcontractor fails to make a required payment to a designated employee benefit fund?

A. The PLA sets forth a process for unions to address a contractor or a subcontractor's failure to make required payments. The process includes potentially the direct payment by the City to the benefit fund of monies owed and the corresponding withholding of payments to the Contractor. See PLA Article 11, Section 2.

Upon notification by a union or fringe benefit fund that a Contractor is delinquent in its payment of benefits and a determination by the Agency that the union or fund has submitted appropriate documentation of such delinquency, the Agency will thereafter require the Contractor to submit cancelled checks or other equivalent proof of payment of benefit contributions with certified payroll reports for work covered by this PLA on which the Contractor is engaged.

The City strongly advises Contractors to read these provisions carefully and to include appropriate provisions in subcontracts addressing these possibilities.

12. Q. Does signing on to the PLA satisfy the Apprenticeship Requirements established for this bid?

A. Yes. By agreeing to perform the Work subject to the PLA, the bidder demonstrates compliance with the apprenticeship requirements imposed by this Invitation for Bids.

13. Q. Who decides on the number of workers needed?

A. Except as expressly limited by a specific provision of the PLA, a Contractor retains full and exclusive authority for the management of their operations, including the determination as to the number of employees to be hired and the qualifications thereof and the promotion, transfer, and layoff of its employees. See PLA Article 6, Section 1.

14. Q. May a contractor discharge a union referral for lack of productivity?

A. Again, except as expressly limited by a specific provision of the PLA, a Contractor retains full and exclusive authority for the management of their operations, including the right to discipline or discharge, for just cause, its employees. See PLA Article 6, Section 1.

15. Q. May a contractor assign a management person to site?

A. Yes. Managers are not subject to the provisions of the PLA, so there is no restriction on management and/or other non-trade personnel, as long as such personnel do not perform trade functions. See Article 3, Section 1.

16. Q. Does the PLA provide a standard work day across all the signatory trades?

A. Yes, all signatory trades will work an eight (8) hour day, Monday through Friday with a day shift at straight time as the standard work week.

17. Q. Does the PLA create a common holiday schedule for all the signatory trades?

A. Yes, the PLA recognizes nine (9) common holidays, including Veterans Day. See PLA Article 12, Section 4.

18. Q. May the Contractor schedule overtime work, including work on a weekend?
- A. Yes, the PLA permits the Contractor to schedule overtime work, including work on weekends. See PLA Article 12, Sections 2, 3, and 5. To the extent that the Agency's approval is required before a Contractor may schedule or be paid for overtime, that approval is still required notwithstanding the PLA language.
19. Q. Are overtime payments affected by the PLA?
- A. Yes, all overtime pay incurred Monday through Saturday will be at time and one half (1 ½). There will be no stacking or pyramiding of overtime pay under any circumstances. See PLA Article 12, Section 2. Sunday and holiday overtime will be paid according to each trade's CBA.
20. Q. Are there special provisions for Saturday work when a day is 'lost' during the week due to weather, power failure or other emergency?
- A. Yes, when this occurs the Contractor may schedule Saturday work at weekday rates. See PLA Article 12, Section 5.
21. Q. Does the PLA contain special provisions for the manning of Temporary Services?
- A. Yes. Where temporary services are required by specific request of the Agency or construction manager, they shall be provided by the Contractor's existing employees during working hours in which a shift is scheduled for employees of the Contractor. The need for temporary services during non-working hours will be determined by the Agency or construction manager. There will be no stacking of trades on temporary services. See PLA Article 15.
22. Q. What do the workers get paid when work is terminated early in a day due to inclement weather or otherwise cut short of 8 hours?
- A. The PLA provides that employees who report to work pursuant to regular schedule and not given work will be paid two hours of straight time. Work terminated early for severe weather or emergency conditions will be paid only for time actually worked. In other instances where work is terminated early, the worker will be paid for a full day. See PLA Article 12, Sections 6 and 8. The usual reporting pay requirement of two hours for employees who report to their work location pursuant to their regular schedule does not apply when the National Weather Service issues a Weather Advisory and the Contractor speaks to the employee at least four hours before their shift starting time. See PLA Article 12, Section 6.
23. Q. If a local collective bargaining agreement of a signatory union expires during the project will a work stoppage occur on a project subject to the PLA?
- A. No. All the signatory unions are bound by the 'no strike' agreement as to the PLA work. Work will continue under the PLA and the otherwise expired local CBA(s) until the new local CBA(s) are negotiated and in effect. See PLA Articles 7 and 19.

24. **Q.** May a Contractor working under the PLA be subject to a strike or other boycott activity by a signatory union at another site while the Contractor is a signatory to the PLA?
- A.** Yes. The PLA applies ONLY to work under the PLA and does not regulate labor relations at other sites even if those sites are in close proximity to PLA work.
25. **Q.** If a Contractor has worked under other PLAs in the New York City area, are the provisions in this PLA generally the same as the others?
- A.** While Project Labor Agreements often look similar to each other, and particular clauses are often used in multiple agreements, each PLA is a unique document and should be examined accordingly.
26. **Q.** What happens if a dispute occurs between the Contractor and an employee during the project?
- A.** The PLA contains a grievance and arbitration process to resolve disputes between the Contractor and the employees. See PLA Article 9.
27. **Q.** What happens if there is a dispute between locals as to which local gets to provide employees for a particular project or a particular aspect of a project?
- A.** The PLA provides for jurisdictional disputes to be resolved in accordance with the NY Plan. See PLA Article 10. A copy of the NY Plan is available upon request from the Department. The PLA provides that work is not to be disrupted or interrupted pending the resolution of any jurisdictional dispute. The work proceeds as assigned by the Contractor until the dispute is resolved. See PLA Article 10, Section 3.



**PROJECT LABOR AGREEMENT  
COVERING NEW CONSTRUCTION  
OF IDENTIFIED CITY OWNED  
BUILDINGS AND STRUCTURES**

**2015 - 2018**

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NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

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**PROJECT LABOR AGREEMENT COVERING IDENTIFIED  
NEW CONSTRUCTION OF NEW YORK CITY OWNED  
FACILITIES & STRUCTURES**

**ARTICLE 1 - PREAMBLE**

WHEREAS, the City of New York desires to provide for the cost efficient, safe, quality, and timely completion of certain new construction ("Program Work," as defined in Article 3) in a manner designed to afford the lowest costs to the Agencies covered by this Agreement, and the Public it represents, and the advancement of permissible statutory objectives;

WHEREAS, this Project Labor Agreement will foster the achievement of these goals, inter alia, by:

(1) providing a mechanism for responding to the unique construction needs associated with this Program Work and achieving the most cost effective means of construction, including direct labor cost savings, by the Building and Construction Trades Council of Greater New York and Vicinity and the signatory Local Unions and their members waiving various shift and other hourly premiums and other work and pay practices which would otherwise apply to Program Work;

(2) expediting the construction process and otherwise minimizing the disruption to the covered Agencies' ongoing operations at the facilities that are the subject of the Agreement;

(3) avoiding the costly delays of potential strikes, slowdowns, walkouts, picketing and other disruptions arising from work disputes, reducing jobsite friction on common situs worksites, and promoting labor harmony and peace for the duration of the Program Work;

(4) standardizing the terms and conditions governing the employment of labor on Program Work;

(5) permitting wide flexibility in work scheduling and shift hours and times to allow maximum work to be done during off hours yet at affordable pay rates;

(6) permitting adjustments to work rules and staffing requirements from those which otherwise might obtain;

(7) providing comprehensive and standardized mechanisms for the settlement of work disputes, including those relating to jurisdiction;

(8) ensuring a reliable source of skilled and experienced labor; and

(9) securing applicable New York State Labor Law exemptions.

WHEREAS, the Building and Construction Trades Council of Greater New York and Vicinity, its participating affiliated Local Unions and their members, desire to assist the City in meeting these operational needs and objectives as well as to provide for stability, security and work opportunities which are afforded by this Project Labor Agreement; and

WHEREAS, the Parties desire to maximize Program Work safety conditions for both workers and the community in the project area.

NOW, THEREFORE, the Parties enter into this Agreement:

## **SECTION 1. PARTIES TO THE AGREEMENT**

This is a Project Labor Agreement ("Agreement") entered into by the City of New York, acting through the Department of Design and Construction, on behalf of itself and the Agencies covered herein, including in their capacity as construction manager of covered projects and/or on behalf of any third party construction manager which may be utilized, and the Building and Construction Trades Council of Greater New York and Vicinity ("Council") (on behalf of itself) and the signatory affiliated Local Union's ("Unions" or "Local Unions"). The Council and each signatory Local Union hereby warrants and represents that it has been duly authorized to enter into this Agreement.



## **ARTICLE 2 - GENERAL CONDITIONS**

### **SECTION 1. DEFINITIONS**

Throughout this Agreement, the various Union parties including the Building and Construction Trades Council of Greater New York and Vicinity and its participating affiliated Local Unions, are referred to singularly and collectively as "Union(s)" or "Local Unions"; the term "Contractor(s)" shall include any Construction Manager, General Contractor and all other contractors, and subcontractors of all tiers engaged in Program Work within the scope of this Agreement as defined in Article 3; "Agency" means means the New York City Department of Design and Construction (DDC) or such other City agency that executes an addendum pursuant to Article 3, Section 1 of this Agreement; the New York City Agency that awards a particular contract subject to this Agreement may be referred to hereafter as the "Agency"; when an Agency acts as Construction Manager, unless otherwise provided, it has the rights and obligations of a "Construction Manager" in addition to the rights and obligations of an Agency; the Building and Construction Trades Council of Greater New York and Vicinity is referred to as the ["BCTC" or "Council"]; and the work covered by this Agreement (as defined in Article 3) is referred to as "Program Work."

### **SECTION 2. CONDITIONS FOR AGREEMENT TO BECOME EFFECTIVE**

This Agreement shall not become effective unless each of the following conditions are met: the Agreement is executed by (1) the Council, on behalf of itself, (2) the participating affiliated Local Unions; and (3) the Commissioner of the Department of Design and Construction or his designee.

### **SECTION 3. ENTITIES BOUND & ADMINISTRATION OF AGREEMENT**

This Agreement shall be binding on all participating Unions and their affiliates, the Construction Manager (in its capacity as such) and all Contractors of all tiers performing Program Work, as defined in Article 3. The Contractors shall include in any subcontract that they let for performance during the term of this Agreement a requirement that their subcontractors, of all tiers, become signatory and bound by this Agreement with respect to that subcontracted work falling within the scope of Article 3 and all Contractors (including subcontractors) performing Program Work shall be required to sign a "Letter of Assent" in the form annexed hereto as Exhibit "A". This Agreement shall be administered by the applicable Agency or a Construction Manager or such other designee as may be named by the Agency or Construction Manager, on behalf of all Contractors.

### **SECTION 4. SUPREMACY CLAUSE**

This Agreement, together with the local Collective Bargaining Agreements appended hereto as Schedule A, represents the complete understanding of all signatories and supersedes any national agreement, local agreement or other collective bargaining agreement of any type which would otherwise apply to this Program Work, in whole or in part, except that Program Work which falls within the jurisdiction of the Operating Engineers Locals 14 and 15 will be performed under the terms and conditions set out in the Schedule A agreements of Operating Engineers Locals 14 and 15. The Collective Bargaining Agreements of the affiliated local unions that cover the particular type of construction work to be performed by the contractor, and as set forth in the Schedule A list of Agreements, shall be deemed the Schedule A Collective Bargaining Agreements ("Schedule A CBA") under this Agreement. Where association and independent

Collective Bargaining Agreements for a particular type of construction work are both set forth in Schedule A, association members shall treat the applicable association agreement as the Schedule A CBA and independent contractors shall treat the applicable independent agreement as the Schedule A CBA. Subject to the foregoing, where a subject covered by the provisions of this Agreement is also covered by a Schedule A Collective Bargaining Agreement, the provisions of this Agreement shall prevail. It is further understood that no Contractor shall be required to sign any other agreement as a condition of performing Program Work. No practice, understanding or agreement between a Contractor and a Local Union which is not set forth in this Agreement shall be binding on this Program Work unless endorsed in writing by the Construction Manager or such other designee as may be designated by the Agency.

#### **SECTION 5. LIABILITY**

The liability of any Contractor and the liability of any Union under this Agreement shall be several and not joint. The Construction Manager and any Contractor shall not be liable for any violations of this Agreement by any other Contractor; and the Council and Local Unions shall not be liable for any violations of this Agreement by any other Union.

#### **SECTION 6. THE AGENCY**

The Agency (or Construction Manager where applicable) shall require in its bid specifications for all Program Work within the scope of Article 3 that all successful bidders, and their subcontractors of all tiers, become bound by, and signatory to, this Agreement. The Agency (or Construction Manager) shall not be liable for any violation of

this Agreement by any Contractor. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of the Agency or Construction Manager in determining which Contractors shall be awarded contracts for Program Work. It is further understood that the Agency or Construction Manager has sole discretion at any time to terminate, delay or suspend the Program Work, in whole or part, on any Program.

#### **SECTION 7. AVAILABILITY AND APPLICABILITY TO ALL SUCCESSFUL BIDDERS**

The Unions agree that this Agreement will be made available to, and will fully apply to, any successful bidder for (or subcontractor of) Program Work who becomes signatory thereto, without regard to whether that successful bidder (or subcontractor) performs work at other sites on either a union or non-union basis and without regard to whether employees of such successful bidder (or subcontractor) are, or are not, members of any unions. This Agreement shall not apply to the work of any Contractor which is performed at any location other than the site of Program Work.

#### **SECTION 8. SUBCONTRACTING**

Contractors will subcontract Program Work only to a person, firm or corporation who is or agrees to become party to this Agreement.

### **ARTICLE 3-SCOPE OF THE AGREEMENT**

#### **SECTION 1. WORK COVERED**

Program Work shall be limited to construction contracts bid and let by the Agency (or its Construction Manager where applicable) after the effective date of this Agreement (and prior to December 31, 2018) for that new construction on any Project for which an

addendum has been issued pursuant to the provisions set forth below. Additional Projects may be added to this Agreement through a Project specific Addendum approved by an agency of the City of New York and by the BCTC on behalf of itself and its affiliated Local Unions. Each Project specific addendum is to outline and include a description of the project being undertaken, the project's location, and the general findings of the Feasibility Analysis used as the basis of the determination to utilize a PLA on the project.

It is understood that, except where the City specifically applies this Project Labor Agreement to such work in its bid documents, Program Work does not include, and this Project Labor Agreement shall not apply to, any other work, including:

1. Contracts let and work performed under contracts bid prior to the effective date of this Agreement and all contracts let after December 31, 2018;
2. Contracts procured on an emergency basis;
3. Contracts that do not exceed \$250,000;
4. Contracts with electric utilities, gas utilities, telephone companies, and railroads, except that it is understood and agreed that these entities may only install their work to a demarcation point, e.g. a telephone closet or utility vault, the location of which is determined prior to construction and employees of such entities shall not be used to replace employees performing Program Work pursuant to this agreement;
5. Contracts for installation of information technology that are not otherwise Program Work; and
6. Contracts that do not exceed \$1 Million that are awarded pursuant to

prequalified lists (PQLs) established by City agencies where entry on to the PQL is restricted to MWBEs, or a combination of MWBEs together with joint ventures which include at least one MWBE, or contractors who agree to subcontract at least 50% of the contract to MWBEs.

## **SECTION 2. TIME LIMITATIONS**

In addition to falling within the scope of Article 3, Section 1, to be covered by this Agreement Program Work must be (1) advertised and let for bid after the effective date of this Agreement, and (2) let for bid prior to December 31, 2018, the expiration date of this Agreement. It is understood that this Agreement, together with all of its provisions, shall remain in effect for all such Program Work until completion, even if not completed by the expiration date of the Agreement. If Program Work otherwise falling within the scope of Article 3, Section 1 is not let for bid by the expiration date of this Agreement, this Agreement may be extended to that work by mutual agreement of the parties.

## **SECTION 3. EXCLUDED EMPLOYEES**

The following persons are not subject to the provisions of this Agreement, even though performing Program Work:

A. Superintendents, supervisors (excluding general and forepersons specifically covered by a craft's Schedule A), engineers, professional engineers and/or licensed architects engaged in inspection and testing, quality control/assurance personnel, timekeepers, mail carriers, clerks, office workers, messengers, guards, technicians, non-manual employees, and all professional, engineering, administrative and management persons;

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

B. Employees of the Agency, New York City, or any other municipal or State agency, authority or entity, or employees of any other public employer, even though working on the Program site while covered Program Work is underway;

C. Employees and entities engaged in off-site manufacture, modifications, repair, maintenance, assembly, painting, handling or fabrication of project components, materials, equipment or machinery or involved in deliveries to and from the Program site, except to the extent they are lawfully included in the bargaining unit of a Schedule A agreement;

D. Employees of the Construction Manager (except that in the event the Agency engages a Contractor to serve as Construction Manager, then those employees of the Construction Manager performing manual, on site construction labor will be covered by this Agreement);

E. Employees engaged in on-site equipment warranty work unless employees are already working on the site and are certified to perform warranty work;

F. Employees engaged in geophysical testing other than boring for core samples;

G. Employees engaged in laboratory, specialty testing, or inspections, pursuant to a professional services agreement between the Agency, or any of the Agency's other professional consultants, and such laboratory, testing, inspection or surveying firm; and

H. Employees engaged in on-site maintenance of installed equipment or systems which maintenance is awarded as part of a contract that includes Program Work

but which maintenance occurs after installation of such equipment or system and is not directly related to construction services.

#### **SECTION 4. NON-APPLICATION TO CERTAIN ENTITIES**

This Agreement shall not apply to those parents, affiliates, subsidiaries, or other joint or sole ventures of any Contractor which do not perform Program Work. It is agreed that this Agreement does not have the effect of creating any joint employment, single employer or alter ego status among the Agency (including in its capacity as Construction Manager) or any Contractor. The Agreement shall further not apply to any New York City or other municipal or State agency, authority, or entity other than a listed Agency and nothing contained herein shall be construed to prohibit or restrict the Agency or its employees, or any State, New York City or other municipal or State authority, agency or entity and its employees, from performing on or off-site work related to Program Work.

As the contracts involving Program Work are completed and accepted, the Agreement shall not have further force or effect on such items or areas except where inspections, additions, repairs, modifications, check-out and/or warranty work are assigned in writing (copy to Local Union involved) by the Agency (or Construction Manager) for performance under the terms of this Agreement.

#### **ARTICLE 4- UNION RECOGNITION AND EMPLOYMENT**

##### **SECTION 1. PRE-HIRE RECOGNITION**

The Contractors recognize the signatory Unions as the sole and exclusive bargaining representatives of all employees who are performing on-site Program Work, with respect to that work.



## SECTION 2. UNION REFERRAL

A. The Contractors agree to employ and hire craft employees for Program Work covered by this Agreement through the job referral systems and hiring halls established in the Local Unions' area collective bargaining agreements. Notwithstanding this, Contractors shall have sole right to determine the competency of all referrals; to determine the number of employees required; to select employees for layoff (subject to Article 5, Section 3); and the sole right to reject any applicant referred by a Local Union, subject to the show-up payments. In the event that a Local Union is unable to fill any request for qualified employees within a 48 hour period after such requisition is made by a Contractor (Saturdays, Sundays and holidays excepted), a Contractor may employ qualified applicants from any other available source. In the event that the Local Union does not have a job referral system, the Contractor shall give the Local Union first preference to refer applicants, subject to the other provisions of this Article. The Contractor shall notify the Local Union of craft employees hired for Program Work within its jurisdiction from any source other than referral by the Union.

B. A Contractor may request by name, and the Local will honor, referral of persons who have applied to the Local for Program Work and who meet the following qualifications:

- (1) possess any license required by New York State law for the Program Work to be performed;
- (2) have worked a total of at least 1000 hours in the Construction field during the prior 3 years; and
- (3) were on the Contractor's active payroll for at least 60 out of the 180 calendar days prior to the contract award.

No more than twelve per centum (12%) of the employees covered by this Agreement, per Contractor by craft, shall be hired through the special provisions above. Under this provision, name referrals begin with the eighth employee needed and continue on that same basis.

C. Notwithstanding Section 2(B), above, certified MWBE contractors for which participation goals are set forth in New York City Administrative Code §6-129, that are not signatory to any Schedule A CBAs, with contracts valued at or under five hundred thousand (\$500,000), may request by name, and the Local will honor, referral of the second (2<sup>nd</sup>), fourth (4<sup>th</sup>), sixth (6<sup>th</sup>), and eighth (8<sup>th</sup>) employee, who have applied to the Local for Program Work and who meet the following qualifications:

- (1) possess any license required by New York State law for the Program Work to be performed;
- (2) have worked a total of at least 1000 hours in the Construction field during the prior 3 years; and
- (3) were on the Contractor's active payroll for at least 60 out of the 180 work days prior to the contract award.

For such contracts valued at above \$500,000 but less than \$1 million, the Local will honor referrals by name of the second (2<sup>nd</sup>), fifth (5<sup>th</sup>), and eighth (8<sup>th</sup>) employee subject to the foregoing requirements. In both cases, name referrals will thereafter be in accordance with Section 2(B), above.

D. Where a certified MWBE Contractor voluntarily enters into a Collective Bargaining Agreement ("CBA") with a BCTC Union, the employees of such Contractor at the time the CBA is executed shall be allowed to join the Union for the

applicable trade subject to satisfying the Union's basic standards of proficiency for admission.

### **SECTION 3. NON-DISCRIMINATION IN REFERRALS**

The Council represents that each Local Union hiring hall and referral system will be operated in a non-discriminatory manner and in full compliance with all applicable federal, state and local laws and regulations which require equal employment opportunities. Referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements and shall be subject to such other conditions as are established in this Article. No employment applicant shall be discriminated against by any referral system or hiring hall because of the applicant's union membership, or lack thereof.

### **SECTION 4: MINORITY, FEMALE, LOCAL AND SECTION 3 REFERRALS**

In the event a Local Union either fails, or is unable to refer qualified minority or female applicants in percentages equaling the workforce participation goals adopted by the City and set forth in the Agency's (or, if applicable, Construction Manager's) bid specifications, within 48 hours of the request for same, the Contractor may employ qualified minority or female applicants from any other available source.

In the event that the City or a City agency determines to adopt local workforce participation goals to be set forth in an Agency's (or, if applicable Construction Manager's) bid specifications, the City and BCTC will work together to seek agreement on appropriate goals to be set forth in applicable bid documents and to be subject to the provisions of this section.

For any Program Work that may become subject to requirements under Section 3 of the Housing and Urban Development Act of 1968, as amended by the Housing and Community Development Act of 1992, and any rules, including new or revised rules, that may be published thereunder, the Local Unions will acknowledge the Section 3 obligations of the Construction Manager or Contractor, as applicable, and agree to negotiate a method to implement this Article in a manner that would allow the Construction Manager or Contractor to meet its Section 3 obligations to the greatest extent feasible, and to post any required notices in the manner required by Section 3. The parties also acknowledge that the Construction Manager and Contractor may also fulfill its Section 3 requirements on Program Work by promoting opportunities for excluded employees, as defined by Article 3, Section 3 of this Agreement, on Program Work and, to the extent permitted by Section 3, by promoting opportunities for craft and other employees on non-Program Work.

#### **SECTION 5. CROSS AND QUALIFIED REFERRALS**

The Local Unions shall not knowingly refer to a Contractor an employee then employed by another Contractor working under this Agreement. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled and qualified crafts employees to fulfill the requirements of the Contractor.

#### **SECTION 6. UNION DUES**

All employees covered by this Agreement shall be subject to the union security provisions contained in the applicable Schedule A local agreements, as amended from time to time, but only for the period of time during which they are performing on-site Program Work and only to the extent of tendering payment of the applicable union dues

and assessments uniformly required for union membership in the Local Unions which represent the craft in which the employee is performing Program Work. No employee shall be discriminated against at any Program Work site because of the employee's union membership or lack thereof. In the case of unaffiliated employees, the dues payment will be received by the Local Unions as an agency shop fee.

#### **SECTION 7. CRAFT FOREPERSONS AND GENERAL FOREPERSONS**

The selection of craft forepersons and/or general forepersons and the number of forepersons required shall be solely the responsibility of the Contractor except where otherwise provided by specific provisions of an applicable Schedule A, and provided that all craft forepersons shall be experienced and qualified journeypersons in their trade as determined by the appropriate Local Union. All forepersons shall take orders exclusively from the designated Contractor representatives. Craft forepersons shall be designated as working forepersons at the request of the Contractor, except when an existing local Collective Bargaining Agreement prohibits a foreperson from working when the craft persons he is leading exceed a specified number.

#### **SECTION 8. ON CALL REPAIR REFERRALS**

A. When an Agency awards a contract that requires the Contractor to have employees available on short notice to make time sensitive repairs with such contract requiring the Contractor to respond within as little as two hours from the time the Contractor is contacted by the Agency ("On Call, Repair Contract"), the Contractor will, within ten (10) days of being awarded an On Call Repair Contract subject to this agreement, notify the appropriate affiliated Union that it has been awarded such a contract

and immediately enter into good faith negotiations with such relevant affiliated Union to establish a procedure to receive time sensitive referrals from such affiliated Union(s).

B. In the event the Contractor and the relevant affiliated Union(s) are unable to negotiate a specific, mutually agreeable procedure for on call repair referral procedure within twenty (20) days of commencement of negotiations or prior to commencement of performance of the contract, whichever is earlier, the Contractor and the relevant affiliated Unions will follow the following procedure:

1. Upon notification by a Contractor that it has been awarded an On Call Repair Contract pursuant to paragraph A above, each relevant affiliate Union shall provide the Contractor with the name and twenty four (24) hour contact information of an On Call, Repair Contract contact person for urgent on call repair referrals.

2. The relevant affiliated Unions shall prepare a list of individuals eligible and prepared for referral on an immediate basis to respond to the on call repair contractor. Such list shall be provided to and in the possession of the designated on call repair contact person for the affiliated Union and available for immediate reference.

3. Individuals on such list must be able to comply with the Contractor's response time pursuant to contract requirements.

4. The Union's On Call, Repair Contract contact person shall respond to a contractor's request for referrals within a reasonable time of the request so that compliance with the contract shall be possible.

C. In the event that the Contractor makes a request for an on call referral that is compliant with this procedure and a Union is not able to respond to the

request, that Union will be deemed to have waived the forty-eight (48) hour referral rule contained in Section 2 above and the Contractor may employ qualified applicants from any other available source that can meet contract requirements for that time sensitive on call repair work only; provided, however, that any work related to the repair work that is not of a time sensitive nature under the contract shall comply with Section 2. If a Union fails to timely refer a worker and the Contractor employs other workers, the Contractor will e-mail the agency within 72 hours and the agency will forward that e-mail to the designated Labor Management Committee contacts.

## **ARTICLE 5- UNION REPRESENTATION**

### **SECTION 1. LOCAL UNION REPRESENTATIVE**

Each Local Union representing on-site employees shall be entitled to designate in writing (copy to Contractor involved and Construction Manager) one representative, and/or the Business Manager, who shall be afforded access to the Program Work site during such time as bargaining unit work is occurring and subject to otherwise applicable policies pertaining to visitors to the site.

### **SECTION 2. STEWARDS**

A. Each Affiliated Union shall have the sole discretion to designate any journey person as a Steward and an alternate Steward. The Union shall notify the Owner and/or Construction Manager as well as the Contractor of the identity of the designated Steward (and alternate) prior to the assumption of such duties. Stewards shall not exercise supervisory functions and will receive the regular rate of pay for their craft classifications. All Stewards shall be working Stewards.

B. In addition to their work as an employee, the Steward shall have the right to receive complaints or grievances and to discuss and assist in their adjustment with the Contractor's appropriate supervisor. Each Steward shall be concerned with the employees of the Steward's trade and, if applicable, subcontractors of their Contractor, but not with the employees of any other trade Contractor. No Contractor shall discriminate against the Steward in the proper performance of Union duties.

C. The Stewards shall not have the right to determine when overtime shall be worked, or who shall work overtime except pursuant to a Schedule A provision providing procedures for the equitable distribution of overtime.

### **SECTION 3. LAYOFF OF A STEWARD**

Contractors agree to notify the appropriate Union 24 hours prior to the layoff of a Steward, except in cases of discipline or discharge for just cause. If a Steward is protected against layoff by a Schedule A provision, such provision shall be recognized to the extent the Steward possesses the necessary qualifications to perform the work required. In any case in which a Steward is discharged or disciplined for just cause, the Local Union involved shall be notified immediately by the Contractor.

## **ARTICLE 6- MANAGEMENT'S RIGHTS**

### **SECTION 1. RESERVATION OF RIGHTS**

Except as expressly limited by a specific provision of this Agreement, Contractors retain full and exclusive authority for the management of their operations including, but not limited to, the right to: direct the work force, including determination as to the number of employees to be hired and the qualifications therefore; the promotion,



transfer, layoff of its employees; require compliance with the directives of the Agency including standard restrictions related to security and access to the site that are equally applicable to Agency employees, guests, or vendors; or the discipline or discharge for just cause of its employees; assign and schedule work; promulgate reasonable Program Work rules that are not inconsistent with this Agreement or rules common in the industry and are reasonably related to the nature of work; and, the requirement, timing and number of employees to be utilized for overtime work. No rules, customs, or practices which limit or restrict productivity or efficiency of the individual, as determined by the Contractor, Agency and/or Construction Manager and/or joint working efforts with other employees shall be permitted or observed.

## **SECTION 2. MATERIALS, METHODS & EQUIPMENT**

There shall be no limitation or restriction upon the Contractor's choice of materials, techniques, methods, technology or design, or, regardless of source or location, upon the use and installation of equipment, machinery, package units, pre-cast, pre-fabricated, pre-finished, or pre-assembled materials or products, tools, or other labor-saving devices. Contractors may, without restriction, install or use materials, supplies or equipment regardless of their source; provided, however, that where there is a Schedule "A" that includes a lawful union standards and practices clauses, then such clause as set forth in Schedule A Agreements will be complied with, unless there is a lawful Agency specification (or specification issued by a Construction Manager which would be lawful if issued by the Agency directly) that would specifically limit or restrict the Contractor's choice of materials, techniques, methods, technology or design, or, regardless of source or location, upon the use and installation of equipment, machinery, package

units, pre-cast, pre-fabricated, pre-finished, or pre-assembled materials or products, tools, or other labor-saving devices, and which would prevent compliance with such Schedule A clause. The on-site installation or application of such items shall be performed by the craft having jurisdiction over such work; provided, however, it is recognized that other personnel having special qualifications may participate, in a supervisory capacity, in the installation, check-off or testing of specialized or unusual equipment or facilities as designated by the Contractor. There shall be no restrictions as to work which is performed off-site for Program Work.

## **ARTICLE 7- WORK STOPPAGES AND LOCKOUTS**

### **SECTION 1. NO STRIKES-NO LOCK OUT**

There shall be no strikes, sympathy strikes, picketing, work stoppages, slowdowns, hand billing, demonstrations or other disruptive activity at the Program Work site for any reason by any Union or employee against any Contractor or employer. There shall be no other Union, or concerted or employee activity which disrupts or interferes with the operation of the Program Work or the objectives of the Agency at any Program Work site. In addition, failure of any Union or employee to cross any picket line established by any Union, signatory or non-signatory to this Agreement, or the picket or demonstration line of any other organization, at or in proximity to a Program Work site where the failure to cross disrupts or interferes with the operation of Program Work is a violation of this Article. Should any employees breach this provision, the Unions will use their best efforts to try to immediately end that breach and return all employees to work. There shall be no lockout at a Program Work site by any signatory Contractor, Agency or Construction Manager.

## **SECTION 2. DISCHARGE FOR VIOLATION**

A Contractor may discharge any employee violating Section 1, above, and any such employee will not be eligible thereafter for referral under this Agreement for a period of 100 days.

## **SECTION 3. NOTIFICATION**

If a Contractor contends that any Union has violated this Article, it will notify the Local Union involved advising of such fact, with copies of the notification to the Council. The Local Union shall instruct and order, the Council shall request, and each shall otherwise use their best efforts to cause, the employees (and where necessary the Council shall use its best efforts to cause the Local Union), to immediately cease and desist from any violation of this Article. If the Council complies with these obligations it shall not be liable for the unauthorized acts of a Local Union or its members. Similarly, a Local Union and its members will not be liable for any unauthorized acts of the Council. Failure of a Contractor or the Construction Manager to give any notification set forth in this Article shall not excuse any violation of Section 1 of this Article.

## **SECTION 4. EXPEDITED ARBITRATION**

Any Contractor or Union alleging a violation of Section 1 of this Article may utilize the expedited procedure set forth below (in lieu of, or in addition to, any actions at law or equity) that may be brought.

A. A party invoking this procedure shall notify J.J. Pierson or Richard Adelman; who shall alternate (beginning with Arbitrator J.J. Pierson) as Arbitrator under this expedited arbitration procedure. If the Arbitrator next on the list is not available to hear

the matter within 24 hours of notice, the next Arbitrator on the list shall be called. Copies of such notification will be simultaneously sent to the alleged violator and Council.

B. The Arbitrator shall thereupon, after notice as to time and place to the Contractor, the Local Union involved, the Council and the Construction Manager, hold a hearing within 48 hours of receipt of the notice invoking the procedure if it is contended that the violation still exists. The hearing will not, however, be scheduled for less than 24 hours after the notice required by Section 3, above.

C. All notices pursuant to this Article may be provided by telephone, telegraph, hand delivery, or fax, confirmed by overnight delivery, to the Arbitrator, Contractor, Construction Manager and Local Union involved. The hearing may be held on any day including Saturdays or Sundays. The hearing shall be completed in one session, which shall not exceed 8 hours duration (no more than 4 hours being allowed to either side to present their case, and conduct their cross examination) unless otherwise agreed. A failure of any Union or Contractor to attend the hearing shall not delay the hearing of evidence by those present or the issuance of an award by the Arbitrator.

D. The sole issue at the hearing shall be whether a violation of Section 1, above, occurred. If a violation is found to have occurred, the Arbitrator shall issue a Cease and Desist Award restraining such violation and serve copies on the Contractor and Union involved. The Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages (any damages issue is reserved solely for court proceedings, if any.) The Award shall be issued in writing within 3 hours after the close of the hearing, and may be issued without an

Opinion. If any involved party desires an Opinion, one shall be issued within 15 calendar days, but its issuance shall not delay compliance with, or enforcement of, the Award.

E. The Agency and Construction Manager (or such other designee of the Agency) may participate in full in all proceedings under this Article.

F. An Award issued under this procedure may be enforced by any court of competent jurisdiction upon the filing of this Agreement together with the Award. Notice of the filing of such enforcement proceedings shall be given to the Union or Contractor involved, and the Construction Manager.

G. Any rights created by statute or law governing arbitration proceedings which are inconsistent with the procedure set forth in this Article, or which interfere with compliance thereto, are hereby waived by the Contractors and Unions to whom they accrue.

H. The fees and expenses of the Arbitrator shall be equally divided between the involved Contractor and Union.

#### **SECTION 5. ARBITRATION OF DISCHARGES FOR VIOLATION**

Procedures contained in Article 9 shall not be applicable to any alleged violation of this Article, with the single exception that an employee discharged for violation of Section 1, above, may have recourse to the procedures of Article 9 to determine only if the employee did, in fact, violate the provisions of Section 1 of this Article; but not for the purpose of modifying the discipline imposed where a violation is found to have occurred.

**ARTICLE 8 - LABOR MANAGEMENT COMMITTEE**

**SECTION 1. SUBJECTS**

The Program Labor Management Committee will meet on a regular basis to: 1) promote harmonious relations among the Contractors and Unions; 2) enhance safety awareness, cost effectiveness and productivity of construction operations; 3) protect the public interests; 4) discuss matters relating to staffing and scheduling with safety and productivity as considerations; and 5) review efforts to meet applicable participation goals for MWBEs and workforce participation goals for minority and female employees.

**SECTION 2. COMPOSITION**

The Committee shall be jointly chaired by a designee of the Agency and the President of the Council. It may include representatives of the Local Unions and Contractors involved in the issues being discussed. The parties may mutually designate an MWBE representative to participate in appropriate Committee discussions. The Committee may conduct business through mutually agreed upon sub-committees.

**ARTICLE 9- GRIEVANCE & ARBITRATION PROCEDURE**

**SECTION 1. PROCEDURE FOR RESOLUTION OF GRIEVANCES**

Any question, dispute or claim arising out of, or involving the interpretation or application of this Agreement (other than jurisdictional disputes or alleged violations of Article 7, Section 1) shall be considered a grievance and shall be resolved pursuant to the exclusive procedure of the steps described below, provided, in all cases, that the question, dispute or claim arose during the term of this Agreement. Grievances shall include the City contract number and the Program Work address; such information is posted at the Program

Work Site if already commenced, and is available in the City Record and Notice to Proceed for projects not already commenced.

Grievances as to whether a scope of work is included or excluded from this Agreement shall be submitted to the Labor Management Committee (LMC) in the first instance rather than Step 1 below. To be timely, such notice must be given no later than ten days prior to a bid opening if the grievance is challenging a determination by an Agency that the contract is not subject to this Agreement. For other grievances as to contractor scope of work issues, notice of such challenges shall be submitted to the LMC within 7 calendar days after the act, occurrence or event giving rise to the grievance. If the scope of work grievance is not resolved within 21 days of its submission to the LMC, then the grievance may proceed directly to Step 3 below.

**Step 1:**

(a) When any employee covered by this Agreement feels aggrieved by a claimed violation of this Agreement, the employee shall, through the Local Union business representative or job steward give notice of the claimed violation to the work site representative of the involved Contractor and the Construction Manager. To be timely, such notice of the grievance must be given within 7 calendar days after the act, occurrence or event giving rise to the grievance. The business representative of the Local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to adjust the matter within 7 calendar days after timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving party, may, within 7 calendar days thereafter, pursue Step 2 of the grievance procedure by serving the involved Contractor with written copies of the grievance setting forth a description of the

claimed violation, the date on which the grievance occurred, and the provisions of the Agreement alleged to have been violated. Grievances and disputes settled at Step 1 are non-precedential except as to the specific Local Union, employee and Contractor directly involved unless the settlement is accepted in writing by the Construction Manager (or designee) as creating a precedent.

(b) Should any signatory to this Agreement have a dispute (excepting jurisdictional disputes or alleged violations of Article 7, Section 1) with any other signatory to this Agreement and, if after conferring, a settlement is not reached within 7 calendar days, the dispute shall be reduced to writing and proceed to Step 2 in the same manner as outlined in subparagraph (a) for the adjustment of employee grievances.

**Step 2:**

A Step 2 grievance shall be filed with the Agency, the BCTC, the Contractor, and, if the grievance is against a subcontractor, the subcontractor. The Business Manager or designee of the involved Local Union, together with representatives of the involved Contractor, Council the Construction Manager (or designee), and, if the grievance is against a subcontractor, the subcontractor shall meet in Step 2 within 7 calendar days of service of the written grievance to arrive at a satisfactory settlement. The BCTC shall schedule the Step 2 meeting.

**Step 3:**

(a) If the grievance shall have been submitted but not resolved in Step 2, any of the participating Step 2 entities may, within 21 calendar days after the initial Step 2 meeting, submit the grievance in writing (copies to other participants, including the



Construction Manager or designee) to the BCTC. In the event the matter is not resolved at Step 2, either J.J. Pierson or Richard Adelman, who shall act, alternately (beginning with Arbitrator J.J. Pierson), as the Arbitrator under this procedure, shall be designated at the Step 2 hearing and the BCTC will notify the arbitrator of his designation. After such notification by the BCTC, the local demanding arbitration shall within a reasonable time request the arbitrator to schedule the matter for an arbitration hearing date. The Labor Arbitration Rules of the American Arbitration Association shall govern the conduct of the arbitration hearing, at which all Step 2 participants shall be parties. The decision of the Arbitrator shall be final and binding on the involved Contractor, Local Union and employees and the fees and expenses of such arbitrations shall be borne equally by the involved Contractor and Local Union.

(b) Failure of the grieving party to adhere to the time limits set forth in this Article shall render the grievance null and void. These time limits may be extended only by written consent of the Construction Manager (or designee), involved Contractor and involved Local Union at the particular step where the extension is agreed upon. The Arbitrator shall have authority to make decisions only on the issues presented to him and shall not have the authority to change, add to, delete or modify any provision of this Agreement.

## **SECTION 2. LIMITATION AS TO RETROACTIVITY**

No arbitration decision or award, with the exception of those related to compliance with requirements to pay prevailing wages and supplements in accordance with federal or State law, may provide retroactivity of any kind exceeding 60 calendar days

prior to the date of service of the written grievance on the Construction Manager and the involved Contractor or Local Union.

### **SECTION 3. PARTICIPATION BY AGENCY AND/OR CONSTRUCTION MANAGER**

The Agency and Construction Manager (or such other designee of the Agency) shall be notified by the involved Contractor of all actions at Steps 2 and 3 and, at its election, may participate in full in all proceedings at these Steps, including Step 3 arbitration.

## **ARTICLE 10 - JURISDICTIONAL DISPUTES**

### **SECTION 1. NO DISRUPTIONS**

There will be no strikes, sympathy strikes, work stoppages, slowdowns, picketing or other disruptive activity of any kind arising out of any jurisdictional dispute. Pending the resolution of the dispute, the work shall continue uninterrupted and as assigned by the Contractor. No jurisdictional dispute shall excuse a violation of Article 7.

### **SECTION 2. ASSIGNMENT**

All Program Work assignments shall be made by the Contractor to unions affiliated with the BCTC consistent with the New York Plan for the Settlement of Jurisdictional Disputes ("New York Plan") and its Greenbook decisions, if any. Where there are no applicable Greenbook decisions, assignments shall be made in accordance with the provisions of the New York Plan and local industry practice.

### **SECTION 3. NO INTERFERENCE WITH WORK**

There shall be no interference or interruption of any kind with the Program Work while any jurisdictional dispute is being resolved. The work shall proceed as assigned by the Contractor until finally resolved under the applicable procedure of this Article. The award shall be confirmed in writing to the involved parties. There shall be no strike, work stoppage or interruption in protest of any such award.

## **ARTICLE 11 - WAGES AND BENEFITS**

### **SECTION 1. CLASSIFICATION AND BASE HOURLY RATE**

All employees covered by this Agreement shall be classified in accordance with the work performed and paid the hourly wage rates applicable for those classifications as required by the applicable prevailing wage laws.

### **SECTION 2. EMPLOYEE BENEFITS**

A. The Contractors agree to pay on a timely basis contributions on behalf of all employees covered by this Agreement to those established jointly trustee employee benefit funds designated in the applicable Collective Bargaining Agreements in Schedule A (in the appropriate Schedule A amounts), provided that such benefits are required to be paid on public works under any applicable prevailing wage law. Bona fide jointly trustee fringe benefit plans established or negotiated through collective bargaining during the life of this Agreement may be added if similarly required under applicable prevailing wage law. Contractors, not otherwise contractually bound to do so, shall not be required to contribute to benefits, trusts or plans of any kind which are not required by the prevailing wage law provided, however, that this provision does not relieve Contractors

signatory to local collective bargaining agreement with any affiliated union from complying with the fringe benefit requirements for all funds contained in the CBA.

B. 1. Notwithstanding Section 2 (A) above, and subject to 2 (B)(2) below, Contractors who designate employees pursuant to Article 4, Section 2 (B) and (C) ("core" employees) that are not signatory to a Schedule A Agreement and who maintain bona fide private benefit plans that satisfy the requirements of Section 220 of the Labor Law, may satisfy the above benefit obligation with respect to those employees by providing those employees with coverage under their private benefit plans (to the extent consistent with Section 220). The total benefit payments to be made on behalf of each such employee must be equal to the total Section 220 supplement amount and any shortfall must be paid by cash supplement to the employee.

2. A contractor that will satisfy its Section 220 obligations in accordance with subsection 2(B)(1) above shall make available to the Agency at the time of contract award a complete set of plan documents for each non-Schedule A benefit plan into which contributions will be made and/or coverage provided pursuant to the provisions of Section 2(B)(1) above. The Contractor shall also provide certification from a certified public accountant as to the annualized hourly value of such benefits consistent with the requirements of Section 220.

3. The City shall verify that the alternate benefit plan(s), together with any cash supplement to the employee, is compliant with Section 220 prior to awarding the Contractor a contract covered by this Agreement. In the event the Contractor's alternate benefit plan(s), together with any cash supplement to the employee, is determined to be

compliant with Section 220 and will be utilized by the Contractor on behalf of Article 4, Section 2(B) and (C) core employees, the Local Unions have no duty to enforce the Contractor's obligations on the alternate benefit plan(s) as they are not party to the alternate plan(s) or privy to the terms and conditions of the plan obligations. In the event the City determines the alternate benefit plan(s), together with any cash supplement to the employee, is not compliant with Section 220, the Contractor may, upon executing a Letter of Assent, satisfy its obligations for all employees, including core employees, by contributing to the Schedule A benefit plans in accordance with the terms of the Schedule A Agreements.

C. The Contractors agree to be bound by the written terms of the legally established jointly trustee Trust Agreements specifying the detailed basis on which payments are to be paid into, and benefits paid out of, such Trust Funds but only with regard to Program Work done under this Agreement and only for those employees to whom this Agreement requires such benefit payments.

D. 1. To the extent consistent with New York City's Procurement Policy Board Rules with respect to prompt payment, as published at [www.nyc.gov/ppb](http://www.nyc.gov/ppb), §4-06(e), and in consideration of the unions' waiver of their rights to withhold labor from a contractor or subcontractor delinquent in the payment of fringe benefits contributions ("Delinquent Contractor"); the Agency agrees that where any such union and/or fringe benefit fund shall notify the Agency, the General Contractor, and the Delinquent Contractor in writing with back-up documentation that the Delinquent Contractor has

failed to make fringe benefit contributions to it as provided herein and the Delinquent Contractor shall fail, within ten (10) calendar days after receipt of such notice, to furnish either proof of such payment or notice that the amount claimed by the union and/or fringe benefit fund is in dispute, the Agency shall withhold from amounts then or thereafter becoming due and payable to the General Contractor an amount equal to that portion of such payment due to the General Contractor that relates solely to the work performed by the Delinquent Contractor which the union or fringe benefit fund claims to be due it, and shall remit the amount when and so withheld to the fringe benefit fund and deduct such payment from the amounts then otherwise due and payable to the General Contractor, which payment shall, as between the General Contractor and the Agency, be deemed a payment by the Agency to the General Contractor; provided however, that in any month, such withholding shall not exceed the amount contained in the General Contractor's monthly invoice for work performed by the Delinquent Contractor. The union or its employee benefit funds shall include in its notification of delinquent payment of fringe benefits only such amount it asserts the Delinquent Contractor failed to pay on the specific project against which the claim is made and the union or its employee benefit funds may not include in such notification any amount such Delinquent Contractor may have failed to pay on any other City or non-City project.

2. In addition, where a union or employee benefit fund gives notice to the City that a Contractor is Delinquent as defined in subsection 2(D)(1) above and the City determines that the notice includes appropriate back-up documentation that the Contractor is delinquent, the City will promptly, but not later than twenty (20) days after receipt of the

notice, provide a copy of said notice to City Agencies. In the event the City determines there is insufficient back-up documentation, it will notify the appropriate union and/or fringe benefit fund promptly, but not later than twenty (20) days after receipt of the Delinquency Notice, and shall include notice of what additional documentation is requested. Any determination by the City that there is insufficient back-up must be reasonable. This provision is intended to enhance compliance with the prevailing wage law and the PLA with respect to the payment of fringe benefits, and is not intended as a substitute for the resolution of a disputed claim pursuant to any applicable law or agreement.

The City and the relevant Agency(s) will thereafter require the Delinquent Contractor to provide cancelled checks or other equivalent proof of payment of benefit contributions that have come due, to be submitted with certified payroll reports for all Program Work covered by this Agreement on which the Delinquent Contractor is engaged, for at least a one-year period or such earlier period if the Contractor is ultimately determined not be a Delinquent Contractor. Such proof of payment when required is a condition of payment of the Delinquent Contractor's invoices by any entity, including, but not limited to, the City, the relevant Agency(s), Construction Manager, General Contractor, the prime or higher level subcontractor, as is appropriate under the Delinquent Contractor's engagement. The union and the funds shall upon request receive copies of the certified payrolls, cancelled checks, or other proof of payment from the City and/or the relevant Agency(s).

E. In the event the General Contractor or Delinquent Contractor shall notify the Agency as above provided that the claim of the union or fringe benefit fund is in

dispute, the Agency shall withhold from amounts then or thereafter becoming due and payable to the General Contractor an amount equal to that portion of such payment due to the General Contractor that relates solely to the work performed by the Delinquent Contractor that the union and/or employee benefit fund claims to be due it, pending resolution of the dispute pursuant to the union's Schedule A agreement, and the amount shall be paid to the party or parties ultimately determined to be entitled thereto, or held until the Delinquent Contractor and union or fringe benefit fund shall otherwise agree as to the disposition thereof; provided however, that such withholding shall not exceed the amount contained in the General Contractor's monthly invoice for work performed by the Delinquent Contractor. In the event the Agency shall be required to withhold amounts from a General Contractor for the benefit of more than one fringe benefit fund, the amounts so withheld in the manner and amount prescribed above shall be applied to or for such fund in the order in which the written notices of nonpayment have been received by the Agency, and if more than one such notice was received on the same day, proportionately based upon the amount of the union and/or fringe benefit fund claims received on such day. Nothing herein contained shall prevent the Agency from commencing an interpleader action to determine entitlement to a disputed payment in accordance with section one thousand six of the civil practice law and rules or any successor provision thereto.

F. Payment to a fringe benefit fund under this provision shall not relieve the General Contractor or Delinquent Contractor from responsibility for the work covered by the payment. Except as otherwise provided, nothing contained herein shall create any obligation on the part of the Agency to pay any union or fringe benefit fund, nor



shall anything provided herein serve to create any relationship in contract or otherwise, implied or expressed, between the union/fund and/or fringe benefit and the Agency.

**ARTICLE 12- HOURS OF WORK, PREMIUM PAYMENTS,  
SHIFTS AND HOLIDAYS**

**SECTION 1. WORK WEEK AND WORK DAY**

A. The standard work week shall consist of 40 hours of work at straight time rates, Monday through Friday, 8 hours per day, plus ½ hour unpaid lunch period.

B. In accordance with Program needs, there shall be flexible start times with advance notice from Contractor to the Union. The Day Shift shall commence between the hours of 6:00 a.m. and 9:00 a.m. and shall end between the hours of 2:30 p.m. and 5:30 p.m., for an 8 hour day. The Evening Shift shall commence between the hours of 3:00 p.m. and 6:00 p.m., unless different times are necessitated by the Agency's phasing plans on specific projects. The Night Shift shall commence between the hours of 11:00 p.m. and 2:00 a.m., unless different times are necessitated by the Agency's phasing plans on specific projects. Subject to the foregoing, starting and quitting times shall occur at the Program Work site designated by the Contractor.

C. Scheduling — Except as provided above, Monday through Friday is the standard work week; 8 hours of work plus ½ hour unpaid lunch.

D. Notice - Contractors shall provide not less than 5 days prior notice to the Local Union involved as to the work week and work hour schedules to be worked or such lesser notice as may be mutually agreed upon.

## **SECTION 2. OVERTIME**

Overtime shall be paid for any work over eight (8) hours in a day and work over forty (40) hours in a week, at time and one half (1½) Monday through Saturday. All overtime work performed on Sunday and Holidays will be paid pursuant to the applicable Schedule A. There shall be no stacking or pyramiding of overtime pay under any circumstances. There will be no restriction upon the Contractor's scheduling of overtime or the nondiscriminatory designation of employees who shall be worked, including the use of employees, other than those who have worked the regular or scheduled work week, at straight time rates. The Contractor shall have the right to schedule work so as to minimize overtime or schedule overtime as to some, but not all, of the crafts and whether or not of a continuous nature.

## **SECTION 3. SHIFTS**

A. Flexible Schedules - Scheduling of shift work, including Saturday and Sunday work, shall be within the discretion of the Contractor in order to meet Program Work schedules and existing Program Work conditions including the minimization of interference with the mission of the Agency. It is not necessary to work a day shift in order to schedule a second or third shift, or a second shift in order to schedule a third shift, or to schedule all of the crafts when only certain crafts or employees are needed. Shifts must have prior approval of the Agency or Construction Manager, and must be scheduled with not less than five work days notice to the Local Union or such lesser notice as may be mutually agreed upon.

B. Second and/or Third Shifts/Saturday and/or Sunday Work - - The second shift shall start between 3 p.m. and 6 p.m. and the third shift shall start between 11 p.m. and 2 a.m., subject to different times necessitated by the Agency phasing plans on specific projects. There shall be no reduction in shift hour work. All employees within a classification performing Program Work will be paid at the same wage rate regardless of the shift or work scheduled work, subject only to the foregoing provisions.

C. Flexible Starting Times - Shift starting times will be adjusted by the Contractor as necessary to fulfill Program Work requirements subject to the notice requirements of paragraph A.

#### SECTION 4. HOLIDAYS

A. Schedule - There shall be nine (9) recognized holidays on the Project:

New Year's Day

Martin Luther King Day

Memorial Day

Labor Day

Independence Day

President's Day

Veteran's Day

Thanksgiving Day

Christmas Day

All said holidays shall be observed on the calendar date except those holidays which occur on Saturday shall be observed on the previous Friday and those that occur on Sunday shall be observed on the following Monday.

B. Payment - Regular holiday pay, if any, for work performed on such a recognized holiday shall be in accordance with the applicable Schedule A.

C. Exclusivity - No holidays other than those listed in Section 4(A) above shall be recognized or observed.

### **SECTION 5. SATURDAY WORK**

The Contractor may schedule a Saturday work day and such time shall be scheduled and paid at time and one-half (1½) unless the applicable Schedule A permits a straight time rate.

### **SECTION 6. REPORTING PAY**

A. Employees who report to the work location pursuant to their regular schedule and who are not provided with work shall be paid two hours reporting pay at straight time rates. An employee whose work is terminated early by a Contractor due to severe weather, power failure, fire or natural disaster or for similar circumstances beyond the Contractor's control, shall receive pay only for such time as is actually worked. In other instances in which an employee's work is terminated early (unless provided otherwise elsewhere in this Agreement), the employee shall be paid for his full shift. Contractors shall not be permitted to call, text or email or voicemail employees in advance of their regularly scheduled shift starting time to avoid reporting pay. Notwithstanding the above, in the event that the National Weather Service issues a weather advisory for the area in which the work location is situated, and the entire project is shut down as a result of the Weather Advisory, the contractor shall be permitted to speak to employees no less than four (4) hours in advance of their shift starting time, unless the Local Union consents to a shorter notice in writing, to advise them not to report to work due to the National Weather Service advisory, and employees who are so notified shall not receive two (2) hours

reporting pay if they report to the work location. The contractor shall make every effort to notify each employee directly and confirm that notification has been received. Voice, text, and email messages left for employees without confirmation of delivery and receipt by employee do not constitute sufficient notice under this provision.

B. When an employee, who has completed their scheduled shift and left the Program Work site, is "called out" to perform special work of a casual, incidental or irregular nature, the employee shall receive overtime pay at the rate of time and one-half of the employee's straight time rate for hours actually worked.

C. When an employee leaves the job or work location of their own volition or is discharged for cause or is not working as a result of the Contractor's invocation of Section 7 below, they shall be paid only for the actual time worked.

D. Except as specifically set forth in this Article there shall be no premiums, bonuses, hazardous duty, high time or other special premium payments or reduction in shift hours of any kind.

E. There shall be no pay for time not actually worked except as specifically set forth in this Article and except where an applicable Schedule A requires a full weeks' pay for forepersons.

#### **SECTION 7. PAYMENT OF WAGES**

A. Termination- Employees who are laid off or discharged for cause shall be paid in full for that which is due them at the time of termination. The Contractor shall also provide the employee with a written statement setting forth the date of lay off or discharge.

### **SECTION 8. EMERGENCY WORK SUSPENSION**

A Contractor may, if considered necessary for the protection of life and/or safety of employees or others, suspend all or a portion of Program Work. In such instances, employees will be paid for actual time worked, except that when a Contractor requests that employees remain at the job site available for work, employees will be paid for that time at their hourly rate of pay.

### **SECTION 9. INJURY/DISABILITY**

An employee who, after commencing work, suffers a work-related injury or disability while performing work duties, shall receive no less than 8 hours wages for that day. Further, the employee shall be rehired at such time as able to return to duties provided there is still Program Work available for which the employee is qualified and able to perform.

### **SECTION 10. TIME KEEPING**

A Contractor may utilize brassing or other systems to check employees in and out. Each employee must check in and out. The Contractor will provide adequate facilities for checking in and out in an expeditious manner.

### **SECTION 11. MEAL PERIOD**

A Contractor shall schedule an unpaid period of not more than 1/2 hour duration at the work location between the 3rd and 5th hour of the scheduled shift. A Contractor may, for efficiency of operation, establish a schedule which coordinates the meal periods of two or more crafts or which provides for staggered lunch periods within a

craft or trade. If an employee is required to work through the meal period, the employee shall be compensated in a manner established in the applicable Schedule A.

## **SECTION 12. BREAK PERIODS**

There will be no rest periods, organized coffee breaks or other non-working time established during working hours. Individual coffee containers will be permitted at the employee's work location.

## **ARTICLE 13 - APPRENTICES**

### **SECTION 1. RATIOS**

Recognizing the need to maintain continuing supportive programs designed to develop adequate numbers of competent workers in the construction industry and to provide craft entry opportunities for minorities, women and economically disadvantaged non-minority males, Contractors will employ apprentices in their respective crafts to perform such work as is within their capabilities and which is customarily performed by the craft in which they are indentured. Contractors may utilize apprentices and such other appropriate classifications in the maximum ratio permitted by the New York State Department of Labor or the maximum allowed per trade. Apprentices and such other classifications as are appropriate shall be employed in a manner consistent with the provisions of the appropriate Schedule A. The parties encourage, as an appropriate source of apprentice recruitment consistent with the rules and operations of the affiliated unions' apprentice-programs, the use of the Edward J. Malloy Initiative for Construction Skills, Non-Traditional Employment for Women and Helmets to Hardhats.

## **ARTICLE 14-SAFETY PROTECTION OF PERSON AND PROPERTY**

### **SECTION 1. SAFETY REQUIREMENTS**

Each Contractor will ensure that applicable OSHA and safety requirements are at all times maintained on the Program Work site and the employees and Unions agree to cooperate fully with these efforts to the extent consistent with their rights and obligations under the law. Employees will cooperate with employer safety policies and will perform their work at all times in a safe manner and protect themselves and the property of the Contractor and Agency from injury or harm, to the extent consistent with their rights and obligations under the law. Failure to do so will be grounds for discipline, including discharge.

### **SECTION 2. CONTRACTOR RULES**

Employees covered by this Agreement shall at all times be bound by the reasonable safety, security, and visitor rules as established by the Contractors and the Construction Manager for this Program Work. Such rules will be published and posted in conspicuous places throughout the Program Work sites. Any site security and access policies established by the Construction Manager or General Contractor intended for specific application to the construction workforce for Program Work and that are not established pursuant to an Agency directive shall be implemented only after notice to the BCTC and its affiliates and an opportunity for negotiation and resolution by the Labor Management Committee.



### **SECTION 3. INSPECTIONS**

The Contractors and Construction Manager retain the right to inspect incoming shipments of equipment, apparatus, machinery and construction materials of every kind.

### **ARTICLE 15 - TEMPORARY SERVICES**

Temporary services, i.e. all temporary heat, climate control, water, power and light, shall only be required upon the determination of the Agency or Construction Manager, and when used shall be staffed and assigned to the appropriate trade(s) with jurisdiction. Temporary services shall be provided by the appropriate Contractors' existing employees during working hours in which a shift is scheduled for employees of this Contractor. The Agency or Construction Manager may determine the need for temporary services requirements during non-working hours, and when used shall be staffed and assigned to the appropriate trades(s), and which may be limited to one person per applicable trade where practicable. There shall be no stacking of trades on temporary services, provided this does not constitute a waiver of primary trade jurisdiction. In the event a temporary system component is claimed by multiple trades, the matter shall be resolved through the New York Plan for Jurisdictional Disputes.

### **ARTICLE 16 - NO DISCRIMINATION**

#### **SECTION 1. COOPERATIVE EFFORTS**

The Contractors and Unions agree that they will not discriminate against any employee or applicant for employment because of creed, race, color, religion, sex,

sexual orientation, national origin, marital status, citizenship status, disability, age or any other status provided by law, in any manner prohibited by law or regulation.

## **SECTION 2. LANGUAGE OF AGREEMENT**

The use of the masculine or feminine gender in this Agreement shall be construed as including both genders.

## **ARTICLE 17- GENERAL TERMS**

### **SECTION 1. PROJECT RULES**

A. The Construction Manager and the Contractors shall establish such reasonable Program Work rules that are not inconsistent with this Agreement or rules common in the industry and are reasonably related to the nature of work. These rules will be explained at the pre-job conference and posted at the Program Work sites and may be amended thereafter as necessary. Notice of amendments will be provided to the appropriate Local Union. Failure of an employee to observe these rules and regulations shall be grounds for discipline, including discharge. The fact that no order was posted prohibiting a certain type of misconduct shall not be a defense to an employee disciplined or discharged for such misconduct when the action taken is for cause.

B. The parties adopt and incorporate the BCTC's Standards of Excellence as annexed hereto as Exhibit "B".

### **SECTION 2. TOOLS OF THE TRADE**

The welding/cutting torch and chain fall are tools of the trade having jurisdiction over the work performed. Employees using these tools shall perform any of the work of the trade. There shall be no restrictions on the emergency use of any tools or

equipment by any qualified employee or on the use of any tools or equipment for the performance of work within the employee's jurisdiction.

### **SECTION 3. SUPERVISION**

Employees shall work under the supervision of the craft foreperson or general foreperson.

### **SECTION 4. TRAVEL ALLOWANCES**

There shall be no payments for travel expenses, travel time, subsistence allowance or other such reimbursements or special pay except as expressly set forth in this Agreement.

### **SECTION 5. FULL WORK DAY**

Employees shall be at their work area at the starting time established by the Contractor, provided they are provided access to the work area. The signatories reaffirm their policy of a fair day's work for a fair day's wage.

### **SECTION 6. COOPERATION AND WAIVER**

The Construction Manager, Contractors and the Unions will cooperate in seeking any NYS Department of Labor, or any other government, approvals that may be needed for implementation of any terms of this Agreement. In addition, the Council, on their own behalf and on behalf of its participating affiliated Local Unions and their individual members, intend the provisions of this Agreement to control to the greatest extent permitted by law, notwithstanding contrary provisions of any applicable prevailing wage, or other, law and intend this Agreement to constitute a waiver of any such prevailing wage, or other, law to the greatest extent permissible only for work within the scope of this

Agreement, including specifically, but not limited to those provisions relating to shift, night, and similar differentials and premiums. This Agreement does not, however, constitute a waiver or modification of the prevailing wage schedules applicable to work not covered by this Agreement.

## **ARTICLE 18. SAVINGS AND SEPARABILITY**

### **SECTION 1. THIS AGREEMENT**

In the event that the application of any provision of this Agreement is enjoined, on either an interlocutory or permanent basis, or is otherwise determined to be in violation of law, or if such application may cause the loss of Program funding or any New York State Labor Law exemption for all or any part of the Program Work, the provision or provisions involved (and/or its application to particular Program Work, as necessary) shall be rendered, temporarily or permanently, null and void, but where practicable the remainder of the Agreement shall remain in full force and effect to the extent allowed by law (and to the extent no funding or exemption is lost), unless the part or parts so found to be in violation of law or to cause such loss are wholly inseparable from the remaining portions of the Agreement and/or are material to the purposes of the Agreement. In the event a court of competent jurisdiction finds any portion of the Agreement to trigger the foregoing, the parties will immediately enter into negotiations concerning the substance affected by such decision for the purpose of achieving conformity with the court determination and the intent of the parties hereto for contracts to be let in the future.

## **SECTION 2. THE BID SPECIFICATIONS**

In the event that the Agency's (or Construction Manager's) bid specifications, or other action, requiring that a successful bidder (and subcontractor) become signatory to this Agreement is enjoined, on either an interlocutory or permanent basis, or is otherwise determined to be in violation of law, or may cause the loss of Program funding or any New York State Labor Law exemption for all or any part of the Program Work, such requirement (and/or its application to particular Program Work, as necessary) shall be rendered, temporarily or permanently, null and void, but where practicable the Agreement shall remain in full force and effect to the extent allowed by law and to the extent no funding or exemption is lost). In such event, the Agreement shall remain in effect for contracts already bid and awarded or in construction only where the Agency and Contractor voluntarily accepts the Agreement. The parties will enter into negotiations as to modifications to the Agreement to reflect the court or other action taken and the intent of the parties for contracts to be let in the future.

## **SECTION 3. NON-LIABILITY**

In the event of an occurrence referenced in Section 1 or Section 2 of this Article, neither the Agency, the Construction Manager, any Contractor, nor any Union shall be liable, directly or indirectly, for any action taken, or not taken, to comply with any court order or injunction, other determination, or in order to maintain funding or a New York State Labor Law exemption for Program Work. Bid specifications will be issued in conformance with court orders then in effect and no retroactive payments or other action will be required if the original court determination is ultimately reversed.

**SECTION 4. NON-WAIVER**

Nothing in this Article shall be construed as waiving the prohibitions of Article 7 as to signatory Contractors and signatory Unions.

**ARTICLE 19 - FUTURE CHANGES IN SCHEDULE A AREA CONTRACTS**

**SECTION 1. CHANGES TO AREA CONTRACTS**

A. Schedule A to this Agreement shall continue in full force and effect until the Contractor and/or Union parties to the Area Collective Bargaining Agreements that are the basis for the Schedule A notify the Agency and Construction Manager in writing of the changes agreed to in that Area Collective Bargaining which are applicable to work covered by this Agreement and their effective dates.

B. It is agreed that any provisions negotiated into Schedule A collective bargaining agreements will not apply to work under this Agreement if such provisions are less favorable to those uniformly required of contractors for construction work normally covered by those agreements; nor shall any provision be recognized or applied on Program Work if it may be construed to apply exclusively, or predominantly, to work covered by this Agreement.

C. Any disagreement between signatories to this Agreement over the incorporation into Schedule A of provisions agreed upon in the renegotiation of Area Collective Bargaining Agreements shall be resolved in accordance with the procedure set forth in Article 9 of this Agreement.

**SECTION 2. LABOR DISPUTES DURING AREA CONTRACT NEGOTIATIONS**

The Unions agree that there will be no strikes, work stoppages, sympathy actions, picketing, slowdowns or other disruptive activity or other violations of Article 7 affecting the Program Work by any Local Union involved in the renegotiation of Area Local Collective Bargaining Agreements nor shall there be any lock-out on such Program Work affecting a Local Union during the course of such renegotiations.

**ARTICLE 20 - WORKERS' COMPENSATION ADR**

**SECTION 1.**

An ADR program may be negotiated and participation in the ADR Program will be optional by trade.

**ARTICLE 21 - HELMETS TO HARDHATS**

**SECTION 1.**

The Contractors and the Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The Contractors and Unions agree to utilize the services of the New York City Helmets to Hardhats Program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

**SECTION 2.**

The Unions and Contractors agree to coordinate with the Program to create and maintain an integrated database of veterans interested in working on this Project and of

apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.



NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

IN WITNESS WHEREOF the parties have caused this Agreement to be executed and  
effective as of the \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_

FOR BUILDING AND CONSTRUCTION TRADES COUNCIL  
OF GREATER NEW YORK AND VICINITY

BY: Gary LaBarbera  
Gary LaBarbera  
President

FOR NEW YORK CITY

BY: \_\_\_\_\_  
Dr. Feniosky Peña-Mora  
Commissioner, Department of Design & Construction

APPROVED AS TO FORM:

\_\_\_\_\_  
ACTING CORPORATION COUNSEL  
NEW YORK CITY

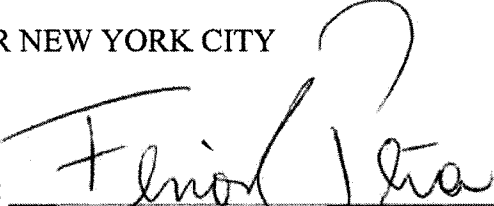
NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

IN WITNESS WHEREOF the parties have caused this Agreement to be executed and  
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FOR BUILDING AND CONSTRUCTION TRADES COUNCIL  
OF GREATER NEW YORK AND VICINITY

BY: \_\_\_\_\_  
Gary LaBarbera  
President

FOR NEW YORK CITY

BY:   
Dr. Feniosky Peña-Mora  
Commissioner, Department of Design & Construction

APPROVED AS TO FORM:

  
\_\_\_\_\_  
ACTING CORPORATION COUNSEL  
NEW YORK CITY

(TM)

SEP 28 2015

LIST OF SIGNATORY UNIONS
Boiler Makers Local No. 5
Carpenters District Council
Cement Masons No. 780
Concrete Workers, District Council No. 16
Derrickmen and Riggers, Local Union No. 197
Drywall Tapers 1974, District Council 9
Electrical Workers Local No. 3
Glaziers Local Union No. 1087 District Council 9
Heat & Frost Insulators, Local Union No. 12A
Heat & Frost Insulators, Local Union No. 12
Iron Workers District Council
Iron Workers Local Union No. 40
Iron Workers Local No. 361
Laborers Local No. 78, Asbestos & Lead Abatement
Laborers Local 1010 Pavers and Road Builders District Council
Laborers 79 Construction and General Building Laborers
Laborers Local No. 731 Excavators
Mason Tenders District Council
Metal Lathers Local No. 46
Metal Polishers District Council 9
Ornamental Iron Workers Local No. 580
Painters District Council 9
Plumbers Local No. 1
Painters, Decorators & Wallcoverers District Council 9
Painters Structural Steel No. 806
Plasterers Local Union No. 262
Roofers & Waterproofers Local 8
Steamfitters Local Union No. 638
Sheet Metal Workers Local No. 28
Sheet Metal Workers Local No. 137
Teamsters Local Union No. 282
Teamsters Local Union 814
Teamsters Local No. 813 Private Sanitation
Tile, Marble & Terrazzo B.A.C. Local Union No. 7

**SCHEDULE "A"**

Union	Current Agreement w/
Architectural and Ornamental Iron Workers Local Union 580, AFL-CIO	Allied Building Metal Industries, Inc.
Building, Concrete, Excavating & Common Laborers Local 731	Independent
Building, Concrete, Excavating & Common Laborers Local 731	Members of the General Contractors Association of New York, Inc.
District Council No. 9, I.U.P.A.T Glaziers Local 1087	Window and Plate Glass Dealers Association
Drywall Tapers and Pointers Local 1974, affiliated with International Union of Painters & Allied Trades and Drywall Taping Contractor's Association & Association of Wall-Ceiling & Carpentry Industries NY, Inc.	Independent
Enterprise Association of Steamfitters and Apprentices Local 638	Mechanical Contractors Association of NY, Inc.
Enterprise Association of Steamfitters and Apprentices Local 638	Independent
Highway Road and Street Laborers Local Union 1010 of the District Council of Pavers and Road Builders of the Laborers' International Union of North America AFL-CIO	Independent
Highway Road and Street Laborers Local Union 1010 of the District Council of Pavers and Road Builders of the Laborers' International Union of North America AFL-CIO	Member of the General Contractors Association of New York, Inc.
International Association of Heat and Frost Insulators and Allied Workers Local No. 12 of New York City	Independent
International Association of Heat and Frost Insulators and Allied Workers Local No. 12 of New York City	The Insulation Contractors Association of New York City, Inc.
International Association of Heat and Frost Insulators and Allied Workers Local No. 12A of New York City	Independent

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

International Association of Heat and Frost Insulators and Allied Workers Local No. 12A of New York City	Environmental Contractors Association, Inc.
International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers, AFL-CIO, Local Lodge No. 5	Boilermakers Association of Greater New York
Local Union No. 3 International Brotherhood of Electrical Workers, AFL-CIO	New York Electrical Contractors Association
International Brotherhood of Teamsters, Local 282, High Rise contract	Building Contractors Association & Independents
Local 46 Metallic Lathers Union and Reinforcing Iron Workers of NY and Vicinity of the International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers	Cement League
Local 46 Metallic Lathers Union and Reinforcing Iron Workers of NY and Vicinity of the International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers	Independent
Local 8 Roofers, Waterproofers & Allied Workers	Roofing and Waterproofing Contractors Association of New York and Vicinity
Local Union 1 of the United Association of Journeymen and Apprentices of the Pipe Fitting Industry of the United States and Canada	Association of Contracting Plumbers of the City of New York
Local Union Number 40 & 361 of Bridge, Structural Ornamental and Reinforcing Iron Workers AFL-CIO	Independent
Operative Plasterers' and Cement Masons' International Association Local No. 262	Independent
Painters and Allied Trades AFL-CIO, District Council No. 9 (Painting and Protective Coatings CBA)	Independent

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

Painters and Allied Trades AFL-CIO, District Council No. 9 (Painting and Protective Coatings CBA)	The Association of Master Painters & Decorators of NY, Inc. and The Association of Wall, Ceiling & Carpentry Industries of NY, Inc. and The Window and Plate Glass Dealers Association
Sheet Metal Workers' International Association, Local 28	Sheet Metal & Air Conditioning Contractors Association of New York City, Inc.
Sheet Metal Workers' International Association, Local 137	The Greater New York Sign Association
Structural Steel and Bridge Painters Local 806, DC 9 International Union of Painters and Allied Trades, AFL-CIO	New York Structural Steel Painting Contractors Association
Teamsters Local 813	Independent
Teamsters Local 813	IESI NY Corporation
Teamsters Local 814	Greater New York Movers and Warehousemen's Bargaining Group
The Cement Masons' Union, Local 780	Cement League
The District Council of Cement and Concrete Workers (comprised of Local 6A; Local 18A and Local 20)	Cement League
The District Council of Cement and Concrete Workers (comprised of Local 6A; Local 18A and Local 20)	Independent

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Heavy Carpenters	GCA
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Dockbuilders Local No. 1556	Concrete Contractors of NY
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Dockbuilders Local 1556	Independent
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Millwright Local 740	Independent
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Timbermen Local 1556	Independent
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Timbermen Local 1556	GCA
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Heavy Carpenters	Independent
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Carpenters	Manufacturing Woodworkers Association of Greater New York Incorporated
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America	The Hoisting Trade Association of New York, Inc.
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America	The Test Boring Association

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America	Building Contractors Association
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America	The Association of Wall-Ceiling & Carpentry Industries of New York, Incorporated
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners	The Cement League
The District Council of NYC and Vicinity of the United Brotherhood of Carpenters and Joiners of America	New York City Millwright Association
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners	Greater New York Floor Covering Association
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Carpenters	Association of Architectural Metal & Glass
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Carpenters	Concrete Contractors of NY
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Building Construction Carpenters	Independent
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Local 2287	Independent
The District Council of New York City and Vicinity of the United Brotherhood of Carpenters and Joiners of America for Shop Carpenters	Independent
The Tile Setters and Tile Finishers Union of New York and New Jersey, Local 7 of the International Bricklayers and Allied Craftworkers	The Greater New York and New Jersey Contractors Association



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United Derrickmen & Riggers Association, Local 197 of NY, LI, Westchester & Vicinity	Contracting Stonesetters Association Inc.
United Derrickmen & Riggers Association L 197 of NY, LI, Westchester and Vicinity	Building Stone and Pre-cast Contractors Association
International Union of Operating Engineers Local 14-14B	Building Contractors Association
International Union of Operating Engineers Local 14-14B	Contractors Association of Greater NY
International Union of Operating Engineers Local 14-14B	GCA
International Union of Operating Engineers Local 14-14B	The Cement League
International Union of Operating Engineers Local 14-14B	Allied Building Metal Industries, Inc.
International Union of Operating Engineers Local 14-14B	Brick Association
International Union of Operating Engineers Local 14-14B	Independent
International Union of Operating Engineers Local 15	Allied Building Metal Industries, Inc.
International Union of Operating Engineers Local 15-15A	General Contractors Association
International Union of Operating Engineers Local 15D	General Contractors Association
International Union of Operating Engineers Local 15D	Structural Steel Erectors

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

International Union of Operating Engineers Local 15-15A	Building Contractors Association
International Union of Operating Engineers Local 15D	Building Contractors Association
International Union of Operating Engineers Local 15-15A	Contractors Association of Greater NY
International Union of Operating Engineers Local 15D	Contractors Association of Greater NY
International Union of Operating Engineers Local 15-15A	The Cement League
International Union of Operating Engineers Local 15D	The Cement League

NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

**Project Labor Agreement -- Letter of Assent**

Dear:

The undersigned party confirms that it agrees to be a party to and be bound by the New York Agency, Project Labor Agreement as such Agreement may, from time to time, be amended by the parties or interpreted pursuant to its terms. The terms of the Project Labor Agreement, its Schedules, Addenda and Exhibits are hereby incorporated by reference herein.

The undersigned, as a Contractor or Subcontractor (hereinafter Contractor) on the Project known as 116th Precinct Station House and located at 244-04 N Conduit Ave, Queens, NY (hereinafter PROJECT), for and in consideration of the award to it of a contract to perform work on said PROJECT, and in further consideration of the mutual promises made in the Project Labor Agreement, a copy of which was received and is acknowledged, hereby:

- (1) Accepts and agrees to be bound by the terms and conditions of the Agreement, together with any and all schedules; amendments and supplements now existing or which are later made thereto;
- (2) Agrees to be bound by the legally established collective bargaining agreements; local trust agreements for employee benefit funds; and trust documents for joint apprentice programs as well as apprentice program rules and procedures but only to the extent of Program Work and as required by the PLA.
- (3) Authorizes the parties to such local trust agreements to appoint trustees and successor trustees to administer the trust funds and hereby ratifies and accepts the trustees so appointed as if made by the Contractor but only to the extent of Program Work as required by the PLA.
- (4) Certifies that it has no commitments or agreements that would preclude its full and complete compliance with the terms and conditions of said Agreement. The Contractor agrees to employ labor that can work in harmony with all other labor on the Project and shall require labor harmony from every lower tier subcontractor it has engaged or may engage to work on the Project. Labor harmony disputes/issues shall be subject to the Labor Management Committee provisions.
- (5) Agrees to secure from any Contractor(s) (as defined in said Agreement) which is or becomes a Subcontractor (of any tier), to it, a duly executed Agreement to be Bound in from identical to this document.

Provide description of the Work, identify craft jurisdiction(s) and all contract numbers below:

## NYC AGENCY NEW CONSTRUCTION CITY OWNED BUILDINGS/STRUCTURES PLA

**Dated:** 1/22/2020

**Citnalta Construction Corp.**  
**(Name of CM; GC; Contractor or**  
**Higher Level Subcontractor)**

Citnalta Construction Corp.  
(Name of Contractor or subcontractor)

(Authorized Officer & Title)

1601 Locust Ave., Bohemia, NY 11716

(Address)

631-563-1110/631-563-3765

(Phone) (Fax)

**Contractor's State License**

#

Sworn to before me this  
22nd day of January, 2020

Rustan Lewis  
Notary Public

**Christina M. Lewis**  
**NOTARY PUBLIC-STATE OF NEW YORK**  
**Registration 01LE6392847**  
**Qualified in Suffolk County**  
**Commission Expires 6/03/2023**

**NEW YORK CITY BUILDING AND CONSTRUCTION TRADES COUNCIL  
STANDARDS OF EXCELLENCE**

The purpose of this Standard of Excellence is to reinforce the pride of every construction worker and the commitment to be the most skilled, most productive and safest workforce available to construction employers and users in the City of New York. It is the commitment of every affiliated local union to use our training and skills to produce the highest quality work and to exercise safe and productive work practices.

The rank and file members represented by the affiliated local unions acknowledge and adopt the following standards:

- *Provide a full days work for a full days pay;*
- *Safely work towards the timely completion of the job;*
- *Arrive to work on time and work until the contractual quitting time;*
- *Adhere to contractual lunch and break times;*
- *Promote a drug and alcohol free work site;*
- *Work in accordance with all applicable safety rules and procedures;*
- *Allow union representatives to handle job site disputes and grievances without resort to slowdowns, or unlawful job disruptions;*
- *Respect management directives that are safe, reasonable and legitimate;*
- *Respect the rights of co-workers;*
- *Respect the property rights of the owner, management and contractors.*

The Unions affiliated with the New York City Building and Construction Trades Council will expect the signatory contractors to safely and efficiently manage their jobs and the unions see this as a corresponding obligation of the contractors under this Standard of Excellence. The affiliated unions will expect the following from its signatory contractors:

- *Management adherence to the collective bargaining agreements;*
- *Communication and cooperation with the trade foremen and stewards;*
- *Efficient, safe and sanitary management of the job site;*
- *Efficient job scheduling to mitigate and minimize unproductive time;*
- *Efficient and adequate staffing by properly trained employees by trade;*
- *Efficient delivery schedules and availability of equipment and tools to ensure efficient job progress;*
- *Ensure proper blueprints, specifications and layout instructions and material are available in a timely manner*
- *Promote job site dispute resolution and leadership skills to mitigate such disputes;*
- *Treatment of all employees in a respectful and dignified manner acknowledging their contributions to a successful project.*

The affiliated unions and their signatory contractors shall ensure that both the rank and file members and the management staff shall be properly trained in the obligations undertaken in the Standard of Excellence.

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# **NOTICE TO BIDDERS**

Please note that the Information for Bidders has been updated to include new Section 41, Viewing of Submitted Bid Documents.

**(NO FURTHER TEXT ON THIS PAGE)**

7/12/2019

DISCONTINUE THE USE OF THIS NOTICE ON 1/1/2020

**(NO TEXT ON THIS PAGE)**



**CITY OF NEW YORK**  
**DEPARTMENT OF**  
**DESIGN AND CONSTRUCTION**  
**DIVISION OF PUBLIC BUILDINGS**

**INFORMATION FOR BIDDERS**

**JULY 2019**

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*CITY OF NEW YORK CITY  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
INFORMATION FOR BIDDERS*

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## INFORMATION FOR BIDDERS

### 1. Description and Location of Work

The description and location of the work for which bids are requested are specified in Attachment 1, "Bid Information". Attachment 1 is included in the BID BOOKLET, VOLUME 1 OF 3.

### 2. Time and Place for Receipt of Bids

Sealed bids shall be received on or before the date and hour specified in Attachment 1, at which time they will be publicly opened and read aloud in the presence of the Commissioner or his or her representative, and any bidders who may desire to be present.

### 3. Definitions

The definitions set forth in the Procurement Policy Board Rules shall apply to this Invitation For Bids.

### 4. Invitation For Bids and Contract Documents

(A) Except for titles, sub-titles, headings, running headlines, tables of contents and indices (all of which are printed herein merely for convenience) the following, except for such portions thereof as may be specifically excluded, shall be deemed to be part of the Contract and the Invitation for Bids.

- (1) All provisions required by law to be inserted in this Contract, whether actually inserted or not
- (2) The Contract Drawings and Specifications
- (3) The General Conditions, the General Requirements and the Special Conditions, if any
- (4) The Contract
- (5) The Information for Bidders; Request for Proposals; Notice of Solicitation and Proposal For Bids; Bid or Proposal, and, if used, the Bid Booklet
- (6) The Budget Director's Certificate; all Addenda issued prior to the receipt of the bids; the Notice of Award; Performance and Payment Bonds, if required; and the Notice to Proceed with the Work.

(B) For particulars as to this procurement, including quantity and quality of the purchase, extent of the work or labor to be performed, delivery and performance schedule, and any other special instructions, prospective bidders are referred to the Invitation For Bids Documents. A copy of such documents can be obtained at the location set forth in Attachment 1.

(C) Deposit for Copy of Invitation For Bids Documents: Prospective bidders may obtain a copy of the Invitation For Bids Documents by complying with the conditions set forth in the Notice of Solicitation. The deposit must be in the form of a check or money order made payable to the City of New York, and drawn upon a state or national bank or trust company, or a check of such bank or trust company signed by a duly authorized officer thereof.

(D) Return of Invitation For Bids Documents: All Invitation For Bids Documents must be returned to the Department upon request. If the bidder elects not to submit a bid thereunder, the Invitation For Bids Documents shall be returned to the Department, along with a statement that no bid will be submitted.

(E) Return of Deposit: Such deposit will be returned within 30 days after the award of the contract or the rejection of all bids as set forth in the advertisement, provided the Invitation For Bids Documents are returned to the location specified in Attachment 1, in physical condition satisfactory to the Commissioner.

(F) Additional Copies: Additional copies of the Invitation For Bids Documents may be obtained, subject to the conditions set forth in the advertisement for bids.

5. Pre-Bid Conference

A pre-bid conference shall be held as set forth in Attachment 1. Nothing stated at the pre-bid conference shall change the terms or conditions of the Invitation For Bids Documents, unless a change is made by written amendment as provided in Section 9 below. Failure to attend a mandatory pre-bid conference shall constitute grounds for the rejection of the bid.

6. Agency Contact

Any questions or correspondence relating to this bid solicitation shall be addressed to the Agency Contact person specified in Attachment 1.

7. Bidder's Oath

(A) The bid shall be properly signed by an authorized representative of the bidder and the bid shall be verified by the written oath of the authorized representative who signed the bid, that the several matters stated and information furnished therein are in all aspects true.

(B) A materially false statement willfully or fraudulently made in connection with the bid or any of the forms completed and submitted with the bid may result in the termination of any Contract between the City and the Bidder. As a result, the Bidder may be barred from participating in future City contracts as well as be subject to possible criminal prosecution.

8. Examination and Viewing of Site, Consideration of Other Sources of Information and Changed Conditions

(A) Pre-Bidding (Investigation) Viewing of Site - Bidders must carefully view and examine the site of the proposed work, as well as its adjacent area, and seek other usual sources of information, for they will be conclusively presumed to have full knowledge of any and all conditions on, about or above the site relating to or affecting in any way the performance of the work to be done under the Contract which were or should have been indicated to a reasonably prudent bidder. To arrange a date for visiting the work site, bidders are to contact the Agency Contact person specified in Attachment 1.

(B) Should the contractor encounter during the progress of the work subsurface conditions at the site materially differing from any shown on the Contract Drawings or indicated in the Specifications or such subsurface conditions as could not reasonably have been anticipated by the contractor and were not anticipated by the City, which conditions will materially affect the cost of the work to be done under the Contract, the attention of the Commissioner must be called immediately to such conditions before they are disturbed. The Commissioner shall thereupon promptly investigate the conditions. If he finds that they do so materially differ, or that they could not reasonably have been anticipated by the contractor and were not anticipated by the City, the Contract may be modified with his written approval.

9. Examination of Proposed Contract

(A) Request for Interpretation or Correction: Prospective bidders must examine the Contract Documents carefully and before bidding must request the Commissioner in writing for an interpretation or correction of every patent ambiguity, inconsistency or error therein which should have been discovered by a reasonably prudent bidder. Such interpretation or correction, as well as any additional contract provisions the Commissioner may decide to include, will be issued in writing by the Commissioner as an addendum to the Contract, which will be transmitted to each person recorded as having received a copy of the Contract Documents from the Department. Transmission of such addendum will be by mail, e-mail, facsimile or hand delivery. Such addendum will also be posted at the place where the Contract Documents are available for the inspection of prospective bidders. Upon transmission as provided for herein, such addendum shall become a part of the Contract Documents, and binding on all bidders, whether or not actual notice of such addendum is shown.

(B) Only Commissioner's Interpretation or Correction Binding: Only the written interpretation or correction so given by the Commissioner shall be binding, and prospective bidders are warned that no other officer, agent or employee of the City is authorized to give information concerning, or to explain or interpret, the Contract.

(C) Documents given to a subcontractor for the purpose of soliciting the subcontractor's bid shall include either a copy of the bid cover sheet or a separate information sheet setting forth the project name, the Contract number (if available), the contracting agency and the Project's location.

10. Form of Bid

Each bid must be submitted upon the prescribed form and must contain: a) the name, residence and place of business of the person or persons making the same; b) the names of all persons interested therein, and if no other person is so interested, such fact must be distinctly stated; c) a statement to the effect that it is made without any connection with any other person making a bid for the same purpose and that it is in all respects fair and without collusion or fraud; d) a statement that no Council member or other officer or employee or person whose salary is payable in whole or part from the City Treasury is directly or indirectly interested therein or in the supplies, materials or equipment and work or labor to which it relates, or in any portion of the profits thereof; e) a statement that the bidder is not in arrears to the City or to any agency upon a debt or contract or taxes, and is not a defaulter as surety or otherwise upon any obligation to the City to any agency thereof, except as set forth in the bid.

THE BID SHALL BE TYPEWRITTEN OR WRITTEN LEGIBLY IN INK. THE BID SHALL BE SIGNED IN INK. ERASURES OR ALTERATIONS SHALL BE INITIALED BY THE SIGNER IN INK. FAILURE TO CONFORM TO THE REQUIREMENTS OF THIS SECTION 10 SHALL RESULT IN THE REJECTION OF THE BID.

11. Irrevocability of Bid

The prices set forth in the bid cannot be revoked and shall be effective until the award of the Contract, unless the bid is withdrawn as provided for in Sections 15 and 18 below.

12. Acknowledgment of Amendments

The receipt of any amendment to the Contract Documents shall be acknowledged by the bidder in its bid submission.

13. Bid Samples and Descriptive Literature

Bid samples and descriptive literature shall not be submitted by the bidder, unless expressly requested elsewhere in the Contract or Contract Documents. Any unsolicited bid samples or descriptive literature which are submitted shall not be examined or tested and shall not be deemed to vary any of the provisions of this Contract.

14. Proprietary Information/Trade Secrets

(A) The bidder shall identify those portions of the bid which it deems to be confidential, proprietary information or trade secrets, and provide justification why such materials shall not be disclosed by the City. All such materials shall be clearly indicated by stamping the pages on which such information appears, at the top and bottom thereof with the word "Confidential". Such materials stamped "Confidential" must be easily separable from the non-confidential sections of the bid.

(B) All such materials so indicated shall be reviewed by the Agency and any decision not to honor a request for confidentiality shall be communicated in writing to the bidder. For those bids which are unsuccessful, all such confidential materials shall be returned to the bidder. Prices, makes and model or catalog numbers of the items offered, deliveries, and terms of payment shall be publicly available after bid opening, regardless of any designation of confidentiality made by the bidder.

15. Pre-Opening Modification or Withdrawal of Bids

Bids may be modified or withdrawn by written notice received in the office designated in Attachment 1, before the time and date set for the bid opening. If a bid is withdrawn in accordance with this Section, the bid security, if any, shall be returned to the bidder.

16. Bid Evaluation and Award

In accordance with the New York City Charter, the Procurement Policy Board Rules and the terms and conditions of this Invitation For Bids, this Contract shall be awarded, if at all, to the responsible bidder whose bid meets the requirements and evaluation criteria set forth in the Invitation For Bids, and whose bid price is either the most favorable bid price or, if the Invitation For Bids so states, the most favorable evaluated bid price. A bid may not be evaluated for any requirement or criterion that is not disclosed in the Invitation For Bids.

Restriction: No negotiations with any bidder shall be allowed to take place except under the circumstances and in the manner set forth in Section 21. Nothing in this Section shall be deemed to permit a contract award to a bidder submitting a higher quality item than that designated in the Invitation For Bids, if that bid is not also the most favorable bid.

17. Late Bids, Late Withdrawals and Late Modifications

Any bid received at the place designated in the solicitation after the time and date set for receipt of bids is late and shall not be considered. Any request for withdrawal or modification received at the place designated in the solicitation after the time and date set for receipt of bids is late and shall not be considered. The exception to this provision is that a late modification of a successful bid that makes the bid terms more favorable to the City shall be considered at any time it is received.

18. Withdrawal of Bids.

Except as provided for in Section 15, above, a bidder may not withdraw its bid before the expiration of forty-five (45) days after the date of the opening of bids; thereafter, a bidder may withdraw its bid only in writing and in advance of an actual award. If within sixty (60) days after the execution of the Contract, the Commissioner fails to fix the date for commencement of work by written notice to the bidder, the bidder, at his option, may ask to be relieved of his obligation to perform the work called for by written notice to the Commissioner. If such notice is given to the Commissioner, and the request to withdraw is granted, the bidder waives all claims in connection with this Contract.

19. Mistake in Bids

(A) Mistake Discovered Before Bid Opening: A bidder may correct mistakes discovered before the time and date set for bid opening by withdrawing or correcting the bid as provided in Section 15 above.

(B) Mistakes Discovered Before Award

(1) In accordance with General Municipal Law (Section 103, subdivision 11), where a unilateral error or mistake is discovered in a bid, such bid may be withdrawn upon written approval of the Agency Chief Contracting Officer if the following conditions are met:

- (a) The mistake is known or made known to the agency prior to the awarding of the Contract or within 3 days after the opening of the bid, whichever period is shorter; and
- (b) The price bid was based upon an error of such magnitude that enforcement would be unconscionable; and
- (c) The bid was submitted in good faith and the bidder submits credible evidence that the mistake was a clerical error as opposed to a judgment error; and
- (d) The error in the bid is actually due to an unintentional and substantial arithmetic error or an unintentional omission of a substantial quantity of work, labor, material or services made directly



in the compilation of the bid, which unintentional arithmetic error or unintentional omission can be clearly shown by objective evidence drawn from inspection of the original work paper, documents, or materials used in the preparation of the bid sought to be withdrawn; and

- (e) It is possible to place the agency in the same position as existed prior to the bid.

(2) Unless otherwise required by law, the sole remedy for a bid mistake in accordance with this Article shall be withdrawal of the bid, and the return of the bid bond or other security, if any, to the bidder. Thereafter, the agency may, in its discretion, award the Contract to the next lowest bidder or rebid the Contract. Any amendment to or reformation of a bid or a Contract to rectify such an error or mistake therein is strictly prohibited.

(3) If the mistake and the intended correct bid are clearly evident on the face of the bid document, the bid shall be corrected to the intended correct bid and may not be withdrawn. Examples of mistakes that may be corrected are typographical errors, errors in extending unit prices, transposition errors and arithmetical errors.

## 20. Low Tie Bids

(A) When two or more low responsive bids from responsible bidders are identical in price, meeting all the requirements and criteria set forth in the Invitation For Bids, the Agency Chief Contracting Officer will break the tie in the following manner and order of priority:

- (1) Award to a certified New York City small, minority or woman-owned business entity bidder;
- (2) Award to a New York City bidder;
- (3) Award to a certified New York State small, minority or woman-owned business bidder;
- (4) Award to a New York State bidder.

(B) If two or more bidders still remain equally eligible after application of paragraph (A) above, award shall be made by a drawing by lot limited to those bidders. The bidders involved shall be invited to attend the drawing. A witness shall be present to verify the drawing and shall certify the results on the bid tabulation sheet.

## 21. Rejection of Bids

(A) Rejection of Individual Bids: The Agency may reject a bid if:

- (1) The bidder fails to furnish any of the information required pursuant to Section 24 or 28 hereof; or if
- (2) The bidder is determined to be not responsible pursuant to the Procurement Policy Board Rules; or if
- (3) The bid is determined to be non-responsive pursuant to the Procurement Policy Board Rules; or if
- (4) The bid, in the opinion of the Agency Chief Contracting Officer, contains unbalanced bid prices and is thus non-responsive, unless the bidder can show that the prices are not unbalanced for the probable required quantity of items, or if the imbalance is corrected pursuant to Section 15.

(B) Rejection of All Bids: The Agency, upon written approval by the Agency Chief Contracting Officer, may reject all bids and may elect to resolicit bids if in its sole opinion it shall deem it in the best interest of the City so to do.

(C) Rejection of All Bids and Negotiation With All Responsible Bidders: The Agency Head may determine that it is appropriate to cancel the Invitation For Bids after bid opening and before award and to complete the acquisition by negotiation. This determination shall be based on one of the following reasons:

- (1) All otherwise acceptable bids received are at unreasonable prices, or only one bid is received and the Agency Chief Contracting Officer cannot determine the reasonableness of the bid price, or no responsive bid has been received from a responsible bidder; or
- (2) In the judgment of the Agency Chief Contracting Officer, the bids were not independently arrived at in open competition, were collusive, or were submitted in bad faith.

(D) When the Agency has determined that the Invitation for Bids is to be canceled and that use of negotiation is appropriate to complete the acquisition, the contracting officer may negotiate and award the Contract

without issuing a new solicitation, subject to the following conditions:

- (1) prior notice of the intention to negotiate and a reasonable opportunity to negotiate have been given by the contracting officer to each responsible bidder that submitted a bid in response to the Invitation for Bids;
- (2) the negotiated price is the lowest negotiated price offered by a responsible bidder; and
- (3) the negotiated price is lower than the lowest rejected bid price of a responsible bidder that submitted a bid in response to the Invitation for Bids.

22. Right to Appeal Determinations of Non-Responsiveness or Non-Responsibility and Right to Protest Solicitations and Award

The bidder has the right to appeal a determination of non-responsiveness or non-responsibility and has the right to protest a solicitation and award. For further information concerning these rights, the bidder is directed to the Procurement Policy Board Rules.

23. Affirmative Action and Equal Employment Opportunity

This Invitation For Bids is subject to applicable provisions of Federal, State and Local Laws and executive orders requiring affirmative action and equal employment opportunity.

24. PASSPort COMPLIANCE

All vendors that intend to do business with the City of New York must complete a disclosure process in order to be considered for a contract. This disclosure process was formerly completed using Vendor Information Exchange System (VENDEX) paper-based forms. The City of New York has moved collection of vendor disclosure information online. In early August 2017, the New York City Mayor's Office of Contract Services (MOCS) launched the Procurement and Sourcing Solutions Portal (PASSPort), a new online procurement system that replaced the paper-VENDEX process. In anticipation of awards, all bidders must create online accounts in the new PASSPort system, and file all disclosure information using PASSPort. Paper submissions, including certifications of no changes to existing VENDEX packages, will not be accepted in lieu of complete online filings using PASSPort.

All vendors that intend to do business with the City, but specifically those that fall into any of the following categories, are required to enroll:

- Have a pending award with a City Agency; or
- Hold a current contract with a City Agency and have either an expiring VENDEX or expiring Certificate of No Change.

The Department of Design and Construction (DDC) and MOCS hereby notifies all proposers that the PASSPort system is available, and that disclosure filing completion is required prior to any award through this competitive bid.

To enroll in PASSPort and to access the PASSPort website (including online training), please visit [www.nyc.gov/passport](http://www.nyc.gov/passport). Contact MOCS at [passport@mocs.nyc.gov](mailto:passport@mocs.nyc.gov) for additional information and technical support.

25. Complaints About the Bid Process

The New York City Comptroller is charged with the audit of contracts in New York City. Any vendor who believes that there has been unfairness, favoritism or impropriety in the bid process should inform the Comptroller, Office of Contract Administration, One Centre Street, Room 835, New York, New York; telephone number (212)669-2323.

26. Bid, Performance and Payment Security

(A) Bid Security: Each bid must be accompanied by bid security in an amount and type specified in Attachment 1 (BID BOOKLET, VOLUME 1 OF 3). The bid security shall assure the City of New York of the

adherence of the bidder to its proposal, the execution of the Contract, and the furnishing of Performance and Payment Bonds by the bidder, if required in Attachment 1. Bid security shall be returned to the bidder as follows:

- (1) Within ten (10) days after the bid opening, the Comptroller will be notified to return the deposits of all but the three (3) lowest bidders. Within five (5) days after the award, the Comptroller will be notified to return the deposits of the remaining two unsuccessful bidders.
- (2) Within five (5) days after the execution of the Contract and acceptance of the Contractor's bonds, the Comptroller will be notified to return the bid security of the successful bidder or, if performance and payment bonds are not required, only after the sum retained under Article 21 of the Contract equals the amount of the bid security.
- (3) Where all bids are rejected, the Comptroller will be notified to return the deposit of the three (3) lowest bidders at the time of rejection.

(B) Performance and Payment Security: Performance and Payment Security must be provided in an amount and type specified in Attachment 1. The performance and payment security shall be delivered by the contractor prior to or at the time of execution of the Contract. If a contractor fails to deliver the required performance and payment security, its bid security shall be enforced, and an award of Contract may be made to the next lowest responsible and responsive bidder, or the contract may be rebid.

(C) Acceptable Types of Security: Acceptable types of security for bids, performance, and payment shall be limited to the following:

- (1) a one-time bond in a form satisfactory to the City;
- (2) a bank certified check or money order;
- (3) obligations of the City of New York; or
- (4) other financial instruments as determined by the Office of Construction in consultation with the Comptroller.

Whenever the successful bidder deposits obligations of the City of New York as performance and payment security, the Comptroller may sell and use the proceeds thereof for any purpose for which the principal or surety on such bond would be liable under the terms of the Contract. If the money is deposited with the Comptroller, the successful bidder shall not be entitled to receive interest on such money from the City.

(D) Form of Bonds: Security provided in the form of bonds must be prepared on the form of bonds authorized by the City of New York. Forms for bid, performance, and payment bonds are included in the Invitation for Bids Documents. Such bonds must have as surety thereunder such surety company or companies as are: (1) approved by the City of New York; (2) authorized to do business in the State of New York, and (3) approved by the Department of the Treasury of the United States. Premiums for any required bonds must be included in the base bid.

The bidder is advised that submission of a bid bond where the surety on such bond fails to meet the criteria set forth herein, shall result in the rejection of the bid as non-responsive.

The Department of the Treasury of the United States advises that information concerning approved surety companies may be obtained as follows: (1) from the Government Printing Office at 215-364-6465; (2) through the Internet at <https://www.fiscal.treasury.gov/surety-bonds/>.

(E) Power of Attorney: Attorneys in fact who sign bid, performance, or payment bonds must file with each bond a certified copy of their power of attorney to sign said bonds.

27. Failure to Execute Contract

In the event of failure of the successful bidder to execute the Contract and furnish the required security within ten (10) days after notice of the award of the Contract, the deposit of the successful bidder or so much thereof as shall be applicable to the amount of the award made shall be retained by the City, and the successful bidder shall be liable for and hereby agrees to pay on demand the difference between the price bid and the price for which such Contract shall be subsequently awarded, including the cost of any required reletting and less the amount of such deposit. No plea of mistake in such accepted bid shall be available to the bidder for the recovery of the deposit or as a defense to any action based upon such accepted bid. Further, should the bidder's failure to comply with this Section cause any funding agency, body or group (Federal, State, City, Public, Private, etc.) to terminate, cancel or reduce the funding on this project, the bidder in such event shall be liable also to the City for the amount of actual funding withdrawn by such agency on this project, less the amount of the forfeited deposit.

28. Bidder Responsibilities and Qualifications

(A) Bidders must include with their bids all information necessary for a determination of bidder responsibility, as set forth in the Specifications.

(B) The Agency may require any bidder or prospective bidder to furnish all books of account, records, vouchers, statements or other information concerning the bidder's financial status for examination as may be required by the Agency to ascertain the bidder's responsibility and capability to perform the Contract. If required, a bidder must also submit a sworn statement setting forth such information as the Agency may require concerning present and proposed plant and equipment, the personnel and qualifications of his working organizations, prior experience and performance record.

(C) Oral Examination on Qualifications: In addition thereto, and when directed by the Agency, the bidder, or a responsible officer, agent or employee of the bidder, must submit to an oral examination to be conducted by the Agency in relation to his proposed tentative plan and schedule of operations, and such other matters as the Agency may deem necessary in order to determine the bidder's ability and responsibility to perform the work in accordance with the Contract. Each person so examined must sign and verify a stenographic transcript of such examination noting thereon such corrections as such person may desire to make.

(D) If the bidder fails or refuses to supply any of the documents or information set forth in paragraph (B) hereof or fails to comply with any of the requirements thereof, the Agency may reject the bid.

29. Employment Report

In accordance with Executive Order No. 50 (1980) as modified by Executive Order 108 (1986), the filing of a completed Employment Report (ER) is a requirement of doing business with the City of New York for construction contractors with contracts of \$1,000,000 or more and subcontractors with construction subcontracts of \$750,000 or more. The required forms and information are included in the Bid Booklet.

30. Labor Law Requirements

(A) General: The successful bidder will be required to comply strictly with all Federal, State and local labor laws and regulations.

(B) New York State Labor Law: This Contract is subject to New York State Labor Law Section 220, which requires that construction workers on the site be paid prevailing wages and supplements. The Contractor is reminded that all wage provisions of this Contract will be enforced strictly and failure to comply will be considered when evaluating performance. Noncompliance may result in the contractor being debarred by the City from future contracts. Complaints filed with the Comptroller may result in decisions which may debar a contractor from bidding contracts with any state governmental entity and other political subdivisions.

(C) Records: The Contractor is expected to submit accurate payroll reports and other required documents and verify attendance and job classifications being utilized in compliance with the law, Contract provisions and agency procedures.

31. Insurance

(A) Bidders are advised that the insurance requirements contained herein are regarded as material terms of the Contract. As required by Article 22 of the Contract, the contractor must effect and maintain with companies licensed and authorized to do business in the State of New York, the types of insurance set forth therein, when required by and in the amounts set forth in Schedule A of the General Conditions. Such required insurance must be provided from the date the contractor is ordered to commence work and up to the date of final acceptance of all required work.

(B) The contractor must, within ten days of receipt of the notice of award, submit the following insurance documentation: (a) original certificate of insurance for general liability in the amount required by Schedule A of the General Conditions, and (b) original certificates of insurance or other proof of coverage for workers' compensation and disability benefits, as required by Section 57 of the New York State Workers' Compensation Law and Section 220 of the Disability Benefits Law.

32. Lump Sum Contracts

(A) Comparison of Bids: Bids on Lump Sum Contracts will be compared on the basis of the lump sum price bid, adjusted for alternate prices bid, if any.

(B) Lump Sum Bids for "General Construction Work" which include excavation shall include all necessary excavation work defined in the Specifications as being included in the lump sum bid. The bidder shall also bid a unit price for the additional cost of excavating material which is defined in the Specifications as excavation for which additional payment will be made. The total estimated additional cost of removing such material will be taken as the quantity set forth in the Engineer's Estimate multiplied by the unit price bid. This total estimated cost of additional excavation shall be added to the lump sum bid for the General Construction Work for the purpose of comparing bids to determine the low bidder.

(C) Variations from Engineer's Estimate: The Engineer's Estimate of the quantity of excavation for which additional payment will be made is approximate only and is given solely to be used as a uniform basis for the comparison of bids and such estimate is not to be considered as part of this contract. The quantities actually required to complete the contract work may be more or less than the quantities in the Engineer's Estimate and, if so, no action for damages or for loss of profits shall accrue to the contractor by reason thereof.

33. Unit Price Contracts

(A) Comparison of Bids: Bids on Unit Price Contracts will be compared on the basis of a total estimated price, arrived at by taking the sum of the estimated quantities of such items, in accordance with the Engineer's Estimate of Quantities set forth in the Bid Form, multiplied by the corresponding unit prices, and including any lump sum bids on individual items.

(B) Variations from Engineer's Estimate: Bidders are warned that the Engineer's Estimate of Quantities on the various items of work and materials is approximate only, given solely to be used as a uniform basis for the comparison of bids, and is not to be considered part of this contract. The quantities actually required to complete the contract work may be less or more than so estimated, and if so, no action for damages or for loss of profits shall accrue to the contractor by reason thereof.

(C) Overruns: The terms and conditions applicable to overruns of unit price items are set forth in Article 26 of the Contract.

34. Excise Tax

Bidders are referred to the Specifications for information on Federal Excise Tax exemptions.

35. Licenses and Permits

The successful bidder will be required to obtain all necessary licenses and permits necessary to perform the work.

36. Multiple Prime Contractors

If more than one prime contractor will be involved on this project, all contractors are required to examine the Invitation for Bid packages for all other parts of the project.

37. Locally Based Enterprise Requirements (LBE)

This Contract is subject to the requirements of Administrative Code, Section 6-108.1, and the regulations promulgated thereunder. No construction contract will be awarded unless and until these requirements have been complied with in their entirety. The bidder is advised of the provisions set forth below, as well as the provisions with respect to the Locally Based Enterprise Program contained in Article 67 of the Contract. The contractor is advised that:

(A) If any portion of the Contract is subcontracted, not less than ten percent of the total dollar amount of the contract shall be awarded to locally based enterprises ("LBEs"); except, where less than ten percent of the total dollar amount of the Contract is subcontracted, such lesser percentage shall be so awarded.

(B) No contractor shall require performance and payment bonds from LBE subcontractors.

(C) No Contract shall be awarded unless the contractor first identifies in its bid:

- (1) the percentage, dollar amount and type of work to be subcontracted; and
- (2) the percentage, dollar amount and type of work to be subcontracted to LBEs.

(D) Within ten calendar days after notification of low bid, the apparent low bidder shall submit an "LBE Participation Schedule" to the contracting agency. If such schedule does not identify sufficient LBE subcontractors to meet the requirements of Administrative Code Section 6-108.1, the apparent low bidder shall submit documentation of its good faith efforts to meet such requirements.

(1) The "LBE Participation Schedule" shall include:

- (a) the name and address of each LBE that will be given a subcontract,
- (b) the percentage, dollar amount and type of work to be subcontracted to the LBE, and
- (c) the dates when the LBE subcontract work will commence and end.

(2) The following documents shall be attached to the "LBE Participation Schedule":

- (a) verification letters from each subcontractor listed in the "LBE Participation Schedule" stating that the LBE will enter into a formal agreement for work,
- (b) certification documents of any proposed LBE subcontractor which is not on the LBE certified list, and
- (c) copies of the certification letter of any proposed subcontractor which is an LBE.

(3) Documentation of good faith efforts to achieve the required LBE percentage shall include as appropriate but not limited to the following:

- (a) attendance at prebid meetings, when scheduled by the agency, to advise bidders of contract requirements;
- (b) advertisement where appropriate in general circulation media, trade association publications and small business media of the specific subcontracts that would be at least equal to the percentage goal for LBE utilization specified by the contractor;
- (c) written notification to association of small, minority and women contractors soliciting specific subcontractors;
- (d) written notification by certified mail to LBE firms that their interest in the contract is solicited for specific work items and their estimated values;
- (e) demonstration of efforts made to select portions of the work for performance by LBE firms in order to increase the likelihood of achieving the stated goal;
- (f) documented efforts to negotiate with LBE firms for specific subcontracts, including at a minimum:
  - (i) The names, address and telephone numbers of LBE firms that are contacted;
  - (ii) A description of the information provided to LBE firms regarding the plans and specifications for portions of the work to be performed;
  - (iii) Documentation showing that no reasonable price can be obtained from LBE firms;
  - (iv) A statement of why agreements with LBE firms were not reached;
- (g) a statement of the reason for rejecting any LBE firm which the contractor deemed to be unqualified; and
- (h) documentation of efforts made to assist the LBE firms contacted that needed assistance in obtaining required insurance.

(E) Unless otherwise waived by the Commissioner with the approval of the Office of Economic and Financial Opportunity, failure of a proposed contractor to provide the information required by paragraphs (C) and (D) above may render the bid non-responsive and the Contract may not be awarded to the bidder. If the contractor states that it will subcontract a specific portion of the work, but can demonstrate despite good faith efforts it cannot achieve its required LBE percentage for subcontracted work until after award of Contract, the Contract may be awarded, subject to a letter of compliance from the contractor stating that it will comply with Administrative Code Section 6-108.1 and subject to approval by the Commissioner. If the contractor has not met its required LBE percentage prior to award, the contractor shall demonstrate that a good faith effort has been made subsequent to award to obtain LBEs on each subcontract until it meets the required percentage.

(F) When a bidder indicates prior to award that no work will be subcontracted, no work may be subcontracted without the prior written approval of the Commissioner, which shall be granted only if the contractor in good faith seeks LBE subcontractors at least six weeks prior to the start of work.

(G) The contractor may not substitute or change any LBE which was identified prior to award of the contract without the written permission of the Commissioner. The contractor shall make a written application to the Commissioner for permission to make such substitution or change, explaining why the contractor needs to change its LBE subcontractor and how the contractor will meet its LBE subcontracting requirement. Copies of such application must be served on the originally identified LBE by certified mail return receipt requested, as well as the proposed substitute LBE. The Commissioner shall determine whether or not to grant the contractor's request for substitution.

### 38. Bid Submission Requirements

The Bid Submission Requirements are set forth in the BID BOOKLET, VOLUME 1 OF 3.

### 39. Comptroller's Certificate

This Contract shall not be binding or of any force unless it is registered by the Comptroller in accordance with Section 328 of the City Charter and the Procurement Policy Board Rules. This Contract shall continue in force only after annual appropriation of funds by the City of New York and certification as hereinabove set forth.

40. Procurement Policy Board Rules

This Invitation For Bids is subject to the Rules of the Procurement Policy Board of the City of New York. In the event of a conflict between said Rules and a provision of this Invitation For Bids, the Rules shall take precedence.

41. Viewing of Submitted Bid Documents

In accordance with NYC Procurement and Policy Board Rules, Section 3-02, the submitted bid documents will be available to view immediately after completion of the bid opening and by appointment for up to 72 hours after the bid opening.

42. DDC Safety Requirements

The DDC Safety Requirements apply to the work to be performed pursuant to the Contract. The DDC Safety Requirements are set forth on the following pages.



**CITY OF NEW YORK**  
**DEPARTMENT OF DESIGN AND CONSTRUCTION**  
**SAFETY REQUIREMENTS FOR CONSTRUCTION**  
**CONTRACTS**

February 2019

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**THE DDC SAFETY REQUIREMENTS FOR CONSTRUCTION CONTRACTS INCLUDE THE FOLLOWING SECTIONS:**

- I. POLICY ON SITE SAFETY**
- II. PURPOSE**
- III. DEFINITIONS**
- IV. RESPONSIBILITIES**
- V. SAFETY QUESTIONNAIRE**
- VI. SITE SAFETY PLAN**
- VII. KICK-OFF/PRE-CONSTRUCTION MEETINGS AND SAFETY REVIEW**
- VIII. EVALUATION DURING WORK IN PROGRESS**
- IX. SAFETY PERFORMANCE EVALUATION**

## I. POLICY ON SITE SAFETY

The City of New York Department of Design and Construction (DDC) is committed to a policy of injury and illness prevention and risk management for construction work that will ensure the safety and health of the workers engaged in the projects and the protection of the general public. Therefore, it is DDC's policy that work carried out by Contractors on DDC contracts must, at a minimum, comply with the most current versions of all applicable federal, state and city laws, rules, and regulations, including without limitation:

- ❑ Code of Federal Regulations, Title 29, Part 1926 (29 CFR 1926) and applicable Sub-parts of Part 1910 – U.S. Occupational Safety and Health Administration (OSHA);
- ❑ Federal Highway Administration – Manual on Uniform Traffic Control Devices (MUTCD);
- ❑ New York Codes, Rules and Regulations (NYCRR), Title 12, Part 23 – Protection in Construction, Demolition and Excavation Operations;
- ❑ New York Codes, Rules and Regulations (NYCRR), Title 16, Part 753 – Protection of Underground Facilities;
- ❑ New York City Administrative Code, Title 28 – New York City Construction Codes;
- ❑ Rules of the City of New York, Title 15, Chapter 13 – Rules Pertaining To the Prevention of the Emission of Dust from Construction Related Activities;
- ❑ Rules of the City of New York, Title 15, Chapter 28 – Citywide Construction Noise Mitigation;
- ❑ Rules of the City of New York, Title 34 Chapter 2 – NYCDOT Highway Rules.

The Contractor will be required to comply with all new and/or revised federal, state and city laws, rules, and regulations, issued during the course of the project, at the expense of the Contractor without any additional costs to the DDC.

## II. PURPOSE

The purpose of this policy is to ensure that Contractors perform their work and supervise their employees in accordance with all applicable federal, state and city rules and regulations. Further, Contractors will be expected to minimize or eliminate jobsite and public hazards, through a planning, inspection, auditing and corrective action process. The goal is to control risks so that injuries, illnesses, and accidents to contractors' employees, DDC employees and the general public, as well as damage to city-owned and private property, are reduced to the lowest level feasible.

## III. DEFINITIONS

**Agency Chief Contracting Officer (ACCO):** The ACCO will mean the person delegated authority by the Commissioner to organize and supervise the procurement activity of subordinate Agency staff in conjunction with the City Chief Procurement Officer (CCPO).

**Competent Person:** As defined by OSHA, an individual who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees or the general public, and who has authorization to take prompt corrective measures to eliminate them. This individual will have completed, at a minimum an authorized 30-hour OSHA Construction Safety Course. The Contractor may be required to provide more than one competent person due to construction operations and based on the number of active work sites.

**Construction Safety Auditor:** A representative of the Construction Safety Unit who provides inspection and assessment services to enhance health and safety on all DDC construction projects. The activities of the Construction Safety Auditor include performing site audits, reviewing safety plans, reviewing construction permits, drawings, verifying Contractor's compliance with applicable federal, state and city laws, rules, regulations, and DDC Contract Safety Requirements, etc. and rendering technical advice and assistance to DDC Resident Engineers and Project Managers.

**Construction Safety Unit:** A unit of DDC Safety and Site Support that assesses contractor's safety on DDC jobsites and advises responsible parties of needed corrective actions.

**Registered Construction Superintendent:** For certain projects, as defined in New York City Construction Codes – Title 28, the contractor will provide a Construction Superintendent registered with the NYC Department of Buildings and responsible for all duties as defined in Chapter 33 of Title 1 of the Rules of the City of New York.

**Contractor:** For purposes of these Safety Requirements, the term "Contractor" will mean any person or entity that enters into a contract for the performance of construction work on a DDC project. The term "Contractor" will include any person or entity which enters into any of the following types of contracts: (1) a prime construction contract for a specific project, (2) a prime construction contract using the Job Order Contracting System ("JOCS Contract"), and (3) a subcontract with a CM/Builder ("First Tier Subcontract").

**Daily Safety Job Briefing:** Daily jobsite safety briefings, given to all jobsite personnel at project site by the Contractor before work begins and/or if hazards or potential hazards are discovered while working, with the purpose of discussing the scheduled activities for the day, the hazards related to these activities, activity specific safety procedures, and Job Hazard Analysis associated with the scheduled construction work. Daily jobsite briefings will be documented, available at the jobsite, and will include at a minimum, topics, name and signature of the person conducting the briefing session, names and signatures of attendants, name of the designated competent person, contractor's name, DDC Project ID, date, time, and location.

**Director - Construction Safety:** Responsible for the operations of the Construction Safety Unit and the DDC Site Safety management programs.

**Job Hazard Analysis (JHA):** A process of identifying the major job tasks and any potential site-specific hazards that may be present during construction and establishing the means and methods to eliminate or control those hazards. A JHA will be documented, available at the jobsite and will include at a minimum work tasks, being performed, identified hazards, control methods for the identified hazards, contractor's name, DDC Project ID, location, date, name and signature of certifying person. A JHA is a living document that will be re-evaluated and revised to address new hazards and tasks that may develop and will be present at the worksite and produced upon request.

**Qualified Person:** As defined by OSHA, an individual who, by possession of a recognized degree, certificate, license, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve problems relating to the subject matter, the work, or the project. Qualified Persons are required under regulation to address issues pertaining, but without limit, to fall protection, scaffold design, maintenance and protection of traffic, and excavation protective system, among others.

**Project Site:** Those areas indicated in the Contract Documents where the Work is to be performed.

**Project Safety Representative:** The designated Project Safety Representative will have at a minimum an OSHA 30-hour Construction Safety Course and other safety training applicable to Contractor's/subcontractor's project work. This individual will be responsible to oversee safety performance of the required construction work, conduct documented daily safety inspections, and implement corrective actions to maintain a safe work site. The Project Safety Representative must have sufficient experience and skills necessary to thoroughly understand the health and safety hazards and controls and must have authority to undertake corrective actions. A dedicated full-time Project Safety Representative may be required on large projects and projects deemed by DDC to be particularly high risk. DDC reserves the right to request a dedicated full-time Project Safety Representative for any reason at any time during the course of the project at the expense of the Contractor without any additional costs to the DDC. The full-time Project Safety Representative will be present at the site during all work activities.

**Resident Engineer ("RE"):** Representative of the Commissioner duly designated by the Commissioner to be his/her representative at the site of the work. The RE may be a consultant retained by DDC, including a Construction Management (CM) or Resident Engineer Inspection (REI) firm. If DDC has retained a CM, REI or other consultant firm to perform management and oversight for the Project (e.g., CM-Builder, CM-Design-Builder, Project Manager, Program Manager), that CM, REI or other consultant is the Resident Engineer for purposes of these Safety Requirements.

**Safety Questionnaire:** Used by DDC to evaluate Contractor's current and past safety performance. It is required to be completed by all Contractors initially when submitting bids for Construction work, or when being pre-qualified and updated annually or as requested by the DDC.

**Site Safety Manager:** For certain projects, as defined in New York City Construction Codes – Title 28, the Contractor will provide a Site Safety Manager with a Site Safety Manager License issued by the New York City Department of Building.

**Site Safety Plan:** A site-specific safety plan developed by the Contractor for a DDC project. The Site Safety Plan will identify hazards associated with the project work and include project specific safety procedures and training appropriate and necessary to complete the work. The Site Safety Plan will be submitted within 30 days from the Award Date or as otherwise directed and is subject to review and acceptance by the Construction Safety Unit prior to the commencement of work at the site.

**Unsafe or Unhealthy Condition:** A condition that could be potentially hazardous to the health and safety of personnel or the public, and/or damaging to equipment, machinery, property, or the environment.

**Weekly Safety Meetings:** Weekly jobsite safety meetings, given to all jobsite personnel by Contractor, with the purpose of discussing general safety topics and job specific requirements encountered at the DDC work site. Weekly safety meetings will be documented and will include at a minimum, topics, name and signature of the person conducting the meeting, names and signatures of attendees, contractor's name, DDC Project ID, date, and location.

**Work:** The construction required by the Contractor's Contract Documents whether completed or partially completed, performed by the Contractor/ subcontractors. Work refers to the furnishing of labor, furnishing and incorporating materials and equipment into the construction and providing any service required by the Contract Documents to fulfill the Contractor's obligation to complete the Project.

#### IV. RESPONSIBILITIES

All persons who manage, perform, and provide support for construction projects will conduct operations in compliance with the requirements identified in this Policy and all applicable governing regulatory agency requirements and guidelines pertaining to safety in construction.

##### A. Resident Engineer

1. Review and facilitate Contractor(s) Site Safety Plan submittals to DDC for acceptability.
2. Notify the Construction Safety Unit of the commencement of construction work.
3. Develop and implement a training verification process to ensure that all CM/REI, consultant, Contractor, and subcontractor employees are properly trained. Maintain all applicable initial and refresher training records and assure documentation availability on site.
4. Maintain documentation of and attend weekly safety meetings and daily safety job briefings.
5. Assure that Contractor(s) JHA's are current to reflect the work tasks being performed, hazards, and control methods to mitigate the identified hazards. Verify that all employees at the job site are trained on the JHAs and maintain supporting documentation on site.
6. Assure adequate planning for all critical construction activities (crane operation, excavation, confined space entry, etc.) including coordination between Contractor(s) /DDC/ other Agencies as required.
7. Maintain custody of all construction related permits, plans, approvals, drawings, etc., related to the project and assure their availability on site.
8. Recognize, minimize, or eliminate jobsite and public hazards, through required planning, inspection, verification, and corrective action process.
9. Monitor the conditions at the site for conformance with the Contractor's Site Safety Plan, DDC policies, permits, and all applicable regulations and documentation that pertain to construction safety.
10. Notify the Contractor and DDC immediately upon determination of any condition or activity existing which is not in compliance with the Contractor's Site Safety Plan, applicable federal, state or local codes or any condition that presents a potential risk of injury to the public or workers or possible damage to property. Direct the Contractor to provide such labor, materials, equipment, and supervision to remedy such conditions.

11. Notify the Construction Safety Unit and the ACCO's Insurance and Risk Management Unit of project-related accidents, incidents, and near misses as per DDC's Construction Safety Emergency and Accident Notification and Response Procedure within two (2) hours.
12. In case of an accident, incident, or near miss, RE is responsible to protect the integrity of the accident site including but not limited to: the safeguarding of all evidence, documentation of all personnel on site at the time of the accident, gather facts related to all accidents, incidents, or near miss, and prepare required DDC Construction Accident Report as per DDC's Construction Safety Emergency and Accident Notification and Response Procedure. Maintain all records pertaining to accidents, incidents, and near miss and have them available upon request.
13. Notify the Construction Safety Unit within two (2) hours of the start of an inspection by any outside/regulatory agency personnel, including NYS, OSHA, NYC DOB or any other City/State/Federal oversight entity and forward a copy of the inspection report within one business day of its receipt.
14. Escort and assist Construction Safety Auditors during all field and record audits.
15. Report any emergency conditions to the Construction Safety Unit immediately.

**Note: In addition to the responsibilities listed above, if the Resident Engineer is a CM/REI or other non-City party hired by the City to manage the Project, the Resident Engineer is also required to do the following:**

16. Provide personnel who are certified and or trained appropriately for the requirements of the project.
17. Perform an investigation for any project-related accidents, incidents, and near misses. Within 24-hours of the time of the accident, incident, or near miss, the CM/REI will submit an investigation report to the Construction Safety Unit. Such report will include proposed remedial measures and implementation of corrective actions to prevent recurrence.

DDC reserves the right to request that the CM/REI replace any CM/REI personnel for any reason at any time during the project.

#### **B. Construction Contractors**

**Note: For CM-Build and CM-Design-Build Projects, the CM will meet all requirements listed in this section, as well as the Resident Engineer section above.**

1. Submit a completed Safety Questionnaire and other safety performance related documentation with its bid or as part of a pre-qualification package.
2. Submit a Site Safety Plan within 30 days from the Award Date or as otherwise directed. The Site Safety Plan is subject to review and acceptance by the Construction Safety Unit prior to the commencement of work at the site. The Site Safety Plan will be revised and updated as necessary during the course of the project.
3. Designate and identify a Project Safety Representative in the Site Safety Plan. The Contractor will immediately notify the Construction Safety Unit, in a form and manner acceptable to the Construction Safety Unit, of any permanent change to the designated Project Safety Representative. In the event the primary designated Project Safety Representative is temporarily unable to perform his or her duties, an alternate Project Safety Representative will be provided. Resumes, outlining the qualification and experience for the Project Safety Representative (s) will be included in the Site Safety Plan and available upon request. DDC reserves the right to request the Contractor to replace a Project Safety Representative for any reason at any time during the course of the project.
4. Designate and identify a Competent Person(s) in the Site Safety Plan. Contractor/subcontractor may be required to provide more than one competent person due to construction operations and based on a number of work tasks/areas. DDC reserves the right to request the Contractor to replace a Competent Person or provide additional Competent Person(s) for any reason at any time during the course of the project. The Competent Person will be present at the site during all work activities.
5. For certain projects, as defined in New York City Construction Codes – Title 28, designate and identify the Licensed Site Safety Manager or Registered Construction Superintendent. Resumes, outlining the qualification and experience for the Licensed Site Safety Manager or Registered Construction Superintendent will be included in the Site Safety Plan and available upon request. The Contractor will immediately notify the Construction Safety Unit, in a form and manner acceptable to the Construction Safety Unit, of any permanent change to the designated Site Safety Manager and/or Construction Superintendent. In the event the primary designated Site Safety Manager or Construction Superintendent is temporarily unable to perform his

or her duties, an alternate Licensed Site Safety Manager and/or Registered Construction Superintendent will be provided. The Construction Safety Unit must be informed of such change. DDC reserves the right to request the Contractor to replace Site Safety Manager or Construction Superintendent for any reason at any time during the course of the project.

6. Develop a written Job Hazard Analysis (JHA) that identifies safety hazards and control methods for project specific work tasks. A preliminary JHA will be included in the Site Safety Plan submitted by the Contractor. A JHA is a living document that will be re-evaluated and revised to address new hazards and tasks that may develop during the course of the project and will be present at the worksite and produced upon request.
7. Develop project specific safety procedures to protect employees, general public, and property during all construction activities for the duration of the project.
8. Ensure that all employees are aware of the hazards associated with the project through documented formal and informal training and/or other communications. Conduct and document new employee and site-specific safety orientation for all Contractor and subcontractor personnel to review the hazards associated with the project as identified in the Site Safety Plan and the specific safety procedures and controls that will be used to protect workers, the general public and property. The Project Safety Representative will conduct this training prior to mobilization and if necessary during the course of the project. Documentation will be provided to the RE.
9. Prior to performing any work on DDC project all Contractor's and subcontractor's employees will have successfully completed, within the previous five calendar years, an OSHA 10-hour construction safety course. All training records (OSHA 10-hour, flagger, scaffold, fall protection, confined space, etc.) will be provided to the RE prior to mobilization, included in the Site Safety Plan, kept current during the course of the project, and available for review.
10. Conduct and document weekly safety meetings and daily job briefing sessions for the duration of the project. Attendance at weekly safety meetings and daily job briefing sessions is mandatory. A written record of weekly safety meetings will be available upon request and job briefing sessions will be available at the worksite.
11. As part of the Site Safety Plan, prepare site specific procedures, such as maintenance and protection of traffic plan, steel erection plan, confined space program, fall protection plan, demolition plan, site specific emergency evacuation plan, etc. (if not otherwise provided in the contract documents) and comply with all of its provisions.
12. Have immediately available for review at the project site where actual construction activities are being performed all applicable documentation, including but not limited to: JHAs for work tasks being performed, all required training records, MPT plan (where applicable), Noise and Dust Mitigation Plans, excavation protective system drawings (where applicable), Emergency Evacuation plan, fall protection program (where applicable), confined space program (where applicable), all required permits, daily job briefing records, all required documentation for crane operation (where applicable), daily inspection checklist, scaffold and sidewalk drawings (when applicable), safety data sheets for chemicals in use.
13. Comply with all federal, state and local safety and health rules, laws, and regulations.
14. Comply with all provisions of the Site Safety Plan.
15. Provide, replace, and adequately maintain at or around the project site, suitable and sufficient signage, lights, barricades and enclosures (fences, sidewalk sheds, netting, bracing, etc.). The project specific MPT plan will be developed, implemented, and reviewed during the course of the project.
16. The Project Safety Representative will conduct daily safety inspections, document the inspection results, implement corrective actions for the identified hazards. Maintain the inspection records and have them available upon request.
17. **Report unsafe or unhealthy conditions to the RE as soon as practical, but no more than 24 hours after discovery, and take prompt actions to remove or abate such conditions. Should an imminent dangerous condition be discovered, Contractor will stop all work in the area of danger until corrections are made.**
18. Report all accidents, incidents and near misses involving injuries to workers or the general public, as well as property damage, to the RE within one (1) hour.
19. Following an accident or incident, unless otherwise directed, the Contractor will not remove or alter any equipment, structure, material, or evidence related to the accident or incident. Exception: Immediate emergency procedures taken to secure structures, temporary construction, operations, or equipment that pose a continued imminent danger or facilitate assistance for persons who are trapped or who have sustained

bodily injury. Take additional measures as necessary to secure the accident or incident site and to protect against any further injury or property damage.

20. The Contractor will perform an investigation into the root cause of the accident, incident, or near miss. Within 24 hours of an accident, incident, or near miss, the Contractor will prepare and submit to the RE a written investigation report detailing findings, corrective actions, and hazard mitigation implementation to prevent recurrence.
21. Notify the RE within two (2) hours of the start of an inspection by any outside regulatory agency personnel, including OSHA, NYC DOB, or others.
22. Maintain all records pertaining to all required safety compliance documents, accidents and incidents reports. DDC reserves the right to request copy of any records pertaining to the safety of the project and required by DDC and other federal, state, and city agencies, including but not limited to permits, training records, safety inspection records, drawings, equipment records, etc.
23. Cooperate with DDC Construction Safety Unit/ RE and address DDC recommendations on safety, which will in no way relieve the Contractor of its responsibilities for safety on the project. The Contractor has sole responsibility for safety.

## **V. SAFETY QUESTIONNAIRE**

DDC requires that all Contractors provide information regarding their current and past safety performance and programs. This will be accomplished by the use of the DDC Safety Questionnaire. As a part of the bid submittal package, the contractor will submit a completed DDC Safety Questionnaire listing company workers' compensation experience modification rating and OSHA Incident Rates for the three (3) years prior to the date of the bid opening. DDC may request a Contractor to update its Questionnaire at any time or to provide more detailed information. The Contractor will provide the requested information within 15 days.

The following criteria will be used by DDC in reviewing the Contractor's responsibility, which will be based on the information provided on the questionnaire:

- Criteria 1: OSHA Injury and Illness Rates (I&IR) are no greater than the average for the industry (based on the most current Bureau of Labor Statistics data for the Contractors SIC code); and
- Criteria 2: Insurance workers compensation Experience Modification Rate (EMR) equal to or less than 1.0; and
- Criteria 3: Any willful violations issued by OSHA or NYC DOB within the last three (3) years; and
- Criteria 4: A fatality (worker or member of public) and injuries, requiring OSHA notification, experienced on or near Contractor's worksite within the last three (3) years; and
- Criteria 5: Past safety performance on DDC projects (accidents; status of site safety plan submittals; etc.)
- Criteria 6: OSHA violation history for the last three (3) years;
- Criteria 7: Contractor will provide OSHA Injury and Illness Records (currently OSHA 300 and 300A Logs) for the last three (3) years.

If the Contractor fails to meet the basic criteria listed above, the Construction Safety Unit may request, through the ACCO, more details concerning the Contractor's safety experience. DDC may request the Contractor to provide copies of, among other things, accident investigation reports, OSHA records, OSHA and NYC DOB citations, EPA citations and written corrective action plan.

## **VI. SITE SAFETY PLAN**

Within thirty (30) days from the Award Date or as otherwise directed, the Contractor will submit the Site Safety Plan. The Site Safety Plan will identify project work scope, safety hazards associated with the project tasks, and include specific safety procedures and training appropriate and necessary to complete the work. The Site Safety Plan is subject to review and acceptance by the Construction Safety Unit prior to the commencement of work at the site. Due to the project work scope and project duration, the Construction Safety Unit may grant a conditional acceptance

for a Site Safety Plan without all sections being complete. In a case of a "Conditional Acceptance" of a Site Safety Plan, the Contractor will provide the remaining sections previously incomplete and/or not submitted for review and acceptance by the Construction Safety Unit prior to the commencement of the construction activities. The Construction Safety Unit reserves the right to withdraw the initial "Conditional Acceptance" if the Contractor fails to provide the remaining sections of a Site Safety Plan. Failure by the Contractor to submit an acceptable Site Safety Plan will be grounds for default.

Site Safety Plan requirements: The Site Safety Plan will be a written document and will apply to all project specific Contractor and subcontractor operations, and will have at a minimum, the following elements with each described in a separate section (It may be necessary to modify the basic format for certain unique or high-risk projects, such as tunnels or high-rise construction). All Site Safety Plan sections will be numbered in the order listed below. For sections, which are not applicable for the type of the work being performed by the Contractor on DDC project, the Contractor will in writing indicate "Not applicable based on the project work scope." The Site Safety Plan will include Contractor's name, DDC project ID, project location (s), and development and revision dates. The Site Safety Plan will include the sections, attachments, and appendixes provided in the Site Safety Plan. All pages of the Site Safety Plan will be numbered.

1. Project Work Scope – Detailed information regarding work tasks that will be performed by Contractor and subcontractors under the project.
2. Responsibility and Organization – Contractor's organization chart with responsible personnel for the project, including titles, names, contact information, roles, and responsibilities. All Contractor's personnel required by the DDC Safety Requirements will be identified.
3. Safety Training and Education – OSHA 10 Hours training, requirements for daily safety briefings and weekly safety meetings, any work task specific training, responsible staff for implementation of training program for the project.
4. Job Hazard Analysis (JHA) – Project specific Job Hazard Analysis including work tasks, identified hazards, hazard control methods (administrative, engineering, PPE) to protect workers, property and general public, Contractor's name, project id, location, name and signature of a certifying person, hazard assessment date.
5. Protection of Public – Project specific procedures covering safety of the general public during all project construction activities.
6. Hazard Corrective Actions - Procedures for hazard identification, including responsible person(s), frequency of safety inspections, implementation of corrective actions, safety inspection checklist.
7. Accident/Exposure Investigation – Project specific procedures for accident/incident/near miss investigation and implementation of corrective actions. Accident/incident/near miss notification procedure of DDC project staff (time frame and responsible personnel).
8. Recording and Reporting Injuries – Procedures to meet 29 CFR 1904 requirements.
9. First Aid and Medical Attention – Responsible staff, location and inspection of First Aid kit, directions to local hospitals; emergency telephone numbers.
10. Project Specific Fire Protection and Prevention Program – Project specific procedures, including responsible staff, fire alarm system/methods, hot work procedures, etc.
11. Housekeeping Procedure.
12. Project Specific Illumination Procedure.
13. Project Specific Sanitation Procedure.
14. Personal Protective Equipment (PPE), including Respiratory Protection Program and Hearing Conservation Program, if required.
15. Hazard Communication Program – Contractor's Hazard Communication Program, responsible staff; training; SDS records, project specific list of chemicals; location of the program and SDS records.
16. Means of Egress – Information regarding free and unobstructed egress from all parts of the building or structure; exit marking; maintenance of means of egress, etc.
17. Employee Emergency Action Plan – Project specific: responsible staff, emergency alarm system/devices, evacuation procedure, procedure to account for employees after evacuation, etc.
18. Evacuation Plan – Project specific evacuation plan (drawing/scheme) with exists and evacuation routes.
19. Ionizing/Nonionizing Radiation – Competent person, license and qualification requirements, type of radiation, employee's exposure and protection, safety procedures, etc.



20. Material Handling, Storage, Use and Disposal – Project specific information regarding material storage, disposal, and handling: procedures, plan/drawings, etc.
21. Signs, Signals, and Barricades – Use of danger/warning signs, safety instruction signs, sidewalk closure and pedestrian fencing and barricades (if not included in the MPT plan), etc.
22. Tools – Hand and Power – Safety procedures for the type of tools to be used.
23. Scaffold – Project specific scaffold types, procedures, training requirements, scaffold drawings, designed, sealed, and signed by NYS Licensed Professional Engineer, or as otherwise directed; competent person, criteria for project specific scaffold, falling object protection, procedures for aerial lifts/scissor lifts.
24. Welding and Cutting – Project specific procedure for welding and cutting, including all necessary safety requirements such as fire prevention, personal protective equipment, hot work permits (if not covered by Contractor's Fire Prevention and Protection program, FDNY certificate requirements).
25. Electrical Safety – Project specific procedures, including lock out-tag out.
26. Fall Protection – Project specific information regarding selected fall protection systems, fall protection plan, responsible staff.
27. Cranes, Derrick, Hoists, Elevators, Conveyors – project specific equipment information including type, rated load capacity, manufacture specification requirements, competent person, exposure to falling load, inspection, recordkeeping, clearance requirements, communication procedure, ground lines, permits.
28. Excavation Safety – Competent person; excavation procedures; project specific protective system, including drawings, designed, sealed, and signed by NYS Licensed Professional Engineer, or as otherwise directed.
29. Protection of Underground Facilities and Utilities Procedure, including responsible staff and responsibilities.
30. Concrete and Masonry Construction Procedures
31. Maintenance and Protection of Traffic Plan – Project specific MPT plan, designed, sealed, and signed by NYS Licensed Professional Engineer, or as otherwise directed; flagmen training, public safety, etc.
32. Steel Erection – Site specific erection plan, requirements for applicable written notifications, competent person, fall protection plan, training requirements, etc.
33. Demolition – Engineering survey, including written evidence, disconnection of all effected utilities, identification of all hazardous chemicals, materials, gases, etc., floor openings, chutes, inspection and maintenance of all stairs/passageways, removal of materials/debris/structural elements, lock out/tag out, competent person.
34. Blasting and the Use of Explosives – Project specific safety procedures, warning signs, training/qualification, transportation, storage and use of explosives, inspection.
35. Stairways and Ladders – Types of stairs and ladders, safety procedures, training requirements.
36. Alcohol and Drug Abuse Policy
37. Rodents and Vermin Controls
38. Toxic and Hazardous Substances – Safety procedures for substances that Contractor's and subcontractor's employees can be exposed on project.
39. Noise Mitigation Plan – Completed project specific Noise Mitigation Plan, and noise mitigation procedures.
40. Confined Space Program – Project specific Confined Space Program, responsible staff, training records, equipment information, rescue procedure, list of project specific confined spaces, forms.
41. Construction Vehicles/Heavy Equipment – Type of construction vehicles/heavy equipment to be used on site, procedures
42. Dust Mitigation Plan – Completed project specific Dust Mitigation Plan, and dust mitigation procedures.
43. Working Over and Near Water. Diving Operations – safety procedures including personal protective equipment, fall protection, rescue services, etc.

The most critical component of the Site Safety Plan is the Job Hazard Analysis (JHA) section. The JHA form is a written document prepared by the Contractor. The Contractor will conduct a site and task assessment to identify the tasks and any potential safety or environmental hazards related to performance of the work, eliminate or implement controls for the potential hazards, and identify proper personal protective equipment for the task. The JHA will be communicated to all Contractor/subcontractor personnel on site. The JHA will include safety hazard identification and controls to protect employees, general public, and property.

The initial JHA will be included in the Contractor's Site Safety Plan and the current JHA form will be available at the construction site for reference. A JHA is a living document that will be re-evaluated and revised to address new hazards and tasks that may develop and will be present at the worksite and produced upon request.

## **VII. KICK-OFF MEETINGS/PRE-CONSTRUCTION AND SAFETY REVIEW**

Prior to the start of construction activities on all DDC projects, RE will invite the Construction Safety Unit to the construction kick-off meeting. The Construction Safety Unit representative(s) will participate in this meeting with the Contractor and RE for the purpose of:

- A. Reviewing DDC Contract Safety Requirements
- B. Reviewing site-specific safety issues based on a project work scope, location, and any other factors which may impact safety of workers and general public.
- C. Reviewing the Site Safety Plan and JHA requirements.
- D. Reviewing Accident/Incident reporting and investigation procedures.
- E. Reviewing designated safety contacts, roles, and responsibilities.
- F. Discussing planned inspections and audits of the site by Construction Safety Unit personnel.

## **VIII. EVALUATION DURING WORK IN PROGRESS**

The Contractor's adherence to these Safety Requirements will be monitored throughout the project. This will be accomplished by the following:

- A. Use of a safety checklist by a representative of the Construction Safety Unit (or other designated DDC representative) and the RE during regular inspections and comprehensive audits of the job site. Field Exit Conferences will be held with the RE and Contractor Project Safety Representatives.
- B. The RE will continually monitor the safety and environmental performance of the Contractor's employees and work methods. Deficiencies will be brought to the attention of the Contractor's Project Safety Representative on site for immediate correction. The RE will maintain a written record of these deficiencies and have these records available upon request. Any critical deficiencies will be immediately reported to the Construction Safety Unit via telephone (718)391-1911.
- C. If the Contractor's safety performance during the project is not up to DDC standards (safety performance measure, accident/incident rate, etc.) the Director – Construction Safety, or his/her designee will meet with the Contractor's Project Safety Representative and other representatives, the RE, and the DDC Environmental Specialist (if environmental issues are involved). The purpose of this meeting is to 1) determine the level of non-compliance; 2) explain and clarify the safety/environmental provisions; 3) agree on a future course of action to correct the deficiencies.
- D. If the deficiencies continue, the Commissioner may, without limitation, declare the Contractor in default.
- E. The Contractor will within 1 hour inform the RE of all accidents/incidents/near misses including all fatalities, any injuries to employees or members of the general public, and property damage (e.g., structural damage, equipment rollovers, utility damage, loads dropped from crane). The RE will notify the Construction Safety Unit as per DDC's Construction Safety Emergency and Accident Notification and Response Procedure and will maintain a record of all Contractor accidents/incidents for the project.
- F. The Contractor and the RE will notify the Construction Safety Unit within two (2) hours of the start of any NYS-DOL/ NYC-COSH/ OSHA/ EPA inspections.

## **IX. SAFETY PERFORMANCE EVALUATION**

The Contractor's safety record, including accident/incident history and DDC safety inspection results, will be considered as part of the Contractor's performance evaluation at the conclusion of the project. Poor safety performance during the course of the project will be a reason to rate a Contractor unsatisfactory which may be reflected in the City's PASSPort system and will be considered for future procurement actions as set forth in the City's Procurement Policy Board Rules.

**CITY OF NEW YORK**  
**STANDARD CONSTRUCTION CONTRACT**

**March 2017**

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**CITY OF NEW YORK  
STANDARD CONSTRUCTION CONTRACT**

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**WITNESSETH:**

The parties, in consideration of the mutual agreements contained herein, agree as follows:

**CHAPTER I: THE CONTRACT AND DEFINITIONS**

**ARTICLE 1. THE CONTRACT**

1.1 Except for titles, subtitles, headings, running headlines, tables of contents and indices (all of which are printed herein merely for convenience), the following, except for such portions thereof as may be specifically excluded, shall be deemed to be part of this **Contract**:

1.1.1 All provisions required by law to be inserted in this **Contract**, whether actually inserted or not;

1.1.2 The Contract Drawings and Specifications;

1.1.3 The General Conditions and Special Conditions, if any;

1.1.4 The **Contract**;

1.1.5 The Information for Bidders; Request for Proposals; Notice of Solicitation and Proposal For Bids; Bid or Proposal, and, if used, the Bid Booklet;

1.1.6 All Addenda issued prior to the receipt of the bids; the Notice of Award; Performance and Payment Bonds, if required; and the Notice to Proceed or the Order to Work.

1.2 Should any conflict occur in or between the Drawings and Specifications, the **Contractor** shall be deemed to have estimated the most expensive way of doing the **Work**, unless the **Contractor** shall have asked for and obtained a decision in writing from the **Commissioner** of the **Agency** that is entering into this **Contract**, before the submission of its bid, as to what shall govern.

**ARTICLE 2. DEFINITIONS**

2.1 The following words and expressions, or pronouns used in their stead, shall, wherever they appear in this Contract, be construed as follows, unless a different meaning is clear from the context:

2.1.1 “**Addendum**” or “**Addenda**” shall mean the additional Contract provisions and/or technical clarifications issued in writing by the Commissioner prior to the receipt of bids.

2.1.2 “**Agency**” shall mean a city, county, borough or other office, position, department, division, bureau, board or commission, or a corporation, institution or agency of government, the expenses of which are paid in whole or in part from the City treasury.

2.1.3 “**Agency Chief Contracting Officer**” (**ACCO**) shall mean a person delegated authority by the Commissioner to organize and supervise the procurement activity of subordinate Agency staff in conjunction with the CCPO, or his/her duly authorized representative.

2.1.4 **"Allowance"** shall mean a sum of money which the Agency may include in the total amount of the Contract for such specific contingencies as the Agency believes may be necessary to complete the Work, e.g., lead or asbestos remediation, and for which the Contractor will be paid on the basis of stipulated unit prices or a formula set forth in the Contract or negotiated between the parties provided, however, that if the Contractor is not directed to use the Allowance, the Contractor shall have no right to such money and it shall be deducted from the total amount of the Contract.

2.1.5 **"City"** shall mean the City of New York.

2.1.6 **"City Chief Procurement Officer" (CCPO)** shall mean a person delegated authority by the Mayor to coordinate and oversee the procurement activity of Mayoral agency staff, including the ACCO and any offices which have oversight responsibility for the procurement of construction, or his/her duly authorized representative.

2.1.7 **"Commissioner"** shall mean the head of the Agency that has entered into this Contract, or his/her duly authorized representative.

2.1.8 **"Comptroller"** shall mean the Comptroller of the City of New York.

2.1.9 **"Contract"** or **"Contract Documents"** shall mean each of the various parts of the contract referred to in Article 1 hereof, both as a whole and severally.

2.1.10 **"Contract Drawings"** shall mean only those drawings specifically entitled as such and listed in the Specifications or in any Addendum, or any drawings furnished by the Commissioner, pertaining or supplemental thereto.

2.1.11 **"Contract Work"** shall mean everything required to be furnished and done by the Contractor by any one or more of the parts of the Contract referred to in Article 1, except Extra Work as hereinafter defined.

2.1.12 **"Contractor"** shall mean the entity which executed this Contract, whether a corporation, firm, partnership, joint venture, individual, or any combination thereof, and its, their, his/her successors, personal representatives, executors, administrators, and assigns, and any person, firm, partnership, joint venture, individual, or corporation which shall at any time be substituted in the place of the Contractor under this Contract.

2.1.13 **"Days"** shall mean calendar days, except where otherwise specified.

2.1.14 **"Engineer"** or **"Architect"** or **"Project Manager"** shall mean the person so designated in writing by the Commissioner in the Notice to Proceed or the Order to Work to act as such in relation to this Contract, including a private Architect or Engineer or Project Manager, as the case may be. Subject to written approval by the Commissioner, the Engineer, Architect or Project Manager may designate an authorized representative.

2.1.15 **"Engineering Audit Officer" (EAO)** shall mean the person so designated by the Commissioner to perform responsible auditing functions hereunder.

2.1.16 **"Extra Work"** shall mean Work other than that required by the Contract at the time of award which is authorized by the Commissioner pursuant to Chapter VI of this Contract.

2.1.17 **"Federal-Aid Contract"** shall mean a contract in which the United States (federal) Government provides financial funding as so designated in the Information for Bidders.

2.1.18 **"Final Acceptance"** shall mean final written acceptance of all the Work by the Commissioner, a copy of which shall be sent to the Contractor.

2.1.19 **"Final Approved Punch List"** shall mean a list, approved pursuant to Article 14.2.2, specifying those items of Work to be completed by the Contractor after Substantial Completion and dates for the completion of each item of Work.

2.1.20 **"Law" or "Laws"** shall mean the Constitution of the State of New York, the New York City Charter, the New York City Administrative Code, a statute of the United States or of the State of New York, a local law of the City of New York, any ordinance, rule or regulation having the force of law, or common law.

2.1.21 **"Materialman"** shall mean any corporation, firm, partnership, joint venture, or individual, other than employees of the Contractor, who or which contracts with the Contractor or any Subcontractor, to fabricate or deliver, or who actually fabricates or delivers, plant, materials or equipment to be incorporated in the Work.

2.1.22 **"Means and Methods of Construction"** shall mean the labor, materials, temporary structures, tools, plant, and construction equipment, and the manner and time of their use, necessary to accomplish the result intended by this Contract.

2.1.23 **"Notice to Proceed" or "Order to Work"** shall mean the written notice issued by the Commissioner specifying the time for commencement of the Work and the Engineer, Architect or Project Manager.

2.1.24 **"Other Contractor(s)"** shall mean any contractor (other than the entity which executed this Contract or its Subcontractors) who or which has a contract with the City for work on or adjacent to the building or Site of the Work.

2.1.25 **"Payroll Taxes"** shall mean State Unemployment Insurance (SUI), Federal Unemployment Insurance (FUI), and payments pursuant to the Federal Insurance Contributions Act (FICA).

2.1.26 **"Project"** shall mean the public improvement to which this Contract relates.

2.1.27 **"Procurement Policy Board" (PPB)** shall mean the Agency of the City of New York whose function is to establish comprehensive and consistent procurement policies and rules which shall have broad application throughout the City.

2.1.28 **"Required Quantity"** in a unit price Contract shall mean the actual quantity of any item of Work or materials which is required to be performed or furnished in order to comply with the Contract.

2.1.29 **"Resident Engineer"** shall mean the representative of the Commissioner duly designated by the Commissioner to be his/her representative at the site of the Work.

2.1.30 **"Site"** shall mean the area upon or in which the Contractor's operations are carried on, and such other areas adjacent thereto as may be designated as such by the Engineer.

2.1.31 “**Small Tools**” shall mean items that are ordinarily required for a worker’s job function, including but not limited to, equipment that ordinarily has no licensing, insurance or substantive storage costs associated with it; such as circular and chain saws, impact drills, threaders, benders, wrenches, socket tools, etc.

2.1.32 “**Specifications**” shall mean all of the directions, requirements, and standards of performance applying to the Work as hereinafter detailed and designated under the Specifications.

2.1.33 “**Subcontractor**” shall mean any person, firm or corporation, other than employees of the Contractor, who or which contracts with the Contractor or with its subcontractors to furnish, or actually furnishes labor, or labor and materials, or labor and equipment, or superintendence, supervision and/or management at the Site. Wherever the word Subcontractor appears, it shall also mean sub-Subcontractor.

2.1.34 “**Substantial Completion**” shall mean the written determination by the Engineer that the Work required under this Contract is substantially, but not entirely, complete and the approval of the **Final Approved Punch List**.

2.1.35 “**Work**” shall mean all services required to complete the Project in accordance with the Contract Documents, including without limitation, labor, material, superintendence, management, administration, equipment, and incidentals, and obtaining any and all permits, certifications and licenses as may be necessary and required to complete the Work, and shall include both Contract Work and Extra Work.

## **CHAPTER II: THE WORK AND ITS PERFORMANCE**

### **ARTICLE 3. CHARACTER OF THE WORK**

3.1 Unless otherwise expressly provided in the **Contract Drawings, Specifications, and Addenda**, the **Work** shall be performed in accordance with the best modern practice, utilizing, unless otherwise specified in writing, new and unused materials of standard first grade quality and workmanship and design of the highest quality, to the satisfaction of the **Commissioner**.

### **ARTICLE 4. MEANS AND METHODS OF CONSTRUCTION**

4.1 Unless otherwise expressly provided in the **Contract Drawings, Specifications, and Addenda**, the **Means and Methods of Construction** shall be such as the **Contractor** may choose; subject, however, to the **Engineer’s** right to reject the **Means and Methods of Construction** proposed by the **Contractor** which in the opinion of the **Engineer**:

4.1.1 Will constitute or create a hazard to the **Work**, or to persons or property; or

4.1.2 Will not produce finished **Work** in accordance with the terms of the **Contract**; or

4.1.3 Will be detrimental to the overall progress of the **Project**.

4.2 The **Engineer’s** approval of the **Contractor’s Means and Methods of Construction**, or his/her failure to exercise his/her right to reject such means or methods, shall not relieve the **Contractor**

of its obligation to complete the **Work** as provided in this **Contract**; nor shall the exercise of such right to reject create a cause of action for damages.

## **ARTICLE 5. COMPLIANCE WITH LAWS**

5.1 The **Contractor** shall comply with all **Laws** applicable to this **Contract** and to the **Work** to be done hereunder.

5.2 Procurement Policy Board Rules: This **Contract** is subject to the Rules of the **PPB** ("**PPB Rules**") in effect at the time of the bid opening for this **Contract**. In the event of a conflict between the **PPB Rules** and a provision of this **Contract**, the **PPB Rules** shall take precedence.

5.3 Noise Control Code provisions.

5.3.1 In accordance with the provisions of Section 24-216(b) of the Administrative Code of the **City** ("**Administrative Code**"), Noise Abatement Contract Compliance, devices and activities which will be operated, conducted, constructed or manufactured pursuant to this **Contract** and which are subject to the provisions of the **City Noise Control Code** shall be operated, conducted, constructed, or manufactured without causing a violation of the Administrative Code. Such devices and activities shall incorporate advances in the art of noise control development for the kind and level of noise emitted or produced by such devices and activities, in accordance with regulations issued by the **Commissioner** of the **City Department of Environmental Protection**.

5.3.2 The **Contractor** agrees to comply with Section 24-219 of the Administrative Code and implementing rules codified at 15 Rules of the City of New York ("**RCNY**") Section 28-100 *et seq.* In accordance with such provisions, the **Contractor**, if the **Contractor** is the responsible party under such regulations, shall prepare and post a Construction Noise Mitigation Plan at each **Site**, in which the **Contractor** shall certify that all construction tools and equipment have been maintained so that they operate at normal manufacturers operating specifications. If the **Contractor** cannot make this certification, it must have in place an Alternative Noise Mitigation Plan approved by the **City Department of Environmental Protection**. In addition, the **Contractor's** certified Construction Noise Mitigation Plan is subject inspection by the **City Department of Environmental Protection** in accordance with Section 28-101 of Title 15 of RCNY. No **Contract Work** may take place at a **Site** unless there is a Construction Noise Mitigation Plan or approved Alternative Noise Mitigation Plan in place. In addition, the **Contractor** shall create and implement a noise mitigation training program. Failure to comply with these requirements may result in fines and other penalties pursuant to the applicable provisions of the Administrative Code and RCNY.

5.4 Ultra Low Sulfur Diesel Fuel: In accordance with the provisions of Section 24-163.3 of the Administrative Code, the **Contractor** specifically agrees as follows:

5.4.1 Definitions. For purposes of this Article 5.4, the following definitions apply:

5.4.1(a) "**Contractor**" means any person or entity that enters into a Public Works Contract with a **City Agency**, or any person or entity that enters into an agreement with such person or entity, to perform work or provide labor or services related to such Public Works Contract.

5.4.1(b) "Motor Vehicle" means any self-propelled vehicle designed for transporting persons or property on a street or highway.

5.4.1(c) "Nonroad Engine" means an internal combustion engine (including the fuel system) that is not used in a Motor Vehicle or a vehicle used solely for competition, or that is not subject to standards promulgated under Section 7411 or Section 7521 of Title 42 of the United States Code, except that this term shall apply to internal combustion engines used to power generators, compressors or similar equipment used in any construction program or project.

5.4.1(d) "Nonroad Vehicle" means a vehicle that is powered by a Nonroad Engine, fifty (50) horsepower and greater, and that is not a Motor Vehicle or a vehicle used solely for competition, which shall include, but not be limited to, excavators, backhoes, cranes, compressors, generators, bulldozers, and similar equipment, except that this term shall not apply to horticultural maintenance vehicles used for landscaping purposes that are powered by a Nonroad Engine of sixty-five (65) horsepower or less and that are not used in any construction program or project.

5.4.1(e) "Public Works Contract" means a contract with a **City Agency** for a construction program or project involving the construction, demolition, restoration, rehabilitation, repair, renovation, or abatement of any building, structure, tunnel, excavation, roadway, park or bridge; a contract with a **City Agency** for the preparation for any construction program or project involving the construction, demolition, restoration, rehabilitation, repair, renovation, or abatement of any building, structure, tunnel, excavation, roadway, park or bridge; or a contract with a **City Agency** for any final work involved in the completion of any construction program or project involving the construction, demolition, restoration, rehabilitation, repair, renovation, or abatement of any building, structure, tunnel, excavation, roadway, park or bridge.

5.4.1(f) "Ultra Low Sulfur Diesel Fuel" means diesel fuel that has a sulfur content of no more than fifteen parts per million (15 ppm).

#### 5.4.2 Ultra Low Sulfur Diesel Fuel

5.4.2(a) All **Contractors** shall use Ultra Low Sulfur Diesel Fuel in diesel-powered Nonroad Vehicles in the performance of this **Contract**.

5.4.2(b) Notwithstanding the requirements of Article 5.4.2(a), **Contractors** may use diesel fuel that has a sulfur content of no more than thirty parts per million (30 ppm) to fulfill the requirements of this Article 5.4.2, where the Commissioner of the **City** Department of Environmental Protection ("DEP Commissioner") has issued a determination that a sufficient quantity of Ultra Low Sulfur Diesel Fuel is not available to meet the needs of **Agencies** and **Contractors**. Any such determination shall expire after six (6) months unless renewed.

5.4.2(c) **Contractors** shall not be required to comply with this Article 5.4.2 where the **City Agency** letting this **Contract** makes a written finding, which is approved, in writing, by the DEP Commissioner, that a sufficient quantity of Ultra Low Sulfur Diesel Fuel, or diesel fuel that has a sulfur content of no more than thirty parts per million (30 ppm) is not available to meet the requirements of Section 24-163.3 of the Administrative Code, provided that such **Contractor** in its fulfillment of the

requirements of this **Contract**, to the extent practicable, shall use whatever quantity of Ultra Low Sulfur Diesel Fuel or diesel fuel that has a sulfur content of no more than thirty parts per million (30 ppm) is available. Any finding made pursuant to this Article 5.4.2(c) shall expire after sixty (60) **Days**, at which time the requirements of this Article 5.4.2 shall be in full force and effect unless the **City Agency** renews the finding in writing and such renewal is approved by the DEP Commissioner.

5.4.2(d) **Contractors** may check on determinations and approvals issued by the DEP Commissioner pursuant to Section 24-163.3 of the Administrative Code, if any, at [www.dep.nyc.gov](http://www.dep.nyc.gov) or by contacting the **City Agency** letting this **Contract**.

5.4.2(e) The requirements of this Article 5.4.2 do not apply where they are precluded by federal or State funding requirements or where the **Contract** is an emergency procurement.

#### 5.4.3 Best Available Technology

5.4.3(a) All **Contractors** shall utilize the best available technology for reducing the emission of pollutants for diesel-powered Nonroad Vehicles in the performance of this **Contract**. For determinations of best available technology for each type of diesel-powered Nonroad Vehicle, **Contractors** shall comply with the regulations of the **City Department of Environmental Protection**, as and when adopted, Chapter 14 of Title 15 of the Rules of the City of New York (RCNY). The **Contractor** shall fully document all steps in the best available technology selection process and shall furnish such documentation to the **City Agency** or the DEP Commissioner upon request. The **Contractor** shall retain all documentation generated in the best available technology selection process for as long as the selected best available technology is in use.

5.4.3(b) No **Contractor** shall be required to replace best available technology for reducing the emission of pollutants or other authorized technology utilized for a diesel-powered Nonroad Vehicle in accordance with the provisions of this Article 5.4.3 within three (3) years of having first utilized such technology for such vehicle.

5.4.3(c) This Article 5.4.3 shall not apply to any vehicle used to satisfy the requirements of a specific Public Works Contract for fewer than twenty (20) **Days**.

5.4.3(d) The **Contractor** shall not be required to comply with this Article 5.4.3 with respect to a diesel-powered Nonroad Vehicle under the following circumstances:

5.4.3(d)(i) Where the **City Agency** makes a written finding, which is approved, in writing, by the DEP Commissioner, that the best available technology for reducing the emission of pollutants as required by this Article 5.4.3 is unavailable for such vehicle, the **Contractor** shall use whatever technology for reducing the emission of pollutants, if any, is available and appropriate for such vehicle.

5.4.3(d)(ii) Where the DEP Commissioner has issued a written waiver based upon the **Contractor** having demonstrated to the DEP Commissioner that the use of the best available technology for reducing the emission of pollutants might endanger the operator of such vehicle or those working near such vehicle, due to engine malfunction, the **Contractor** shall use whatever technology for

reducing the emission of pollutants, if any, is available and appropriate for such vehicle, which would not endanger the operator of such vehicle or those working near such vehicle.

5.4.3(d)(iii) In determining which technology to use for the purposes of Articles 5.4.3(d)(i) and 5.4.3(d)(ii) above, the **Contractor** shall primarily consider the reduction in emissions of particulate matter and secondarily consider the reduction in emissions of nitrogen oxides associated with the use of such technology, which shall in no event result in an increase in the emissions of either such pollutant.

5.4.3(d)(iv) The **Contractor** shall submit requests for a finding or a waiver pursuant to this Article 5.4.3(d) in writing to the DEP Commissioner, with a copy to the **ACCO** of the **City Agency** letting this **Contract**. Any finding or waiver made or issued pursuant to Articles 5.4.3(d)(i) and 5.4.3(d)(ii) above shall expire after one hundred eighty (180) **Days**, at which time the requirements of Article 5.4.3(a) shall be in full force and effect unless the **City Agency** renews the finding, in writing, and the DEP Commissioner approves such finding, in writing, or the DEP Commissioner renews the waiver, in writing.

5.4.3(e) The requirements of this Article 5.4.3 do not apply where they are precluded by federal or State funding requirements or where the **Contract** is an emergency procurement.

5.4.4 Section 24-163 of the Administrative Code. The **Contractor** shall comply with Section 24-163 of the Administrative Code related to the idling of the engines of motor vehicles while parking.

#### 5.4.5 Compliance

5.4.5(a) The **Contractor's** compliance with Article 5.4 may be independently monitored. If it is determined that the **Contractor** has failed to comply with any provision of Article 5.4, any costs associated with any independent monitoring incurred by the **City** shall be reimbursed by the **Contractor**.

5.4.5(b) Any **Contractor** who violates any provision of Article 5.4, except as provided in Article 5.4.5(c) below, shall be liable for a civil penalty between the amounts of one thousand (\$1,000) and ten thousand (\$10,000) dollars, in addition to twice the amount of money saved by such **Contractor** for failure to comply with Article 5.4.

5.4.5(c) No **Contractor** shall make a false claim with respect to the provisions of Article 5.4 to a **City Agency**. Where a **Contractor** has been found to have done so, such **Contractor** shall be liable for a civil penalty of twenty thousand (\$20,000) dollars, in addition to twice the amount of money saved by such **Contractor** in association with having made such false claim.

#### 5.4.6 Reporting

5.4.6(a) For all Public Works Contracts covered by this Article 5.4, the **Contractor** shall report to the **City Agency** the following information:



5.4.6(a)(i) The total number of diesel-powered Nonroad Vehicles used to fulfill the requirements of this Public Works Contract;

5.4.6(a)(ii) The number of such Nonroad Vehicles that were powered by Ultra Low Sulfur Diesel Fuel;

5.4.6(a)(iii) The number of such Nonroad Vehicles that utilized the best available technology for reducing the emission of pollutants, including a breakdown by vehicle model and the type of technology;

5.4.6(a)(iv) The number of such Nonroad Vehicles that utilized such other authorized technology in accordance with Article 5.4.3, including a breakdown by vehicle model and the type of technology used for each such vehicle;

5.4.6(a)(v) The locations where such Nonroad Vehicles were used; and

5.4.6(a)(vi) Where a determination is in effect pursuant to Article 5.4.2(b) or 5.4.2(c), detailed information concerning the **Contractor's** efforts to obtain Ultra Low Sulfur Diesel Fuel or diesel fuel that has a sulfur content of no more than thirty parts per million (30 ppm).

5.4.6(b) The **Contractor** shall submit the information required by Article 5.4.6(a) at the completion of **Work** under the Public Works Contract and on a yearly basis no later than August 1 throughout the term of the Public Works Contract. The yearly report shall cover **Work** performed during the preceding fiscal year (July 1 - June 30).

5.5 Ultra Low Sulfur Diesel Fuel. In accordance with the Coordinated Construction Act for Lower Manhattan, as amended:

5.5.1 Definitions. For purposes of this Article 5.5, the following definitions apply:

5.5.1(a) "Lower Manhattan" means the area to the south of and within the following lines: a line beginning at a point where the United States pierhead line in the Hudson River as it exists now or may be extended would intersect with the southerly line of West Houston Street in the Borough of Manhattan extended, thence easterly along the southerly side of West Houston Street to the southerly side of Houston Street, thence easterly along the southerly side of Houston Street to the southerly side of East Houston Street, thence northeasterly along the southerly side of East Houston Street to the point where it would intersect with the United States pierhead line in the East River as it exists now or may be extended, including tax lots within or immediately adjacent thereto.

5.5.1(b) "Lower Manhattan Redevelopment Project" means any project in Lower Manhattan that is funded in whole or in part with federal or State funding, or any project intended to improve transportation between Lower Manhattan and the two air terminals in the City known as LaGuardia Airport and John F. Kennedy International Airport, or between Lower Manhattan and the air terminal in Newark known as Newark Liberty International Airport, and that is funded in whole or in part with federal funding.

5.5.1(c) "Nonroad Engine" means an internal combustion engine (including the fuel system) that is not used in a Motor Vehicle or a vehicle used solely for competition, or that is not subject to standards promulgated under Section 7411 or Section 7521 of Title 42 of the United States Code, except that this term shall apply to internal combustion engines used to power generators, compressors or similar equipment used in any construction program or project.

5.5.1(d) "Nonroad Vehicle" means a vehicle that is powered by a Nonroad Engine, fifty (50) horsepower (HP) and greater, and that is not a Motor Vehicle or a vehicle used solely for competition, which shall include, but not be limited to, excavators, backhoes, cranes, compressors, generators, bulldozers, and similar equipment, except that this terms shall not apply to horticultural maintenance vehicles used for landscaping purposes that are powered by a Nonroad Engine of sixty-five (65) HP or less and that are not used in any construction program or project.

5.5.1(e) "Ultra Low Sulfur Diesel Fuel" means diesel fuel that has a sulfur content of no more than fifteen parts per million (15 ppm).

5.5.2 Requirements. **Contractors** and **Subcontractors** are required to use only Ultra Low Sulfur Diesel Fuel to power the diesel-powered Nonroad Vehicles with engine HP rating of fifty (50) HP and above used on a Lower Manhattan Redevelopment Project and, where practicable, to reduce the emission of pollutants by retrofitting such Nonroad Vehicles with oxidation catalysts, particulate filters, or technology that achieves lowest particulate matter emissions.

5.6 Pesticides. In accordance with Section 17-1209 of the Administrative Code, to the extent that the **Contractor** or any **Subcontractor** applies pesticides to any property owned or leased by the **City**, the **Contractor**, and any **Subcontractor** shall comply with Chapter 12 of the Administrative Code.

5.7 Waste Treatment, Storage, and Disposal Facilities and Transporters. In connection with the **Work**, the **Contractor** and any **Subcontractor** shall use only those waste treatment, storage, and disposal facilities and waste transporters that possess the requisite license, permit or other governmental approval necessary to treat, store, dispose, or transport the waste, materials or hazardous substances.

5.8 Environmentally Preferable Purchasing. The **Contractor** shall ensure that products purchased or leased by the **Contractor** or any **Subcontractor** for the **Work** that are not specified by the **City** or are submitted as equivalents to a product specified by the **City** comply with the requirements of the New York City Environmentally Preferable Purchasing Program contained in Chapter 11 of Title 43 of the RCNY, pursuant to Chapter 3 of Title 6 of the Administrative Code.

## **ARTICLE 6. INSPECTION**

6.1 During the progress of the **Work** and up to the date of **Final Acceptance**, the **Contractor** shall at all times afford the representatives of the **City** every reasonable, safe, and proper facility for inspecting all **Work** done or being done at the **Site** and also for inspecting the manufacture or preparation of materials and equipment at the place of such manufacture or preparation.

6.2 The **Contractor's** obligation hereunder shall include the uncovering or taking down of finished **Work** and its restoration thereafter; provided, however, that the order to uncover, take down and restore shall be in writing, and further provided that if **Work** thus exposed proves satisfactory, and if the **Contractor** has complied with Article 6.1, such uncovering or taking down and restoration shall be

considered an item of **Extra Work** to be paid for in accordance with the provisions of Article 26. If the **Work** thus exposed proves unsatisfactory, the **City** has no obligation to compensate the **Contractor** for the uncovering, taking down or restoration.

6.3 Inspection and approval by the **Commissioner**, the **Engineer**, **Project Manager**, or **Resident Engineer**, of finished **Work** or of **Work** being performed, or of materials and equipment at the place of manufacture or preparation, shall not relieve the **Contractor** of its obligation to perform the **Work** in strict accordance with the **Contract**. Finished or unfinished **Work** not found to be in strict accordance with the **Contract** shall be replaced as directed by the **Engineer**, even though such **Work** may have been previously approved and paid for. Such corrective **Work** is **Contract Work** and shall not be deemed **Extra Work**.

6.4 Rejected **Work** and materials shall be promptly taken down and removed from the **Site**, which must at all times be kept in a reasonably clean and neat condition.

## **ARTICLE 7. PROTECTION OF WORK AND OF PERSONS AND PROPERTY; NOTICES AND INDEMNIFICATION**

7.1 During the performance of the **Work** and up to the date of **Final Acceptance**, the **Contractor** shall be under an absolute obligation to protect the finished and unfinished **Work** against any damage, loss, injury, theft and/or vandalism and in the event of such damage, loss, injury, theft and/or vandalism, it shall promptly replace and/or repair such **Work** at the **Contractor's** sole cost and expense, as directed by the **Resident Engineer**. The obligation to deliver finished **Work** in strict accordance with the **Contract** prior to **Final Acceptance** shall be absolute and shall not be affected by the **Resident Engineer's** approval of, or failure to prohibit, the **Means and Methods of Construction** used by the **Contractor**.

7.2 During the performance of the **Work** and up to the date of **Final Acceptance**, the **Contractor** shall take all reasonable precautions to protect all persons and the property of the **City** and of others from damage, loss or injury resulting from the **Contractor's**, and/or its **Subcontractors'** operations under this **Contract**. The **Contractor's** obligation to protect shall include the duty to provide, place or replace, and adequately maintain at or about the **Site** suitable and sufficient protection such as lights, barricades, and enclosures.

7.3 The **Contractor** shall comply with the notification requirements set forth below in the event of any loss, damage or injury to **Work**, persons or property, or any accidents arising out of the operations of the **Contractor** and/or its **Subcontractors** under this **Contract**.

7.3.1 The **Contractor** shall make a full and complete report in writing to the **Resident Engineer** within three (3) **Days** after the occurrence.

7.3.2 The **Contractor** shall also send written notice of any such event to all insurance carriers that issued potentially responsive policies (including commercial general liability insurance carriers for events relating to the **Contractor's** own employees) no later than twenty (20) days after such event and again no later than twenty (20) days after the initiation of any claim and/or action resulting therefrom. Such notice shall contain the following information: the number of the insurance policy, the name of the Named Insured, the date and location of the incident, and the identity of the persons injured or property damaged. For any policy on which the **City** and/or the **Engineer**, **Architect**, or **Project Manager** are Additional Insureds, such notice shall expressly specify that "this notice is

being given on behalf of the City of New York as Additional Insured, such other Additional Insureds, as well as the Named Insured.”

7.3.2(a) Whenever such notice is sent under a policy on which the **City** is an Additional Insured, the **Contractor** shall provide copies of the notice to the **Comptroller**, the **Commissioner** and the **City Corporation Counsel**. The copy to the **Comptroller** shall be sent to the Insurance Unit, NYC Comptroller’s Office, 1 Centre Street – Room 1222, New York, New York, 10007. The copy to the **Commissioner** shall be sent to the address set forth in Schedule A of the General Conditions. The copy to the **City Corporation Counsel** shall be sent to Insurance Claims Specialist, Affirmative Litigation Division, New York City Law Department, 100 Church Street, New York, New York 10007.

7.3.2(b) If the **Contractor** fails to provide any of the foregoing notices to any appropriate insurance carrier(s) in a timely and complete manner, the **Contractor** shall indemnify the **City** for all losses, judgments, settlements, and expenses, including reasonable attorneys’ fees, arising from an insurer’s disclaimer of coverage citing late notice by or on behalf of the **City**.

7.4 To the fullest extent permitted by law, the **Contractor** shall defend, indemnify, and hold the **City**, its employees, and officials (the “Indemnitees”) harmless against any and all claims (including but not limited to claims asserted by any employee of the **Contractor** and/or its **Subcontractors**) and costs and expenses of whatever kind (including but not limited to payment or reimbursement of attorneys’ fees and disbursements) allegedly arising out of or in any way related to the operations of the **Contractor** and/or its **Subcontractors** in the performance of this **Contract** or from the **Contractor’s** and/or its **Subcontractors’** failure to comply with any of the provisions of this **Contract** or of the **Law**. Such costs and expenses shall include all those incurred in defending the underlying claim and those incurred in connection with the enforcement of this Article 7.4 by way of cross-claim, third-party claim, declaratory action or otherwise. The parties expressly agree that the indemnification obligation hereunder contemplates (1) full indemnity in the event of liability imposed against the Indemnitees without negligence and solely by reason of statute, operation of **Law** or otherwise; and (2) partial indemnity in the event of any actual negligence on the part of the Indemnitees either causing or contributing to the underlying claim (in which case, indemnification will be limited to any liability imposed over and above that percentage attributable to actual fault whether by statute, by operation of **Law**, or otherwise). Where partial indemnity is provided hereunder, all costs and expenses shall be indemnified on a pro rata basis.

7.4.1 Indemnification under Article 7.4 or any other provision of the **Contract** shall operate whether or not **Contractor** or its **Subcontractors** have placed and maintained the insurance specified under Article 22.

7.5 The provisions of this Article 7 shall not be deemed to create any new right of action in favor of third parties against the **Contractor** or the **City**.

### **CHAPTER III: TIME PROVISIONS**

#### **ARTICLE 8. COMMENCEMENT AND PROSECUTION OF THE WORK**

8.1 The **Contractor** shall commence the **Work** on the date specified in the **Notice to Proceed** or the **Order to Work**. The time for performance of the **Work** under the **Contract** shall be computed from

the date specified in the **Notice to Proceed** or the **Order to Work**. **TIME BEING OF THE ESSENCE** to the **City**, the **Contractor** shall thereafter prosecute the **Work** diligently, using such **Means and Methods of Construction** as are in accord with Article 4 herein and as will assure its completion not later than the date specified in this Contract, or on the date to which the time for completion may be extended.

#### **ARTICLE 9. PROGRESS SCHEDULES**

9.1 To enable the **Work** to be performed in an orderly and expeditious manner, the **Contractor**, within fifteen (15) **Days** after the **Notice to Proceed** or **Order to Work**, unless otherwise directed by the **Engineer**, shall submit to the **Engineer** a proposed progress schedule based on the Critical Path Method in the form of a bar graph or in such other form as specified by the **Engineer**, and monthly cash flow requirements, showing:

9.1.1 The anticipated time of commencement and completion of each of the various operations to be performed under this **Contract**; and

9.1.2 The sequence and interrelation of each of these operations with the others and with those of other related contracts; and

9.1.3 The estimated time required for fabrication or delivery, or both, of all materials and equipment required for the **Work**, including the anticipated time for obtaining required approvals pursuant to Article 10; and

9.1.4 The estimated amount in dollars the **Contractor** will claim on a monthly basis.

9.2 The proposed schedule shall be revised as directed by the **Engineer**, until finally approved by the **Engineer**, and after such approval, subject to the provisions of Article 11, shall be strictly adhered to by the **Contractor**.

9.3 If the **Contractor** shall fail to adhere to the approved progress schedule, or to the schedule as revised pursuant to Article 11, it shall promptly adopt such other or additional **Means and Methods of Construction**, at its sole cost and expense, as will make up for the time lost and will assure completion in accordance with the approved progress schedule. The approval by the **City** of a progress schedule which is shorter than the time allotted under the **Contract** shall not create any liability for the **City** if the approved progress schedule is not met.

9.4 The **Contractor** will not receive any payments until the proposed progress schedule is submitted.

#### **ARTICLE 10. REQUESTS FOR INFORMATION OR APPROVAL**

10.1 From time to time as the **Work** progresses and in the sequence indicated by the approved progress schedule, the **Contractor** shall submit to the **Engineer** a specific request in writing for each item of information or approval required by the **Contractor**. These requests shall state the latest date upon which the information or approval is actually required by the **Contractor**, and shall be submitted in a reasonable time in advance thereof to provide the **Engineer** a sufficient time to act upon such submissions, or any necessary re-submissions thereof.

10.2 The **Contractor** shall not have any right to an extension of time on account of delays due to the **Contractor's** failure to submit requests for the required information or the required approval in accordance with the above requirements.

**ARTICLE 11. NOTICE OF CONDITIONS CAUSING DELAY AND DOCUMENTATION OF DAMAGES CAUSED BY DELAY**

11.1 After the commencement of any condition which is causing or may cause a delay in completion of the **Work**, including conditions for which the **Contractor** may be entitled to an extension of time, the following notifications and submittals are required:

11.1.1 Within fifteen (15) **Days** after the **Contractor** becomes aware or reasonably should be aware of each such condition, the **Contractor** must notify the **Resident Engineer** or **Engineer**, as directed by the **Commissioner**, in writing of the existence, nature and effect of such condition upon the approved progress schedule and the **Work**, and must state why and in what respects, if any, the condition is causing or may cause a delay. Such notice shall include a description of the construction activities that are or could be affected by the condition and may include any recommendations the **Contractor** may have to address the delay condition and any activities the **Contractor** may take to avoid or minimize the delay.

11.1.2 If the **Contractor** shall claim to be sustaining damages for delay as provided for in this Article 11, within forty-five (45) **Days** from the time such damages are first incurred for each such condition, the **Contractor** shall submit to the **Commissioner** a verified written statement of the details and estimates of the amounts of such damages, including categories of expected damages and projected monthly costs, together with documentary evidence of such damages as the **Contractor** may have at the time of submission ("statement of delay damages"), as further detailed in Article 11.6. The **Contractor** may submit the above statement within such additional time as may be granted by the **Commissioner** in writing upon written request therefor.

11.1.3 Articles 11.1.1 and 11.1.2 do not relieve the **Contractor** of its obligation to comply with the provisions of Article 44.

11.2 Failure of the **Contractor** to strictly comply with the requirements of Article 11.1.1 may, in the discretion of the **Commissioner**, be deemed sufficient cause to deny any extension of time on account of delay arising out of such condition. Failure of the **Contractor** to strictly comply with the requirements of both Articles 11.1.1 and 11.1.2 shall be deemed a conclusive waiver by the **Contractor** of any and all claims for damages for delay arising from such condition and no right to recover on such claims shall exist.

11.3 When appropriate and directed by the **Engineer**, the progress schedule shall be revised by the **Contractor** until finally approved by the **Engineer**. The revised progress schedule must be strictly adhered to by the **Contractor**.

11.4 **Compensable Delays**

11.4.1 The **Contractor** agrees to make claim only for additional costs attributable to delay in the performance of this **Contract** necessarily extending the time for completion of the **Work** or resulting from acceleration directed by the **Commissioner** and required to maintain the progress schedule, occasioned solely by any act or omission to act of the **City** listed below. The **Contractor** also agrees that delay from any other cause shall be

compensated, if at all, solely by an extension of time to complete the performance of the **Work**.

- 11.4.1.1 The failure of the **City** to take reasonable measures to coordinate and progress the **Work** to the extent required by the **Contract**, except that the **City** shall not be responsible for the **Contractor's** obligation to coordinate and progress the **Work** of its **Subcontractors**.
- 11.4.1.2 Unreasonable delays attributable to the review of shop drawings, the issuance of change orders, or the cumulative impact of change orders that were not brought about by any act or omission of the **Contractor**.
- 11.4.1.3 The unavailability of the **Site** caused by acts or omissions of the **City**.
- 11.4.1.4 The issuance by the **Engineer** of a stop work order that was not brought about through any act or omission of the **Contractor**.
- 11.4.1.5 Differing site conditions or environmental hazards that were neither known nor reasonably ascertainable on a pre-bid inspection of the **Site** or review of the bid documents or other publicly available sources, and that are not ordinarily encountered in the **Project's** geographical area or neighborhood or in the type of **Work** to be performed.
- 11.4.1.6 Delays caused by the **City's** bad faith or its willful, malicious, or grossly negligent conduct;
- 11.4.1.7 Delays not contemplated by the parties;
- 11.4.1.8 Delays so unreasonable that they constitute an intentional abandonment of the **Contract** by the **City**; and
- 11.4.1.9 Delays resulting from the **City's** breach of a fundamental obligation of the **Contract**.

11.4.2 No claim may be made for any alleged delay in **Substantial Completion** of the **Work** if the **Work** will be or is substantially completed by the date of **Substantial Completion** provided for in Schedule A unless acceleration has been directed by the **Commissioner** to meet the date of **Substantial Completion** set forth in Schedule A, or unless there is a provision in the **Contract** providing for additional compensation for early completion.

11.4.3 The provisions of this Article 11 apply only to claims for additional costs attributable to delay and do not preclude determinations by the **Commissioner** allowing reimbursements for additional costs for **Extra Work** pursuant to Articles 25 and 26 of this **Contract**. To the extent that any cost attributable to delay is reimbursed as part of a change order, no additional claim for compensation under this Article 11 shall be allowed.

11.5 **Non-Compensable Delays.** The **Contractor** agrees to make no claim for, and is deemed to have included in its bid prices for the various items of the **Contract**, the extra/additional costs attributable to any delays caused by or attributable to the items set forth below. For such items, the **Contractor** shall be compensated, if at all, solely by an extension of time to complete the performance of the **Work**, in accordance with the provisions of Article 13. Such extensions of time will be granted, if at all, pursuant to the grounds set forth in Article 13.3.

11.5.1 The acts or omissions of any third parties, including but not limited to **Other Contractors**, public/ governmental bodies (other than **City Agencies**), utilities or private enterprises, who are disclosed in the **Contract Documents** or are ordinarily encountered or generally recognized as related to the **Work**;

11.5.2 Any situation which was within the contemplation of the parties at the time of entering into the **Contract**, including any delay indicated or disclosed in the **Contract Documents** or that would be generally recognized by a reasonably prudent contractor as related to the nature of the **Work**, and/or the existence of any facility or appurtenance owned, operated or maintained by any third party, as indicated or disclosed in the **Contract Documents** or ordinarily encountered or generally recognized as related to the nature of the **Work**;

11.5.3 Restraining orders, injunctions or judgments issued by a court which were caused by a Contractor's submission, action or inaction or by a Contractor's **Means and Methods of Construction**, or by third parties, unless such order, injunction or judgment was the result of an act or omission by the **City**;

11.5.4 Any labor boycott, strike, picketing, lockout or similar situation;

11.5.5 Any shortages of supplies or materials, or unavailability of equipment, required by the **Contract Work**;

11.5.6 Climatic conditions, storms, floods, droughts, tidal waves, fires, hurricanes, earthquakes, landslides or other catastrophes or acts of God, or acts of war or of the public enemy or terrorist acts, including the **City's** reasonable responses thereto; and

11.5.7 **Extra Work** which does not significantly affect the overall completion of the **Contract**, reasonable delays in the review or issuance of change orders or field orders and/or in shop drawing reviews or approvals.

#### 11.6 Required Content of Submission of Statement of Delay Damages

11.6.1 In the verified written statement of delay damages required by Article 11.1.2, the following information shall be provided by the **Contractor**:

11.6.1.1 For each delay, the start and end dates of the claimed periods of delay and, in addition, a description of the operations that were delayed, an explanation of how they were delayed, and the reasons for the delay, including identifying the applicable act or omission of the **City** listed in Article 11.4.

11.6.1.2 A detailed factual statement of the claim providing all necessary dates, locations and items of **Work** affected by the claim.

11.6.1.3 The estimated amount of additional compensation sought and a breakdown of that amount into categories as described in Article 11.7.

11.6.1.4 Any additional information requested by the **Commissioner**.

#### 11.7 Recoverable Costs

11.7.1 Delay damages may be recoverable for the following costs actually and necessarily incurred in the performance of the **Work**:

11.7.1.1 Direct labor, including payroll taxes (subject to statutory wage caps) and supplemental benefits, based on time and materials records;

11.7.1.2 Necessary materials (including transportation to the **Site**), based on time and material records;



- 11.7.1.3 Reasonable rental value of necessary plant and equipment other than small tools, plus fuel/energy costs according to the applicable formula set forth in Articles 26.2.4 and/or 26.2.8, based on time and material records;
- 11.7.1.4 Additional insurance and bond costs;
- 11.7.1.5 Extended **Site** overhead, field office rental, salaries of field office staff, on-site project managers and superintendents, field office staff vehicles, **Project**-specific storage, field office utilities and telephone, and field office consumables;
- 11.7.1.6 Labor escalation costs based on actual costs;
- 11.7.1.7 Materials and equipment escalation costs based on applicable industry indices unless documentation of actual increased cost is provided;
- 11.7.1.8 Additional material and equipment storage costs based on actual documented costs and additional costs necessitated by extended manufacturer warranty periods; and
- 11.7.1.9 Extended home office overhead calculated based on the following formula:
  - (1) Subtract from the original **Contract** amount the amount earned by original contractual **Substantial Completion** date (not including change orders);
  - (2) Remove 15% overhead and profit from the calculation in item (1) by dividing the results of item (1) by 1.15;
  - (3) Multiply the result of item (2) by 7.25% for the total home office overhead;
  - (4) Multiply the result of item (3) by 7.25% for the total profit; and
  - (5) The total extended home office overhead will be the total of items (3) and (4).

11.7.2 Recoverable Subcontractor Costs. When the **Work** is performed by a **Subcontractor**, the **Contractor** may be paid the actual and necessary costs of such subcontracted **Work** as outlined above in Articles 11.7.1.1 through 11.7.1.8, and an additional overhead of 5% of the costs outlined in Articles 11.7.1.1 through 11.7.1.3.

11.7.3 Non-Recoverable Costs. The parties agree that the **City** will have no liability for the following items and the **Contractor** agrees it shall make no claim for the following items:

- 11.7.3.1 Profit, or loss of anticipated or unanticipated profit, except as provided in Article 11.7.1.9;
- 11.7.3.2 Consequential damages, including, but not limited to, construction or bridge loans or interest paid on such loans, loss of bonding capacity, bidding opportunities, or interest in investment, or any resulting insolvency;
- 11.7.3.3 Indirect costs or expenses of any nature except those included in Article 11.7.1;
- 11.7.3.4 Direct or indirect costs attributable to performance of **Work** where the **Contractor**, because of situations or conditions within its control, has not progressed the **Work** in a satisfactory manner; and
- 11.7.3.5 Attorneys' fees and dispute and claims preparation expenses.

- 11.8 Any claims for delay under this Article 11 are not subject to the jurisdiction of the Contract Dispute Resolution Board pursuant to the dispute resolution process set forth in Article 27.
- 11.9 Any compensation provided to the **Contractor** in accordance with this Article 11 will be made pursuant to a claim filed with the **Comptroller**. Nothing in this Article 11 extends the time for the **Contractor** to file an action with respect to a claim within six months after **Substantial Completion** pursuant to Article 56.

## **ARTICLE 12. COORDINATION WITH OTHER CONTRACTORS**

12.1 During the progress of the **Work**, **Other Contractors** may be engaged in performing other work or may be awarded other contracts for additional work on this **Project**. In that event, the **Contractor** shall coordinate the **Work** to be done hereunder with the work of such **Other Contractors** and the **Contractor** shall fully cooperate with such **Other Contractors** and carefully fit its own **Work** to that provided under other contracts as may be directed by the **Engineer**. The **Contractor** shall not commit or permit any act which will interfere with the performance of work by any **Other Contractors**.

12.2 If the **Engineer** determines that the **Contractor** is failing to coordinate its **Work** with the work of **Other Contractors** as the **Engineer** has directed, then the **Commissioner** shall have the right to withhold any payments otherwise due hereunder until the **Contractor** completely complies with the **Engineer's** directions.

12.3 The **Contractor** shall notify the **Engineer** in writing if any **Other Contractor** on this **Project** is failing to coordinate its work with the **Work** of this **Contract**. If the **Engineer** finds such charges to be true, the **Engineer** shall promptly issue such directions to the **Other Contractor** with respect thereto as the situation may require. The **City** shall not, however, be liable for any damages suffered by any **Other Contractor's** failure to coordinate its work with the **Work** of this **Contract** or by reason of the **Other Contractor's** failure to promptly comply with the directions so issued by the **Engineer**, or by reason of any **Other Contractor's** default in performance, it being understood that the **City** does not guarantee the responsibility or continued efficiency of any contractor. The **Contractor** agrees to make no claim against the **City** for any damages relating to or arising out of any directions issued by the **Engineer** pursuant to this Article 12 (including but not limited to the failure of any **Other Contractor** to comply or promptly comply with such directions), or the failure of any **Other Contractor** to coordinate its work, or the default in performance of any **Other Contractor**.

12.4 The **Contractor** shall indemnify and hold the **City** harmless from any and all claims or judgments for damages and from costs and expenses to which the **City** may be subjected or which it may suffer or incur by reason of the **Contractor's** failure to comply with the **Engineer's** directions promptly; and the **Comptroller** shall have the right to exercise the powers reserved in Article 23 with respect to any claims which may be made for damages due to the **Contractor's** failure to comply with the **Engineer's** directions promptly. Insofar as the facts and **Law** relating to any claim would preclude the **City** from being completely indemnified by the **Contractor**, the **City** shall be partially indemnified by the **Contractor** to the fullest extent provided by **Law**.

12.5 Should the **Contractor** sustain any damage through any act or omission of any **Other Contractor** having a contract with the **City** for the performance of work upon the **Site** or of work which may be necessary to be performed for the proper prosecution of the **Work** to be performed hereunder, or through any act or omission of a subcontractor of such **Other Contractor**, the **Contractor** shall have no claim against the **City** for such damage, but shall have a right to recover such damage from the **Other**

**Contractor** under the provision similar to the following provisions which apply to this **Contract** and have been or will be inserted in the contracts with such **Other Contractors**:

12.5.1 Should any **Other Contractor** having or who shall hereafter have a contract with the **City** for the performance of work upon the **Site** sustain any damage through any act or omission of the **Contractor** hereunder or through any act or omission of any **Subcontractor** of the **Contractor**, the **Contractor** agrees to reimburse such **Other Contractor** for all such damages and to defend at its own expense any action based upon such claim and if any judgment or claim (even if the allegations of the action are without merit) against the **City** shall be allowed the **Contractor** shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith and agrees to indemnify and hold the **City** harmless from all such claims. Insofar as the facts and **Law** relating to any claim would preclude the **City** from being completely indemnified by the **Contractor**, the **City** shall be partially indemnified by the **Contractor** to the fullest extent provided by **Law**.

12.6 The **City's** right to indemnification hereunder shall in no way be diminished, waived or discharged by its recourse to assessment of liquidated damages as provided in Article 15, or by the exercise of any other remedy provided for by **Contract** or by **Law**.

### **ARTICLE 13. EXTENSION OF TIME FOR PERFORMANCE**

13.1 If performance by the **Contractor** is delayed for a reason set forth in Article 13.3, the **Contractor** may be allowed a reasonable extension of time in conformance with this Article 13 and the **PPB Rules**.

13.2 Any extension of time may be granted only by the **ACCO** or by the Board for the Extension of Time (hereafter "Board") (as set forth below) upon written application by the **Contractor**.

13.3 Grounds for Extension: If such application is made, the **Contractor** shall be entitled to an extension of time for delay in completion of the **Work** caused solely:

13.3.1 By the acts or omissions of the **City**, its officials, agents or employees; or

13.3.2 By the act or omissions of **Other Contractors** on this **Project**; or

13.3.3 By supervening conditions entirely beyond the control of either party hereto (such as, but not limited to, acts of God or the public enemy, excessive inclement weather, war or other national emergency making performance temporarily impossible or illegal, or strikes or labor disputes not brought about by any act or omission of the **Contractor**).

13.3.4 The **Contractor** shall, however, be entitled to an extension of time for such causes only for the number of **Days** of delay which the **ACCO** or the Board may determine to be due solely to such causes, and then only if the **Contractor** shall have strictly complied with all of the requirements of Articles 9 and 10.

13.4 The **Contractor** shall not be entitled to receive a separate extension of time for each of several causes of delay operating concurrently, but, if at all, only for the actual period of delay in completion of the **Work** as determined by the **ACCO** or the Board, irrespective of the number of causes contributing to produce such delay. If one of several causes of delay operating concurrently results from any act, fault or omission of the **Contractor** or of its **Subcontractors** or **Materialmen**, and would of itself (irrespective

of the concurrent causes) have delayed the **Work**, no extension of time will be allowed for the period of delay resulting from such act, fault or omission.

13.5 The determination made by the **ACCO** or the Board on an application for an extension of time shall be binding and conclusive on the **Contractor**.

13.6 The **ACCO** or the Board acting entirely within their discretion may grant an application for an extension of time for causes of delay other than those herein referred.

13.7 Permitting the **Contractor** to continue with the **Work** after the time fixed for its completion has expired, or after the time to which such completion may have been extended has expired, or the making of any payment to the **Contractor** after such time, shall in no way operate as a waiver on the part of the **City** of any of its rights under this **Contract**.

13.8 Application for Extension of Time:

13.8.1 Before the **Contractor's** time extension request will be considered, the **Contractor** shall notify the **ACCO** of the condition which allegedly has caused or is causing the delay, and shall submit a written application to the **ACCO** identifying:

13.8.1(a) The **Contractor**; the registration number; and **Project** description;

13.8.1(b) Liquidated damage assessment rate, as specified in the **Contract**;

13.8.1(c) Original total bid price;

13.8.1(d) The original **Contract** start date and completion date;

13.8.1(e) Any previous time extensions granted (number and duration); and

13.8.1(f) The extension of time requested.

13.8.2 In addition, the application for extension of time shall set forth in detail:

13.8.2(a) The nature of each alleged cause of delay in completing the **Work**;

13.8.2(b) The date upon which each such cause of delay began and ended and the number of **Days** attributable to each such cause;

13.8.2(c) A statement that the **Contractor** waives all claims except for those delineated in the application, and the particulars of any claims which the **Contractor** does not agree to waive. For time extensions for **Substantial Completion** and final completion payments, the application shall include a detailed statement of the dollar amounts of each element of claim item reserved; and

13.8.2(d) A statement indicating the **Contractor's** understanding that the time extension is granted only for purposes of permitting continuation of **Contract** performance and payment for **Work** performed and that the **City** retains its right to conduct an investigation and assess liquidated damages as appropriate in the future.

13.9 Analysis and Approval of Time Extensions:

13.9.1 For time extensions for partial payments, a written determination shall be made by the **ACCO** who may, for good and sufficient cause, extend the time for the performance of the **Contract** as follows:

13.9.1(a) If the **Work** is to be completed within six (6) months, the time for performance may be extended for sixty (60) **Days**;

13.9.1(b) If the **Work** is to be completed within less than one (1) year but more than six (6) months, an extension of ninety (90) **Days** may be granted;

13.9.1(c) If the **Contract** period exceeds one (1) year, besides the extension granted in Article 13.9.1(b), an additional thirty (30) **Days** may be granted for each multiple of six (6) months involved beyond the one (1) year period; or

13.9.1(d) If exceptional circumstances exist, the **ACCO** may extend the time for performance beyond the extensions in Articles 13.9.1(a), 13.9.1(b), and 13.9.1(c). In that event, the **ACCO** shall file with the Mayor's Office of Contract Services a written explanation of the exceptional circumstances.

13.9.2 For extensions of time for **Substantial Completion** and final completion payments, the **Engineer**, in consultation with the **ACCO**, shall prepare a written analysis of the delay (including a preliminary determination of the causes of delay, the beginning and end dates for each such cause of delay, and whether the delays are excusable under the terms of this **Contract**). The report shall be subject to review by and approval of the Board, which shall have authority to question its analysis and determinations and request additional facts or documentation. The report as reviewed and made final by the Board shall be made a part of the **Agency** contract file. Neither the report itself nor anything contained therein shall operate as a waiver or release of any claim the **City** may have against the **Contractor** for either actual or liquidated damages.

13.9.3 Approval Mechanism for Time Extensions for **Substantial Completion** or Final Completion Payments: An extension shall be granted only with the approval of the Board which is comprised of the **ACCO** of the **Agency**, the **City** Corporation Counsel, and the **Comptroller**, or their authorized representatives.

13.9.4 Neither the granting of any application for an extension of time to the **Contractor** or any **Other Contractor** on this **Project** nor the papers, records or reports related to any application for or grant of an extension of time or determination related thereto shall be referred to or offered in evidence by the **Contractor** or its attorneys in any action or proceeding.

13.10 No Damage for Delay: The **Contractor** agrees to make no claim for damages for delay in the performance of this **Contract** occasioned by any act or omission to act of the **City** or any of its representatives, except as provided for in Article 11.

#### **ARTICLE 14. COMPLETION AND FINAL ACCEPTANCE OF THE WORK**

14.1 Date for **Substantial Completion**: The **Contractor** shall substantially complete the **Work** within the time fixed in Schedule A of the General Conditions, or within the time to which such **Substantial Completion** may be extended.

14.2 Determining the Date of **Substantial Completion**: The **Work** will be deemed to be substantially complete when the two conditions set forth below have been met.

14.2.1 Inspection: The **Engineer** or **Resident Engineer**, as applicable, has inspected the **Work** and has made a written determination that it is substantially complete.

14.2.2 Approval of **Final Approved Punch List** and Date for **Final Acceptance**: Following inspection of the **Work**, the **Engineer/Resident Engineer** shall furnish the **Contractor** with a final punch list, specifying all items of **Work** to be completed and proposing dates for the completion of each specified item of **Work**. The **Contractor** shall then submit in writing to the **Engineer/Resident Engineer** within ten (10) **Days** of the **Engineer/Resident Engineer** furnishing the final punch list either acceptance of the dates or proposed alternative dates for the completion of each specified item of **Work**. If the **Contractor** neither accepts the dates nor proposes alternative dates within ten (10) **Days**, the schedule proposed by the **Engineer/Resident Engineer** shall be deemed accepted. If the **Contractor** proposes alternative dates, then, within a reasonable time after receipt, the **Engineer/Resident Engineer**, in a written notification to the **Contractor**, shall approve the **Contractor's** completion dates or, if they are unable to agree, the **Engineer/Resident Engineer** shall establish dates for the completion of each item of **Work**. The latest completion date specified shall be the date for **Final Acceptance** of the **Work**.

14.3 Date of **Substantial Completion**. The date of approval of the **Final Approved Punch List**, shall be the date of **Substantial Completion**. The date of approval of the **Final Approved Punch List** shall be either (a) if the **Contractor** approves the final punch list and proposed dates for completion furnished by the **Engineer/Resident Engineer**, the date of the **Contractor's** approval; or (b) if the **Contractor** neither accepts the dates nor proposes alternative dates, ten (10) **Days** after the **Engineer/Resident Engineer** furnishes the **Contractor** with a final punch list and proposed dates for completion; or (c) if the **Contractor** proposes alternative dates, the date that the **Engineer/Resident Engineer** sends written notification to the **Contractor** either approving the **Contractor's** proposed alternative dates or establishing dates for the completion for each item of **Work**.

14.4 Determining the Date of **Final Acceptance**: The **Work** will be accepted as final and complete as of the date of the **Engineer's/Resident Engineer's** inspection if, upon such inspection, the **Engineer/Resident Engineer** finds that all items on the **Final Approved Punch List** are complete and no further **Work** remains to be done. The **Commissioner** will then issue a written determination of **Final Acceptance**.

14.5 Request for Inspection: Inspection of the **Work** by the **Engineer/Resident Engineer** for the purpose of **Substantial Completion** or **Final Acceptance** shall be made within fourteen (14) **Days** after receipt of the **Contractor's** written request therefor.

14.6 Request for Re-inspection: If upon inspection for the purpose of **Substantial Completion** or **Final Acceptance**, the **Engineer/Resident Engineer** determines that there are items of **Work** still to be performed, the **Contractor** shall promptly perform them and then request a re-inspection. If upon re-inspection, the **Engineer/Resident Engineer** determines that the **Work** is substantially complete or finally accepted, the date of such re-inspection shall be the date of **Substantial Completion** or **Final Acceptance**. Re-inspection by the **Engineer/Resident Engineer** shall be made within ten (10) **Days** after receipt of the **Contractor's** written request therefor.

14.7 Initiation of Inspection by the **Engineer/Resident Engineer**: If the **Contractor** does not request inspection or re-inspection of the **Work** for the purpose of **Substantial Completion** or **Final Acceptance**, the **Engineer/Resident Engineer** may initiate such inspection or re-inspection.

#### **ARTICLE 15. LIQUIDATED DAMAGES**

15.1 In the event the **Contractor** fails to substantially complete the **Work** within the time fixed for such **Substantial Completion** in Schedule A of the General Conditions, plus authorized time extensions, or if the **Contractor**, in the sole determination of the **Commissioner**, has abandoned the **Work**, the **Contractor** shall pay to the **City** the sum fixed in Schedule A of the General Conditions, for each and every **Day** that the time consumed in substantially completing the **Work** exceeds the time allowed therefor; which said sum, in view of the difficulty of accurately ascertaining the loss which the **City** will suffer by reason of delay in the **Substantial Completion** of the **Work** hereunder, is hereby fixed and agreed as the liquidated damages that the **City** will suffer by reason of such delay, and not as a penalty. This Article 15 shall also apply to the **Contractor** whether or not the **Contractor** is defaulted pursuant to Chapter X of this **Contract**. Neither the failure to assess liquidated damages nor the granting of any time extension shall operate as a waiver or release of any claim the **City** may have against the **Contractor** for either actual or liquidated damages.

15.2 Liquidated damages received hereunder are not intended to be nor shall they be treated as either a partial or full waiver or discharge of the **City's** right to indemnification, or the **Contractor's** obligation to indemnify the **City**, or to any other remedy provided for in this **Contract** or by **Law**.

15.3 The **Commissioner** may deduct and retain out of the monies which may become due hereunder, the amount of any such liquidated damages; and in case the amount which may become due hereunder shall be less than the amount of liquidated damages suffered by the **City**, the **Contractor** shall be liable to pay the difference.

#### **ARTICLE 16. OCCUPATION OR USE PRIOR TO COMPLETION**

16.1 Unless otherwise provided for in the **Specifications**, the **Commissioner** may take over, use, occupy or operate any part of the **Work** at any time prior to **Final Acceptance**, upon written notification to the **Contractor**. The **Engineer** or **Resident Engineer**, as applicable, shall inspect the part of the **Work** to be taken over, used, occupied, or operated, and will furnish the **Contractor** with a written statement of the **Work**, if any, which remains to be performed on such part. The **Contractor** shall not object to, nor interfere with, the **Commissioner's** decision to exercise the rights granted by Article 16. In the event the **Commissioner** takes over, uses, occupies, or operates any part of the **Work**:

16.1.1 the **Engineer/Resident Engineer** shall issue a written determination of **Substantial Completion** with respect to such part of the **Work**;

16.1.2 the **Contractor** shall be relieved of its absolute obligation to protect such part of the unfinished **Work** in accordance with Article 7;

16.1.3 the **Contractor's** guarantee on such part of the **Work** shall begin on the date of such use by the **City**; and;

16.1.4 the **Contractor** shall be entitled to a return of so much of the amount retained in accordance with Article 21 as it relates to such part of the **Work**, except so much thereof as may be retained under Articles 24 and 44.

## CHAPTER IV: SUBCONTRACTS AND ASSIGNMENTS

### ARTICLE 17. SUBCONTRACTS

17.1 The **Contractor** shall not make subcontracts totaling an amount more than the percentage of the total **Contract** price fixed in Schedule A of the General Conditions, without prior written permission from the **Commissioner**. All subcontracts made by the **Contractor** shall be in writing. No **Work** may be performed by a **Subcontractor** prior to the **Contractor** entering into a written subcontract with the **Subcontractor** and complying with the provisions of this Article 17.

17.2 Before making any subcontracts, the **Contractor** shall submit a written statement to the **Commissioner** giving the name and address of the proposed **Subcontractor**; the portion of the **Work** and materials which it is to perform and furnish; the cost of the subcontract; the VENDEX questionnaire if required; the proposed subcontract if requested by the **Commissioner**; and any other information tending to prove that the proposed **Subcontractor** has the necessary facilities, skill, integrity, past experience, and financial resources to perform the **Work** in accordance with the terms and conditions of this **Contract**.

17.3 In addition to the requirements in Article 17.2, **Contractor** is required to list the **Subcontractor** in the web based Subcontractor Reporting System through the City's Payee Information Portal (PIP), available at [www.nyc.gov/pip](http://www.nyc.gov/pip).<sup>1</sup> For each **Subcontractor** listed, **Contractor** is required to provide the following information: maximum contract value, description of **Subcontractor's** Work, start and end date of the subcontract and identification of the **Subcontractor's** industry. Thereafter, **Contractor** will be required to report in the system the payments made to each **Subcontractor** within 30 days of making the payment. If any of the required information changes throughout the Term of the **Contract**, **Contractor** will be required to revise the information in the system.

Failure of the **Contractor** to list a **Subcontractor** and/or to report **Subcontractor** payments in a timely fashion may result in the **Commissioner** declaring the **Contractor** in default of the **Contract** and will subject **Contractor** to liquidated damages in the amount of \$100 per day for each day that the **Contractor** fails to identify a **Subcontractor** along with the required information about the **Subcontractor** and/or fails to report payments to a **Subcontractor**, beyond the time frames set forth herein or in the notice from the City. Article 15 shall govern the issue of liquidated damages.

17.4 If an approved **Subcontractor** elects to subcontract any portion of its subcontract, the proposed sub-subcontract shall be submitted in the same manner as directed above.

17.5 The **Commissioner** will notify the **Contractor** in writing whether the proposed **Subcontractor** is approved. If the proposed **Subcontractor** is not approved, the **Contractor** may submit another proposed **Subcontractor** unless the **Contractor** decides to do the **Work**. No **Subcontractor** shall be permitted to enter or perform any work on the Site unless approved.

17.6 Before entering into any subcontract hereunder, the **Contractor** shall provide the proposed **Subcontractor** with a complete copy of this document and inform the proposed **Subcontractor** fully and completely of all provisions and requirements of this **Contract** relating either directly or indirectly to the **Work** to be performed and the materials to be furnished under such subcontract, and every such

<sup>1</sup> In order to use the new system, a PIP account will be required. Detailed instructions on creating a PIP account and using the new system are also available at [www.nyc.gov/pip](http://www.nyc.gov/pip). Additional assistance with PIP may be obtained by emailing the Financial Information Services Agency Help Desk at [pip@fisa.nyc.gov](mailto:pip@fisa.nyc.gov).



**Subcontractor** shall expressly stipulate that all labor performed and materials furnished by the **Subcontractor** shall strictly comply with the requirements of this **Contract**.

17.7 Documents given to a prospective **Subcontractor** for the purpose of soliciting the **Subcontractor's** bid shall include either a copy of the bid cover or a separate information sheet setting forth the **Project** name, the **Contract** number (if available), the **Agency** (as noted in Article 2.1.6), and the **Project's** location.

17.8 The **Commissioner's** approval of a **Subcontractor** shall not relieve the **Contractor** of any of its responsibilities, duties, and liabilities hereunder. The **Contractor** shall be solely responsible to the **City** for the acts or defaults of its **Subcontractor** and of such **Subcontractor's** officers, agents, and employees, each of whom shall, for this purpose, be deemed to be the agent or employee of the **Contractor** to the extent of its subcontract.

17.9 If the **Subcontractor** fails to maintain the necessary facilities, skill, integrity, past experience, and financial resources (other than due to the **Contractor's** failure to make payments where required) to perform the **Work** in accordance with the terms and conditions of this **Contract**, the **Contractor** shall promptly notify the **Commissioner** and replace such **Subcontractor** with a newly approved **Subcontractor** in accordance with this Article 17.

17.10 The **Contractor** shall be responsible for ensuring that all **Subcontractors** performing **Work** at the **Site** maintain all insurance required by **Law**.

17.11 The **Contractor** shall promptly, upon request, file with the **Engineer** a conformed copy of the subcontract and its cost. The subcontract shall provide the following:

17.11.1 Payment to **Subcontractors**: The agreement between the **Contractor** and its **Subcontractor** shall contain the same terms and conditions as to method of payment for **Work**, labor, and materials, and as to retained percentages, as are contained in this **Contract**.

17.11.2 Prevailing Rate of Wages: The agreement between the **Contractor** and its **Subcontractor** shall include the prevailing wage rates and supplemental benefits to be paid in accordance with Labor Law Section 220.

17.11.3 Section 6-123 of the Administrative Code: Pursuant to the requirements of Section 6-123 of the Administrative Code, every agreement between the **Contractor** and a **Subcontractor** in excess of fifty thousand (\$50,000) dollars shall include a provision that the **Subcontractor** shall not engage in any unlawful discriminatory practice as defined in Title VIII of the Administrative Code (Section 8-101 *et seq.*).

17.11.4 All requirements required pursuant to federal and/or state grant agreement(s), if applicable to the **Work**.

17.12 The **Commissioner** may deduct from the amounts certified under this **Contract** to be due to the **Contractor**, the sum or sums due and owing from the **Contractor** to the **Subcontractors** according to the terms of the said subcontracts, and in case of dispute between the **Contractor** and its **Subcontractor**, or **Subcontractors**, as to the amount due and owing, the **Commissioner** may deduct and withhold from the amounts certified under this **Contract** to be due to the **Contractor** such sum or sums as may be claimed by such **Subcontractor**, or **Subcontractors**, in a sworn affidavit, to be due and owing until such time as such claim or claims shall have been finally resolved.

17.13 On contracts where performance bonds and payment bonds are executed, the **Contractor** shall include on each requisition for payment the following data: **Subcontractor's** name, value of the subcontract, total amount previously paid to **Subcontractor** for **Work** previously requisitioned, and the amount, including retainage, to be paid to the **Subcontractor** for **Work** included in the requisition.

17.14 On **Contracts** where performance bonds and payment bonds are not executed, the **Contractor** shall include with each requisition for payment submitted hereunder, a signed statement from each and every **Subcontractor** and/or **Materialman** for whom payment is requested in such requisition. Such signed statement shall be on the letterhead of the **Subcontractor** and/or **Materialman** for whom payment is requested and shall (i) verify that such **Subcontractor** and/or **Materialman** has been paid in full for all **Work** performed and/or material supplied to date, exclusive of any amount retained and any amount included on the current requisition, and (ii) state the total amount of retainage to date, exclusive of any amount retained on the current requisition.

## **ARTICLE 18. ASSIGNMENTS**

18.1 The **Contractor** shall not assign, transfer, convey or otherwise dispose of this **Contract**, or the right to execute it, or the right, title or interest in or to it or any part thereof, or assign, by power of attorney or otherwise any of the monies due or to become due under this **Contract**, unless the previous written consent of the **Commissioner** shall first be obtained thereto, and the giving of any such consent to a particular assignment shall not dispense with the necessity of such consent to any further or other assignments.

18.2 Such assignment, transfer, conveyance or other disposition of this **Contract** shall not be valid until filed in the office of the **Commissioner** and the **Comptroller**, with the written consent of the **Commissioner** endorsed thereon or attached thereto.

18.3 Failure to obtain the previous written consent of the **Commissioner** to such an assignment, transfer, conveyance or other disposition, may result in the revocation and annulment of this **Contract**. The **City** shall thereupon be relieved and discharged from any further liability to the **Contractor**, its assignees, transferees or sublessees, who shall forfeit and lose all monies therefor earned under the **Contract**, except so much as may be required to pay the **Contractor's** employees.

18.4 The provisions of this clause shall not hinder, prevent, or affect an assignment by the **Contractor** for the benefit of its creditors made pursuant to the **Laws** of the State of New York.

18.5 This **Contract** may be assigned by the **City** to any corporation, agency or instrumentality having authority to accept such assignment.

## **CHAPTER V: CONTRACTOR'S SECURITY AND GUARANTEE**

### **ARTICLE 19. SECURITY DEPOSIT**

19.1 If performance and payment bonds are required, the **City** shall retain the bid security to ensure that the successful bidder executes the **Contract** and furnishes the required payment and performance security within ten (10) **Days** after notice of the award of the **Contract**. If the successful bidder fails to execute the **Contract** and furnish the required payment and performance security, the **City** shall retain such bid security as set forth in the Information for Bidders. If the successful bidder executes the

**Contract** and furnishes the required payment and performance security, the **City** shall return the bid security within a reasonable time after the furnishing of such bonds and execution of the **Contract** by the **City**.

19.2 If performance and payment bonds are not required, the bid security shall be retained by the **City** as security for the **Contractor's** faithful performance of the **Contract**. If partial payments are provided, the bid security will be returned to the **Contractor** after the sum retained under Article 21 equals the amount of the bid security, subject to other provisions of this **Contract**. If partial payments are not provided, the bid security will be released when final payment is certified by the **City** for payment.

19.3 If the **Contractor** is declared in default under Article 48 prior to the return of the deposit, or if any claim is made such as referred to in Article 23, the amount of such deposit, or so much thereof as the **Comptroller** may deem necessary, may be retained and then applied by the **Comptroller**:

19.3.1 To compensate the **City** for any expense, loss or damage suffered or incurred by reason of or resulting from such default, including the cost of re-letting and liquidated damages; or

19.3.2 To indemnify the **City** against any and all claims.

## **ARTICLE 20. PAYMENT GUARANTEE**

20.1 On **Contracts** where one hundred (100%) percent performance bonds and payment bonds are executed, this Article 20 does not apply.

20.2 In the event the terms of this **Contract** do not require the **Contractor** to provide a payment bond or where the **Contract** does not require a payment bond for one hundred (100%) percent of the **Contract** price, the **City** shall, in accordance with the terms of this Article 20, guarantee payment of all lawful claims for:

20.2.1 Wages and compensation for labor performed and/or services rendered; and

20.2.2 Materials, equipment, and supplies provided, whether incorporated into the **Work** or not, when demands have been filed with the **City** as provided hereinafter by any person, firm, or corporation which furnished labor, material, equipment, supplies, or any combination thereof, in connection with the **Work** performed hereunder (hereinafter referred to as the "beneficiary") at the direction of the **City** or the **Contractor**.

20.3 The provisions of Article 20.2 are subject to the following limitations and conditions:

20.3.1 If the **Contractor** provides a payment bond for a value that is less than one hundred (100%) percent of the value of the **Contract Work**, the payment bond provided by the **Contractor** shall be primary (and non-contributing) to the payment guarantee provided under this Article 20.

20.3.2 The guarantee is made for the benefit of all beneficiaries as defined in Article 20.2 provided that those beneficiaries strictly adhere to the terms and conditions of Article 20.3.4 and 20.3.5.

20.3.3 Nothing in this Article 20 shall prevent a beneficiary providing labor, services or material for the **Work** from suing the **Contractor** for any amounts due and owing the beneficiary by the **Contractor**.

20.3.4 Every person who has furnished labor or material, to the **Contractor** or to a **Subcontractor** of the **Contractor**, in the prosecution of the **Work** and who has not been paid in full therefor before the expiration of a period of ninety (90) **Days** after the date on which the last of the labor was performed or material was furnished by him/her for which the claim is made, shall have the right to sue on this payment guarantee in his/her own name for the amount, or the balance thereof, unpaid at the time of commencement of the action; provided, however, that a person having a direct contractual relationship with a **Subcontractor** of the **Contractor** but no contractual relationship express or implied with the **Contractor** shall not have a right of action upon the guarantee unless he/she shall have given written notice to the **Contractor** within one hundred twenty (120) **Days** from the date on which the last of the labor was performed or the last of the material was furnished, for which his/her claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the material was furnished or for whom the labor was performed. The notice shall be served by delivering the same personally to the **Contractor** or by mailing the same by registered mail, postage prepaid, in an envelope addressed to the **Contractor** at any place where it maintains an office or conducts its business; provided, however, that where such notice is actually received by the **Contractor** by other means, such notice shall be deemed sufficient.

20.3.5 Except as provided in Labor Law Section 220-g, no action on this payment guarantee shall be commenced after the expiration of the one-year limitations period set forth in Section 137(4)(b) of the State Finance Law.

20.3.6 The **Contractor** shall promptly forward to the **City** any notice or demand received pursuant to Article 20.3.4. The **Contractor** shall inform the **City** of any defenses to the notice or demand and shall forward to the **City** any documents the **City** requests concerning the notice or demand.

20.3.7 All demands made against the **City** by a beneficiary of this payment guarantee shall be presented to the **Engineer** along with all written documentation concerning the demand which the **Engineer** deems reasonably appropriate or necessary, which may include, but shall not be limited to: the subcontract; any invoices presented to the **Contractor** for payment; the notarized statement of the beneficiary that the demand is due and payable, that a request for payment has been made of the **Contractor** and that the demand has not been paid by the **Contractor** within the time allowed for such payment by the subcontract; and copies of any correspondence between the beneficiary and the **Contractor** concerning such demand. The **City** shall notify the **Contractor** that a demand has been made. The **Contractor** shall inform the **City** of any defenses to the demand and shall forward to the **City** any documents the **City** requests concerning the demand.

20.3.8 The **City** shall make payment only if, after considering all defenses presented by the **Contractor**, it determines that the payment is due and owing to the beneficiary making the demand.

20.3.9 No beneficiary shall be entitled to interest from the **City**, or to any other costs, including, but not limited to, attorneys' fees, except to the extent required by State Finance Law Section 137.

20.4 Upon the receipt by the **City** of a demand pursuant to this Article 20, the **City** may withhold from any payment otherwise due and owing to the **Contractor** under this **Contract** an amount sufficient to satisfy the demand.

20.4.1 In the event the **City** determines that the demand is valid, the **City** shall notify the **Contractor** of such determination and the amount thereof and direct the **Contractor** to immediately pay such amount to the beneficiary. In the event the **Contractor**, within seven (7) **Days** of receipt of such notification from the **City**, fails to pay the beneficiary, such failure shall constitute an automatic and irrevocable assignment of payment by the **Contractor** to the beneficiary for the amount of the demand determined by the **City** to be valid. The **Contractor**, without further notification or other process, hereby gives its unconditional consent to such assignment of payment to the beneficiary and authorizes the **City**, on its behalf, to take all necessary actions to implement such assignment of payment, including without limitation the execution of any instrument or documentation necessary to effectuate such assignment.

20.4.2 In the event that the amount otherwise due and owing to the **Contractor** by the **City** is insufficient to satisfy such demand, the **City** may, at its option, require payment from the **Contractor** of an amount sufficient to cover such demand and exercise any other right to require or recover payment which the **City** may have under **Law** or **Contract**.

20.4.3 In the event the **City** determines that the demand is invalid, any amount withheld pending the **City's** review of such demand shall be paid to the **Contractor**; provided, however, no lien has been filed. In the event a claim or an action has been filed, the terms and conditions set forth in Article 23 shall apply. In the event a lien has been filed, the parties will be governed by the provisions of the Lien Law of the State of New York.

20.5 The provisions of this Article 20 shall not prevent the **City** and the **Contractor** from resolving disputes in accordance with the **PPB** Rules, where applicable.

20.6 In the event the **City** determines that the beneficiary is entitled to payment pursuant to this Article 20, such determination and any defenses and counterclaims raised by the **Contractor** shall be taken into account in evaluating the **Contractor's** performance.

20.7 Nothing in this Article 20 shall relieve the **Contractor** of the obligation to pay the claims of all persons with valid and lawful claims against the **Contractor** relating to the **Work**.

20.8 The **Contractor** shall not require any performance, payment or other bonds of any **Subcontractor** if this **Contract** does not require such bonds of the **Contractor**.

20.9 The payment guarantee made pursuant to this Article 20 shall be construed in a manner consistent with Section 137 of the State Finance Law and shall afford to persons furnishing labor or materials to the **Contractor** or its **Subcontractors** in the prosecution of the **Work** under this **Contract** all of the rights and remedies afforded to such persons by such section, including but not limited to, the right to commence an action against the **City** on the payment guarantee provided by this Article 20 within the one-year limitations period set forth in Section 137(4)(b).

## **ARTICLE 21. RETAINED PERCENTAGE**

21.1 If this **Contract** requires one hundred (100%) percent performance and payment security, then as further security for the faithful performance of this **Contract**, the **Commissioner** shall deduct, and

retain until the substantial completion of the **Work**, five (5%) percent of the value of **Work** certified for payment in each partial payment voucher.

21.2 If this **Contract** does not require one hundred (100%) percent performance and payment security and if the price for which this **Contract** was awarded does not exceed one million (\$1,000,000) dollars, then as further security for the faithful performance of this **Contract**, the **Commissioner** shall deduct, and retain until the substantial completion of the **Work**, five (5%) percent of the value of **Work** certified for payment in each partial payment voucher.

21.3 If this **Contract** does not require one hundred (100%) percent performance and payment security and if the price for which this **Contract** was awarded exceeds one million (\$1,000,000) dollars, then as further security for the faithful performance of this **Contract**, the **Commissioner** shall deduct, and retain until the substantial completion of the **Work**, up to ten (10%) percent of the value of **Work** certified for payment in each partial payment voucher. The percentage to be retained is set forth in Schedule A of the General Conditions.

## **ARTICLE 22. INSURANCE**

22.1 Types of Insurance: The **Contractor** shall procure and maintain the following types of insurance if, and as indicated, in Schedule A of the General Conditions (with the minimum limits and special conditions specified in Schedule A). Such insurance shall be maintained from the date the **Contractor** is required to provide Proof of Insurance pursuant to Article 22.3.1 through the date of completion of all required **Work** (including punch list work as certified in writing by the **Resident Engineer**), except for insurance required pursuant to Article 22.1.4, which may terminate upon **Substantial Completion** of the **Contract**. All insurance shall meet the requirements set forth in this Article 22. Wherever this Article requires that insurance coverage be "at least as broad" as a specified form (including all ISO forms), there is no obligation that the form itself be used, provided that the **Contractor** can demonstrate that the alternative form or endorsement contained in its policy provides coverage at least as broad as the specified form.

22.1.1 Commercial General Liability Insurance: The **Contractor** shall provide Commercial General Liability Insurance covering claims for property damage and/or bodily injury, including death, which may arise from any of the operations under this **Contract**. Coverage under this insurance shall be at least as broad as that provided by the latest edition of Insurance Services Office ("ISO") Form CG 0001. Such insurance shall be "occurrence" based rather than "claims-made" and include, without limitation, the following types of coverage: premises operations; products and completed operations; contractual liability (including the tort liability of another assumed in a contract); broad form property damage; independent contractors; explosion, collapse and underground (XCU); construction means and methods; and incidental malpractice. Such insurance shall contain a "per project" aggregate limit, as specified in Schedule A, that applies separately to operations under this **Contract**.

22.1.1(a) Such Commercial General Liability Insurance shall name the **City** as an Additional Insured. Coverage for the City shall specifically include the **City's** officials and employees, be at least as broad as the latest edition of ISO Form CG 20 10 and provide completed operations coverage at least as broad as the latest edition of ISO Form CG 20 37.

22.1.1(b) Such Commercial General Liability Insurance shall name all other entities designated as additional insureds in Schedule A but only for claims arising from the

**Contractor's** operations under this **Contract**, with coverage at least as broad as the latest edition of ISO Form CG 20 26.

22.1.1(c) If the **Work** requires a permit from the Department of Buildings pursuant to 1 RCNY Section 101-08, the **Contractor** shall provide Commercial General Liability Insurance with limits of at least those required by 1 RCNY section 101-08 or greater limits required by the Agency in accordance with Schedule A. If the **Work** does not require such a permit, the minimum limits shall be those provided for in Schedule A.

22.1.1(d) If any of the **Work** includes repair of a waterborne vessel owned by or to be delivered to the **City**, such Commercial General Liability shall include, or be endorsed to include, Ship Repairer's Legal Liability Coverage to protect against, without limitation, liability arising from navigation of such vessels prior to delivery to and acceptance by the **City**.

22.1.2 Workers' Compensation Insurance, Employers' Liability Insurance, and Disability Benefits Insurance: The **Contractor** shall provide, and shall cause its **Subcontractors** to provide, Workers Compensation Insurance, Employers' Liability Insurance, and Disability Benefits Insurance in accordance with the **Laws** of the State of New York on behalf of all employees providing services under this **Contract** (except for those employees, if any, for which the **Laws** require insurance only pursuant to Article 22.1.3).

22.1.3 United States Longshoremen's and Harbor Workers Act and/or Jones Act Insurance: If specified in Schedule A of the General Conditions or if required by **Law**, the **Contractor** shall provide insurance in accordance with the United States Longshoremen's and Harbor Workers Act and/or the Jones Act, on behalf of all qualifying employees providing services under this **Contract**.

22.1.4 Builders Risk Insurance: If specified in Schedule A of the General Conditions, the **Contractor** shall provide Builders Risk Insurance on a completed value form for the total value of the **Work** through **Substantial Completion** of the **Work** in its entirety. Such insurance shall be provided on an All Risk basis and include coverage, without limitation, for windstorm (including named windstorm), storm surge, flood and earth movement. Unless waived by the **Commissioner**, it shall include coverage for ordinance and law, demolition and increased costs of construction, debris removal, pollutant clean up and removal, and expediting costs. Such insurance shall cover, without limitation, (a) all buildings and/or structures involved in the **Work**, as well as temporary structures at the **Site**, and (b) any property that is intended to become a permanent part of such building or structure, whether such property is on the **Site**, in transit or in temporary storage. Policies shall name the **Contractor** as Named Insured and list the **City** as both an Additional Insured and a Loss Payee as its interest may appear.

22.1.4(a) Policies of such insurance shall specify that, in the event a loss occurs at an occupied facility, occupancy of such facility is permitted without the consent of the issuing insurance company.

22.1.4(b) Such insurance may be provided through an Installation Floater, at the **Contractor's** option, if it otherwise conforms with the requirements of this Article 22.1.4.

22.1.5 Commercial Automobile Liability Insurance: The **Contractor** shall provide Commercial Automobile Liability Insurance for liability arising out of ownership,

maintenance or use of any owned (if any), non-owned and hired vehicles to be used in connection with this **Contract**. Coverage shall be at least as broad as the latest edition of ISO Form CA0001. If vehicles are used for transporting hazardous materials, the Automobile Liability Insurance shall be endorsed to provide pollution liability broadened coverage for covered vehicles (endorsement CA 99 48) as well as proof of MCS 90.

22.1.6 **Contractors Pollution Liability Insurance:** If specified in Schedule A of the General Conditions, the **Contractor** shall maintain, or cause the **Subcontractor** doing such **Work** to maintain, Contractors Pollution Liability Insurance covering bodily injury and property damage. Such insurance shall provide coverage for actual, alleged or threatened emission, discharge, dispersal, seepage, release or escape of pollutants (including asbestos), including any loss, cost or expense incurred as a result of any cleanup of pollutants (including asbestos) or in the investigation, settlement or defense of any claim, action, or proceedings arising from the operations under this **Contract**. Such insurance shall be in the **Contractor's** name and list the **City** as an Additional Insured and any other entity specified in Schedule A. Coverage shall include, without limitation, (a) loss of use of damaged property or of property that has not been physically injured, (b) transportation, and (c) non-owned disposal sites.

22.1.6(a) Coverage for the **City** as Additional Insured shall specifically include the **City's** officials and employees and be at least as broad as provided to the **Contractor** for this **Project**.

22.1.6(b) If such insurance is written on a claims-made policy, such policy shall have a retroactive date on or before the effective date of this **Contract**, and continuous coverage shall be maintained, or an extended discovery period exercised, for a period of not less than three (3) years from the time the **Work** under this **Contract** is completed.

#### 22.1.7 **Marine Insurance:**

22.1.7(a) **Marine Protection and Indemnity Insurance:** If specified in Schedule A of the General Conditions or if the **Contractor** engages in marine operations in the execution of any part of the **Work**, the **Contractor** shall maintain, or cause the **Subcontractor** doing such **Work** to maintain, Marine Protection and Indemnity Insurance with coverage at least as broad as Form SP-23. The insurance shall provide coverage for the **Contractor** or **Subcontractor** (whichever is doing this **Work**) and for the **City** (together with its officials and employees) and any other entity specified in Schedule A as an Additional Insured for bodily injury and property damage arising from marine operations under this **Contract**. Coverage shall include, without limitation, injury or death of crew members (if not fully provided through other insurance), removal of wreck, damage to piers, wharves and other fixed or floating objects and loss of or damage to any other vessel or craft, or to property on such other vessel or craft.

22.1.7(b) **Hull and Machinery Insurance:** If specified in Schedule A of the General Conditions or if the **Contractor** engages in marine operations in the execution of any part of the **Work**, the **Contractor** shall maintain, or cause the **Subcontractor** doing such **Work** to maintain, Hull and Machinery Insurance with coverage for the **Contractor** or **Subcontractor** (whichever is doing this **Work**) and for the **City** (together with its officials and employees) as Additional Insured at least as broad as the latest edition of American Institute Tug Form for all tugs used under this



**Contract** and Collision Liability at least as broad as the latest edition of American Institute Hull Clauses.

22.1.7(c) Marine Pollution Liability Insurance: If specified in Schedule A of the General Conditions or if the **Contractor** engages in marine operations in the execution of any part of the **Work**, the **Contractor** shall maintain, or cause the **Subcontractor** doing such Work to maintain, Marine Pollution Liability Insurance covering itself (or the Subcontractor doing such Work) as Named Insured and the **City** (together with its officials and employees) and any other entity specified in Schedule A as an Additional Insured. Coverage shall be at least as broad as that provided by the latest edition of Water Quality Insurance Syndicate Form and include, without limitation, liability arising from the discharge or substantial threat of a discharge of oil, or from the release or threatened release of a hazardous substance including injury to, or economic losses resulting from, the destruction of or damage to real property, personal property or natural resources.

22.1.8 The **Contractor** shall provide such other types of insurance, at such minimum limits and with such conditions, as are specified in Schedule A of the General Conditions.

## 22.2 General Requirements for Insurance Coverage and Policies:

22.2.1 All required insurance policies shall be maintained with companies that may lawfully issue the required policy and have an A.M. Best rating of at least A-/VII or a Standard and Poor's rating of at least A, unless prior written approval is obtained from the **City** Corporation Counsel.

22.2.2 The **Contractor** shall be solely responsible for the payment of all premiums for all required policies and all deductibles and self-insured retentions to which such policies are subject, whether or not the **City** is an insured under the policy.

22.2.3 In his/her sole discretion, the **Commissioner** may, subject to the approval of the **Comptroller** and the **City** Corporation Counsel, accept Letters of Credit and/or custodial accounts in lieu of required insurance.

22.2.4 The **City's** limits of coverage for all types of insurance required pursuant to Schedule A of the General Conditions shall be the greater of (i) the minimum limits set forth in Schedule A or (ii) the limits provided to the **Contractor** as Named Insured under all primary, excess, and umbrella policies of that type of coverage.

22.2.5 The **Contractor** may satisfy its insurance obligations under this Article 22 through primary policies or a combination of primary and excess/umbrella policies, so long as all policies provide the scope of coverage required herein.

22.2.6 Policies of insurance provided pursuant to this Article 22 shall be primary and non-contributing to any insurance or self-insurance maintained by the **City**.

## 22.3 Proof of Insurance:

22.3.1 For all types of insurance required by Article 22.1 and Schedule A, except for insurance required by Articles 22.1.4 and 22.1.7, the **Contractor** shall file proof of insurance in accordance with this Article 22.3 within ten (10) **Days** of award. For insurance

provided pursuant to Articles 22.1.4 and 22.1.7, proof shall be filed by a date specified by the **Commissioner** or ten (10) **Days** prior to the commencement of the portion of the **Work** covered by such policy, whichever is earlier.

22.3.2 For Workers' Compensation Insurance provided pursuant to Article 22.1.2, the **Contractor** shall submit one of the following forms: C-105.2 Certificate of Workers' Compensation Insurance; U-26.3 - State Insurance Fund Certificate of Workers' Compensation Insurance; Request for WC/DB Exemption (Form CE-200); equivalent or successor forms used by the New York State Workers' Compensation Board; or other proof of insurance in a form acceptable to the **Commissioner**. For Disability Benefits Insurance provided pursuant to Article 22.1.2, the Contractor shall submit DB-120.1 - Certificate Of Insurance Coverage Under The NYS Disability Benefits Law, Request for WC/DB Exemption (Form CE-200); equivalent or successor forms used by the New York State Workers' Compensation Board; or other proof of insurance in a form acceptable to the **Commissioner**. ACORD forms are not acceptable.

22.3.3 For policies provided pursuant to all of Article 22.1 other than Article 22.1.2, the **Contractor** shall submit one or more Certificates of Insurance on forms acceptable to the **Commissioner**. All such Certificates of Insurance shall certify (a) the issuance and effectiveness of such policies of insurance, each with the specified minimum limits (b) for insurance secured pursuant to Article 22.1.1 that the **City** and any other entity specified in Schedule A is an Additional Insured thereunder; (c) in the event insurance is required pursuant to Article 22.1.6 and/or Article 22.1.7, that the **City** is an Additional Insured thereunder; (d) the company code issued to the insurance company by the National Association of Insurance Commissioners (the NAIC number); and (e) the number assigned to the **Contract** by the **City**. All such Certificates of Insurance shall be accompanied by either a duly executed "Certification by Insurance Broker or Agent" in the form contained in Part III of Schedule A or copies of all policies referenced in such Certificate of Insurance as certified by an authorized representative of the issuing insurance carrier. If any policy is not available at the time of submission, certified binders may be submitted until such time as the policy is available, at which time a certified copy of the policy shall be submitted.

22.3.4 Documentation confirming renewals of insurance shall be submitted to the **Commissioner** prior to the expiration date of coverage of policies required under this **Contract**. Such proofs of insurance shall comply with the requirements of Articles 22.3.2 and 22.3.3.

22.3.5 The **Contractor** shall be obligated to provide the **City** with a copy of any policy of insurance provided pursuant to this Article 22 upon the demand for such policy by the **Commissioner** or the **City** Corporation Counsel.

#### 22.4 Operations of the **Contractor**:

22.4.1 The **Contractor** shall not commence the **Work** unless and until all required certificates have been submitted to and accepted by the **Commissioner**. Acceptance by the **Commissioner** of a certificate does not excuse the **Contractor** from securing insurance consistent with all provisions of this Article 22 or of any liability arising from its failure to do so.

22.4.2 The **Contractor** shall be responsible for providing continuous insurance coverage in the manner, form, and limits required by this **Contract** and shall be authorized to perform **Work** only during the effective period of all required coverage.

22.4.3 In the event that any of the required insurance policies lapse, are revoked, suspended or otherwise terminated, for whatever cause, the **Contractor** shall immediately stop all **Work**, and shall not recommence **Work** until authorized in writing to do so by the **Commissioner**. Upon quitting the **Site**, except as otherwise directed by the **Commissioner**, the **Contractor** shall leave all plant, materials, equipment, tools, and supplies on the **Site**. **Contract** time shall continue to run during such periods and no extensions of time will be granted. The **Commissioner** may also declare the **Contractor** in default for failure to maintain required insurance.

22.4.4 In the event the **Contractor** receives notice, from an insurance company or other person, that any insurance policy required under this Article 22 shall be cancelled or terminated (or has been cancelled or terminated) for any reason, the **Contractor** shall immediately forward a copy of such notice to both the **Commissioner** and the New York City Comptroller, attn: Office of Contract Administration, Municipal Building, One Centre Street, room 1005, New York, New York 10007. Notwithstanding the foregoing, the **Contractor** shall ensure that there is no interruption in any of the insurance coverage required under this Article 22.

22.4.5 Where notice of loss, damage, occurrence, accident, claim or suit is required under an insurance policy maintained in accordance with this Article 22, the **Contractor** shall notify in writing all insurance carriers that issued potentially responsive policies of any such event relating to any operations under this **Contract** (including notice to Commercial General Liability insurance carriers for events relating to the **Contractor's** own employees) no later than 20 days after such event. For any policy where the **City** is an Additional Insured, such notice shall expressly specify that "this notice is being given on behalf of the City of New York as Insured as well as the Named Insured." Such notice shall also contain the following information: the number of the insurance policy, the name of the named insured, the date and location of the damage, occurrence, or accident, and the identity of the persons or things injured, damaged or lost. The **Contractor** shall simultaneously send a copy of such notice to the City of New York c/o Insurance Claims Specialist, Affirmative Litigation Division, New York City Law Department, 100 Church Street, New York, New York 10007.

22.4.6 In the event of any loss, accident, claim, action, or other event that does or can give rise to a claim under any insurance policy required under this Article 22, the **Contractor** shall at all times fully cooperate with the **City** with regard to such potential or actual claim.

22.5 **Subcontractor Insurance:** In the event the **Contractor** requires any **Subcontractor** to procure insurance with regard to any operations under this **Contract** and requires such **Subcontractor** to name the **Contractor** as an **Additional Insured** thereunder, the **Contractor** shall ensure that the **Subcontractor** name the **City**, including its officials and employees, as an Additional Insured with coverage at least as broad as the most recent edition of ISO Form CG 20 26.

22.6 Wherever reference is made in Article 7 or this Article 22 to documents to be sent to the **Commissioner** (e.g., notices, filings, or submissions), such documents shall be sent to the address set forth in Schedule A of the General Conditions. In the event no address is set forth in Schedule A, such documents are to be sent to the **Commissioner's** address as provided elsewhere in this **Contract**.

22.7 Apart from damages or losses covered by insurance provided pursuant to Articles 22.1.2, 22.1.3, or 22.1.5, the **Contractor** waives all rights against the **City**, including its officials and employees, for any damages or losses that are covered under any insurance required under this Article 22 (whether or

not such insurance is actually procured or claims are paid thereunder) or any other insurance applicable to the operations of the **Contractor** and/or its employees, agents, or **Subcontractors**.

22.8 In the event the **Contractor** utilizes a self-insurance program to satisfy any of the requirements of this Article 22, the **Contractor** shall ensure that any such self-insurance program provides the **City** with all rights that would be provided by traditional insurance under this Article 22, including but not limited to the defense and indemnification obligations that insurers are required to undertake in liability policies.

22.9 Materiality/Non-Waiver: The **Contractor's** failure to secure policies in complete conformity with this Article 22, or to give an insurance company timely notice of any sort required in this **Contract** or to do anything else required by this Article 22 shall constitute a material breach of this **Contract**. Such breach shall not be waived or otherwise excused by any action or inaction by the **City** at any time.

22.10 Pursuant to General Municipal Law Section 108, this **Contract** shall be void and of no effect unless **Contractor** maintains Workers' Compensation Insurance for the term of this **Contract** to the extent required and in compliance with the New York State Workers' Compensation Law.

22.11 Other Remedies: Insurance coverage provided pursuant to this Article 22 or otherwise shall not relieve the **Contractor** of any liability under this **Contract**, nor shall it preclude the **City** from exercising any rights or taking such other actions available to it under any other provisions of this **Contract** or **Law**.

### **ARTICLE 23. MONEY RETAINED AGAINST CLAIMS**

23.1 If any claim shall be made by any person or entity (including **Other Contractors** with the **City** on this **Project**) against the **City** or against the **Contractor** and the **City** for any of the following:

- (a) An alleged loss, damage, injury, theft or vandalism of any of the kinds referred to in Articles 7 and 12, plus the reasonable costs of defending the **City**, which in the opinion of the **Comptroller** may not be paid by an insurance company (for any reason whatsoever); or
- (b) An infringement of copyrights, patents or use of patented articles, tools, etc., as referred to in Article 57; or
- (c) Damage claimed to have been caused directly or indirectly by the failure of the **Contractor** to perform the **Work** in strict accordance with this **Contract**,

the amount of such claim, or so much thereof as the **Comptroller** may deem necessary, may be withheld by the **Comptroller**, as security against such claim, from any money due hereunder. The **Comptroller**, in his/her discretion, may permit the **Contractor** to substitute other satisfactory security in lieu of the monies so withheld.

23.2 If an action on such claim is timely commenced and the liability of the **City**, or the **Contractor**, or both, shall have been established therein by a final judgment of a court of competent jurisdiction, or if such claim shall have been admitted by the **Contractor** to be valid, the **Comptroller** shall pay such judgment or admitted claim out of the monies retained by the **Comptroller** under the provisions of this Article 23, and return the balance, if any, without interest, to the **Contractor**.

## **ARTICLE 24. MAINTENANCE AND GUARANTY**

24.1 The **Contractor** shall promptly repair, replace, restore or rebuild, as the **Commissioner** may determine, any finished **Work** in which defects of materials or workmanship may appear or to which damage may occur because of such defects, during the one (1) year period subsequent to the date of **Substantial Completion** (or use and occupancy in accordance with Article 16), except where other periods of maintenance and guaranty are provided for in Schedule A.

24.2 As security for the faithful performance of its obligations hereunder, the **Contractor**, upon filing its requisition for payment on **Substantial Completion**, shall deposit with the **Commissioner** a sum equal to one (1%) percent of the price (or the amount fixed in Schedule A of the General Conditions) in cash or certified check upon a state or national bank and trust company or a check of such bank and trust company signed by a duly authorized officer thereof and drawn to the order of the **Comptroller**, or obligations of the **City**, which the **Comptroller** may approve as of equal value with the sum so required.

24.3 In lieu of the above, the **Contractor** may make such security payment to the **City** by authorizing the **Commissioner** in writing to deduct the amount from the **Substantial Completion** payment which shall be deemed the deposit required above.

24.4 If the **Contractor** has faithfully performed all of its obligations hereunder the **Commissioner** shall so certify to the **Comptroller** within five (5) **Days** after the expiration of one (1) year from the date of **Substantial Completion** and acceptance of the **Work** or within thirty (30) **Days** after the expiration of the guarantee period fixed in the **Specifications**. The security payment shall be repaid to the **Contractor** without interest within thirty (30) **Days** after certification by the **Commissioner** to the **Comptroller** that the **Contractor** has faithfully performed all of its obligations hereunder.

24.5 Notice by the **Commissioner** to the **Contractor** to repair, replace, rebuild or restore such defective or damaged **Work** shall be timely, pursuant to this article, if given not later than ten (10) **Days** subsequent to the expiration of the one (1) year period or other periods provided for herein.

24.6 If the **Contractor** shall fail to repair, replace, rebuild or restore such defective or damaged **Work** promptly after receiving such notice, the **Commissioner** shall have the right to have the **Work** done by others in the same manner as provided for in the completion of a defaulted **Contract**, under Article 51.

24.7 If the security payment so deposited is insufficient to cover the cost of such **Work**, the **Contractor** shall be liable to pay such deficiency on demand by the **Commissioner**.

24.8 The **Engineer's** certificate setting forth the fair and reasonable cost of repairing, replacing, rebuilding or restoring any damaged or defective **Work** when performed by one other than the **Contractor**, shall be binding and conclusive upon the **Contractor** as to the amount thereof.

24.9 The **Contractor** shall obtain all manufacturers' warranties and guaranties of all equipment and materials required by this **Contract** in the name of the **City** and shall deliver same to the **Commissioner**. All of the **City's** rights and title and interest in and to said manufacturers' warranties and guaranties may be assigned by the **City** to any subsequent purchasers of such equipment and materials or lessees of the premises into which the equipment and materials have been installed.

## **CHAPTER VI: CHANGES, EXTRA WORK, AND DOCUMENTATION OF CLAIM**

### **ARTICLE 25. CHANGES**

25.1 Changes may be made to this **Contract** only as duly authorized in writing by the **Commissioner** in accordance with the **Law** and this **Contract**. All such changes, modifications, and amendments will become a part of the **Contract**. **Work** so ordered shall be performed by the **Contractor**.

25.2 **Contract** changes will be made only for **Work** necessary to complete the **Work** included in the original scope of the **Contract** and/or for non-material changes to the scope of the **Contract**. Changes are not permitted for any material alteration in the scope of **Work** in the **Contract**.

25.3 The **Contractor** shall be entitled to a price adjustment for **Extra Work** performed pursuant to a written change order. Adjustments to price shall be computed in one or more of the following ways:

25.3.1 By applicable unit prices specified in the **Contract**; and/or

25.3.2 By agreement of a fixed price; and/or

25.3.3 By time and material records; and/or

25.3.4 In any other manner approved by the **CCPO**.

25.4 All payments for change orders are subject to pre-audit by the **Engineering Audit Officer** and may be post-audited by the **Comptroller** and/or the **Agency**.

### **ARTICLE 26. METHODS OF PAYMENT FOR OVERRUNS AND EXTRA WORK**

26.1 **Overrun of Unit Price Item:** An overrun is any quantity of a unit price item which the **Contractor** is directed to provide which is in excess of one hundred twenty-five (125%) percent of the estimated quantity for that item set forth in the bid schedule.

26.1.1 For any unit price item, the **Contractor** will be paid at the unit price bid for any quantity up to one hundred twenty-five (125%) percent of the estimated quantity for that item set forth in the bid schedule. If during the progress of the **Work**, the actual quantity of any unit price item required to complete the **Work** approaches the estimated quantity for that item, and for any reason it appears that the actual quantity of any unit price item necessary to complete the **Work** will exceed the estimated quantity for that item by twenty-five (25%) percent, the **Contractor** shall immediately notify the **Engineer** of such anticipated overrun. The **Contractor** shall not be compensated for any quantity of a unit price item provided which is in excess of one hundred twenty-five (125%) percent of the estimated quantity for that item set forth in the bid schedule without written authorization from the **Engineer**.

26.1.2 If the actual quantity of any unit price item necessary to complete the **Work** will exceed one hundred twenty five (125%) percent of the estimated quantity for that item set forth in the bid schedule, the **City** reserves the right and the **Contractor** agrees to negotiate a new unit price for such item. In no event shall such negotiated new unit price exceed the unit bid price. If the **City** and **Contractor** cannot agree on a new unit price, then the **City** shall order the **Contractor** and the **Contractor** agrees to provide additional quantities of

the item on the basis of time and material records for the actual and reasonable cost as determined under Article 26.2, but in no event at a unit price exceeding the unit price bid.

**26.2 Extra Work:** For **Extra Work** where payment is by agreement on a fixed price in accordance with Article 25.3.2, the price to be paid for such **Extra Work** shall be based on the fair and reasonable estimated cost of the items set forth below. For **Extra Work** where payment is based on time and material records in accordance with Article 25.3.3, the price to be paid for such **Extra Work** shall be the actual and reasonable cost of the items set forth below, calculated in accordance with the formula specified therein, if any.

26.2.1 Necessary materials (including transportation to the **Site**); plus

26.2.2 Necessary direct labor, including payroll taxes (subject to statutory wage caps) and supplemental benefits; plus

26.2.3 Sales and personal property taxes, if any, required to be paid on materials not incorporated into such **Extra Work**; plus

26.2.4 Reasonable rental value of **Contractor**-owned (or **Subcontractor**-owned, as applicable), necessary plant and equipment other than **Small Tools**, plus fuel/energy costs. Except for fuel costs for pick-up trucks which shall be reimbursed based on a consumption of five (5) gallons per shift, fuel costs shall be reimbursed based on actual costs or, in the absence of auditable documentation, the following fuel consumption formula per operating hour:  $(.035) \times (\text{HP rating}) \times (\text{Fuel cost/gallon})$ . Reasonable rental value is defined as the lower of either seventy-five percent of the monthly prorated rental rates established in "The AED Green Book, Rental Rates and Specifications for Construction Equipment" published by Equipment Watch (the "Green Book"), or seventy-five percent of the monthly prorated rental rates established in the "Rental Rate Blue Book for Construction Equipment" published by Equipment Watch (the "Blue Book") (the applicable Blue Book rate being for rental only without the addition of any operational costs listed in the Blue Book). The reasonable rental value is deemed to be inclusive of all operating costs except for fuel/energy consumption and equipment operator's wages/costs. For multiple shift utilization, reimbursement shall be calculated as follows: first shift shall be seventy-five (75%) percent of such rental rates; second shift shall be sixty (60%) percent of the first shift rate; and third shift shall be forty (40%) percent of the first shift rate. Equipment on standby shall be reimbursed at one-third (1/3) the prorated monthly rental rate. **Contractor**-owned (or **Subcontractor**-owned, as applicable) equipment includes equipment from rental companies affiliated with or controlled by the **Contractor** (or **Subcontractor**, as applicable), as determined by the **Commissioner**. In establishing cost reimbursement for non-operating **Contractor**-owned (or **Subcontractor**-owned, as applicable) equipment (scaffolding, sheeting systems, road plates, etc.), the **City** may restrict reimbursement to a purchase-salvage/life cycle basis if less than the computed rental costs; plus

26.2.5 Necessary installation and dismantling of such plant and equipment, including transportation to and from the **Site**, if any, provided that, in the case of non-**Contractor**-owned (or non-**Subcontractor**-owned, as applicable) equipment rented from a third party, the cost of installation and dismantling are not allowable if such costs are included in the rental rate; plus

26.2.6 Necessary fees charged by governmental entities; plus

26.2.7 Necessary construction-related service fees charged by non-governmental entities, such as landfill tipping fees; plus

26.2.8 Reasonable rental costs of non-**Contractor**-owned (or non-**Subcontractor**-owned, as applicable) necessary plant and equipment other than **Small Tools**, plus fuel/energy costs. Except for fuel costs for pick-up trucks which shall be reimbursed based on a consumption of five (5) gallons per shift, fuel costs shall be reimbursed based on actual costs or, in the absence of auditable documentation, the following fuel consumption formula per hour of operation:  $(.035) \times (\text{HP rating}) \times (\text{Fuel cost/gallon})$ . In lieu of renting, the **City** reserves the right to direct the purchase of non-operating equipment (scaffolding, sheeting systems, road plates, etc.), with payment on a purchase-salvage/life cycle basis, if less than the projected rental costs; plus

26.2.9 Workers' Compensation Insurance, and any insurance coverage expressly required by the **City** for the performance of the **Extra Work** which is different than the types of insurance required by Article 22 and Schedule A of the General Conditions. The cost of Workers' Compensation Insurance is subject to applicable payroll limitation caps and shall be based upon the carrier's Manual Rate for such insurance derived from the applicable class Loss Cost ("LC") and carrier's Lost Cost Multiplier ("LCM") approved by the New York State Department of Financial Services, and with the exception of experience rating, rate modifiers as promulgated by the New York Compensation Insurance Rating Board ("NYCIRB"); plus

26.2.10 Additional costs incurred as a result of the **Extra Work** for performance and payment bonds; plus

26.2.11 Twelve percent (12%) percent of the total of items in Articles 26.2.1 through 26.2.5 as compensation for overhead, except that no percentage for overhead will be allowed on **Payroll Taxes** or on the premium portion of overtime pay or on sales and personal property taxes. Overhead shall include without limitation, all costs and expenses in connection with administration, management superintendence, small tools, and insurance required by Schedule A of the General Conditions other than Workers' Compensation Insurance; plus

26.2.12 Ten (10%) percent of the total of items in Articles 26.2.1 through 26.2.5, plus the items in Article 26.2.11, as compensation for profit, except that no percentage for profit will be allowed on **Payroll Taxes** or on the premium portion of overtime pay or on sales and personal property taxes; plus

26.2.13 Five (5%) percent of the total of items in Articles 26.2.6 through 26.2.10 as compensation for overhead and profit.

26.3 Where the **Extra Work** is performed in whole or in part by other than the **Contractor's** own forces pursuant to Article 26.2, the **Contractor** shall be paid, subject to pre-audit by the **Engineering Audit Officer**, the cost of such **Work** computed in accordance with Article 26.2 above, plus an additional allowance of five (5%) percent to cover the **Contractor's** overhead and profit.

26.4 Where a change is ordered, involving both **Extra Work** and omitted or reduced **Contract Work**, the **Contract** price shall be adjusted, subject to pre-audit by the **EAO**, in an amount based on the difference between the cost of such **Extra Work** and of the omitted or reduced **Work**.

26.5 Where the **Contractor** and the **Commissioner** can agree upon a fixed price for **Extra Work** in accordance with Article 25.3.2 or another method of payment for **Extra Work** in accordance with



Article 25.3.4, or for **Extra Work** ordered in connection with omitted **Work**, such method, subject to pre-audit by the **EAO**, may, at the option of the **Commissioner**, be substituted for the cost plus a percentage method provided in Article 26.2; provided, however, that if the **Extra Work** is performed by a **Subcontractor**, the **Contractor** shall not be entitled to receive more than an additional allowance of five (5%) percent for overhead and profit over the cost of such **Subcontractor's Work** as computed in accordance with Article 26.2.

## **ARTICLE 27. RESOLUTION OF DISPUTES**

27.1 All disputes between the **City** and the **Contractor** of the kind delineated in this Article 27.1 that arise under, or by virtue of, this **Contract** shall be finally resolved in accordance with the provisions of this Article 27 and the **PPB Rules**. This procedure for resolving all disputes of the kind delineated herein shall be the exclusive means of resolving any such disputes.

27.1.1 This Article 27 shall not apply to disputes concerning matters dealt with in other sections of the **PPB Rules**, or to disputes involving patents, copyrights, trademarks, or trade secrets (as interpreted by the courts of New York State) relating to proprietary rights in computer software.

27.1.2 This Article 27 shall apply only to disputes about the scope of **Work** delineated by the **Contract**, the interpretation of **Contract** documents, the amount to be paid for **Extra Work** or disputed work performed in connection with the **Contract**, the conformity of the **Contractor's Work** to the **Contract**, and the acceptability and quality of the **Contractor's Work**; such disputes arise when the **Engineer, Resident Engineer, Engineering Audit Officer**, or other designee of the **Commissioner** makes a determination with which the **Contractor** disagrees.

27.2 All determinations required by this Article 27 shall be made in writing clearly stated, with a reasoned explanation for the determination based on the information and evidence presented to the party making the determination. Failure to make such determination within the time required by this Article 27 shall be deemed a non-determination without prejudice that will allow application to the next level.

27.3 During such time as any dispute is being presented, heard, and considered pursuant to this Article 27, the **Contract** terms shall remain in force and the **Contractor** shall continue to perform **Work** as directed by the **ACCO** or the **Engineer**. Failure of the **Contractor** to continue **Work** as directed shall constitute a waiver by the **Contractor** of its claim.

27.4 Presentation of Disputes to **Commissioner**.

Notice of Dispute and Agency Response. The **Contractor** shall present its dispute in writing ("Notice of Dispute") to the **Commissioner** within thirty (30) Days of receiving written notice of the determination or action that is the subject of the dispute. This notice requirement shall not be read to replace any other notice requirements contained in the **Contract**. The Notice of Dispute shall include all the facts, evidence, documents, or other basis upon which the **Contractor** relies in support of its position, as well as a detailed computation demonstrating how any amount of money claimed by the **Contractor** in the dispute was arrived at. Within thirty (30) Days after receipt of the detailed written submission comprising the complete Notice of Dispute, the **Engineer, Resident Engineer, Engineering Audit Officer**, or other designee of the **Commissioner** shall submit to the **Commissioner** all materials he or she deems pertinent to the dispute. Following initial submissions to the **Commissioner**, either party may demand of the other the production of any document or other material the demanding party believes may be relevant to the dispute. The requested party shall produce all relevant materials that are not otherwise

protected by a legal privilege recognized by the courts of New York State. Any question of relevancy shall be determined by the **Commissioner** whose decision shall be final. Willful failure of the **Contractor** to produce any requested material whose relevancy the **Contractor** has not disputed, or whose relevancy has been affirmatively determined, shall constitute a waiver by the **Contractor** of its claim.

27.4.1 **Commissioner Inquiry.** The **Commissioner** shall examine the material and may, in his or her discretion, convene an informal conference with the **Contractor**, the **ACCO**, and the **Engineer, Resident Engineer, Engineering Audit Officer**, or other designee of the **Commissioner** to resolve the issue by mutual consent prior to reaching a determination. The **Commissioner** may seek such technical or other expertise as he or she shall deem appropriate, including the use of neutral mediators, and require any such additional material from either or both parties as he or she deems fit. The **Commissioner's** ability to render, and the effect of, a decision hereunder shall not be impaired by any negotiations in connection with the dispute presented, whether or not the **Commissioner** participated therein. The **Commissioner** may or, at the request of any party to the dispute, shall compel the participation of any **Other Contractor** with a contract related to the **Work** of this **Contract**, and that **Contractor** shall be bound by the decision of the **Commissioner**. Any **Other Contractor** thus brought into the dispute resolution proceeding shall have the same rights and obligations under this Article 27 as the **Contractor** initiating the dispute.

27.4.2 **Commissioner Determination.** Within thirty (30) **Days** after the receipt of all materials and information, or such longer time as may be agreed to by the parties, the **Commissioner** shall make his or her determination and shall deliver or send a copy of such determination to the **Contractor**, the **ACCO**, and **Engineer, Resident Engineer, Engineering Audit Officer**, or other designee of the **Commissioner**, as applicable, together with a statement concerning how the decision may be appealed.

27.4.3 **Finality of Commissioner's Decision.** The **Commissioner's** decision shall be final and binding on all parties, unless presented to the Contract Dispute Resolution Board pursuant to this Article 27. The **City** may not take a petition to the Contract Dispute Resolution Board. However, should the **Contractor** take such a petition, the **City** may seek, and the Contract Dispute Resolution Board may render, a determination less favorable to the **Contractor** and more favorable to the **City** than the decision of the **Commissioner**.

27.5 **Presentation of Dispute to the Comptroller.** Before any dispute may be brought by the **Contractor** to the Contract Dispute Resolution Board, the **Contractor** must first present its claim to the **Comptroller** for his or her review, investigation, and possible adjustment.

27.5.1 **Time, Form, and Content of Notice.** Within thirty (30) **Days** of its receipt of a decision by the **Commissioner**, the **Contractor** shall submit to the **Comptroller** and to the **Commissioner** a Notice of Claim regarding its dispute with the **Agency**. The Notice of Claim shall consist of (i) a brief written statement of the substance of the dispute, the amount of money, if any, claimed and the reason(s) the **Contractor** contends the dispute was wrongly decided by the **Commissioner**; (ii) a copy of the written decision of the **Commissioner**; and (iii) a copy of all materials submitted by the **Contractor** to the **Agency**, including the Notice of Dispute. The **Contractor** may not present to the **Comptroller** any material not presented to the **Commissioner**, except at the request of the **Comptroller**.

27.5.2 Response. Within thirty (30) **Days** of receipt of the Notice of Claim, the **Agency** shall make available to the **Comptroller** a copy of all material submitted by the **Agency** to the **Commissioner** in connection with the dispute. The **Agency** may not present to the **Comptroller** any material not presented to the **Commissioner** except at the request of the **Comptroller**.

27.5.3 **Comptroller Investigation.** The **Comptroller** may investigate the claim in dispute and, in the course of such investigation, may exercise all powers provided in Sections 7-201 and 7-203 of the Administrative Code. In addition, the **Comptroller** may demand of either party, and such party shall provide, whatever additional material the **Comptroller** deems pertinent to the claim, including original business records of the **Contractor**. Willful failure of the **Contractor** to produce within fifteen (15) **Days** any material requested by the **Comptroller** shall constitute a waiver by the **Contractor** of its claim. The **Comptroller** may also schedule an informal conference to be attended by the **Contractor**, **Agency** representatives, and any other personnel desired by the **Comptroller**.

27.5.4 Opportunity of **Comptroller** to Compromise or Adjust Claim. The **Comptroller** shall have forty-five (45) **Days** from his or her receipt of all materials referred to in Article 27.5.3 to investigate the disputed claim. The period for investigation and compromise may be further extended by agreement between the **Contractor** and the **Comptroller**, to a maximum of ninety (90) **Days** from the **Comptroller's** receipt of all materials. The **Contractor** may not present its petition to the Contract Dispute Resolution Board until the period for investigation and compromise delineated in this Article 27.5.4 has expired. In compromising or adjusting any claim hereunder, the **Comptroller** may not revise or disregard the terms of the **Contract** between the parties.

27.6 Contract Dispute Resolution Board. There shall be a Contract Dispute Resolution Board composed of:

27.6.1 The chief administrative law judge of the Office of Administrative Trials and Hearings (OATH) or his/her designated OATH administrative law judge, who shall act as chairperson, and may adopt operational procedures and issue such orders consistent with this Article 27 as may be necessary in the execution of the Contract Dispute Resolution Board's functions, including, but not limited to, granting extensions of time to present or respond to submissions;

27.6.2 The **CCPO** or his/her designee; any designee shall have the requisite background to consider and resolve the merits of the dispute and shall not have participated personally and substantially in the particular matter that is the subject of the dispute or report to anyone who so participated; and

27.6.3 A person with appropriate expertise who is not an employee of the **City**. This person shall be selected by the presiding administrative law judge from a prequalified panel of individuals, established and administered by OATH with appropriate background to act as decision-makers in a dispute. Such individual may not have a contract or dispute with the **City** or be an officer or employee of any company or organization that does, or regularly represents persons, companies, or organizations having disputes with the **City**.

27.7 Petition to the Contract Dispute Resolution Board. In the event the claim has not been settled or adjusted by the **Comptroller** within the period provided in this Article 27, the **Contractor**,

within thirty (30) **Days** thereafter, may petition the Contract Dispute Resolution Board to review the **Commissioner's** determination.

27.7.1 **Form and Content of Petition by Contractor.** The **Contractor** shall present its dispute to the Contract Dispute Resolution Board in the form of a petition, which shall include (i) a brief written statement of the substance of the dispute, the amount of money, if any, claimed, and the reason(s) the **Contractor** contends the dispute was wrongly decided by the **Commissioner**; (ii) a copy of the written Decision of the **Commissioner**, (iii) copies of all materials submitted by the **Contractor** to the Agency; (iv) a copy of the written decision of the **Comptroller**, if any, and (v) copies of all correspondence with, or written material submitted by the **Contractor**, to the **Comptroller**. The **Contractor** shall concurrently submit four (4) complete sets of the Petition: one set to the City Corporation Counsel (Attn: Commercial and Real Estate Litigation Division) and three (3) sets to the Contract Dispute Resolution Board at OATH's offices with proof of service on the City Corporation Counsel. In addition, the **Contractor** shall submit a copy of the written statement of the substance of the dispute, cited in (i) above, to both the **Commissioner** and the **Comptroller**.

27.7.2 **Agency Response.** Within thirty (30) **Days** of its receipt of the Petition by the City Corporation Counsel, the **Agency** shall respond to the brief written statement of the **Contractor** and make available to the Contract Dispute Resolution Board all material it submitted to the **Commissioner** and **Comptroller**. Three (3) complete copies of the **Agency** response shall be provided to the Contract Dispute Resolution Board and one to the **Contractor**. Extensions of time for submittal of the **Agency** response shall be given as necessary upon a showing of good cause or, upon consent of the parties, for an initial period of up to thirty (30) **Days**.

27.7.3 **Further Proceedings.** The Contract Dispute Resolution Board shall permit the **Contractor** to present its case by submission of memoranda, briefs, and oral argument. The Contract Dispute Resolution Board shall also permit the **Agency** to present its case in response to the **Contractor** by submission of memoranda, briefs, and oral argument. If requested by the City Corporation Counsel, the **Comptroller** shall provide reasonable assistance in the preparation of the **Agency's** case. Neither the **Contractor** nor the **Agency** may support its case with any documentation or other material that was not considered by the **Comptroller**, unless requested by the Contract Dispute Resolution Board. The Contract Dispute Resolution Board, in its discretion, may seek such technical or other expert advice as it shall deem appropriate and may seek, on its own or upon application of a party, any such additional material from any party as it deems fit. The Contract Dispute Resolution Board, in its discretion, may combine more than one dispute between the parties for concurrent resolution.

27.7.4 **Contract Dispute Resolution Board Determination.** Within forty-five (45) **Days** of the conclusion of all written submissions and oral arguments, the Contract Dispute Resolution Board shall render a written decision resolving the dispute. In an unusually complex case, the Contract Dispute Resolution Board may render its decision in a longer period, not to exceed ninety (90) **Days**, and shall so advise the parties at the commencement of this period. The Contract Dispute Resolution Board's decision must be consistent with the terms of the **Contract**. Decisions of the Contract Dispute Resolution Board shall only resolve matters before the Contract Dispute Resolution Board and shall not have precedential effect with respect to matters not before the Contract Dispute Resolution Board.

27.7.5 Notification of Contract Dispute Resolution Board Decision. The Contract Dispute Resolution Board shall send a copy of its decision to the **Contractor**, the **ACCO**, the **Engineer**, the **Comptroller**, the **City Corporation Counsel**, the **CCPO**, and the **PPB**. A decision in favor of the **Contractor** shall be subject to the prompt payment provisions of the **PPB Rules**. The Required Payment Date shall be thirty (30) Days after the date the parties are formally notified of the Contract Dispute Resolution Board's decision.

27.7.6 Finality of Contract Dispute Resolution Board Decision. The Contract Dispute Resolution Board's decision shall be final and binding on all parties. Any party may seek review of the Contract Dispute Resolution Board's decision solely in the form of a challenge, filed within four (4) months of the date of the Contract Dispute Resolution Board's decision, in a court of competent jurisdiction of the State of New York, County of New York pursuant to Article 78 of the Civil Practice Law and Rules. Such review by the court shall be limited to the question of whether or not the Contract Dispute Resolution Board's decision was made in violation of lawful procedure, was affected by an error of **Law**, or was arbitrary and capricious or an abuse of discretion. No evidence or information shall be introduced or relied upon in such proceeding that was not presented to the Contract Dispute Resolution Board in accordance with this Article 27.

27.8 Any termination, cancellation, or alleged breach of the **Contract** prior to or during the pendency of any proceedings pursuant to this Article 27 shall not affect or impair the ability of the **Commissioner** or Contract Dispute Resolution Board to make a binding and final decision pursuant to this Article 27.

#### **ARTICLE 28. RECORD KEEPING FOR EXTRA OR DISPUTED WORK OR WORK ON A TIME & MATERIALS BASIS**

28.1 While the **Contractor** or any of its **Subcontractors** is performing **Work** on a time and material basis or **Extra Work** on a time and material basis ordered by the **Commissioner** under Article 25, or where the **Contractor** believes that it or any of its **Subcontractors** is performing **Extra Work** but a final determination by **Agency** has not been made, or the **Contractor** or any of its **Subcontractors** is performing disputed **Work** (whether on or off the **Site**), or complying with a determination or order under protest in accordance with Articles 11, 27, and 30, in each such case the **Contractor** shall furnish the **Resident Engineer** daily with three (3) copies of written statements signed by the **Contractor's** representative at the **Site** showing:

28.1.1 The name, trade, and number of each worker employed on such **Work** or engaged in complying with such determination or order, the number of hours employed, and the character of the **Work** each is doing; and

28.1.2 The nature and quantity of any materials, plant and equipment furnished or used in connection with the performance of such **Work** or compliance with such determination or order, and from whom purchased or rented.

28.2 A copy of such statement will be countersigned by the **Resident Engineer**, noting thereon any items not agreed to or questioned, and will be returned to the **Contractor** within two (2) **Days** after submission.

28.3 The **Contractor** and its **Subcontractors**, when required by the **Commissioner**, or the **Comptroller**, shall also produce for inspection, at the office of the **Contractor** or **Subcontractor**, any and all of its books, bid documents, financial statements, vouchers, records, daily job diaries and reports,

and cancelled checks, and any other documents relating to showing the nature and quantity of the labor, materials, plant and equipment actually used in the performance of such **Work**, or in complying with such determination or order, and the amounts expended therefor, and shall permit the **Commissioner** and the **Comptroller** to make such extracts therefrom, or copies thereof, as they or either of them may desire.

28.4 In connection with the examination provided for herein, the **Commissioner**, upon demand therefor, will produce for inspection by the **Contractor** such records as the **Agency** may have with respect to such **Extra Work** or disputed **Work** performed under protest pursuant to order of the **Commissioner**, except those records and reports which may have been prepared for the purpose of determining the accuracy and validity of the **Contractor's** claim.

28.5 Failure to comply strictly with these requirements shall constitute a waiver of any claim for extra compensation or damages on account of the performance of such **Work** or compliance with such determination or order.

#### **ARTICLE 29. OMITTED WORK**

29.1 If any **Contract Work** in a lump sum **Contract**, or if any part of a lump sum item in a unit price, lump sum, or percentage-bid **Contract** is omitted by the **Commissioner** pursuant to Article 33, the **Contract** price, subject to audit by the EAO, shall be reduced by a pro rata portion of the lump sum bid amount based upon the percent of **Work** omitted subject to Article 29.4. For the purpose of determining the pro rata portion of the lump sum bid amount, the bid breakdown submitted in accordance with Article 41 shall be considered, but shall not be the determining factor.

29.2 If the whole of a lump sum item or units of any other item is so omitted by the **Commissioner** in a unit price, lump sum, or percentage-bid **Contract**, then no payment will be made therefor except as provided in Article 29.4.

29.3 For units that have been ordered but are only partially completed, the unit price shall be reduced by a pro rata portion of the unit price bid based upon the percentage of **Work** omitted subject to Article 29.4.

29.4 In the event the **Contractor**, with respect to any omitted **Work**, has purchased any non-cancelable material and/or equipment that is not capable of use except in the performance of this **Contract** and has been specifically fabricated for the sole purpose of this **Contract**, but not yet incorporated into the **Work**, the **Contractor** shall be paid for such material and/or equipment in accordance with Article 64.2.1(b); provided, however, such payment is contingent upon the **Contractor's** delivery of such material and/or equipment in acceptable condition to a location designated by the **City**.

29.5 The **Contractor** agrees to make no claim for damages or for loss of overhead and profit with regard to any omitted **Work**.

#### **ARTICLE 30. NOTICE AND DOCUMENTATION OF COSTS AND DAMAGES; PRODUCTION OF FINANCIAL RECORDS**

30.1 If the **Contractor** shall claim to be sustaining damages by reason of any act or omission of the **City** or its agents, it shall submit to the **Commissioner** within forty-five (45) **Days** from the time such damages are first incurred, and every thirty (30) **Days** thereafter to the extent additional damages are being incurred for the same condition, verified statements of the details and the amounts of such

damages, together with documentary evidence of such damages. The **Contractor** may submit any of the above statements within such additional time as may be granted by the **Commissioner** in writing upon written request therefor. Failure of the **Commissioner** to respond in writing to a written request for additional time within thirty (30) **Days** shall be deemed a denial of the request. On failure of the **Contractor** to strictly comply with the foregoing provisions, such claims shall be deemed waived and no right to recover on such claims shall exist. Damages that the **Contractor** may claim in any action or dispute resolution procedure arising under or by reason of this **Contract** shall not be different from or in excess of the statements and documentation made pursuant to this Article 30. This Article 30.1 does not apply to claims submitted to the **Commissioner** pursuant to Article 11 or to claims disputing a determination under Article 27.

30.2 In addition to the foregoing statements, the **Contractor** shall, upon notice from the **Commissioner**, produce for examination at the **Contractor's** office, by the **Engineer, Architect or Project Manager**, all of its books of account, bills, invoices, payrolls, subcontracts, time books, daily reports, bank deposit books, bank statements, check books, and cancelled checks, showing all of its acts and transactions in connection with or relating to or arising by reason of this **Contract**, and submit itself and persons in its employment, for examination under oath by any person designated by the **Commissioner** or **Comptroller** to investigate claims made or disputes against the **City** under this **Contract**. At such examination, a duly authorized representative of the **Contractor** may be present.

30.3 In addition to the statements required under Article 28 and this Article 30, the **Contractor** and/or its **Subcontractor** shall, within thirty (30) **Days** upon notice from the **Commissioner** or **Comptroller**, produce for examination at the **Contractor's** and/or **Subcontractor's** office, by a representative of either the **Commissioner** or **Comptroller**, all of its books of account, bid documents, financial statements, accountant workpapers, bills, invoices, payrolls, subcontracts, time books, daily reports, bank deposit books, bank statements, check books, and cancelled checks, showing all of its acts and transactions in connection with or relating to or arising by reason of this **Contract**. Further, the **Contractor** and/or its **Subcontractor** shall submit any person in its employment, for examination under oath by any person designated by the **Commissioner** or **Comptroller** to investigate claims made or disputes against the **City** under this **Contract**. At such examination, a duly authorized representative of the **Contractor** may be present.

30.4 Unless the information and examination required under Article 30.3 is provided by the **Contractor** and/or its **Subcontractor** upon thirty (30) **Days'** notice from the **Commissioner** or **Comptroller**, or upon the **Commissioner's** or **Comptroller's** written authorization to extend the time to comply, the **City** shall be released from all claims arising under, relating to or by reason of this **Contract**, except for sums certified by the **Commissioner** to be due under the provisions of this **Contract**. It is further stipulated and agreed that no person has the power to waive any of the foregoing provisions and that in any action or dispute resolution procedure against the **City** to recover any sum in excess of the sums certified by the **Commissioner** to be due under or by reason of this **Contract**, the **Contractor** must allege in its complaint and prove, at trial or during such dispute resolution procedure, compliance with the provisions of this Article 30.

30.5 In addition, after the commencement of any action or dispute resolution procedure by the **Contractor** arising under or by reason of this **Contract**, the **City** shall have the right to require the **Contractor** to produce for examination under oath, up until the trial of the action or hearing before the Contract Dispute Resolution Board, the books and documents described in Article 30.3 and submit itself and all persons in its employ for examination under oath. If this Article 30 is not complied with as required, then the **Contractor** hereby consents to the dismissal of the action or dispute resolution procedure.

## **CHAPTER VII: POWERS OF THE RESIDENT ENGINEER, THE ENGINEER OR ARCHITECT AND THE COMMISSIONER**

### **ARTICLE 31. THE RESIDENT ENGINEER**

31.1 The **Resident Engineer** shall have the power to inspect, supervise, and control the performance of the **Work**, subject to review by the **Commissioner**. The **Resident Engineer** shall not, however, have the power to issue an **Extra Work** order, except as specifically designated in writing by the **Commissioner**.

### **ARTICLE 32. THE ENGINEER OR ARCHITECT OR PROJECT MANAGER**

32.1 The **Engineer** or **Architect** or **Project Manager**, in addition to those matters elsewhere herein delegated to the **Engineer** and expressly made subject to his/her determination, direction or approval, shall have the power, subject to review by the **Commissioner**:

32.1.1 To determine the amount, quality, and location of the **Work** to be paid for hereunder; and

32.1.2 To determine all questions in relation to the **Work**, to interpret the **Contract Drawings, Specifications, and Addenda**, and to resolve all patent inconsistencies or ambiguities therein; and

32.1.3 To determine how the **Work** of this **Contract** shall be coordinated with **Work** of **Other Contractors** engaged simultaneously on this **Project**, including the power to suspend any part of the **Work**, but not the whole thereof; and

32.1.4 To make minor changes in the **Work** as he/she deems necessary, provided such changes do not result in a net change in the cost to the **City** or to the **Contractor** of the **Work** to be done under the **Contract**; and

32.1.5 To amplify the **Contract Drawings**, add explanatory information and furnish additional **Specifications** and drawings, consistent with this **Contract**.

32.2 The foregoing enumeration shall not imply any limitation upon the power of the **Engineer** or **Architect** or **Project Manager**, for it is the intent of this **Contract** that all of the **Work** shall generally be subject to his/her determination, direction, and approval, except where the determination, direction or approval of someone other than the **Engineer** or **Architect** or **Project Manager** is expressly called for herein.

32.3 The **Engineer** or **Architect** or **Project Manager** shall not, however, have the power to issue an **Extra Work** order, except as specifically designated in writing by the **Commissioner**.

### **ARTICLE 33. THE COMMISSIONER**

33.1 The **Commissioner**, in addition to those matters elsewhere herein expressly made subject to his/her determination, direction or approval, shall have the power:



33.1.1 To review and make determinations on any and all questions in relation to this **Contract** and its performance; and

33.1.2 To modify or change this **Contract** so as to require the performance of **Extra Work** (subject, however, to the limitations specified in Article 25) or the omission of **Contract Work**; and

33.1.3 To suspend the whole or any part of the **Work** whenever in his/her judgment such suspension is required:

33.1.3(a) In the interest of the **City** generally; or

33.1.3(b) To coordinate the **Work** of the various contractors engaged on this **Project** pursuant to the provisions of Article 12; or

33.1.3(c) To expedite the completion of the entire **Project** even though the completion of this particular **Contract** may thereby be delayed.

#### **ARTICLE 34. NO ESTOPPEL**

34.1 Neither the **City** nor any **Agency**, official, agent or employee thereof, shall be bound, precluded or estopped by any determination, decision, approval, order, letter, payment or certificate made or given under or in connection with this **Contract** by the **City**, the **Commissioner**, the **Engineer**, the **Resident Engineer**, or any other official, agent or employee of the **City**, either before or after the final completion and acceptance of the **Work** and payment therefor:

34.1.1 From showing the true and correct classification, amount, quality or character of the **Work** actually done; or that any such determination, decision, order, letter, payment or certificate was untrue, incorrect or improperly made in any particular, or that the **Work**, or any part thereof, does not in fact conform to the requirements of this **Contract**; and

34.1.2 From demanding and recovering from the **Contractor** any overpayment made to it, or such damages as the **City** may sustain by reason of the **Contractor's** failure to perform each and every part of its **Contract**.

### **CHAPTER VIII: LABOR PROVISIONS**

#### **ARTICLE 35. EMPLOYEES**

35.1 The **Contractor** and its **Subcontractors** shall not employ on the **Work**:

35.1.1 Anyone who is not competent, faithful and skilled in the **Work** for which he/she shall be employed; and whenever the **Commissioner** shall inform the **Contractor**, in writing, that any employee is, in his/her opinion, incompetent, unfaithful or disobedient, that employee shall be discharged from the **Work** forthwith, and shall not again be employed upon it; or

35.1.2 Any labor, materials or means whose employment, or utilization during the course of this **Contract**, may tend to or in any way cause or result in strikes, work stoppages, delays, suspension of **Work** or similar troubles by workers employed by the **Contractor** or its **Subcontractors**, or by any of the trades working in or about the buildings and premises where **Work** is being performed under this **Contract**, or by **Other Contractors** or their **Subcontractors** pursuant to other contracts, or on any other building or premises owned or operated by the **City**, its **Agencies**, departments, boards or authorities. Any violation by the **Contractor** of this requirement may, upon certification of the **Commissioner**, be considered as proper and sufficient cause for declaring the **Contractor** to be in default, and for the **City** to take action against it as set forth in Chapter X of this **Contract**, or such other article of this **Contract** as the Commissioner may deem proper; or

35.1.3 In accordance with Section 220.3-e of the Labor Law of the State of New York (hereinafter "Labor Law"), the **Contractor** and its **Subcontractors** shall not employ on the **Work** any apprentice, unless he/she is a registered individual, under a bona fide program registered with the New York State Department of Labor. The allowable ratio of apprentices to journey-level workers in any craft classification shall not be greater than the ratio permitted to the **Contractor** as to its work force on any job under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not registered as above, shall be paid the wage rate determined by the **Comptroller** of the **City** for the classification of **Work** actually performed. The **Contractor** or **Subcontractor** will be required to furnish written evidence of the registration of its program and apprentices as well as all the appropriate ratios and wage rates, for the area of the construction prior to using any apprentices on the **Contract Work**.

35.2 If the total cost of the **Work** under this **Contract** is at least two hundred fifty thousand (\$250,000) dollars, all laborers, workers, and mechanics employed in the performance of the **Contract** on the public work site, either by the **Contractor**, **Subcontractor** or other person doing or contracting to do the whole or a part of the **Work** contemplated by the **Contract**, shall be certified prior to performing any **Work** as having successfully completed a course in construction safety and health approved by the United States Department of Labor's Occupational Safety and Health Administration that is at least ten (10) hours in duration.

35.3 In accordance with Local Law Nos. 30-2012 and 33-2012, codified at sections 6-132 and 12-113 of the Administrative Code, respectively,

35.3.1 The **Contractor** shall not take an adverse personnel action with respect to an officer or employee in retaliation for such officer or employee making a report of information concerning conduct which such officer or employee knows or reasonably believes to involve corruption, criminal activity, conflict of interest, gross mismanagement or abuse of authority by any officer or employee relating to this **Contract** to (a) the Commissioner of the Department of Investigation, (b) a member of the New York City Council, the Public Advocate, or the **Comptroller**, or (c) the **CCPO**, **ACCO**, **Agency head**, or **Commissioner**.

35.3.2 If any of the **Contractor's** officers or employees believes that he or she has been the subject of an adverse personnel action in violation of Article 35.3.1, he or she shall be entitled to bring a cause of action against the **Contractor** to recover all relief necessary to make him or her whole. Such relief may include but is not limited to: (a) an injunction to restrain continued retaliation, (b) reinstatement to the position such employee would have had but for the retaliation or to an equivalent position, (c) reinstatement of full fringe benefits and seniority rights, (d) payment of two times back

pay, plus interest, and (e) compensation for any special damages sustained as a result of the retaliation, including litigation costs and reasonable attorney's fees.

35.3.3 The **Contractor** shall post a notice provided by the **City** in a prominent and accessible place on any site where work pursuant to the **Contract** is performed that contains information about:

35.3.3(a) how its employees can report to the New York City Department of Investigation allegations of fraud, false claims, criminality or corruption arising out of or in connection with the **Contract**; and

35.3.3(b) the rights and remedies afforded to its employees under Administrative Code sections 7-805 (the New York City False Claims Act) and 12-113 (the Whistleblower Protection Expansion Act) for lawful acts taken in connection with the reporting of allegations of fraud, false claims, criminality or corruption in connection with the **Contract**.

35.3.4 For the purposes of this Article 35.3, "adverse personnel action" includes dismissal, demotion, suspension, disciplinary action, negative performance evaluation, any action resulting in loss of staff, office space, equipment or other benefit, failure to appoint, failure to promote, or any transfer or assignment or failure to transfer or assign against the wishes of the affected officer or employee.

35.3.5 This Article 35.3 is applicable to all of the **Contractor's Subcontractors** having subcontracts with a value in excess of \$100,000; accordingly, the **Contractor** shall include this rider in all subcontracts with a value a value in excess of \$100,000.

35.4 Article 35.3 is not applicable to this **Contract** if it is valued at \$100,000 or less. Articles 35.3.1, 35.3.2, 35.3.4, and 35.3.5 are not applicable to this **Contract** if it was solicited pursuant to a finding of an emergency.

35.5 Paid Sick Leave Law.

35.5.1 Introduction and General Provisions.

35.5.1(a) The Earned Sick Time Act, also known as the Paid Sick Leave Law ("PSLL"), requires covered employees who annually perform more than 80 hours of work in New York City to be provided with paid sick time.<sup>2</sup> Contractors of the **City** or of other governmental entities may be required to provide sick time pursuant to the PSLL.

35.5.1(b) The PSLL became effective on April 1, 2014, and is codified at Title 20, Chapter 8, of the New York City Administrative Code. It is administered by the City's Department of Consumer Affairs ("DCA"); DCA's rules promulgated under the PSLL are codified at Chapter 7 of Title 6 of the Rules of the City of New York ("Rules").

<sup>2</sup> Pursuant to the PSLL, if fewer than five employees work for the same employer, as determined pursuant to New York City Administrative Code § 20-912(g), such employer has the option of providing such employees uncompensated sick time.

35.5.1(c) The **Contractor** agrees to comply in all respects with the PSLL and the Rules, and as amended, if applicable, in the performance of this **Contract**. The **Contractor** further acknowledges that such compliance is a material term of this **Contract** and that failure to comply with the PSLL in performance of this **Contract** may result in its termination.

35.5.1(d) The **Contractor** must notify the **Agency Chief Contracting Officer** of the **Agency** with whom it is contracting in writing within ten (10) days of receipt of a complaint (whether oral or written) regarding the PSLL involving the performance of this **Contract**. Additionally, the **Contractor** must cooperate with DCA's education efforts and must comply with DCA's subpoenas and other document demands as set forth in the PSLL and Rules.

35.5.1(e) The PSLL is summarized below for the convenience of the **Contractor**. The **Contractor** is advised to review the PSLL and Rules in their entirety. On the website [www.nyc.gov/PaidSickLeave](http://www.nyc.gov/PaidSickLeave) there are links to the PSLL and the associated Rules as well as additional resources for employers, such as Frequently Asked Questions, timekeeping tools and model forms, and an event calendar of upcoming presentations and webinars at which the **Contractor** can get more information about how to comply with the PSLL. The **Contractor** acknowledges that it is responsible for compliance with the PSLL notwithstanding any inconsistent language contained herein.

#### 35.5.2 Pursuant to the PSLL and the Rules: Applicability, Accrual, and Use.

35.5.2(a) An employee who works within the City of New York for more than eighty hours in any consecutive 12-month period designated by the employer as its "calendar year" pursuant to the PSLL ("Year") must be provided sick time. Employers must provide a minimum of one hour of sick time for every 30 hours worked by an employee and compensation for such sick time must be provided at the greater of the employee's regular hourly rate or the minimum wage. Employers are not required to provide more than 40 hours of sick time to an employee in any Year.

35.5.2(b) An employee has the right to determine how much sick time he or she will use, provided that employers may set a reasonable minimum increment for the use of sick time not to exceed four hours per **Day**. In addition, an employee may carry over up to 40 hours of unused sick time to the following Year, provided that no employer is required to allow the use of more than forty hours of sick time in a Year or carry over unused paid sick time if the employee is paid for such unused sick time and the employer provides the employee with at least the legally required amount of paid sick time for such employee for the immediately subsequent Year on the first **Day** of such Year.

35.5.2(c) An employee entitled to sick time pursuant to the PSLL may use sick time for any of the following:

- i. such employee's mental illness, physical illness, injury, or health condition or the care of such illness, injury, or condition or such employee's need for medical diagnosis or preventive medical care;
- ii. such employee's care of a family member (an employee's child, spouse, domestic partner, parent, sibling, grandchild or grandparent, or the child or parent of an employee's spouse or domestic partner) who has a mental

- illness, physical illness, injury or health condition or who has a need for medical diagnosis or preventive medical care;
- iii. closure of such employee's place of business by order of a public official due to a public health emergency; or
  - iv. such employee's need to care for a child whose school or childcare provider has been closed due to a public health emergency.

35.5.2(d) An employer must not require an employee, as a condition of taking sick time, to search for a replacement. However, an employer may require an employee to provide: reasonable notice of the need to use sick time; reasonable documentation that the use of sick time was needed for a reason above if for an absence of more than three consecutive work days; and/or written confirmation that an employee used sick time pursuant to the PSLL. However, an employer may not require documentation specifying the nature of a medical condition or otherwise require disclosure of the details of a medical condition as a condition of providing sick time and health information obtained solely due to an employee's use of sick time pursuant to the PSLL must be treated by the employer as confidential.

35.5.2(e) If an employer chooses to impose any permissible discretionary requirement as a condition of using sick time, it must provide to all employees a written policy containing those requirements, using a delivery method that reasonably ensures that employees receive the policy. If such employer has not provided its written policy, it may not deny sick time to an employee because of non-compliance with such a policy.

35.5.2(f) Sick time to which an employee is entitled must be paid no later than the payday for the next regular payroll period beginning after the sick time was used.

35.5.3 Exemptions and Exceptions. Notwithstanding the above, the PSLL does not apply to any of the following:

35.5.3(a) an independent contractor who does not meet the definition of employee under section 190(2) of the New York State Labor Law;

35.5.3(b) an employee covered by a valid collective bargaining agreement in effect on April 1, 2014, until the termination of such agreement;

35.5.3(c) an employee in the construction or grocery industry covered by a valid collective bargaining agreement if the provisions of the PSLL are expressly waived in such collective bargaining agreement;

35.5.3(d) an employee covered by another valid collective bargaining agreement if such provisions are expressly waived in such agreement and such agreement provides a benefit comparable to that provided by the PSLL for such employee;

35.5.3(e) an audiologist, occupational therapist, physical therapist, or speech language pathologist who is licensed by the New York State Department of Education and who calls in for work assignments at will, determines his or her own schedule, has the ability to reject or accept any assignment referred to him or her, and is paid an average hourly wage that is at least four times the federal minimum wage;

35.5.3(f) an employee in a work study program under Section 2753 of Chapter 42 of the United States Code;

35.5.3(g) an employee whose work is compensated by a qualified scholarship program as that term is defined in the Internal Revenue Code, Section 117 of Chapter 20 of the United States Code; or

35.5.3(h) a participant in a Work Experience Program (WEP) under section 336-c of the New York State Social Services Law.

35.5.4 Retaliation Prohibited. An employer may not threaten or engage in retaliation against an employee for exercising or attempting in good faith to exercise any right provided by the PSLL. In addition, an employer may not interfere with any investigation, proceeding, or hearing pursuant to the PSLL.

35.5.5 Notice of Rights.

35.5.5(a) An employer must provide its employees with written notice of their rights pursuant to the PSLL. Such notice must be in English and the primary language spoken by an employee, provided that DCA has made available a translation into such language. Downloadable notices are available on DCA's website at <http://www.nyc.gov/html/dca/html/law/PaidSickLeave.shtml>.

35.5.5(b) Any person or entity that willfully violates these notice requirements is subject to a civil penalty in an amount not to exceed fifty dollars for each employee who was not given appropriate notice.

35.5.6 Records. An employer must retain records documenting its compliance with the PSLL for a period of at least three years, and must allow DCA to access such records in furtherance of an investigation related to an alleged violation of the PSLL.

35.5.7 Enforcement and Penalties.

35.5.7(a) Upon receiving a complaint alleging a violation of the PSLL, DCA has the right to investigate such complaint and attempt to resolve it through mediation. Within 30 Days of written notification of a complaint by DCA, or sooner in certain circumstances, the employer must provide DCA with a written response and such other information as DCA may request. If DCA believes that a violation of the PSLL has occurred, it has the right to issue a notice of violation to the employer.

35.5.7(b) DCA has the power to grant an employee or former employee all appropriate relief as set forth in New York City Administrative Code § 20-924(d). Such relief may include, among other remedies, treble damages for the wages that should have been paid, damages for unlawful retaliation, and damages and reinstatement for unlawful discharge. In addition, DCA may impose on an employer found to have violated the PSLL civil penalties not to exceed \$500 for a first violation, \$750 for a second violation within two years of the first violation, and \$1,000 for each succeeding violation within two years of the previous violation.

35.5.8 More Generous Policies and Other Legal Requirements. Nothing in the PSLL is intended to discourage, prohibit, diminish, or impair the adoption or retention of a more generous sick time policy, or the obligation of an employer to comply with any contract,

collective bargaining agreement, employment benefit plan or other agreement providing more generous sick time. The PSLI provides minimum requirements pertaining to sick time and does not preempt, limit or otherwise affect the applicability of any other law, regulation, rule, requirement, policy or standard that provides for greater accrual or use by employees of sick leave or time, whether paid or unpaid, or that extends other protections to employees. The PSLI may not be construed as creating or imposing any requirement in conflict with any federal or state law, rule or regulation.

35.6 HireNYC: Hiring and Reporting Requirements. This Article 35.6 applies to construction contracts of \$1,000,000 or more. The **Contractor** shall comply with the requirements of Articles 35.6.1-35.6.5 for all non-trades jobs (e.g., for an administrative position arising out of **Work** and located in New York City). The **Contractor** shall reasonably cooperate with SBS and the **City** on specific outreach events, including "Hire-on-the-Spot" events, for the hiring of trades workers in connection with the **Work**. If provided elsewhere in this **Contract**, this **Contract** is subject to a project labor agreement.

35.6.1 Enrollment. The **Contractor** shall enroll with the HireNYC system, found at [www.nyc.gov/sbs](http://www.nyc.gov/sbs), within thirty (30) days after the registration of this **Contract** pursuant to Section 328 of the New York City Charter. The **Contractor** shall provide information about the business, designate a primary contact and say whether it intends to hire for any entry to mid-level job opportunities arising from this **Contract** and located in New York City, and, if so, the approximate start date of the first hire.

#### 35.6.2 Job Posting Requirements.

35.6.2(a) Once enrolled in HireNYC, the **Contractor** agrees to update the HireNYC portal with all entry to mid-level job opportunities arising from this **Contract** and located in New York City, if any, which shall be defined as jobs requiring no more than an associate degree, as provided by the New York State Department of Labor (see Column F of <https://labor.ny.gov/stats/2012-2022-NYS-Employment-Prospects.xls>). The information to be updated includes the types of entry and mid-level positions made available from the work arising from the **Contract** and located in New York City, the number of positions, the anticipated schedule of initiating the hiring process for these positions, and the contact information for the **Contractor's** representative charged with overseeing hiring. The **Contractor** must update the HireNYC portal with any hiring needs arising from the contract and located in New York City, and the requirements of the jobs to be filled, no less than three weeks prior to the intended first day of employment for each new position, except with the permission of SBS, not to be unreasonably withheld, and must also update the HireNYC portal as set forth below.

35.6.2(b) After enrollment through HireNYC and submission of relevant information, SBS will work with the **Contractor** to develop a recruitment plan which will outline the candidate screening process, and will provide clear instructions as to when, where, and how interviews will take place. HireNYC will screen applicants based on employer requirements and refer applicants whom it believes are qualified to the **Contractor** for interviews. The **Contractor** must interview referred applicants whom it believes are qualified.

35.6.2(c) After completing an interview of a candidate referred by HireNYC, the **Contractor** must provide feedback via the portal within twenty (20) business days to indicate which candidates were interviewed and hired, if any. In addition, the **Contractor** shall provide the start date of new hires, and additional information

reasonably related to such hires, within twenty (20) business days after the start date. In the event the **Contractor** does not have any job openings covered by this Rider in any given year, the **Contractor** shall be required to provide an annual update to HireNYC to that effect. For this purpose, the reporting year shall run from the date of the registration of the **Contract** pursuant to Charter section 328 and each anniversary date.

35.6.2(d) These requirements do not limit the **Contractor's** ability to assess the qualifications of prospective workers, and to make final hiring and retention decisions. No provision of this Article 35.6 shall be interpreted so as to require the **Contractor** to employ any particular worker.

35.6.2(e) In addition, the provisions of this Article 35.6 shall not apply to positions that the **Contractor** intends to fill with employees employed pursuant to the job retention provision of Section 22-505 of the Administrative Code of the City of New York. The **Contractor** shall not be required to report such openings with HireNYC. However, the **Contractor** shall enroll with the HireNYC system pursuant to Article 35.6.1, above, and, if such positions subsequently become open, then the remaining provisions of this Article 35.6 will apply.

35.6.3 Breach and Liquidated Damages. If the **Contractor** fails to comply with the terms of the **ContrSact** and this Article 35.6 ( 1) by not enrolling its business with HireNYC; (2) by not informing HireNYC, as required, of open positions; or (3) by failing to interview a qualified candidate, the **Agency** may assess liquidated damages in the amount of two-thousand five hundred dollars (\$2,500) per breach. For all other events of noncompliance with the terms of this Article 35.6, the **Agency** may assess liquidated damages in the amount of five hundred dollars (\$500) per breach. Furthermore, in the event the **Contractor** breaches the requirements of this Article 35.6 during the term of the **Contract**, the **City** may hold the **Contractor** in default of this **Contract**.

35.6.4 Audit Compliance. In addition to the auditing requirements set forth in other parts of the **Contract**, the **Contractor** shall permit SBS and the **City** to inspect any and all records concerning or relating to job openings or the hiring of individuals for work arising from the **Contract** and located in New York City. The **Contractor** shall permit an inspection within seven (7) business days of the request.

35.6.5 Other Reporting Requirements. The **Contractor** shall report to the **City**, on a monthly basis, all information reasonably requested by the **City** that is necessary for the **City** to comply with any reporting requirements imposed by **Law**, including any requirement that the **City** maintain a publicly accessible database. In addition, the **Contractor** agrees to comply with all reporting requirements imposed by **Law**, or as otherwise requested by the **City**.

35.6.6 Federal Hiring Requirements. If this **Contract** is federally funded (as indicated elsewhere in this **Contract**), the **Contractor** shall comply with all federal hiring requirements as may be set forth in this **Contract**, including, as applicable: (a) Section 3 of the HUD Act of 1968, which requires, to the greatest extent feasible, economic opportunities for 30 percent of new hires be given to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing and Executive Order 11246, which prohibits discrimination in employment due to race, color, religion, sex or national origin, and requires the implementation of goals for minority and female participation for work involving any construction trade.



## **ARTICLE 36. NO DISCRIMINATION**

36.1 The **Contractor** specifically agrees, as required by Labor Law Section 220-e, as amended, that:

36.1.1 In the hiring of employees for the performance of **Work** under this **Contract** or any subcontract hereunder, neither the **Contractor**, **Subcontractor**, nor any person acting on behalf of such **Contractor** or **Subcontractor**, shall by reason of race, creed, color or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the **Work** to which the employment relates;

36.1.2 Neither the **Contractor**, **Subcontractor**, nor any person on its behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of **Work** under this **Contract** on account of race, creed, color or national origin;

36.1.3 There may be deducted from the amount payable to the **Contractor** by the **City** under this **Contract** a penalty of fifty (\$50.00) dollars for each person for each **Day** during which such person was discriminated against or intimidated in violation of the provisions of this **Contract**; and

36.1.4 This **Contract** may be cancelled or terminated by the **City** and all moneys due or to become due hereunder may be forfeited, for a second or any subsequent violation of the terms or conditions of this Article 36.

36.1.5 This Article 36 covers all construction, alteration and repair of any public building or public work occurring in the State of New York and the manufacture, sale, and distribution of materials, equipment, and supplies to the extent that such operations are performed within the State of New York pursuant to this **Contract**.

36.2 The **Contractor** specifically agrees, as required by Section 6-108 of the Administrative Code, as amended, that:

36.2.1 It shall be unlawful for any person engaged in the construction, alteration or repair of buildings or engaged in the construction or repair of streets or highways pursuant to a **Contract** with the **City** or engaged in the manufacture, sale or distribution of materials, equipment or supplies pursuant to a **Contract** with the **City** to refuse to employ or to refuse to continue in any employment any person on account of the race, color or creed of such person.

36.2.2 It shall be unlawful for any person or any servant, agent or employee of any person, described in Article 36.1.2, to ask, indicate or transmit, orally or in writing, directly or indirectly, the race, color or creed or religious affiliation of any person employed or seeking employment from such person, firm or corporation.

36.2.3 Breach of the foregoing provisions shall be deemed a violation of a material provision of this **Contract**.

36.2.4 Any person, or the employee, manager or owner of or officer of such firm or corporation who shall violate any of the provisions of this Article 36.2 shall, upon

conviction thereof, be punished by a fine of not more than one hundred (\$100.00) dollars or by imprisonment for not more than thirty (30) **Days**, or both.

36.3 This **Contract** is subject to the requirements of Executive Order No. 50 (1980) ("E.O. 50"), as revised, and the rules and regulations promulgated thereunder. No contract will be awarded unless and until these requirements have been complied with in their entirety. By signing this **Contract**, the **Contractor** agrees that it:

36.3.1 Will not engage in any unlawful discrimination against any employee or applicant for employment because of race, creed, color, national origin, sex, age, disability, marital status or sexual orientation with respect to all employment decisions including, but not limited to, recruitment, hiring, upgrading, demotion, downgrading, transfer, training, rates of pay or other forms of compensation, layoff, termination, and all other terms and conditions of employment; and

36.3.2 Will not engage in any unlawful discrimination in the selection of **Subcontractors** on the basis of the owner's race, color, creed, national origin, sex, age, disability, marital status or sexual orientation; and

36.3.3 Will state in all solicitations or advertisements for employees placed by or on behalf of the **Contractor** that all qualified applicants will receive consideration for employment without unlawful discrimination based on race, creed, color, national origin, sex, age, citizens status, disability, marital status, sexual orientation, or that it is an equal employment opportunity employer; and

36.3.4 Will send to each labor organization or representative of workers with which it has a collective bargaining agreement or other contract or memorandum of understanding, written notification of its equal employment opportunity commitments under E.O. 50 and the rules and regulations promulgated thereunder; and

36.3.5 Will furnish, before the award of the **Contract**, all information and reports, including an employment report, that are required by E.O. 50, the rules and regulations promulgated thereunder, and orders of the **City Department of Business Services, Division of Labor Services (DLS)** and will permit access to its books, records, and accounts by the **DLS** for the purposes of investigation to ascertain compliance with such rules, regulations, and orders.

36.4 The **Contractor** understands that in the event of its noncompliance with the nondiscrimination clauses of this **Contract** or with any of such rules, regulations, or orders, such noncompliance shall constitute a material breach of this **Contract** and noncompliance with E.O. 50 and the rules and regulations promulgated thereunder. After a hearing held pursuant to the rules of the **DLS**, the Director of the **DLS** may direct the **Commissioner** to impose any or all of the following sanctions:

36.4.1 Disapproval of the **Contractor**; and/or

36.4.2 Suspension or termination of the **Contract**; and/or

36.4.3 Declaring the **Contractor** in default; and/or

36.4.4 In lieu of any of the foregoing sanctions, the Director of the **DLS** may impose an employment program.

In addition to any actions taken under this **Contract**, failure to comply with E.O. 50 and the rules and regulations promulgated thereunder, in one or more instances, may result in a **City Agency** declaring the **Contractor** to be non-responsible in future procurements. The **Contractor** further agrees that it will refrain from entering into any **Contract** or **Contract** modification subject to E.O. 50 and the rules and regulations promulgated thereunder with a **Subcontractor** who is not in compliance with the requirements of E.O. 50 and the rules and regulations promulgated thereunder.

36.5 The **Contractor** specifically agrees, as required by Section 6-123 of the Administrative Code, that:

36.5.1 The **Contractor** will not engage in any unlawful discriminatory practice in violation of Title 8 of the Administrative Code; and

36.5.2 Any failure to comply with this Article 36.5 may subject the **Contractor** to the remedies set forth in Section 6-123 of the Administrative Code, including, where appropriate, sanctions such as withholding of payment, imposition of an employment program, finding the **Contractor** to be in default, cancellation of the **Contract**, or any other sanction or remedy provided by **Law** or **Contract**.

#### **ARTICLE 37. LABOR LAW REQUIREMENTS**

37.1 The **Contractor** shall strictly comply with all applicable provisions of the Labor Law, as amended. Such compliance is a material term of this **Contract**.

37.2 The **Contractor** specifically agrees, as required by Labor Law Sections 220 and 220-d, as amended, that:

37.2.1 **Hours of Work:** No laborer, worker, or mechanic in the employ of the **Contractor**, **Subcontractor** or other person doing or contracting to do the whole or a part of the **Work** contemplated by this **Contract** shall be permitted or required to work more than eight (8) hours in any one (1) **Day**, or more than five (5) **Days** in any one (1) week, except as provided in the Labor Law and in cases of extraordinary emergency including fire, flood, or danger to life or property, or in the case of national emergency when so proclaimed by the President of the United States of America.

37.2.2 In situations in which there are not sufficient laborers, workers, and mechanics who may be employed to carry on expeditiously the **Work** contemplated by this **Contract** as a result of such restrictions upon the number of hours and **Days** of labor, and the immediate commencement or prosecution or completion without undue delay of the **Work** is necessary for the preservation of the **Site** and/or for the protection of the life and limb of the persons using the same, such laborers, workers, and mechanics shall be permitted or required to work more than eight (8) hours in any one (1) **Day**; or five (5) **Days** in any one (1) week; provided, however, that upon application of any **Contractor**, the **Commissioner** shall have first certified to the Commissioner of Labor of the State of New York (hereinafter "Commissioner of Labor") that such public **Work** is of an important nature and that a delay in carrying it to completion would result in serious disadvantage to the public; and provided, further, that such Commissioner of Labor shall have determined that such an emergency does in fact exist as provided in Labor Law Section 220.2.

37.2.3 Failure of the **Commissioner** to make such a certification to the Commissioner of Labor shall not entitle the **Contractor** to damages for delay or for any cause whatsoever.

37.2.4 Prevailing Rate of Wages: The wages to be paid for a legal day's **Work** to laborers, workers, or mechanics employed upon the **Work** contemplated by this **Contract** or upon any materials to be used thereon shall not be less than the "prevailing rate of wage" as defined in Labor Law Section 220, and as fixed by the **Comptroller** in the attached Schedule of Wage Rates and in updated schedules thereof. The prevailing wage rates and supplemental benefits to be paid are those in effect at the time the **Work** is being performed.

37.2.5 Requests for interpretation or correction in the Information for Bidders includes all requests for clarification of the classification of trades to be employed in the performance of the **Work** under this **Contract**. In the event that a trade not listed in the **Contract** is in fact employed during the performance of this **Contract**, the **Contractor** shall be required to obtain from the **Agency** the prevailing wage rates and supplementary benefits for the trades used and to complete the performance of this **Contract** at the price at which the **Contract** was awarded.

37.2.6 Minimum Wages: Except for employees whose wage is required to be fixed pursuant to Labor Law Section 220, all persons employed by the **Contractor** and any **Subcontractor** in the manufacture or furnishing of the supplies, materials, or equipment, or the furnishing of work, labor, or services, used in the performance of this **Contract**, shall be paid, without subsequent deduction or rebate unless expressly authorized by **Law**, not less than the sum mandated by **Law**.

37.3 Working Conditions: No part of the **Work**, labor or services shall be performed or rendered by the **Contractor** in any plants, factories, buildings or surroundings or under working conditions which are unsanitary or hazardous or dangerous to the health and safety of employees engaged in the performance of this **Contract**. Compliance with the safety, sanitary, and factory inspection **Laws** of the state in which the **Work** is to be performed shall be prima facie evidence of compliance with this Article 37.3.

37.4 Prevailing Wage Enforcement: The **Contractor** agrees to pay for all costs incurred by the **City** in enforcing prevailing wage requirements, including the cost of any investigation conducted by or on behalf of the **Agency** or the **Comptroller**, where the **City** discovers a failure to comply with any of the requirements of this Article 37 by the **Contractor** or its **Subcontractor(s)**. The **Contractor** also agrees that, should it fail or refuse to pay for any such investigation, the **Agency** is hereby authorized to deduct from a **Contractor's** account an amount equal to the cost of such investigation.

37.4.1 The Labor Law Section 220 and Section 220-d, as amended, provide that this **Contract** shall be forfeited and no sum paid for any **Work** done hereunder on a second conviction for willfully paying less than:

37.4.1(a) The stipulated prevailing wage scale as provided in Labor Law section 220, as amended, or

37.4.1(b) The stipulated minimum hourly wage scale as provided in Labor Law section 220-d, as amended.

37.4.2 For any breach or violation of either working conditions (Article 37.3) or minimum wages (Article 37.2.6) provisions, the party responsible therefor shall be liable to the **City** for liquidated damages, which may be withheld from any amounts due on any contracts with the **City** of such party responsible, or may be recovered in actions brought by the **City**

Corporation Counsel in the name of the **City**, in addition to damages for any other breach of this **Contract**, for a sum equal to the amount of any underpayment of wages due to any employee engaged in the performance of this **Contract**. In addition, the **Commissioner** shall have the right to cancel contracts and enter into other contracts for the completion of the original contract, with or without public letting, and the original **Contractor** shall be liable for any additional cost. All sums withheld or recovered as deductions, rebates, refunds, or underpayment of wages hereunder, shall be held in a special deposit account and shall be paid without interest, on order of the **Comptroller**, directly to the employees who have been paid less than minimum rates of pay as set forth herein and on whose account such sums were withheld or recovered, provided that no claims by employees for such payments shall be entertained unless made within two (2) years from the date of actual notice to the **Contractor** of the withholding or recovery of such sums by the **City**.

37.4.3 A determination by the **Comptroller** that a **Contractor** and/or its **Subcontractor** willfully violated Labor Law Section 220 will be forwarded to the **City's** five District Attorneys for review.

37.4.4 The **Contractor's** or **Subcontractor's** noncompliance with this Article 37.4 and Labor Law Section 220 may result in an unsatisfactory performance evaluation and the **Comptroller** may also find and determine that the **Contractor** or **Subcontractor** willfully violated the New York Labor Law.

37.4.4(a) An unsatisfactory performance evaluation for noncompliance with this Article 37.4 may result in a determination that the **Contractor** is a non-responsible bidder on subsequent procurements with the **City** and thus a rejection of a future award of a contract with the **City**, as well as any other sanctions provided for by Law.

37.4.4(b) Labor Law Section 220-b, as amended, provides that when two (2) final determinations have been rendered against a **Contractor** or **Subcontractor** within any consecutive six (6) year period determining that such **Contractor** or **Subcontractor** has willfully failed to pay the prevailing rate of wages or to provide supplements in accordance with the Labor Law and this Article 37.4, whether such failures were concurrent or consecutive and whether or not such final determinations concerning separate public works projects are rendered simultaneously, such **Contractor** or **Subcontractor** shall be ineligible to submit a bid on or be awarded any public works contract with the **City** for a period of five (5) years from the second final determination. If the final determination involves the falsification of payroll records or the kickback of wages or supplements, the **Contractor** or **Subcontractor** shall be ineligible to submit a bid on or be awarded any public works contract with the **City** for a period of five (5) years from the first final determination.

37.4.4(c) Labor Law Section 220, as amended, provides that the **Contractor** or **Subcontractor** found to have violated this Article 37.4 may be directed to make payment of wages or supplements including interest found to be due, and the **Contractor** or **Subcontractor** may be directed to make payment of a further sum as a civil penalty in an amount not exceeding twenty-five (25%) percent of the total amount found to be due.

37.5 The **Contractor** and its **Subcontractors** shall within ten (10) **Days** after mailing of a Notice of Award or written order, post in prominent and conspicuous places in each and every plant, factory, building, and structure where employees of the **Contractor** and its **Subcontractors** engaged in the

performance of this **Contract** are employed, notices furnished by the **City**, in relation to prevailing wages and supplements, minimum wages, and other stipulations contained in Sections 220 and 220-h of the Labor Law, and the **Contractor** and its **Subcontractors** shall continue to keep such notices posted in such prominent and conspicuous places until **Final Acceptance** of the supplies, materials, equipment, or **Work**, labor, or services required to be furnished or rendered under this **Contract**.

37.6 The **Contractor** shall strictly comply with all of the provisions of Articles 37.6.1 through 37.6.5, and provide for all workers, laborers or mechanics in its employ, the following:

37.6.1 Notices Posted At Site: Post, in a location designated by the **City**, schedules of prevailing wages and supplements for this **Project**, a copy of all re-determinations of such schedules for the **Project**, the Workers' Compensation Law Section 51 notice, all other notices required by **Law** to be posted at the **Site**, the **City** notice that this **Project** is a public works project on which each worker is entitled to receive the prevailing wages and supplements for the occupation at which he or she is working, and all other notices which the **City** directs the **Contractor** to post. The **Contractor** shall provide a surface for such notices which is satisfactory to the **City**. The **Contractor** shall maintain and keep current such notices in a legible manner and shall replace any notice or schedule which is damaged, defaced, illegible or removed for any reason. The **Contractor** shall post such notices before commencing any **Work** on the **Site** and shall maintain such notices until all **Work** on the **Site** is complete; and

37.6.2 Daily Site Sign-in Sheets: Maintain daily **Site** sign-in sheets, and require that **Subcontractors** maintain daily **Site** sign-in sheets for its employees, which include blank spaces for an employee's name to be both printed and signed, job title, date started and Social Security number, the time the employee began work and the time the employee left work, until **Final Acceptance** of the supplies, materials, equipment, or **Work**, labor, or services to be furnished or rendered under this **Contract** unless exception is granted by the **Comptroller** upon application by the **Agency**. In the alternative, subject to the approval of the **CCPO**, the **Contractor** and **Subcontractor** may maintain an electronic or biometric sign-in system, which provides the information required by this Article 37.6.2; and

37.6.3 Individual Employee Information Notices: Distribute a notice to each worker, laborer or mechanic employed under this **Contract**, in a form provided by the **Agency**, that this **Project** is a public works project on which each worker, laborer or mechanic is entitled to receive the prevailing rate of wages and supplements for the occupation at which he or she is working. If the total cost of the **Work** under this **Contract** is at least two hundred fifty thousand (\$250,000) dollars, such notice shall also include a statement that each worker, laborer or mechanic must be certified prior to performing any **Work** as having successfully completed a course in construction safety and health approved by the United States Department of Labor's Occupational Safety and Health Administration that is at least ten (10) hours in duration. Such notice shall be distributed to each worker before he or she starts performing any **Work** of this **Contract** and with the first paycheck after July first of each year. "Worker, laborer or mechanic" includes employees of the **Contractor** and all **Subcontractors** and all employees of suppliers entering the **Site**. At the time of distribution, the **Contractor** shall have each worker, laborer or mechanic sign a statement, in a form provided by the **Agency**, certifying that the worker has received the notice required by this Article 37.6.3, which signed statement shall be maintained with the payroll records required by this **Contract**; and

37.6.3(a) The **Contractor** and each **Subcontractor** shall notify each worker, laborer or mechanic employed under this **Contract** in writing of the prevailing rate of

wages for their particular job classification. Such notification shall be given to every worker, laborer, and mechanic on their first pay stub and with every pay stub thereafter; and

**37.6.4 Site Laminated Identification Badges:** The **Contractor** shall provide laminated identification badges which include a photograph of the worker's, laborer's or mechanic's face and indicate the worker's, laborer's or mechanic's name, trade, employer's name, and employment starting date (month/day/year). Further, the **Contractor** shall require as a condition of employment on the **Site**, that each and every worker, laborer or mechanic wear the laminated identification badge at all times and that it may be seen by any representative of the **City**. The **Commissioner** may grant a written waiver from the requirement that the laminated identification badge include a photograph if the **Contractor** demonstrates that the identity of an individual wearing a laminated identification badge can be easily verified by another method; and

**37.6.5 Language Other Than English Used On Site:** Provide the **ACCO** notice when three (3) or more employees (worker and/or laborer and/or mechanic) on the **Site**, at any time, speak a language other than English. The **ACCO** will then provide the **Contractor** the notices described in Article 37.6.1 in that language or languages as may be required. The **Contractor** is responsible for all distributions under this Article 37; and

**37.6.6 Provision of Records:** The **Contractor** and **Subcontractor(s)** shall produce within five (5) **Days** on the **Site** of the **Work** and upon a written order of the **Engineer**, the **Commissioner**, the **ACCO**, the **Agency EAO**, or the **Comptroller**, such records as are required to be kept by this Article 37.6; and

**37.6.7** The **Contractor** and **Subcontractor(s)** shall pay employees by check or direct deposit. If this **Contract** is for an amount greater than one million (\$1,000,000) dollars, checks issued by the **Contractor** to covered employees shall be generated by a payroll service or automated payroll system (an in-house system may be used if approved by the **Agency**). For any subcontract for an amount greater than seven hundred fifty thousand (\$750,000) dollars, checks issued by a **Subcontractor** to covered employees shall be generated by a payroll service or automated payroll system (an in-house system may be used if approved by the **Agency**); and

**37.6.8** The failure of the **Contractor** or **Subcontractor(s)** to comply with the provisions of Articles 37.6.1 through 37.6.7 may result in the **Commissioner** declaring the **Contractor** in default and/or the withholding of payments otherwise due under the **Contract**.

**37.7** The **Contractor** and its **Subcontractors** shall keep such employment and payroll records as are required by Section 220 of the Labor Law. The failure of the **Contractor** or **Subcontractor(s)** to comply with the provisions of this Article 37.7 may result in the **Commissioner** declaring the **Contractor** in default and/or the withholding of payments otherwise due under the **Contract**.

**37.8** At the time the **Contractor** makes application for each partial payment and for final payment, the **Contractor** shall submit to the **Commissioner** a written payroll certification, in the form provided by this **Contract**, of compliance with the prevailing wage, minimum wage, and other provisions and stipulations required by Labor Law Section 220 and of compliance with the training requirements of Labor Law Section 220-h set forth in Article 35.2. This certification of compliance shall be a condition precedent to payment and no payment shall be made to the **Contractor** unless and until each such certification shall have been submitted to and received by the **Commissioner**.

37.9 This **Contract** is executed by the **Contractor** with the express warranty and representation that the **Contractor** is not disqualified under the provisions of Section 220 of the Labor Law from the award of the **Contract**.

37.10 Any breach or violation of any of the foregoing shall be deemed a breach or violation of a material provision of this **Contract**, and grounds for cancellation thereof by the **City**.

### **ARTICLE 38. PAYROLL REPORTS**

38.1 The **Contractor** and its **Subcontractor(s)** shall maintain on the **Site** during the performance of the **Work** the original payrolls or transcripts thereof which the **Contractor** and its **Subcontractor(s)** are required to maintain and shall submit such original payrolls or transcripts, subscribed and affirmed by it as true, within thirty (30) **Days** after issuance of its first payroll, and every thirty (30) **Days** thereafter, pursuant to Labor Law Section 220(3-a)(a)(iii). The **Contractor** and **Subcontractor(s)** shall submit such original payrolls or transcripts along with each and every payment requisition. If payment requisitions are not submitted at least once a month, the **Contractor** and its **Subcontractor(s)** shall submit original payrolls and transcripts both along with its payment requisitions and independently of its payment requisitions.

38.2 The **Contractor** shall maintain payrolls or transcripts thereof for six (6) years from the date of completion of the **Work** on this **Contract**. If such payrolls and transcripts are maintained outside of New York City after the completion of the **Work** and their production is required pursuant to this Article 38, the **Contractor** shall produce such records in New York City upon request by the **City**.

38.3 The **Contractor** and **Subcontractor(s)** shall comply with any written order, direction, or request made by the **Engineer**, the **Commissioner**, the **ACCO**, the **Agency EAO**, the **Agency Labor Law Investigator(s)**, or the **Comptroller**, to provide to the requesting party any of the following information and/or records within five (5) **Days** of such written order, direction, or request:

38.3.1 Such original payrolls or transcripts thereof subscribed and affirmed by it as true and the statements signed by each worker pursuant to this Chapter VIII; and/or

38.3.2 Attendance sheets for each **Day** on which any employee of the **Contractor** and/or any of the **Subcontractor(s)** performed **Work** on the **Site**, which attendance sheet shall be in a form acceptable to the **Agency** and shall provide information acceptable to the **Agency** to identify each such employee; and/or

38.3.3 Any other information to satisfy the **Engineer**, the **Commissioner**, the **ACCO**, the **Agency EAO**, the **Agency Labor Law Investigator(s)** or the **Comptroller**, that this Chapter VIII and the Labor Law, as to the hours of employment and prevailing rates of wages and/or supplemental benefits, are being observed.

38.4 The failure of the **Contractor** or **Subcontractor(s)** to comply with the provisions of Articles 38.1 and/or 38.2 may result in the **Commissioner** declaring the **Contractor** in default and/or the withholding of payments otherwise due under the **Contract**.

### **ARTICLE 39. DUST HAZARDS**

39.1 Should a harmful dust hazard be created in performing the **Work** of this **Contract**, for the elimination of which appliances or methods have been approved by the Board of Standards and Appeals



of the City of New York, such appliances and methods shall be installed, maintained, and effectively operated during the continuance of such harmful dust hazard. Failure to comply with this provision after notice shall make this **Contract** voidable at the sole discretion of the **City**.

## **CHAPTER IX: PARTIAL AND FINAL PAYMENTS**

### **ARTICLE 40. CONTRACT PRICE**

40.1 The **City** shall pay, and the **Contractor** agrees to accept, in full consideration for the **Contractor's** performance of the **Work** subject to the terms and conditions hereof, the lump sum price or unit prices for which this **Contract** was awarded, plus the amount required to be paid for any **Extra Work** ordered by the **Commissioner** under Article 25, less credit for any **Work** omitted pursuant to Article 29.

### **ARTICLE 41. BID BREAKDOWN ON LUMP SUM**

41.1 Within fifteen (15) **Days** after the commencement date specified in the **Notice to Proceed** or **Order to Work**, unless otherwise directed by the **Resident Engineer**, the **Contractor** shall submit to the **Resident Engineer** a breakdown of its bid price, or of lump sums bid for items of the **Contract**, showing the various operations to be performed under the **Contract**, as directed in the progress schedule required under Article 9, and the value of each of such operations, the total of such items to equal the lump sum price bid. Said breakdown must be approved in writing by the **Resident Engineer**.

41.2 No partial payment will be approved until the **Contractor** submits a bid breakdown that is acceptable to the **Resident Engineer**.

41.3 The **Contractor** shall also submit such other information relating to the bid breakdown as directed by the **Resident Engineer**. Thereafter, the breakdown may be used only for checking the **Contractor's** applications for partial payments hereunder, but shall not be binding upon the **City**, the **Commissioner**, or the **Engineer** for any purpose whatsoever.

### **ARTICLE 42. PARTIAL PAYMENTS**

42.1 From time to time as the **Work** progresses satisfactorily, but not more often than once each calendar month (except where the **Commissioner** approves in writing the submission of invoices on a more frequent basis and for invoices relating to **Work** performed pursuant to a change order), the **Contractor** may submit to the **Engineer** a requisition for a partial payment in the prescribed form, which shall contain an estimate of the quantity and the fair value of the **Work** done during the payment period.

42.2 Partial payments may be made for materials, fixtures, and equipment in advance of their actual incorporation in the **Work**, as the **Commissioner** may approve, and upon the terms and conditions set forth in the General Conditions.

42.3 The **Contractor** shall also submit to the **Commissioner** in connection with every application for partial payment a verified statement in the form prescribed by the **Comptroller** setting forth the information required under Labor Law Section 220-a.

42.4 Within thirty (30) **Days** after receipt of a satisfactory payment application, and within sixty (60) **Days** after receipt of a satisfactory payment application in relation to **Work** performed pursuant to a change order, the **Engineer** will prepare and certify, and the **Commissioner** will approve, a voucher for a partial payment in the amount of such approved estimate, less any and all deductions authorized to be made by the **Commissioner** under the terms of this **Contract** or by **Law**.

#### **ARTICLE 43. PROMPT PAYMENT**

43.1 The Prompt Payment provisions of the **PPB** Rules in effect at the time of the bid will be applicable to payments made under this **Contract**. The provisions require the payment to the **Contractor** of interest on payments made after the required payment date, except as set forth in the **PPB** Rules.

43.2 The **Contractor** shall submit a proper invoice to receive payment, except where the **Contract** provides that the **Contractor** will be paid at predetermined intervals without having to submit an invoice for each scheduled payment.

43.3 Determination of interest due will be made in accordance with the **PPB** Rules.

43.4 If the **Contractor** is paid interest, the proportionate share(s) of that interest shall be forwarded by the **Contractor** to its **Subcontractor(s)**.

43.5 The **Contractor** shall pay each **Subcontractor** or **Materialman** not later than seven (7) **Days** after receipt of payment out of amounts paid to the **Contractor** by the **City** for **Work** performed by the **Subcontractor** or **Materialman** under this **Contract**.

43.5.1 If **Contractor** fails to make any payment to any **Subcontractor** or **Materialman** within seven (7) **Days** after receipt of payment by the **City** pursuant to this Article 43.5, then the **Contractor** shall pay interest on amounts due to such **Subcontractor** or **Materialman** at the rate of interest in effect on the date such payment is made by the **Contractor** computed in accordance with Section 756-b (1)(b) of the New York General Business Law. Accrual of interest shall commence on the **Day** immediately following the expiration of the seventh **Day** following receipt of payment by the **Contractor** from the **City** and shall end on the date on which payment is made.

43.6 The **Contractor** shall include in each of its subcontracts a provision requiring each **Subcontractor** to make payment to each of its **Subcontractors** or **Materialmen** for **Work** performed under this **Contract** in the same manner and within the same time period set forth above.

#### **ARTICLE 44. SUBSTANTIAL COMPLETION PAYMENT**

44.1 The **Contractor** shall submit with the **Substantial Completion** requisition:

44.1.1 A final verified statement of any pending Article 27 disputes in accordance with the **PPB** Rules and this **Contract** and any and all alleged claims against the **City**, in any way connected with or arising out of this **Contract** (including those as to which details may have been furnished pursuant to Articles 11, 27, 28, and 30) setting forth with respect to each such claim the total amount thereof, the various items of labor and materials included therein, and the alleged value of each item; and if the alleged claim be one for delay, the alleged cause of each such delay, the period or periods of time, giving the dates when the

**Contractor** claims the performance of the **Work** or a particular part thereof was delayed, and an itemized statement and breakdown of the amount claimed for each such delay.

44.1.1(a) With respect to each such claim, the **Commissioner**, the **Comptroller** and, in the event of litigation, the **City Corporation Counsel** shall have the same right to inspect, and to make extracts or copies of, the **Contractor's** books, vouchers, records, etc., as is referred to in Articles 11, 27, 28, and 30. Nothing contained in this Article 44.1.1(a) is intended to or shall relieve the **Contractor** from the obligation of complying strictly with Articles 11, 27, 28, and 30. The **Contractor** is warned that unless such claims are completely set forth as herein required, the **Contractor** upon acceptance of the **Substantial Completion** payment pursuant to this Article 44, will have waived any such claims.

#### 44.1.2 A Final Approved Punch List.

44.1.3 Where required, a request for an extension of time to achieve **Substantial Completion** or final extension of time.

44.2 The **Commissioner** shall issue a voucher calling for payment of any part or all of the balance due for **Work** performed under the **Contract**, including monies retained under Article 21, less any and all deductions authorized to be made by the **Commissioner**, under this **Contract** or by **Law**, and less twice the amount the **Commissioner** considers necessary to ensure the completion of the balance of the **Work** by the **Contractor**. Such a payment shall be considered a partial and not a final payment. No **Substantial Completion** payment shall be made under this Article 44 where the **Contractor** failed to complete the **Work** within the time fixed for such completion in the Schedule A of the General Conditions, or within the time to which completion may have been extended, until an extension or extensions of time for the completion of **Work** have been acted upon pursuant to Article 13.

44.3 No further partial payments shall be made to the **Contractor** after **Substantial Completion**, except the **Substantial Completion** payment and payment pursuant to any **Contractor's** requisition that were properly filed with the **Commissioner** prior to the date of **Substantial Completion**; however, the **Commissioner** may grant a waiver for further partial payments after the date of **Substantial Completion** to permit payments for change order **Work** and/or release of retainage and deposits pursuant to Articles 21 and 24. Such waiver shall be in writing.

44.4 The **Contractor** acknowledges that nothing contained in this Article 44 is intended to or shall in any way diminish the force and effect of Article 13.

### **ARTICLE 45. FINAL PAYMENT**

45.1 After completion and **Final Acceptance** of the **Work**, the **Contractor** shall submit all required certificates and documents, together with a requisition for the balance claimed to be due under the **Contract**, less the amount authorized to be retained for maintenance under Article 24. Such submission shall be within 90 days of the date of the **Commissioner's** written determination of **Final Acceptance**, or within such additional time as may be granted by the **Commissioner** in writing. If the **Contractor** fails to submit all required certificates and documents within the time allowed, no payment of the balance claimed shall be made to the **Contractor** and the **Contractor** shall be deemed to have forfeited its right to payment of any balance claimed. A verified statement similar to that required in connection with applications for partial payments shall also be submitted to the **Commissioner**.

45.2 Amended Verified Statement of Claims: The **Contractor** shall also submit with the final requisition any amendments to the final verified statement of any pending dispute resolution procedures in accordance with the **PPB Rules** and this **Contract** and any and all alleged claims against the **City**, in any way connected with or arising out of this **Contract** (including those as to which details may have been furnished pursuant to Articles 11, 27, 28, and 30) that have occurred subsequent to **Substantial Completion**, setting forth with respect to each such claim the total amount thereof, the various items of labor and materials included therein, and the alleged value of each such item; and if the alleged claim be one for delay, the alleged cause of each such delay, the period or periods of time, giving the dates when the **Contractor** claims the performance of the **Work** or a particular part thereof was delayed, and an itemized statement and breakdown of the amount claimed for each such delay. With reference to each such claim, the **Commissioner**, the **Comptroller** and, in the event of litigation, the **City Corporation Counsel** shall have the same right to inspect, and to make extracts or copies of, the **Contractor's** books, vouchers, records, etc., as is referred to in Articles 11, 27, 28, and 30. Nothing contained in this Article 45.2, is intended to or shall relieve the **Contractor** from the obligation of complying strictly with Articles 11, 27, 28, and 30. The **Contractor** is warned that unless such claims are completely set forth as herein required, the **Contractor**, upon acceptance of the Final Payment pursuant to Article 46, will have waived any such claims.

45.3 Preparation of Final Voucher: Upon determining the balance due hereunder other than on account of claims, the **Engineer** will prepare and certify, for the **Commissioner's** approval, a voucher for final payment in that amount less any and all deductions authorized to be made by the **Commissioner** under this **Contract** or by **Law**. In the case of a lump sum **Contract**, the **Commissioner** shall certify the voucher for final payment within thirty (30) **Days** from the date of completion and acceptance of the **Work**, provided all requests for extensions of time have been acted upon.

45.3.1 All prior certificates and vouchers upon which partial payments were made, being merely estimates made to enable the **Contractor** to prosecute the **Work** more advantageously, shall be subject to correction in the final voucher, and the certification of the **Engineer** thereon and the approval of the **Commissioner** thereof, shall be conditions precedent to the right of the **Contractor** to receive any money hereunder. Such final voucher shall be binding and conclusive upon the **Contractor**.

45.3.2 Payment pursuant to such final voucher, less any deductions authorized to be made by the **Commissioner** under this **Contract** or by **Law**, shall constitute the final payment, and shall be made by the **Comptroller** within thirty (30) **Days** after the filing of such voucher in his/her office.

45.4 The **Contractor** acknowledges that nothing contained in this Article 45 is intended to or shall in any way diminish the force and effect of Article 13.

#### **ARTICLE 46. ACCEPTANCE OF FINAL PAYMENT**

46.1 The acceptance by the **Contractor**, or by anyone claiming by or through it, of the final payment, whether such payment be made pursuant to any judgment of any court, or otherwise, shall constitute and operate as a release of the **City** from any and all claims of and liability to the **Contractor** for anything heretofore done or furnished for the **Contractor** relating to or arising out of this **Contract** and the **Work** done hereunder, and for any prior act, neglect or default on the part of the **City** or any of its officials, agents or employees, excepting only a claim against the **City** for the amounts deducted or retained in accordance with the terms and provisions of this **Contract** or by **Law**, and excepting any claims, not otherwise waived, or any pending dispute resolution procedures which are contained in the

verified statement filed with the **Contractor's** substantial and final requisitions pursuant to Articles 44 and 45.

46.2 The **Contractor** is warned that the execution by it of a release, in connection with the acceptance of the final payment, containing language purporting to reserve claims other than those herein specifically excepted from the operation of this Article 46, or those for amounts deducted by the **Commissioner** from the final requisition or from the final payment as certified by the **Engineer** and approved by the **Commissioner**, shall not be effective to reserve such claims, anything stated to the **Contractor** orally or in writing by any official, agent or employee of the **City** to the contrary notwithstanding.

46.3 Should the **Contractor** refuse to accept the final payment as tendered by the **Comptroller**, it shall constitute a waiver of any right to interest thereon.

46.4 The **Contractor**, however, shall not be barred by this Article 46 from commencing an action for breach of **Contract** to the extent permitted by **Law** and by the terms of the **Contract** for any claims that are contained in the verified statement filed with the **Contractor's** substantial and final requisitions pursuant to Articles 44 and 45 or that arose after submission of the final payment requisition, provided that a detailed and verified statement of claim is served upon the contracting **Agency** and **Comptroller** not later than forty (40) **Days** after the making of such final payment by electronic funds transfer (EFT) or the mailing of such final payment. The statement shall specify the items upon which the claim will be based and any such claim shall be limited to such items.

#### **ARTICLE 47. APPROVAL BY PUBLIC DESIGN COMMISSION**

47.1 All works of art, including paintings, mural decorations, stained glass, statues, bas-reliefs, and other sculptures, monuments, fountains, arches, and other structures of a permanent character intended for ornament or commemoration, and every design of the same to be used in the performance of this **Contract**, and the design of all bridges, approaches, buildings, gates, fences, lamps, or structures to be erected, pursuant to the terms of this **Contract**, shall be submitted to the Art Commission, d/b/a the Public Design Commission of the City of New York, and shall be approved by the Public Design Commission prior to the erection or placing in position of the same. The final payment shall not become due or payable under this **Contract** unless and until the Public Design Commission shall certify that the design for the **Work** herein contracted for has been approved by the said Public Design Commission, and that the same has been executed in substantial accordance with the design so approved, pursuant to the provisions of Chapter 37, Section 854 of the **City Charter**, as amended.

### **CHAPTER X: CONTRACTOR'S DEFAULT**

#### **ARTICLE 48. COMMISSIONER'S RIGHT TO DECLARE CONTRACTOR IN DEFAULT**

48.1 In addition to those instances specifically referred to in other Articles herein, the **Commissioner** shall have the right to declare the **Contractor** in default of this **Contract** if:

48.1.1 The **Contractor** fails to commence **Work** when notified to do so by the **Commissioner**; or if

48.1.2 The **Contractor** shall abandon the **Work**; or if

48.1.3 The **Contractor** shall refuse to proceed with the **Work** when and as directed by the **Commissioner**; or if

48.1.4 The **Contractor** shall, without just cause, reduce its working force to a number which, if maintained, would be insufficient, in the opinion of the **Commissioner**, to complete the **Work** in accordance with the progress schedule; or if

48.1.5 The **Contractor** shall fail or refuse to increase sufficiently such working force when ordered to do so by the **Commissioner**; or if

48.1.6 The **Contractor** shall sublet, assign, transfer, convert or otherwise dispose of this **Contract** other than as herein specified; or sell or assign a majority interest in the **Contractor**; or if

48.1.7 The **Contractor** fails to secure and maintain all required insurance; or if

48.1.8 A receiver or receivers are appointed to take charge of the **Contractor's** property or affairs; or if

48.1.9 The **Commissioner** shall be of the opinion that the **Contractor** is or has been unnecessarily or unreasonably or willfully delaying the performance and completion of the **Work**, or the award of necessary subcontracts, or the placing of necessary material and equipment orders; or if

48.1.10 The **Commissioner** shall be of the opinion that the **Contractor** is or has been willfully or in bad faith violating any of the provisions of this **Contract**; or if

48.1.11 The **Commissioner** shall be of the opinion that the **Work** cannot be completed within the time herein provided therefor or within the time to which such completion may have been extended; provided, however, that the impossibility of timely completion is, in the **Commissioner's** opinion, attributable to conditions within the **Contractor's** control; or if

48.1.12 The **Work** is not completed within the time herein provided therefor or within the time to which the **Contractor** may be entitled to have such completion extended; or if

48.1.13 Any statement or representation of the **Contractor** in the **Contract** or in any document submitted by the **Contractor** with respect to the **Work**, the **Project**, or the **Contract** (or for purposes of securing the **Contract**) was untrue or incorrect when made; or if

48.1.14 The **Contractor** or any of its officers, directors, partners, five (5%) percent shareholders, principals, or other persons substantially involved in its activities, commits any of the acts or omissions specified as the grounds for debarment in the **PPB Rules**.

48.2 Before the **Commissioner** shall exercise his/her right to declare the **Contractor** in default, the **Commissioner** shall give the **Contractor** an opportunity to be heard, upon not less than two (2) **Days'** notice.

## **ARTICLE 49. EXERCISE OF THE RIGHT TO DECLARE DEFAULT**

49.1 The right to declare the **Contractor** in default for any of the grounds specified or referred to in Article 48 shall be exercised by sending the **Contractor** a notice, signed by the **Commissioner**, setting forth the ground or grounds upon which such default is declared (hereinafter referred to as a "Notice of Default").

49.2 The **Commissioner's** determination that the **Contractor** is in default shall be conclusive, final, and binding on the parties and such a finding shall preclude the **Contractor** from commencing a plenary action for any damages relating to the **Contract**. If the **Contractor** protests the determination of the **Commissioner**, the **Contractor** may commence an action in a court of competent jurisdiction of the State of New York under Article 78 of the New York Civil Practice Law and Rules.

## **ARTICLE 50. QUITTING THE SITE**

50.1 Upon receipt of such notice the **Contractor** shall immediately discontinue all further operations under this **Contract** and shall immediately quit the **Site**, leaving untouched all plant, materials, equipment, tools, and supplies then on the **Site**.

## **ARTICLE 51. COMPLETION OF THE WORK**

51.1 The **Commissioner**, after declaring the **Contractor** in default, may then have the **Work** completed by such means and in such manner, by contract with or without public letting, or otherwise, as he/she may deem advisable, utilizing for such purpose such of the **Contractor's** plant, materials, equipment, tools, and supplies remaining on the **Site**, and also such **Subcontractors**, as he/she may deem advisable.

51.2 After such completion, the **Commissioner** shall make a certificate stating the expense incurred in such completion, which shall include the cost of re-letting and also the total amount of liquidated damages (at the rate provided for in the **Contract**) from the date when the **Work** should have been completed by the **Contractor** in accordance with the terms hereof to the date of actual completion of the **Work**. Such certificate shall be binding and conclusive upon the **Contractor**, its sureties, and any person claiming under the **Contractor**, as to the amount thereof.

51.3 The expense of such completion, including any and all related and incidental costs, as so certified by the **Commissioner**, and any liquidated damages assessed against the **Contractor**, shall be charged against and deducted out of monies which are earned by the **Contractor** prior to the date of default. Should the expense of such completion, as certified by the **Commissioner**, exceed the total sum which would have been payable under the **Contract** if it had been completed by the **Contractor**, any excess shall be paid by the **Contractor**.

## **ARTICLE 52. PARTIAL DEFAULT**

52.1 In case the **Commissioner** shall declare the **Contractor** in default as to a part of the **Work** only, the **Contractor** shall discontinue such part, shall continue performing the remainder of the **Work** in strict conformity with the terms of this **Contract**, and shall in no way hinder or interfere with any **Other Contractor(s)** or persons whom the **Commissioner** may engage to complete the **Work** as to which the **Contractor** was declared in default.

52.2 The provisions of this Chapter relating to declaring the **Contractor** in default as to the entire **Work** shall be equally applicable to a declaration of partial default, except that the **Commissioner** shall be entitled to utilize for completion of the part of the **Work** as to which the **Contractor** was declared in default only such plant, materials, equipment, tools, and supplies as had been previously used by the **Contractor** on such part.

#### **ARTICLE 53. PERFORMANCE OF UNCOMPLETED WORK**

53.1 In completing the whole or any part of the **Work** under the provisions of this Chapter X, the **Commissioner** shall have the power to depart from or change or vary the terms and provisions of this **Contract**, provided, however, that such departure, change or variation is made for the purpose of reducing the time or expense of such completion. Such departure, change or variation, even to the extent of accepting a lesser or different performance, shall not affect the conclusiveness of the **Commissioner's** certificate of the cost of completion referred to in Article 51, nor shall it constitute a defense to an action to recover the amount by which such certificate exceeds the amount which would have been payable to the **Contractor** hereunder but for its default.

#### **ARTICLE 54. OTHER REMEDIES**

54.1 In addition to the right to declare the **Contractor** in default pursuant to this Chapter X, the **Commissioner** shall have the absolute right, in his/her sole discretion and without a hearing, to complete or cause to be completed in the same manner as described in Articles 51 and 53, any or all unsatisfactory or uncompleted punch list **Work** that remains after the completion date specified in the **Final Approved Punch List**. A written notice of the exercise of this right shall be sent to the **Contractor** who shall immediately quit the **Site** in accordance with the provisions of Article 50.

54.2 The expense of completion permitted under Article 54.1, including any and all related and incidental costs, as so certified by the **Commissioner**, shall be charged against and deducted out of monies which have been earned by the **Contractor** prior to the date of the exercise of the right set forth in Article 54.1; the balance of such monies, if any, subject to the other provisions of this **Contract**, to be paid to the **Contractor** without interest after such completion. Should the expense of such completion, as certified by the **Commissioner**, exceed the total sum which would have been payable under the **Contract** if it had been completed by the **Contractor**, any excess shall be paid by the **Contractor**.

54.3 The previous provisions of this Chapter X shall be in addition to any and all other remedies available under **Law** or in equity.

54.4 The exercise by the **City** of any remedy set forth herein shall not be deemed a waiver by the **City** of any other legal or equitable remedy contained in this **Contract** or provided under **Law**.

### **CHAPTER XI: MISCELLANEOUS PROVISIONS**

#### **ARTICLE 55. CONTRACTOR'S WARRANTIES**

55.1 In consideration of, and to induce, the award of this **Contract** to the **Contractor**, the **Contractor** represents and warrants:



55.1.1 That it is financially solvent, sufficiently experienced and competent to perform the **Work**; and

55.1.2 That the facts stated in its bid and the information given by it pursuant to the Information for Bidders is true and correct in all respects; and

55.1.3 That it has read and complied with all requirements set forth in the **Contract**.

#### **ARTICLE 56. CLAIMS AND ACTIONS THEREON**

56.1 Any claim, that is not subject to dispute resolution under the **PPB Rules** or this **Contract**, against the **City** for damages for breach of **Contract** shall not be made or asserted in any action, unless the **Contractor** shall have strictly complied with all requirements relating to the giving of notice and of information with respect to such claims, as herein before provided.

56.2 Nor shall any action be instituted or maintained on any such claims unless such action is commenced within six (6) months after **Substantial Completion**; except that:

56.2.1 Any claims arising out of events occurring after **Substantial Completion** and before **Final Acceptance** of the **Work** shall be asserted within six (6) months of **Final Acceptance** of the **Work**;

56.2.2 If the **Commissioner** exercises his/her right to complete or cause to complete any or all unsatisfactory or uncompleted punch list **Work** that remains after the completion date specified in the **Final Approved Punch List** pursuant to Article 54, any such action shall be commenced within six (6) months from the date the **Commissioner** notifies the **Contractor** in writing that he/she has exercised such right. Any claims for monies deducted, retained or withheld under the provisions of this **Contract** shall be asserted within six (6) months after the date when such monies otherwise become due and payable hereunder; and

56.2.3 If the **Commissioner** exercises his/her right to terminate the **Contract** pursuant to Article 64, any such action shall be commenced within six (6) months of the date the **Commissioner** exercises said right.

#### **ARTICLE 57. INFRINGEMENT**

57.1 The **Contractor** shall be solely responsible for and shall defend, indemnify, and hold the **City** harmless from any and all claims (even if the allegations of the lawsuit are without merit) and judgments for damages and from costs and expenses to which the **City** may be subject to or which it may suffer or incur allegedly arising out of or in connection with any infringement by the **Contractor** of any copyright, trade secrets, trademark or patent rights or any other property or personal right of any third party by the **Contractor** and/or its **Subcontractors** in the performance or completion of the **Work**. Insofar as the facts or **Law** relating to any claim would preclude the **City** from being completely indemnified by the **Contractor**, the **City** shall be partially indemnified by the **Contractor** to the fullest extent permitted by **Law**.

## **ARTICLE 58. NO CLAIM AGAINST OFFICIALS, AGENTS OR EMPLOYEES**

58.1 No claim whatsoever shall be made by the **Contractor** against any official, agent or employee of the **City** for, or on account of, anything done or omitted to be done in connection with this **Contract**.

## **ARTICLE 59. SERVICE OF NOTICES**

59.1 The **Contractor** hereby designates the business address, fax number, and email address specified in its bid, as the place where all notices, directions or other communications to the **Contractor** may be delivered, or to which they may be mailed. Any notice, direction, or communication from either party to the other shall be in writing and shall be deemed to have been given when (i) delivered personally; (ii) sent by certified mail, return receipt requested; (iii) delivered by overnight or same day courier service in a properly addressed envelope with confirmation; or (iv) sent by fax or email and, unless receipt of the fax or e-mail is acknowledged by the recipient by fax or e-mail, deposited in a post office box regularly maintained by the United States Postal Service in a properly addressed, postage pre-paid envelope.

59.2 **Contractor's** notice address, email address, or fax number may be changed at any time by an instrument in writing, executed and acknowledged by the **Contractor**, and delivered to the **Commissioner**.

59.3 Nothing herein contained shall, however, be deemed to preclude or render inoperative the service of any notice, direction or other communication upon the **Contractor** personally, or, if the **Contractor** is a corporation, upon any officer thereof.

## **ARTICLE 60. UNLAWFUL PROVISIONS DEEMED STRICKEN FROM CONTRACT**

60.1 If this **Contract** contains any unlawful provision not an essential part of the **Contract** and which shall not appear to have been a controlling or material inducement to the making thereof, the same shall be deemed of no effect and shall, upon notice by either party, be deemed stricken from the **Contract** without affecting the binding force of the remainder.

## **ARTICLE 61. ALL LEGAL PROVISIONS DEEMED INCLUDED**

61.1 It is the intent and understanding of the parties to this **Contract** that each and every provision of **Law** required to be inserted in this **Contract** shall be and is inserted herein. Furthermore, it is hereby stipulated that every such provision is to be deemed to be inserted herein, and if, through mistake or otherwise, any such provision is not inserted, or is not inserted in correct form, then this **Contract** shall forthwith upon the application of either party be amended by such insertion so as to comply strictly with the **Law** and without prejudice to the rights of either party hereunder.

## **ARTICLE 62. TAX EXEMPTION**

62.1 The **City** is exempt from payment of Federal, State, and local taxes, including sales and compensating use taxes of the State of New York and its cities and counties on all tangible personal property sold to the **City** pursuant to the provisions of this **Contract**. These taxes are not to be included in bids. However, this exemption does not apply to tools, machinery, equipment or other property leased by or to the **Contractor**, **Subcontractor** or **Materialman** or to tangible personal property which, even

though it is consumed, is not incorporated into the completed **Work** (consumable supplies) and tangible personal property that the **Contractor** is required to remove from the **Site** during or upon completion of the **Work**. The **Contractor** and its **Subcontractors** and **Materialmen** shall be responsible for and pay any and all applicable taxes, including sales and compensating use taxes, on such leased tools, machinery, equipment or other property and upon all such consumable supplies and tangible personal property that the **Contractor** is required to remove from the **Site** during or upon completion of the **Work**.

62.2 The **Contractor** agrees to sell and the **City** agrees to purchase all tangible personal property, other than consumable supplies and other tangible personal property that the **Contractor** is required to remove from the **Site** during or upon completion of the **Work**, that is required, necessary or proper for or incidental to the construction of the **Project** covered by this **Contract**. The sum paid under this **Contract** for such tangible personal property shall be in full payment and consideration for the sale of such tangible personal property.

62.2.1 The **Contractor** agrees to construct the **Project** and to perform all **Work**, labor and services rendered, necessary, proper or incidental thereto for the sum shown in the bid for the performance of such **Work**, labor, and services, and the sum so paid pursuant to this **Contract** for such **Work**, labor, and services, shall be in full consideration for the performance by the **Contractor** of all its duties and obligations under this **Contract** in connection with said **Work**, labor, and services.

62.3 20 NYCRR Section 541.3(d) provides that a **Contractor's** purchases of tangible personal property that is either incorporated into real property owned by a governmental entity or purchased for and sold to a governmental entity are exempt from sales and use tax. The **City** shall not pay sales tax for any such tangible personal property that it purchases from the **Contractor** pursuant to the **Contract**. With respect to such tangible personal property, the **Contractor**, at the request of the **City**, shall furnish to the **City** such bills of sale and other instruments as may be required by the **City**, properly executed, acknowledged and delivered assuring to the **City** title to such tangible personal property, free of liens and/or encumbrances, and the **Contractor** shall mark or otherwise identify all such tangible personal property as the property of the **City**.

62.4 Title to all tangible personal property to be sold by the **Contractor** to the **City** pursuant to the provisions of the **Contract** shall immediately vest in and become the sole property of the **City** upon delivery of such tangible personal property to the **Site**. Notwithstanding such transfer of title, the **Contractor** shall have the full and continuing responsibility to install such tangible personal property in accordance with the provisions of this **Contract**, protect it, maintain it in a proper condition and forthwith repair, replace and make good any damage thereto, theft or disappearance thereof, and furnish additional tangible personal property in place of any that may be lost, stolen or rendered unusable, without cost to the **City**, until such time as the **Work** covered by the **Contract** is fully accepted by the **City**. Such transfer of title shall in no way affect any of the **Contractor's** obligations hereunder. In the event that, after title has passed to the **City**, any of the tangible personal property is rejected as being defective or otherwise unsatisfactory, title to all such tangible personal property shall be deemed to have been transferred back to the **Contractor**.

62.5 The purchase by **Subcontractors** or **Materialmen** of tangible personal property to be sold hereunder shall be a purchase or procurement for resale to the **Contractor** (either directly or through other **Subcontractors**) and therefore not subject to the aforesaid sales and compensating use taxes, provided that the subcontracts and purchase agreements provide for the resale of such tangible personal property and that such subcontracts and purchase agreements are in a form similar to this **Contract** with respect to the separation of the sale of consumable supplies and tangible personal property that the

**Contractor** is required to remove from the **Site** during or upon completion of the **Work** from the **Work** and labor, services, and any other matters to be provided, and provided further that the subcontracts and purchase agreements provide separate prices for tangible personal property and all other services and matters. Such separation shall actually be followed in practice, including the separation of payments for tangible personal property from the payments for other **Work** and labor and other things to be provided.

62.6 The **Contractor** and its **Subcontractors** and **Materialmen** shall furnish a **Contractor Exempt Purchase Certificate** to all persons, firms or corporations from which they purchase tangible personal property for the performance of the **Work** covered by this **Contract**.

62.7 In the event any of the provisions of this Article 62 shall be deemed to be in conflict with any other provisions of this **Contract** or create any ambiguity, then the provisions of this Article 62 shall control.

### **ARTICLE 63. INVESTIGATION(S) CLAUSE**

63.1 The parties to this **Contract** agree to cooperate fully and faithfully with any investigation, audit or inquiry conducted by a United States, a State of New York (State) or a **City** governmental agency or authority that is empowered directly or by designation to compel the attendance of witnesses and to examine witnesses under oath, or conducted by the Inspector General of a governmental agency that is a party in interest to the transaction, submitted bid, submitted proposal, contract, lease, permit or license that is the subject of the investigation, audit or inquiry.

63.2 If any person who has been advised that his/her statement, and any information from such statement, will not be used against him/her in any subsequent criminal proceeding refuses to testify before a grand jury or other governmental agency or authority empowered directly or by designation to compel the attendance of witnesses and to examine witnesses under oath concerning the award of or performance under any transaction, agreement, lease, permit, contract, or license entered into with the **City**, the State, or any political subdivision or public authority thereof, or the Port Authority of New York and New Jersey, or any local development corporation within the **City**, or any public benefit corporation organized under the **Laws** of the State of New York, or;

63.3 If any person refuses to testify for a reason other than the assertion of his/her privilege against self incrimination in an investigation, audit or inquiry conducted by a **City** or State governmental agency or authority empowered directly or by designation to compel the attendance of witnesses and to take testimony under oath, or by the Inspector General of the governmental agency that is a party in interest in, and is seeking testimony concerning the award of, or performance under any transaction, agreement, lease, permit, contract, or license entered into with the **City**, the State, or any political subdivision thereof or any local development corporation within the **City**, then;

63.4 The **Commissioner** whose **Agency** is a party in interest to the transaction, submitted bid, submitted proposal, contract, lease, permit, or license shall convene a hearing, upon not less than five (5) **Days'** written notice to the parties involved to determine if any penalties should attach for the failure of a person to testify.

63.5 If any non-governmental party to the hearing requests an adjournment, the **Commissioner** who convened the hearing may, upon granting the adjournment, suspend any contract, lease, permit, or license, pending the final determination pursuant to Article 63.7 without the **City** incurring any penalty or damages for delay or otherwise.

63.6 The penalties which may attach after a final determination by the **Commissioner** may include but shall not exceed:

63.6.1 The disqualification for a period not to exceed five (5) years from the date of an adverse determination for any person, or any entity of which such person was a member at the time the testimony was sought, from submitting bids for, or transacting business with, or entering into or obtaining any contract, lease, permit or license with or from the **City**; and/or

63.6.2 The cancellation or termination of any and all such existing **City** contracts, leases, permits or licenses that the refusal to testify concerns and that have not been assigned as permitted under this **Contract**, nor the proceeds of which pledged, to an unaffiliated and unrelated institutional lender for fair value prior to the issuance of the notice scheduling the hearing, without the **City** incurring any penalty or damages on account of such cancellation or termination; monies lawfully due for goods delivered, work done, rentals, or fees accrued prior to the cancellation or termination shall be paid by the **City**.

63.7 The **Commissioner** shall consider and address in reaching his/her determination and in assessing an appropriate penalty the factors in Articles 63.7.1 and 63.7.2. The **Commissioner** may also consider, if relevant and appropriate, the criteria established in Articles 63.7.3 and 63.7.4, in addition to any other information which may be relevant and appropriate:

63.7.1 The party's good faith endeavors or lack thereof to cooperate fully and faithfully with any governmental investigation or audit, including but not limited to the discipline, discharge, or disassociation of any person failing to testify, the production of accurate and complete books and records, and the forthcoming testimony of all other members, agents, assignees or fiduciaries whose testimony is sought.

63.7.2 The relationship of the person who refused to testify to any entity that is a party to the hearing, including but not limited to, whether the person whose testimony is sought has an ownership interest in the entity and/or the degree of authority and responsibility the person has within the entity.

63.7.3 The nexus of the testimony sought to the subject entity and its contracts, leases, permits or licenses with the **City**.

63.7.4 The effect a penalty may have on an unaffiliated and unrelated party or entity that has a significant interest in an entity subject to penalties under Article 63.6, provided that the party or entity has given actual notice to the **Commissioner** upon the acquisition of the interest, or at the hearing called for in Article 63.4, gives notice and proves that such interest was previously acquired. Under either circumstance the party or entity shall present evidence at the hearing demonstrating the potential adverse impact a penalty will have on such person or entity.

#### 63.8 Definitions:

63.8.1 The term "license" or "permit" as used in this Article 63 shall be defined as a license, permit, franchise or concession not granted as a matter of right.

63.8.2 The term "person" as used in this Article 63 shall be defined as any natural person doing business alone or associated with another person or entity as a partner, director, officer, principal or employee.

63.8.3 The term "entity" as used in this Article 63 shall be defined as any firm, partnership, corporation, association, joint venture, or person that receives monies, benefits, licenses, leases, or permits from or through the **City** or otherwise transacts business with the **City**.

63.8.4 The term "member" as used in this Article 63 shall be defined as any person associated with another person or entity as a partner, director, officer, principal or employee.

63.9 In addition to and notwithstanding any other provision of this **Contract**, the **Commissioner** may in his/her sole discretion terminate this **Contract** upon not less than three (3) **Days**' written notice in the event the **Contractor** fails to promptly report in writing to the **Commissioner** of the Department of Investigations ("DOI") of the **City** any solicitation of money, goods, requests for future employment or other benefit or thing of value, by or on behalf of any employee of the **City** or other person, firm, corporation or entity for any purpose which may be related to the procurement or obtaining of this **Contract** by the **Contractor**, or affecting the performance of this **Contract**.

#### **ARTICLE 64. TERMINATION BY THE CITY**

64.1 In addition to termination pursuant to any other article of this **Contract**, the **Commissioner** may, at any time, terminate this **Contract** by written notice to the **Contractor**. In the event of termination, the **Contractor** shall, upon receipt of such notice, unless otherwise directed by the **Commissioner**:

64.1.1 Stop **Work** on the date specified in the notice;

64.1.2 Take such action as may be necessary for the protection and preservation of the **City's** materials and property;

64.1.3 Cancel all cancelable orders for material and equipment;

64.1.4 Assign to the **City** and deliver to the **Site** or another location designated by the **Commissioner**, any non-cancelable orders for material and equipment that is not capable of use except in the performance of this **Contract** and has been specifically fabricated for the sole purpose of this **Contract** and not incorporated in the **Work**;

64.1.5 Take no action which will increase the amounts payable by the **City** under this **Contract**.

64.2 In the event of termination by the **City** pursuant to this Article 64, payment to the **Contractor** shall be in accordance with Articles 64.2.1, 64.2.2 or 64.2.3, to the extent that each respective article applies.

64.2.1 Lump Sum Contracts or Items: On all lump sum **Contracts**, or on lump sum items in a **Contract**, the **City** will pay the **Contractor** the sum of the amounts described in Articles 64.2.1(a) and 64.2.1(b), less all payments previously made pursuant to this **Contract**. On lump sum **Contracts** only, the **City** will also pay the **Contractor** an additional sum as provided in Article 64.2.1(c).

64.2.1(a) For **Work** completed prior to the notice of termination, the **Contractor** shall be paid a pro rata portion of the lump sum bid amount, plus approved change orders, based upon the percent completion of the **Work**, as determined by the

**Commissioner.** For the purpose of determining the pro rata portion of the lump sum bid amount to which the **Contractor** is entitled, the bid breakdown submitted in accordance with Article 41 shall be considered, but shall not be dispositive. The **Commissioner's** determination hereunder shall be final, binding, and conclusive.

64.2.1(b) For non-cancelable material and equipment that is not capable of use except in the performance of this **Contract** and has been specifically fabricated for the sole purpose of this **Contract**, but not yet incorporated in the **Work**, the **Contractor** shall be paid the lesser of the following, less salvage value:

64.2.1(b)(i) The Direct Cost, as defined in Article 64.2.4; or

64.2.1(b)(ii) The fair and reasonable value, if less than Direct Cost, of such material and equipment, plus necessary and reasonable delivery costs.

64.2.1(b)(iii) In addition, the **Contractor** shall be paid five (5%) percent of the amount described in Article 64.2.1(b)(i) or Article 64.2.1(b)(ii), whichever applies.

64.2.1(c) Except as otherwise provided in Article 64.2.1(d), on all lump sum **Contracts**, the **Contractor** shall be paid the percentage indicated below applied to the difference between the total lump sum bid amount and the total of all payments made prior to the notice of termination plus all payments allowed pursuant to Articles 64.2.1(a) and 64.2.1(b):

64.2.1(c)(i) Five (5%) percent of the first five million (\$5,000,000) dollars; and

64.2.1(c)(ii) Three (3%) percent of any amount between five million (\$5,000,000) dollars and fifteen million (\$15,000,000) dollars; plus

64.2.1(c)(iii) One (1%) percent of any amount over fifteen million (\$15,000,000) dollars.

64.2.1(d) In the event the **City** terminates a lump sum **Contract** pursuant to this Article 64 within ninety (90) **Days** after registration of the **Contract** with the **Comptroller**, the **Contractor** shall be paid one (1%) percent of the difference between the lump sum bid amount and the total of all payments made pursuant to this Article 64.2.

64.2.2 Unit Price Contracts or Items: On all unit price **Contracts**, or on unit price items in a **Contract**, the **City** will pay the **Contractor** the sum of the amounts described in Articles 64.2.2(a) and 64.2.2(b), less all payments previously made pursuant to this **Contract**:

64.2.2(a) For all completed units, the unit price stated in the **Contract**, and

64.2.2(b) For units that have been ordered but are only partially completed, the **Contractor** will be paid:

64.2.2(b)(i) A pro rata portion of the unit price stated in the **Contract** based upon the percent completion of the unit and

64.2.2(b)(ii) For non-cancelable material and equipment, payment will be made pursuant to Article 64.2.1(b).

64.2.3 Time and Materials Contracts or Items Based on Time and Material Records: On all **Contracts** or items in a **Contract** where payment for the **Work** is based on time and material records, the **Contractor** shall be paid in accordance with Article 26, less all payments previously made pursuant to this **Contract**.

64.2.4 Direct Costs: Direct Costs as used in this Article 64.2 shall mean:

64.2.4(a) The actual purchase price of material and equipment, plus necessary and reasonable delivery costs,

64.2.4(b) The actual cost of labor involved in construction and installation at the **Site**, and

64.2.4(c) The actual cost of necessary bonds and insurance purchased pursuant to requirements of this **Contract** less any amounts that have been or should be refunded by the **Contractor's** sureties or insurance carriers.

64.2.4(d) Direct Costs shall not include overhead.

64.3 In no event shall any payments under this Article 64 exceed the **Contract** price for such items.

64.4 All payments pursuant to Article 64 shall be in the nature of liquidated damages and shall be accepted by the **Contractor** in full satisfaction of all claims against the **City**.

64.5 The **City** may deduct or set off against any sums due and payable pursuant to this Article 64, any deductions authorized by this **Contract** or by **Law** (including but not limited to liquidated damages) and any claims it may have against the **Contractor**. The **City's** exercise of the right to terminate the **Contract** pursuant to this Article 64 shall not impair or otherwise effect the **City's** right to assert any claims it may have against the **Contractor** in a plenary action.

64.6 Where the **Work** covered by the **Contract** has been substantially completed, as determined in writing by the **Commissioner**, termination of the **Work** shall be handled as an omission of **Work** pursuant to Articles 29 and 33, in which case a change order will be issued to reflect an appropriate reduction in the **Contract** sum, or if the amount is determined after final payment, such amount shall be paid by the **Contractor**.

## **ARTICLE 65. CHOICE OF LAW, CONSENT TO JURISDICTION AND VENUE**

65.1 This **Contract** shall be deemed to be executed in the **City** regardless of the domicile of the **Contractor**, and shall be governed by and construed in accordance with the **Laws** of the State of New York and the **Laws** of the United States, where applicable.

65.2 The parties agree that any and all claims asserted against the **City** arising under this **Contract** or related thereto shall be heard and determined in the courts of the State of New York ("New York State Courts") located in the **City** and County of New York. To effect this **Contract** and intent, the **Contractor** agrees:



65.2.1 If the **City** initiates any action against the **Contractor** in Federal court or in a New York State Court, service of process may be made on the **Contractor** either in person, wherever such **Contractor** may be found, or by registered mail addressed to the **Contractor** at its address as set forth in this **Contract**, or to such other address as the **Contractor** may provide to the **City** in writing; and

65.2.2 With respect to any action between the **City** and the **Contractor** in a New York State Court, the **Contractor** hereby expressly waives and relinquishes any rights it might otherwise have:

65.2.2(a) To move to dismiss on grounds of forum non conveniens;

65.2.2(b) To remove to Federal Court; and

65.2.2(c) To move for a change of venue to a New York State Court outside New York County.

65.2.3 With respect to any action brought by the **City** against the **Contractor** in a Federal Court located in the **City**, the **Contractor** expressly waives and relinquishes any right it might otherwise have to move to transfer the action to a Federal Court outside the **City**.

65.2.4 If the **Contractor** commences any action against the **City** in a court located other than in the **City** and County of New York, upon request of the **City**, the **Contractor** shall either consent to a transfer of the action to a New York State Court of competent jurisdiction located in the **City** and County of New York or, if the Court where the action is initially brought will not or cannot transfer the action, the **Contractor** shall consent to dismiss such action without prejudice and may thereafter reinstate the action in a New York State Court of competent jurisdiction in New York County.

65.3 If any provision(s) of this Article 65 is held unenforceable for any reason, each and all other provision(s) shall nevertheless remain in full force and effect.

#### **ARTICLE 66. PARTICIPATION IN AN INTERNATIONAL BOYCOTT**

66.1 The **Contractor** agrees that neither the **Contractor** nor any substantially owned affiliated company is participating or shall participate in an international boycott in violation of the provisions of the Federal Export Administration Act of 1979, as amended, or the regulations of the United States Department of Commerce (Commerce Department) promulgated thereunder.

66.2 Upon the final determination by the Commerce Department or any other agency of the United States as to, or conviction of the **Contractor** or a substantially-owned affiliated company thereof for participation in an international boycott in violation of the provisions of the Export Administration Act of 1979, as amended, or the regulations promulgated thereunder, the **Comptroller** may, at his/her option, render forfeit and void this **Contract**.

66.3 The **Contractor** shall comply in all respects, with the provisions of Section 6-114 of the Administrative Code and the rules and regulations issued by the **Comptroller** thereunder.

## **ARTICLE 67. LOCALLY BASED ENTERPRISE PROGRAM**

67.1 This **Contract** is subject to the requirements of Section 6-108.1 of the Administrative Code and regulations promulgated thereunder. No construction contract shall be awarded unless and until these requirements have been complied with in their entirety; however, compliance with this Article 67 is not required if the Agency sets Subcontractor Participation Goals for Minority- and Women-Owned Business Enterprises (M/WBEs).

67.2 Unless specifically waived by the **Commissioner** with the approval of the Division of Economic and Financial Opportunity of the **City** Department of Business Services, if any portion of the **Contract** is subcontracted, not less than ten (10%) percent of the total dollar amount of the **Contract** shall be awarded to locally based enterprises (LBEs); except that where less than ten (10%) percent of the total dollar amount of the **Contract** is subcontracted, such lesser percentage shall be so awarded.

67.3 The **Contractor** shall not require performance and payment bonds from LBE **Subcontractors**.

67.4 If the **Contractor** has indicated prior to award that no **Work** will be subcontracted, no **Work** shall be subcontracted without the prior approval of the **Commissioner**, which shall be granted only if the **Contractor** makes a good faith effort beginning at least six (6) weeks before the **Work** is to be performed to obtain LBE **Subcontractors** to perform the **Work**.

67.5 If the **Contractor** has not identified sufficient LBE **Subcontractors** prior to award, it shall sign a letter of compliance stating that it complies with Section 6-108.1 of the Administrative Code, recognizes that achieving the LBE requirement is a condition of its **Contract**, and shall submit documentation demonstrating its good faith efforts to obtain LBEs. After award, the **Contractor** shall begin to solicit LBE's to perform subcontracted **Work** at least six (6) weeks before the date such **Work** is to be performed and shall demonstrate that a good faith effort has been made to obtain LBEs on each subcontract until it meets the required percentage.

67.6 Failure of the **Contractor** to comply with the requirements of Section 6-108.1 of the Administrative Code and the regulations promulgated thereunder shall constitute a material breach of this **Contract**. Remedy for such breach may include the imposition of any or all of the following sanctions:

67.6.1 Reducing the **Contractor's** compensation by an amount equal to the dollar value of the percentage of the LBE subcontracting requirement not complied with;

67.6.2 Declaring the **Contractor** in default;

67.6.3 If the **Contractor** is an LBE, de-certifying and declaring the **Contractor** ineligible to participate in the LBE program for a period of up to three (3) years.

## **ARTICLE 68. ANTITRUST**

68.1 The **Contractor** hereby assigns, sells, and transfers to the **City** all right, title, and interest in and to any claims and causes of action arising under the antitrust **Laws** of New York State or of the United States relating to the particular goods or services purchased or procured by the **City** under this **Contract**.

## ARTICLE 69. MacBRIDE PRINCIPLES PROVISIONS

### 69.1 Notice To All Prospective **Contractors**:

69.1.1 Local Law No. 34 of 1991 became effective on September 10, 1991 and added Section 6-115.1 of the Administrative Code. The local **Law** provides for certain restrictions on **City Contracts** to express the opposition of the people of the **City** to employment discrimination practices in Northern Ireland to promote freedom of work-place opportunity.

69.1.2 Pursuant to Section 6-115.1, prospective **Contractors** for **Contracts** to provide goods or services involving an expenditure of an amount greater than ten thousand (\$10,000.) dollars, or for construction involving an amount greater than fifteen thousand (\$15,000.) dollars, are asked to sign a rider in which they covenant and represent, as a material condition of their **Contract**, that any business operations in Northern Ireland conducted by the **Contractor** and any individual or legal entity in which the **Contractor** holds a ten (10%) percent or greater ownership interest in the **Contractor** will be conducted in accordance with the MacBride Principles of nondiscrimination in employment.

69.1.3 Prospective **Contractors** are not required to agree to these conditions. However, in the case of **Contracts** let by competitive sealed bidding, whenever the lowest responsible bidder has not agreed to stipulate to the conditions set forth in this notice and another bidder who has agreed to stipulate to such conditions has submitted a bid within five (5%) percent of the lowest responsible bid for a **Contract** to supply goods, services or contraction of comparable quality, the **Agency** shall refer such bids to the Mayor, the Speaker or other officials, as appropriate, who may determine, in accordance with applicable **Law**, that it is in the best interest of the **City** that the **Contract** be awarded to other than the lowest responsible pursuant to Section 313(b)(2) of the **City** Charter.

69.1.4 In the case of **Contracts** let by other than competitive sealed bidding, if a prospective **Contractor** does not agree to these conditions, no **Agency**, elected official or the **City** Council shall award the **Contract** to that bidder unless the **Agency** seeking to use the goods, services or construction certifies in writing that the **Contract** is necessary for the **Agency** to perform its functions and there is no other responsible **Contractor** who will supply goods, services or construction of comparable quality at a comparable price.

69.2 In accordance with Section 6-115.1 of the Administrative Code, the **Contractor** stipulates that such **Contractor** and any individual or legal entity in which the **Contractor** holds a ten (10%) percent or greater ownership interest in the **Contractor** either:

69.2.1 Have no business operations in Northern Ireland, or

69.2.2 Shall take lawful steps in good faith to conduct any business operations they have in Northern Ireland in accordance with the MacBride Principles, and shall permit independent monitoring of their compliance with such principles.

69.3 For purposes of this Article, the following terms shall have the following meanings:

69.3.1 "MacBride Principles" shall mean those principles relating to nondiscrimination in employment and freedom of work-place opportunity which require employers doing business in Northern Ireland to:

69.3.1(a) increase the representation of individuals from under-represented religious groups in the workforce, including managerial, supervisory, administrative, clerical and technical jobs;

69.3.1(b) take steps to promote adequate security for the protection of employees from under-represented religious groups both at the work-place and while traveling to and from **Work**;

69.3.1(c) ban provocative religious or political emblems from the workplace;

69.3.1(d) publicly advertise all job openings and make special recruitment efforts to attract applicants from under-represented religious groups;

69.3.1(e) establish layoff, recall, and termination procedures which do not in practice favor a particular religious group;

69.3.1(f) abolish all job reservations, apprenticeship restrictions and different employment criteria which discriminate on the basis of religion;

69.3.1(g) develop training programs that will prepare substantial numbers of current employees from under-represented religious groups for skilled jobs, including the expansion of existing programs and the creation of new programs to train, upgrade, and improve the skills of workers from under-represented religious groups;

69.3.1(h) establish procedures to assess, identify, and actively recruit employees from under-represented religious groups with potential for further advancement; and

69.3.1(i) appoint a senior management staff member to oversee affirmative action efforts and develop a timetable to ensure their full implementation.

69.4 The **Contractor** agrees that the covenants and representations in Article 69.2 are material conditions to this **Contract**. In the event the **Agency** receives information that the **Contractor** who made the stipulation required by this Article 69 is in violation thereof, the **Agency** shall review such information and give the **Contractor** an opportunity to respond. If the **Agency** finds that a violation has occurred, the **Agency** shall have the right to declare the **Contractor** in default in default and/or terminate this **Contract** for cause and procure supplies, services or **Work** from another source in the manner the **Agency** deems proper. In the event of such termination, the **Contractor** shall pay to the **Agency**, or the **Agency** in its sole discretion may withhold from any amounts otherwise payable to the **Contractor**, the difference between the **Contract** price for the uncompleted portion of this **Contract** and the cost to the **Agency** of completing performance of this **Contract** either itself or by engaging another **Contractor** or **Contractors**. In the case of a requirement **Contract**, the **Contractor** shall be liable for such difference in price for the entire amount of supplies required by the **Agency** for the uncompleted term of **Contractor's Contract**. In the case of a construction **Contract**, the **Agency** shall also have the right to hold the **Contractor** in partial or total default in accordance with the default provisions of this **Contract**, and/or may seek debarment or suspension of the **Contractor**. The rights and remedies of the **Agency** hereunder shall be in addition to, and not in lieu of, any rights and remedies the **Agency** has pursuant to this **Contract** or by operation of **Law**.

## **ARTICLE 70. ELECTRONIC FILING/NYC DEVELOPMENT HUB**

70.1 The **Contractor** shall electronically file all alteration type-2 and alteration type-3 applications via the New York City Development Hub Web site, except applications for the following types of minor alterations: enlargements, curb cuts, legalizations, fire alarms, builders pavement plans, and jobs filed on Landmark Preservation Commission calendared properties. All such filings must be professionally certified. Information about electronic filing via the New York City Development Hub is available on the City Department of Buildings Web site at [www.nyc.gov/buildings](http://www.nyc.gov/buildings).

## **ARTICLE 71. PROHIBITION OF TROPICAL HARDWOODS**

71.1 Tropical hardwoods, as defined in Section 165 of the New York State Finance Law (Finance Law), shall not be utilized in the performance of this **Contract** except as expressly permitted by Section 165 of the Finance Law.

## **ARTICLE 72. CONFLICTS OF INTEREST**

72.1 Section 2604 of the City Charter and other related provisions of the City Charter, the Administrative Code, and the Penal Law are applicable under the terms of this **Contract** in relation to conflicts of interest and shall be extended to **Subcontractors** authorized to perform **Work**, labor and services pursuant to this **Contract** and further, it shall be the duty and responsibility of the **Contractor** to so inform its respective **Subcontractors**. Notice is hereby given that, under certain circumstances, penalties may be invoked against the donor as well as the recipient of any form of valuable gift.

## **ARTICLE 73. MERGER CLAUSE**

73.1 The written **Contract** herein, contains all the terms and conditions agreed upon by the parties hereto, and no other agreement, oral or otherwise, regarding the subject matter of this **Contract** shall be deemed to exist or to bind any of the parties hereto, or to vary any of the terms contained herein.

## **ARTICLE 74. STATEMENT OF WORK**

74.1 The **Contractor** shall furnish all labor and materials and perform all **Work** in strict accordance with the **Specifications** and **Addenda** thereto, numbered as shown in Schedule A.

## **ARTICLE 75. COMPENSATION TO BE PAID TO CONTRACTOR**

75.1 The City will pay and the **Contractor** will accept in full consideration for the performance of the **Contract**, subject to additions and deductions as provided herein, the total sum shown in Schedule A, this said sum being the amount at which the **Contract** was awarded to the **Contractor** at a public letting thereof, based upon the **Contractor's** bid for the **Contract**.

## **ARTICLE 76. ELECTRONIC FUNDS TRANSFER**

76.1 In accordance with Section 6-107.1 of the Administrative Code, the **Contractor** agrees to accept payments under this **Contract** from the City by electronic funds transfer (EFT). An EFT is any

transfer of funds, other than a transaction originated by check, draft or similar paper instrument, which is initiated through an electronic terminal, telephonic instrument or computer or magnetic tape so as to order, instruct or authorize a financial institution to debit or credit an account. Prior to the first payment made under this **Contract**, the **Contractor** shall designate one financial institution or other authorized payment agent and shall complete the attached "EFT Vendor Payment Enrollment Form" in order to provide the Commissioner of the City Department of Finance with information necessary for the **Contractor** to receive electronic funds transfer payments through a designated financial institution or authorized payment agent. The crediting of the amount of a payment to the appropriate account on the books of a financial institution or other authorized payment agent designated by the **Contractor** shall constitute full satisfaction by the City for the amount of the payment under this **Contract**. The account information supplied by the **Contractor** to facilitate the electronic funds transfer shall remain confidential to the fullest extent provided by Law.

76.2 The **Commissioner** may waive the application of the requirements of this Article 76 to payments on contracts entered into pursuant to Section 315 of the City Charter. In addition, the Commissioner of the Department of Finance and the Comptroller may jointly issue standards pursuant to which the **Agency** may waive the requirements of this Article 76 for payments in the following circumstances: (i) for individuals or classes of individuals for whom compliance imposes a hardship; (ii) for classifications or types of checks; or (iii) in other circumstances as may be necessary in the interest of the City.

#### **ARTICLE 77. RECORDS RETENTION**

77.1 The **Contractor** agrees to retain all books, records, and other documents relevant to this **Contract** for six years after the final payment or termination of this **Contract**, whichever is later. City, state, and federal auditors and any other persons duly authorized by the City shall have full access to and the right to examine any such books, records, and other documents during the retention period.

#### **ARTICLE 78. EXAMINATION AND VIEWING OF SITE, CONSIDERATION OF OTHER SOURCES OF INFORMATION AND CHANGED SITE CONDITIONS**

78.1 Pre-Bidding (Investigation) Viewing of Site – Bidders must carefully view and examine the Site of the proposed **Work**, as well as its adjacent area, and seek other usual sources of information, for they will be conclusively presumed to have full knowledge of any and all conditions and hazards on, about or above the Site relating to or affecting in any way the performance of the **Work** to be done under the **Contract** that were or should have been known by a reasonably prudent bidder. To arrange a date for visiting the Site, bidders are to contact the **Agency** contact person specified in the bid documents.

78.2 Should the **Contractor** encounter during the progress of the Work site conditions or environmental hazards at the Site materially differing from any shown on the **Contract Drawings** or indicated in the **Specifications** or such conditions or environmental hazards as could not reasonably have been anticipated by the **Contractor**, which conditions or hazards will materially affect the cost of the **Work** to be done under the **Contract**, the attention of the **Commissioner** must be called immediately to such conditions or hazards before they are disturbed. The **Commissioner** shall thereupon promptly investigate the conditions or hazards. If the **Commissioner** finds that they do so materially differ, and that they could not have been reasonably anticipated by the **Contractor**, the **Contract** may be modified with the **Commissioner's** written approval.

**ARTICLE 79. PARTICIPATION BY MINORITY-OWNED AND WOMEN-OWNED  
BUSINESS ENTERPRISES IN CITY PROCUREMENT**

**NOTICE TO ALL PROSPECTIVE CONTRACTORS**

**ARTICLE I. M/WBE PROGRAM**

Local Law No. 129 of 2005 added and Local Law 1 of 2013 amended Section 6-129 of the Administrative Code of the City of New York (hereinafter "Section 6-129"). Section 6-129 establishes the program for participation in City procurement ("M/WBE Program") by minority-owned business enterprises ("MBEs") and women-owned business enterprises ("WBEs"), certified in accordance with Section 1304 of the New York City Charter. As stated in Section 6-129, the intent of the program is to address the impact of discrimination on the City's procurement process, and to promote the public interest in avoiding fraud and favoritism in the procurement process, increasing competition for City business, and lowering contract costs. The contract provisions contained herein are pursuant to Section 6-129, and the rules of the Department of Small Business Services ("DSBS") promulgated thereunder.

**If this Contract is subject to the M/WBE Program established by Section 6-129, the specific requirements of MBE and/or WBE participation for this Contract are set forth in Schedule B of the Contract (entitled the "M/WBE Utilization Plan"), and are detailed below. The Contractor must comply with all applicable MBE and WBE requirements for this Contract.**

All provisions of Section 6-129 are hereby incorporated in the Contract by reference and all terms used herein that are not defined herein shall have the meanings given such terms in Section 6-129. Article I, Part A, below, sets forth provisions related to the participation goals for construction, standard and professional services contracts. Article I, Part B, below, sets forth miscellaneous provisions related to the M/WBE Program.

**PART A**

**PARTICIPATION GOALS FOR CONSTRUCTION, STANDARD  
AND PROFESSIONAL SERVICES CONTRACTS OR TASK ORDERS**

1. The **MBE and/or WBE Participation Goals** established for this Contract or Task Orders issued pursuant to this Contract, ("**Participation Goals**"), as applicable, are set forth on Schedule B, Part I to this Contract (see Page 1, line 1 Total Participation Goals) or will be set forth on Schedule B, Part I to Task Orders issued pursuant to this Contract, as applicable.

The **Participation Goals** represent a percentage of the total dollar value of the Contract or Task Order, as applicable, that may be achieved by awarding subcontracts to firms certified with New York City Department of Small Business Services as MBEs and/or WBEs, and/or by crediting the participation of prime contractors and/or qualified joint ventures as provided in Section 3 below, unless the goals have been waived or modified by Agency in accordance with Section 6-129 and Part A, Sections 10 and 11 below, respectively.

2. If **Participation Goals** have been established for this Contract or Task Orders issued pursuant to this Contract, Contractor agrees or shall agree as a material term of the Contract that Contractor shall be subject to the **Participation Goals**, unless the goals are waived or modified by Agency in accordance with Section 6-129 and Part A, Sections 10 and 11 below, respectively.

3. If **Participation Goals** have been established for this Contract or Task Order issued pursuant to this Contract, a Contractor that is an MBE and/or WBE shall be permitted to count its own participation toward fulfillment of the relevant **Participation Goal**, provided that in accordance with Section 6-129 the value of Contractor's participation shall be determined by subtracting from the total value of the Contract or Task Order, as applicable, any amounts that the Contractor pays to direct subcontractors (as defined in Section 6-129(c)(13)), and provided further that a Contractor that is certified as both an MBE and a WBE may count its own participation either toward the goal for MBEs or the goal for WBEs, but not both.

A Contractor that is a qualified joint venture (as defined in Section 6-129(c)(30)) shall be permitted to count a percentage of its own participation toward fulfillment of the relevant **Participation Goal**. In accordance with Section 6-129, the value of Contractor's participation shall be determined by subtracting from the total value of the Contract or Task Order, as applicable, any amounts that Contractor pays to direct subcontractors, and then multiplying the remainder by the percentage to be applied to total profit to determine the amount to which an MBE or WBE is entitled pursuant to the joint venture agreement, provided that where a participant in a joint venture is certified as both an MBE and a WBE, such amount shall be counted either toward the goal for MBEs or the goal for WBEs, but not both.

4. A. If **Participation Goals** have been established for this Contract, a prospective contractor shall be required to submit with its bid or proposal, as applicable, a completed Schedule B, M/WBE Utilization Plan, Part II (see Pages 2-4) indicating: (a) whether the contractor is an MBE or WBE, or qualified joint venture; (b) the percentage of work it intends to award to direct subcontractors; and (c) in cases where the contractor intends to award direct subcontracts, a description of the type and dollar value of work designated for participation by MBEs and/or WBEs, and the time frames in which such work is scheduled to begin and end. In the event that this M/WBE Utilization Plan indicates that the bidder or proposer, as applicable, does not intend to meet the **Participation Goals**, the bid or proposal, as applicable, shall be deemed non-responsive, unless Agency has granted the bidder or proposer, as applicable, a pre- award waiver of the Participation Goals in accordance with Section 6-129 and Part A, Section 10 below.

B. (i) If this Contract is for a master services agreement or other requirements type contract that will result in the issuance of Task Orders that will be individually registered ("Master Services Agreement") and is subject to M/WBE **Participation Goals**, a prospective contractor shall be required to submit with its bid or proposal, as applicable, a completed Schedule B, M/WBE Participation Requirements for Master Services Agreements That Will Require Individually Registered Task Orders, Part II (page 2) indicating the prospective contractor's certification and required affirmations to make all reasonable good faith efforts to meet participation goals established on each individual Task Order issued pursuant to this Contract, or if a partial waiver is obtained or such goals are modified by the Agency, to meet the modified **Participation Goals** by soliciting and obtaining the participation of certified MBE and/or WBE firms. In the event that the Schedule B indicates that the bidder or proposer, as applicable, does not intend to meet the **Participation Goals** that may be established on Task Orders issued pursuant to this Contract, the bid or proposal, as applicable, shall be deemed nonresponsive.



(ii) **Participation Goals** on a Master Services Agreement will be established for individual Task Orders issued after the Master Services Agreement is awarded. If **Participation Goals** have been established on a Task Order, a contractor shall be required to submit a Schedule B – M/WBE Utilization Plan For Independently Registered Task Orders That Are Issued Pursuant to Master Services Agreements, Part II (see Pages 2-4) indicating: (a) whether the contractor is an MBE or WBE, or qualified joint venture; (b) the percentage of work it intends to award to direct subcontractors; and (c) in cases where the contractor intends to award direct subcontracts, a description of the type and dollar value of work designated for participation by MBEs and/or WBEs, and the time frames in which such work is scheduled to begin and end. The contractor must engage in good faith efforts to meet the **Participation Goals** as established for the Task Order unless Agency has granted the contractor a pre-award waiver of the Participation Goals in accordance with Section 6-129 and Part A, Section 10 below.

**C. THE BIDDER/PROPOSER MUST COMPLETE THE SCHEDULE B INCLUDED HEREIN (SCHEDULE B, PART II). A SCHEDULE B SUBMITTED BY THE BIDDER/PROPOSER WHICH DOES NOT INCLUDE THE VENDOR CERTIFICATION AND REQUIRED AFFIRMATIONS (SEE SECTION V OF PART II) WILL BE DEEMED TO BE NON-RESPONSIVE, UNLESS A FULL WAIVER OF THE PARTICIPATION GOALS IS GRANTED (SCHEDULE B, PART III). IN THE EVENT THAT THE CITY DETERMINES THAT THE BIDDER/PROPOSER HAS SUBMITTED A SCHEDULE B WHERE THE VENDOR CERTIFICATION AND REQUIRED AFFIRMATIONS ARE COMPLETED BUT OTHER ASPECTS OF THE SCHEDULE B ARE NOT COMPLETE, OR CONTAIN A COPY OR COMPUTATION ERROR THAT IS AT ODDS WITH THE VENDOR CERTIFICATION AND AFFIRMATIONS, THE BIDDER/PROPOSER WILL BE NOTIFIED BY THE AGENCY AND WILL BE GIVEN FOUR (4) CALENDAR DAYS FROM RECEIPT OF NOTIFICATION TO CURE THE SPECIFIED DEFICIENCIES AND RETURN A COMPLETED SCHEDULE B TO THE AGENCY. FAILURE TO DO SO WILL RESULT IN A DETERMINATION THAT THE BID/PROPOSAL IS NON-RESPONSIVE. RECEIPT OF NOTIFICATION IS DEFINED AS THE DATE NOTICE IS E-MAILED OR FAXED (IF THE BIDDER/PROPOSER HAS PROVIDED AN E-MAIL ADDRESS OR FAX NUMBER), OR NO LATER THAN FIVE (5) CALENDAR DAYS FROM THE DATE OF MAILING OR UPON DELIVERY, IF DELIVERED.**

5. Where an M/WBE Utilization Plan has been submitted, the Contractor shall, within 30 days of issuance by Agency of a notice to proceed, submit a list of proposed persons or entities to which it intends to award subcontracts within the subsequent 12 months. In the case of multiyear contracts, such list shall also be submitted every year thereafter. The Agency may also require the Contractor to report periodically about the contracts awarded by its direct subcontractors to indirect subcontractors (as defined in Section 6-129(c)(22)). **PLEASE NOTE: If this Contract is a public works project subject to GML §101(5) (i.e., a contract valued at or below \$3M for projects in New York City) or if the Contract is subject to a project labor agreement in accordance with Labor Law §222, and the bidder is required to identify at the time of bid submission its intended subcontractors for the Wicks trades (plumbing and gas fitting; steam heating, hot water heating, ventilating and air conditioning (HVAC); and electric wiring), the Contractor must identify all those to which it intends to award construction subcontracts for any portion of the Wicks trade work at the time of bid submission, regardless of what point in the life of the contract such subcontracts will occur. In identifying intended subcontractors in the bid submission, bidders may satisfy any Participation Goals established for this Contract by proposing one or more subcontractors that are MBEs and/or WBEs for any portion of the Wicks trade work. In the event that the Contractor's selection of a subcontractor is disapproved, the Contractor shall have a reasonable time to propose alternate subcontractors.**

6. MBE and WBE firms must be certified by DSBS in order for the Contractor to credit such firms' participation toward the attainment of the **Participation Goals**. Such certification must occur prior to the

firms' commencement of work. A list of MBE and WBE firms may be obtained from the DSBS website at [www.nyc.gov/buycertified](http://www.nyc.gov/buycertified), by emailing DSBS at [buyer@sbs.nyc.gov](mailto:buyer@sbs.nyc.gov), by calling (212) 513-6356, or by visiting or writing DSBS at 110 William St., New York, New York, 10038, 7th floor. Eligible firms that have not yet been certified may contact DSBS in order to seek certification by visiting [www.nyc.gov/getcertified](http://www.nyc.gov/getcertified), emailing [MWBE@sbs.nyc.gov](mailto:MWBE@sbs.nyc.gov), or calling the DSBS certification helpline at (212) 513-6311. A firm that is certified as both an MBE and a WBE may be counted either toward the goal for MBEs or the goal for WBEs, but not both. No credit shall be given for participation by a graduate MBE or graduate WBE, as defined in Section 6-129(c)(20).

7. Where an **M/WBE Utilization Plan** has been submitted, the Contractor shall, with each voucher for payment, and/or periodically as Agency may require, submit statements, certified under penalty of perjury, which shall include, but not be limited to,: the total amount the Contractor paid to its direct subcontractors, and, where applicable pursuant to Section 6-129(j), the total amount direct subcontractors paid to indirect subcontractors; the names, addresses and contact numbers of each MBE or WBE hired as a subcontractor by the Contractor, and, where applicable, hired by any of the Contractor's direct subcontractors; and the dates and amounts paid to each MBE or WBE. The Contractor shall also submit, along with its voucher for final payment: the total amount it paid to subcontractors, and, where applicable pursuant to Section 6-129(j), the total amount its direct subcontractors paid directly to their indirect subcontractors; and a final list, certified under penalty of perjury, which shall include the name, address and contact information of each subcontractor that is an MBE or WBE, the work performed by, and the dates and amounts paid to each.

8. If payments made to, or work performed by, MBEs or WBEs are less than the amount specified in the Contractor's **M/WBE Utilization Plan**, Agency shall take appropriate action, in accordance with Section 6-129 and Article II below, unless the Contractor has obtained a modification of its **M/WBE Utilization Plan** in accordance with Section 6-129 and Part A, Section 11 below.

9. Where an **M/WBE Utilization Plan** has been submitted, and the Contractor requests a change order the value of which exceeds the greater of 10 percent of the Contract or Task Order, as applicable, or \$500,000, Agency shall review the scope of work for the Contract or Task Order, as applicable, and the scale and types of work involved in the change order, and determine whether the **Participation Goals** should be modified.

10. Pre-award waiver of the **Participation Goals**. (a) A bidder or proposer, or contractor with respect to a Task Order, may seek a pre-award full or partial waiver of the **Participation Goals** in accordance with Section 6-129, which requests that Agency change one or more **Participation Goals** on the grounds that the **Participation Goals** are unreasonable in light of the availability of certified firms to perform the services required, or by demonstrating that it has legitimate business reasons for proposing a lower level of subcontracting in its **M/WBE Utilization Plan**.

(b) To apply for a full or partial waiver of the **Participation Goals**, a bidder, proposer, or contractor, as applicable, must complete Part III (Page 5) of Schedule B and submit such request no later than seven (7) calendar days prior to the date and time the bids, proposals, or Task Orders are due, in writing to the Agency by email at [poped@ddc.nyc.gov](mailto:poped@ddc.nyc.gov) or via facsimile at (718) 391-1886. Bidders, proposers, or contractors, as applicable, who have submitted requests will receive an Agency response by no later than two (2) calendar days prior to the due date for bids, proposals, or Task Orders; provided, however, that if that date would fall on a weekend or holiday, an Agency response will be provided by close-of-business on the business day before such weekend or holiday date.

(c) If the Agency determines that the **Participation Goals** are unreasonable in light of the availability of certified firms to perform the services required, it shall revise the solicitation and extend the deadline for bids and proposals, or revise the Task Order, as applicable.

(d) Agency may grant a full or partial waiver of the **Participation Goals** to a bidder, proposer or contractor, as applicable, who demonstrates—before submission of the bid, proposal or Task Order, as applicable—that it has legitimate business reasons for proposing the level of subcontracting in its **M/WBE Utilization Plan**. In making its determination, Agency shall consider factors that shall include, but not be limited to, whether the bidder, proposer or contractor, as applicable, has the capacity and the bona fide intention to perform the Contract without any subcontracting, or to perform the Contract without awarding the amount of subcontracts represented by the **Participation Goals**. In making such determination, Agency may consider whether the **M/WBE Utilization Plan** is consistent with past subcontracting practices of the bidder, proposer or contractor, as applicable, whether the bidder, proposer or contractor, as applicable, has made efforts to form a joint venture with a certified firm, and whether the bidder, proposer, or contractor, as applicable, has made good faith efforts to identify other portions of the Contract that it intends to subcontract.

11. Modification of **M/WBE Utilization Plan**. (a) A Contractor may request a modification of its **M/WBE Utilization Plan** after award of this Contract. **PLEASE NOTE: If this Contract is a public works project subject to GML §101(5) (i.e., a contract valued at or below \$3M for projects in New York City) or if the Contract is subject to a project labor agreement in accordance with Labor Law §222, and the bidder is required to identify at the time of bid submission its intended subcontractors for the Wicks trades (plumbing and gas fitting; steam heating, hot water heating, ventilating and air conditioning (HVAC); and electric wiring), the Contractor may request a Modification of its M/WBE Utilization Plan as part of its bid submission.** The Agency may grant a request for Modification of a Contractor's **M/WBE Utilization Plan** if it determines that the Contractor has established, with appropriate documentary and other evidence, that it made reasonable, good faith efforts to meet the **Participation Goals**. In making such determination, Agency shall consider evidence of the following efforts, as applicable, along with any other relevant factors:

- (i) The Contractor advertised opportunities to participate in the Contract, where appropriate, in general circulation media, trade and professional association publications and small business media, and publications of minority and women's business organizations;
- (ii) The Contractor provided notice of specific opportunities to participate in the Contract, in a timely manner, to minority and women's business organizations;
- (iii) The Contractor sent written notices, by certified mail or facsimile, in a timely manner, to advise MBEs or WBEs that their interest in the Contract was solicited;
- (iv) The Contractor made efforts to identify portions of the work that could be substituted for portions originally designated for participation by MBEs and/or WBEs in the **M/WBE Utilization Plan**, and for which the Contractor claims an inability to retain MBEs or WBEs;
- (v) The Contractor held meetings with MBEs and/or WBEs prior to the date their bids or proposals were due, for the purpose of explaining in detail the scope and requirements of the work for which their bids or proposals were solicited;
- (vi) The Contractor made efforts to negotiate with MBEs and/or WBEs as relevant to perform specific subcontracts, or act as suppliers or service providers;
- (vii) Timely written requests for assistance made by the Contractor to Agency's **M/WBE liaison officer** and to **DSBS**;
- (viii) Description of how recommendations made by **DSBS** and Agency were acted upon and an explanation of why action upon such recommendations did not lead to the desired level of participation of MBEs and/or WBEs.

Agency's **M/WBE officer** shall provide written notice to the Contractor of the determination.

(b) The Agency may modify the **Participation Goals** when the scope of the work has been changed by the Agency in a manner that affects the scale and types of work that the Contractor indicated in its **M/WBE Utilization Plan** would be awarded to subcontractors.

12. If this Contract is for an indefinite quantity of construction, standard or professional services or is a requirements type contract and the Contractor has submitted an **M/WBE Utilization Plan** and has committed to subcontract work to MBEs and/or WBEs in order to meet the **Participation Goals**, the Contractor will not be deemed in violation of the M/WBE Program requirements for this Contract with regard to any work which was intended to be subcontracted to an MBE and/or WBE to the extent that the Agency has determined that such work is not needed.

13. If **Participation Goals** have been established for this Contract or a Task Order issued pursuant to this Contract, at least once annually during the term of the Contract or Task Order, as applicable, Agency shall review the Contractor's progress toward attainment of its M/WBE Utilization Plan, including but not limited to, by reviewing the percentage of work the Contractor has actually awarded to MBE and/or WBE subcontractors and the payments the Contractor made to such subcontractors.

14. If **Participation Goals** have been established for this Contract or a Task Order issued pursuant to this Contract, Agency shall evaluate and assess the Contractor's performance in meeting those goals, and such evaluation and assessment shall become part of the Contractor's overall contract performance evaluation.

#### **PART B: MISCELLANEOUS**

1. The Contractor shall take notice that, if this solicitation requires the establishment of an **M/WBE Utilization Plan**, the resulting contract may be audited by DSBS to determine compliance with Section 6-129. See §6-129(e)(10). Furthermore, such resulting contract may also be examined by the City's Comptroller to assess compliance with the **M/WBE Utilization Plan**.

2. Pursuant to DSBS rules, construction contracts that include a requirement for an **M/WBE Utilization Plan** shall not be subject to the law governing Locally Based Enterprises set forth in Section 6-108.1 of the Administrative Code of the City of New York.

3. DSBS is available to assist contractors and potential contractors in determining the availability of MBEs and/or WBEs to participate as subcontractors, and in identifying opportunities that are appropriate for participation by MBEs and/or WBEs in contracts.

4. Prospective contractors are encouraged to enter into qualified joint venture agreements with MBEs and/or WBEs as defined by Section 6-129(c)(30).

5. By submitting a bid or proposal the Contractor hereby acknowledges its understanding of the M/WBE Program requirements set forth herein and the pertinent provisions of Section 6-129, and any rules promulgated thereunder, and if awarded this Contract, the Contractor hereby agrees to comply with the M/WBE Program requirements of this Contract and pertinent provisions of Section 6-129, and any rules promulgated thereunder, all of which shall be deemed to be material terms of this Contract. The Contractor hereby agrees to make all reasonable, good faith efforts to solicit and obtain the participation of MBEs and/or WBEs to meet the required **Participation Goals**.

#### **ARTICLE II. ENFORCEMENT**

1. If Agency determines that a bidder or proposer, as applicable, has, in relation to this procurement, violated Section 6-129 or the DSBS rules promulgated pursuant to Section 6-129, Agency may disqualify such bidder or proposer, as applicable, from competing for this Contract and the Agency may revoke such bidder's or proposer's prequalification status, if applicable.

2. Whenever Agency believes that the Contractor or a subcontractor is not in compliance with Section 6-129 or the DSBS rules promulgated pursuant to Section 6-129, or any provision of this Contract that implements Section 6-129, including, but not limited to any **M/WBE** Utilization Plan, Agency shall send a written notice to the Contractor describing the alleged noncompliance and offering the Contractor an opportunity to be heard. Agency shall then conduct an investigation to determine whether such Contractor or subcontractor is in compliance.

3. In the event that the Contractor has been found to have violated Section 6-129, the DSBS rules promulgated pursuant to Section 6-129, or any provision of this Contract that implements Section 6-129, including, but not limited to, any **M/WBE** Utilization Plan, Agency may determine that one of the following actions should be taken:

- (a) entering into an agreement with the Contractor allowing the Contractor to cure the violation;
- (b) revoking the Contractor's pre-qualification to bid or make proposals for future contracts;
- (c) making a finding that the Contractor is in default of the Contract;
- (d) terminating the Contract;
- (e) declaring the Contractor to be in breach of Contract;
- (f) withholding payment or reimbursement;
- (g) determining not to renew the Contract;
- (h) assessing actual and consequential damages;
- (i) assessing liquidated damages or reducing fees, provided that liquidated damages may be based on amounts representing costs of delays in carrying out the purposes of the M/WBE Program, or in meeting the purposes of the Contract, the costs of meeting utilization goals through additional procurements, the administrative costs of investigation and enforcement, or other factors set forth in the Contract;
- (j) exercising rights under the Contract to procure goods, services or construction from another contractor and charge the cost of such contract to the Contractor that has been found to be in noncompliance; or
- (k) taking any other appropriate remedy.

4. If an **M/WBE** Utilization Plan has been submitted, and pursuant to this Article II, Section 3, the Contractor has been found to have failed to fulfill its **Participation Goals** contained in its **M/WBE** Utilization Plan or the **Participation Goals** as modified by Agency pursuant to Article I, Part A, Section 11, Agency may assess liquidated damages in the amount of ten percent (10%) of the difference between the dollar amount of work required to be awarded to MBE and/or WBE firms to meet the **Participation Goals** and the dollar amount the Contractor actually awarded and paid, and/or credited, to MBE and/or WBE firms. In view of the difficulty of accurately ascertaining the loss which the City will suffer by reason of Contractor's failure to meet the **Participation Goals**, the foregoing amount is hereby fixed and agreed as the liquidated damages that the City will suffer by reason of such failure, and not as a penalty. Agency may deduct and retain out of any monies which may become due under this Contract the amount of any such liquidated damages; and in case the amount which may become due under this Contract shall be less than the amount of liquidated damages suffered by the City, the Contractor shall be liable to pay the difference.

5. Whenever Agency has reason to believe that an MBE and/or WBE is not qualified for certification, or is participating in a contract in a manner that does not serve a commercially useful function (as defined in Section 6-129(c)(8)), or has violated any provision of Section 6-129, Agency shall notify the Commissioner of DSBS who shall determine whether the certification of such business enterprise should be revoked.

6. Statements made in any instrument submitted to Agency pursuant to Section 6-129 shall be submitted under penalty of perjury and any false or misleading statement or omission shall be grounds for the application of any applicable criminal and/or civil penalties for perjury. The making of a false or fraudulent statement by an MBE and/or WBE in any instrument submitted pursuant to Section 6-129 shall, in addition, be grounds for revocation of its certification.

7. The Contractor's record in implementing its **M/WBE** Utilization Plan shall be a factor in the evaluation of its performance. Whenever Agency determines that a Contractor's compliance with an **M/WBE** Utilization Plan has been unsatisfactory, Agency shall, after consultation with the City Chief Procurement Officer, file an advice of caution form for inclusion in VENDEX as caution data.

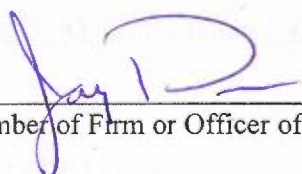
IN WITNESS WHEREOF, the Commissioner, on behalf of the City of New York, and the Contractor, have executed this agreement in quadruplicate, two parts of which are to remain with the Commissioner, another to be filed with the Comptroller of the City, and the fourth to be delivered to the Contractor.

THE CITY OF NEW YORK

By:   
Commissioner

NOTARIAL SEAL  
NOTARY PUBLIC  
STATE OF NEW YORK  
JENNIFER L. GILL  
JANUARY 1, 2017 - JANUARY 1, 2020  
JENNIFER L. GILL  
JANUARY 1, 2017 - JANUARY 1, 2020

CONTRACTOR: Citnalty Construction Corp.

By:   
(Member of Firm or Officer of Corporation)

Title: V.P.

(Where Contractor is a Corporation, add):  
Attest:

\_\_\_\_\_  
Secretary

(Seal)

\_\_\_\_\_



ACKNOWLEDGEMENT OF PRINCIPAL, IF A CORPORATION

State of New York County of Queens ss:

On this 6 day of March, 2020, before me personally came Jay Dier  
to me known who, being by me duly sworn did depose and say that he resides at 1601 Locust Ave  
Bohemia, NY that he is the Vice President  
of the corporation described in and which executed the foregoing instrument; that he knows the seal of said  
corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of  
the directors of said corporation, and that he signed his name thereto by like order.

MARIA JOHNSTON  
Notary Public, State of New York  
No. 01JO6351081  
Qualified in Queens County  
Commission Expires Nov. 28, 2020

  
\_\_\_\_\_  
Notary Public or Commissioner of Deeds

ACKNOWLEDGEMENT OF PRINCIPAL, IF A PARTNERSHIP

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, before me personally appeared \_\_\_\_\_  
to me known, and known to me to be one of the members of the firm of \_\_\_\_\_  
described in and who executed the foregoing instrument; and he  
acknowledged to me that he executed the same as and for the act and deed of said firm.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds

ACKNOWLEDGEMENT OF PRINCIPAL, IF AN INDIVIDUAL

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, before me personally appeared \_\_\_\_\_  
to me known, and known to me to be the person described in and who executed the foregoing instrument;  
and acknowledged that he executed the same.


\_\_\_\_\_  
Notary Public or Commissioner of Deeds



ACKNOWLEDGEMENT BY COMMISSIONER

State of New York County of Queens ss:

On this 6<sup>th</sup> day of March, 2020, before me personally came Lorraine Grillo  
to me known, and known to be the \_\_\_\_\_ Commissioner of the Department of Design and Construction of  
The City of New York, the person described as such in and who as such executed the foregoing instrument  
and acknowledged to me that he executed the same as \_\_\_\_\_ Commissioner for the purposes therein  
mentioned.

  
\_\_\_\_\_  
Notary Public or Commissioner of Deeds

**MARIA JOHNSTON**  
Notary Public, State of New York  
No. 01JO6351081  
Qualified in Queens County  
Commission Expires Nov. 28, 2020

AUTHORITY

MAYOR'S CERTIFICATE NO. CBX  
BUDGET DIRECTOR'S CERTIFICATE NO.

DATED  
DATED

APPROPRIATION  
COMMISSIONER'S CERTIFICATE

In conformity with the provisions of Section 6-101 of the Administrative Code of the City of New York, it is hereby certified that the estimated cost of the work, materials and supplies required by the within Contract, amounting to

Seventy-Seven Million Nine Hundred Seventy-One  
Thousand Nine Hundred Sixty-two

Dollars (\$ 77,971,962.00 )

is chargeable to the fund of the Department of Design and Construction entitled Code

Department of Design and Construction

I hereby certify that the specifications contained herein comply with the terms and conditions of the BUDGET.

  
Commissioner

COMPTROLLER'S CERTIFICATE

The City of New York \_\_\_\_\_

Pursuant to the provisions of Section 6-101 of the Administrative Code of the City of New York, I hereby certify that there remains unapplied and unexpended a balance of the above mentioned fund applicable to this Contract sufficient to pay the estimated expense of executing the same viz:

\$ \_\_\_\_\_

\_\_\_\_\_  
Comptroller

MAYOR'S CERTIFICATE OR  
CERTIFICATE OF THE DIRECTOR  
OF THE BUDGET

**Performance Bond #1 (Pages 100 to 103): Use if the total contract price is \$5 Million Or Less.**  
**Performance Bond #1 has been approved by the U.S. Small Business Administration ("SBA")**  
**for participation in its Bond Guarantee Program.**

PERFORMANCE BOND #1 (Page 1)

**PERFORMANCE BOND #1**

**KNOW ALL PERSONS BY THESE PRESENTS:,**

That we, \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

hereinafter referred to as the "Principal,"  
and, \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

hereinafter referred to as the "Surety" ("Sureties") are held and firmly bound to THE CITY OF NEW YORK, hereinafter referred to as the "City" or to its successors and assigns in the penal sum of \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(\$ \_\_\_\_\_) Dollars, lawful money of the United States for the payment of which said sum of money well and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS,** the Principal is about to enter, or has entered, into a Contract in writing with the City for \_\_\_\_\_  
\_\_\_\_\_

a copy of which Contract is annexed to and hereby made a part of this bond as though herein set forth in full;

**NOW, THEREFORE,** the conditions of this obligation are such that if the Principal, his or its representatives or assigns, shall well and faithfully perform the said Contract and all modifications, amendments, additions and alterations thereto that may hereafter be made, according to its terms and its true intent and meaning, including repair and or replacement of defective work and guarantees of maintenance for the periods stated in the Contract, and shall fully indemnify and save harmless the City from all cost and damage which it may suffer by reason of the Principal's default of the Contract, and shall fully reimburse and repay the City for all outlay and expense which the City may incur in making

**Performance Bond #1 (Pages 100 to 103):** Use if the total contract price is \$5 Million Or Less. Performance Bond #1 has been approved by the U.S. Small Business Administration ("SBA") for participation in its Bond Guarantee Program.

PERFORMANCE BOND #1 (Page 2)

good any such default and shall protect the said City of New York against, and pay any and all amounts, damages, cost and judgments which may or shall be recovered against said City or its officers or agents or which the said City of New York may be called upon to pay any person or corporation by reason of any damages arising or growing out of the Principal's default of the Contract, then this obligation shall be null and void, otherwise to remain in full force and effect.

The Surety (Sureties), for value received, hereby stipulates and agrees, upon written notice from the City that the City has determined that the Principal is in default of the Contract, to (1) pay the City the cost to complete the contract as determined by the City in excess of the balance of the Contract held by the City, plus any damages or costs to which the City is entitled, up to the full amount of the above penal sum, (2) fully perform and complete the Work to be performed under the Contract, pursuant to the terms, conditions, and covenants thereof, or (3) tender a completion Contractor that is acceptable to the City. The Surety (Sureties) further agrees, at its option, either to notify the City that it elects to pay the city the cost of completion plus any applicable damages and costs under option (1) above, or to commence and diligently perform the Work specified in the Contract, including physical site work, within twenty-five (25) business days after written notice thereof from the City and, if the Surety elects to fully perform and complete the Work, then to complete all Work within the time set forth in the Contract or such other time as agreed to between the City and Surety in accordance with the Contract. If the Surety elects to tender payment pursuant to (1) above, then the Surety shall tender such amount within fifteen (15) business days notification from the City of the cost of completion. The Surety and the City reserve all rights and defenses each may have against the other; provided, however, that the Surety expressly agrees that its reservation of rights shall not provide a basis for non-performance of its obligation to pay the City the cost of completion, to commence and complete all Work as provided herein, or to tender a completion contractor.

The Surety (Sureties), for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of said Surety (Sureties) and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition, or change in or to the said Contract or the Work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or any moneys due or to become due thereunder; and said Surety (Sureties) does hereby waive notice of any and all of such extensions, modifications, omissions, additions, changes, payments, and waivers, and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to subcontractors shall have the same effect as to said Surety (Sureties) as though done or omitted to be done by or in relation to said Principal. Notwithstanding the above, if the City makes payments to the Principal before the time required by the contract that in the aggregate exceed \$100,000 or 10% of the Contract price, whichever is less, and that have not become earned prior to the Principal being found to be in default, then all payments made to the Principal before the time required by the Contract shall be added to the remaining contract value available to be paid for the completion of the Contract as if such sums had not been paid to the Principal, but shall not provide a basis for non-performance of its obligation to pay the City the cost of completion, to commence and to complete all Work as provided herein, or to tender a completion contractor.

**Performance Bond #1 (Pages 100 to 103): Use if the total contract price is \$5 Million Or Less. Performance Bond #1 has been approved by the U.S. Small Business Administration ("SBA") for participation in its Bond Guarantee Program.**

PERFORMANCE BOND #1 (Page 3)

**IN WITNESS WHEREOF,** The Principal and the Surety (Sureties) have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereunto affixed and these presents to be signed by their proper officers, this

\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.  
(Seal)

\_\_\_\_\_  
Principal (L.S.)

By: \_\_\_\_\_  
(Seal) Surety

By: \_\_\_\_\_  
(Seal) Surety

By: \_\_\_\_\_  
(Seal) Surety

By: \_\_\_\_\_  
(Seal) Surety

By: \_\_\_\_\_  
(Seal) Surety

By: \_\_\_\_\_

Bond Premium Rate \_\_\_\_\_

Bond Premium Cost \_\_\_\_\_

If the Contractor (Principal) is a partnership, the bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a corporation, the bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of the bond corresponding to the number of counterparts of the Contract.

**Performance Bond #1 (Pages 100 to 103): Use if the total contract price is \$5 Million Or Less. Performance Bond #1 has been approved by the U.S. Small Business Administration ("SBA") for participation in its Bond Guarantee Program.m.**

PERFORMANCE BOND #1 (Page 4)

**ACKNOWLEDGMENT OF PRINCIPAL IF A CORPORATION**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ before me personally came \_\_\_\_\_,  
to me known, who, being by me duly sworn did depose and say that he/she resides  
at \_\_\_\_\_

\_\_\_\_\_ ; that he/she is the \_\_\_\_\_  
of the corporation described in and which executed the foregoing instrument; and that he/she signed his/her name to  
the foregoing instrument by order of the directors of said corporation as the duly authorized and binding act thereof.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds.

**ACKNOWLEDGMENT OF PRINCIPAL IF A PARTNERSHIP**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ before me personally came \_\_\_\_\_,  
to me known, who, being by me duly sworn did dispose and say that he/she resides  
at \_\_\_\_\_

\_\_\_\_\_ ; that he/she is \_\_\_\_\_ partner of  
\_\_\_\_\_, a limited/general partnership existing under the laws of the State of \_\_\_\_\_,  
the partnership described in and which executed the foregoing instrument;  
and that he/she signed his/her name to the foregoing instrument as the duly authorized and binding act of  
said partnership.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds.

**ACKNOWLEDGMENT OF PRINCIPAL IF AN INDIVIDUAL**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ before me personally came \_\_\_\_\_,  
to me known, who, being by me duly sworn did depose and say that he/she resides  
at \_\_\_\_\_

\_\_\_\_\_, and that he/she is the individual whose name is  
subscribed to the within instrument and acknowledged to me that by his/her signature on the  
instrument, said individual executed the instrument.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds

Each executed bond should be accompanied by: (a) appropriate acknowledgments of the respective parties; (b) appropriate  
duly certified copy of Power of Attorney or other certificate of authority where bond is executed by agent, officer or other  
representative of Principal or Surety; (c) a duly certified extract from By-Laws or resolutions of Surety under which Power  
of Attorney or other certificate of authority of its agent, officer or representative was issued, and (d) certified copy of latest  
published financial statement of assets and liabilities of Surety.

\*\*\*\*\*

Affix Acknowledgments and Justification of Sureties.

**Performance Bond #2 (Pages 104 to 107): Use if the total contract price is more than \$5 Million.**

PERFORMANCE BOND #2 (Page 1)

**PERFORMANCE BOND #2**

Bond No. 107423061

**KNOW ALL PERSONS BY THESE PRESENTS:**

That we, Citnalta Construction Corp.

1601 Locust Avenue, Bohemia, NY 11716

hereinafter referred to as the "Principal,"  
and, Travelers Casualty and Surety Company of America

One Tower Square, Hartford, CT 06183

hereinafter referred to as the "Surety" ("Sureties") are held and firmly bound to THE CITY OF NEW YORK, hereinafter referred to as the "City" or to its successors and assigns in the penal sum of Seventy Seven Million Nine Hundred Seventy One Thousand Nine Hundred Sixty Two and 00/100

(\$77,971,962.00) Dollars, lawful money of the United States for the payment of which said sum of money well and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal is about to enter, or has entered, into a Contract in writing with the City for PO002-116 New 116th Precinct Station House, Borough of Queens, City of New York

a copy of which Contract is annexed to and hereby made a part of this bond as though herein set forth in full;

**NOW, THEREFORE**, the conditions of this obligation are such that if the Principal, his or its representatives or assigns, shall well and faithfully perform the said Contract and all modifications, amendments, additions and alterations thereto that may hereafter be made, according to its terms and its true intent and meaning, including repair and or replacement of defective work and guarantees of maintenance for the periods stated in the Contract, and shall fully indemnify and save harmless the City from all cost and damage which it may suffer by reason of the Principal's default of the Contract, and shall fully reimburse and repay the City for all outlay and expense which the City may incur in making



**Performance Bond #2 (Pages 104 to 107): Use if the total contract price is more than \$5 Million.**

**PERFORMANCE BOND #2 (Page 2)**

good any such default and shall protect the said City of New York against, and pay any and all amounts, damages, cost and judgments which may or shall be recovered against said City or its officers or agents or which the said City of New York may be called upon to pay any person or corporation by reason of any damages arising or growing out of the Principal's default of the Contract, then this obligation shall be null and void, otherwise to remain in full force and effect.

The Surety (Sureties), for value received, hereby stipulates and agrees, upon written notice from the City that the City has determined that the Principal is in default of the Contract, to either (1) pay the full amount of the above penal sum in complete discharge and exoneration of this bond and of all the liabilities of the Surety relating to this bond, or (2) fully perform and complete the Work to be performed under the Contract, pursuant to the terms, conditions, and covenants thereof. The Surety (Sureties) further agrees, at its option, either to tender the penal sum or to commence and diligently perform the Work specified in the Contract, including physical site work, within twenty-five (25) business days after written notice thereof from the City and to complete all Work within the time set forth in the Contract or such other time as agreed to between the City and Surety in accordance with the Contract. The Surety and the City reserve all rights and defenses each may have against the other; provided, however, that the Surety expressly agrees that its reservation of rights shall not provide a basis for non-performance of its obligation to commence and to complete all Work as provided herein.

The Surety (Sureties), for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of said Surety (Sureties) and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition, or change in or to the said Contract or the Work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any Work to be performed or any moneys due or to become due thereunder; and said Surety (Sureties) does hereby waive notice of any and all of such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers, and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to said Surety (Sureties) as though done or omitted to be done by or in relation to said Principal.

**Performance Bond #2 (Pages 104 to 107): Use if the total contract price is more than \$5 Million.**

PERFORMANCE BOND #2 (Page 3)

**IN WITNESS WHEREOF**, The Principal and the Surety (Sureties) have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereunto affixed and these presents to be signed by their proper officers, this

\_\_\_\_ 5th \_\_\_\_\_ day of \_\_\_\_\_ May \_\_\_\_\_ 20 21 \_\_\_\_\_  
(Seal) \_\_\_\_\_ Citnalta Construction Corp. \_\_\_\_\_ (L.S.)

\_\_\_\_ Principal  
By: \_\_\_\_\_  
(Seal) \_\_\_\_\_ Surety

Travelers Casualty and Surety Company of America  
By: \_\_\_\_\_  
(Seal) \_\_\_\_\_ Susan Lupski, Attorney-In-Fact \_\_\_\_\_ Surety

By: \_\_\_\_\_  
(Seal) \_\_\_\_\_ Surety

By: \_\_\_\_\_  
(Seal) \_\_\_\_\_ Surety

By: \_\_\_\_\_  
(Seal) \_\_\_\_\_ Surety

By: \_\_\_\_\_

Bond Premium Rate \$7.65/M Sliding Scale \_\_\_\_\_

Bond Premium Cost \$497,202.00 \_\_\_\_\_

If the Contractor (Principal) is a partnership, the bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a corporation, the bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of the bond corresponding to the number of counterparts of the Contract.



**Performance Bond #2 (Pages 104 to 107): Use if the total contract price is more than \$5 Million.**

PERFORMANCE BOND #2 (Page 4)

**ACKNOWLEDGMENT OF PRINCIPAL IF A CORPORATION**

State of New York County of Suffolk ss:

On this 7th day of May, 20 21 before me personally came Michael Gargiulo

to me known, who, being by me duly sworn did depose and say that he resides at 22 Woodlot Rd.

St James, NY 11780; that he/she is the President of the corporation described in and which executed the foregoing instrument; that he/she signed his/her name to the foregoing instrument by order of the directors of said corporation as the duly authorized and binding act thereof.

Christina M. Lewis  
Notary Public or Commissioner of Deeds.

NOTARY PUBLIC-STATE OF NEW YORK  
Registration 01LE6392847  
Qualified In Suffolk County  
Commission Expires 6/03/2023

**ACKNOWLEDGMENT OF PRINCIPAL IF A PARTNERSHIP**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ before me personally came \_\_\_\_\_

to me known, who, being by me duly sworn did depose and say that he/she resides at \_\_\_\_\_

\_\_\_\_\_ ; that he/she is \_\_\_\_\_ partner of \_\_\_\_\_, a limited/general partnership existing under the laws of the State of \_\_\_\_\_, the partnership described in and which executed the foregoing instrument; and that he/she signed his/her name to the foregoing instrument as the duly authorized and binding act of said partnership.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds

**ACKNOWLEDGMENT OF PRINCIPAL IF AN INDIVIDUAL**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_ before me personally came \_\_\_\_\_

to me known, who, being by me duly sworn did depose and say that he/she resides at \_\_\_\_\_

\_\_\_\_\_, and that he/she is the individual whose name is subscribed to the within instrument and acknowledged to me that by his/her signature on the instrument, said individual executed the instrument.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds

Each executed bond should be accompanied by: (a) appropriate acknowledgments of the respective parties; (b) appropriate duly certified copy of Power of Attorney or other certificate of authority where bond is executed by agent, officer or other representative of Principal or Surety; (c) a duly certified extract from By-Laws or resolutions of Surety under which Power of Attorney or other certificate of authority of its agent, officer or representative was issued, and (d) certified copy of latest published financial statement of assets and liabilities of Surety.

\*\*\*\*\*

Affix Acknowledgments and Justification of Sureties.

CITY OF NEW YORK  
DDC

107

STANDARD CONSTRUCTION CONTRACT  
March 2017





**Travelers Casualty and Surety Company of America**  
**Travelers Casualty and Surety Company**  
**St. Paul Fire and Marine Insurance Company**

**POWER OF ATTORNEY**

**KNOW ALL MEN BY THESE PRESENTS:** That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Susan Lupski of Uniondale, New York**, their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

**IN WITNESS WHEREOF**, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **3rd day of February, 2017**.



State of Connecticut

City of Hartford ss.

By:

  
Robert L. Raney, Senior Vice President

On this the **3rd day of February, 2017**, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

**In Witness Whereof**, I hereunto set my hand and official seal.

My Commission expires the **30th day of June, 2021**



  
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

**RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

**FURTHER RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

**FURTHER RESOLVED**, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

**FURTHER RESOLVED**, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this **5th** day of **May**, 20**21**



  
Kevin E. Hughes, Assistant Secretary

**To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.**  
**Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.**

ACKNOWLEDGEMENT OF SURETY COMPANY

STATE OF NEW YORK

COUNTY OF NASSAU

On this May 5, 2021, before me personally came  
Susan Lupski to me known, who, being by me duly sworn,  
did depose and say; that he/she resides in Nassau County, State of New York that  
he/she is the Attorney-In-Fact of the Travelers Casualty and Surety Company of America  
the corporation described in which executed the above instrument; that he/she knows the seal of said  
corporation; that the seal affixed to said instrument is such corporate seal; that is was so affixed by the  
Board of Directors of said corporation; and that he/she signed his/her name thereto by like order; and  
the affiant did further depose and say that the Superintendent of Insurance of the State of New York,  
has, pursuant to Section 1111 of the Insurance Law of the State of New York, issued to  
Travelers Casualty and Surety Company of America (Surety)  
his/her certificate of qualification evidencing the qualification of said Company and its sufficiency under  
any law of the State of New York as surety and guarantor, and the propriety of accepting and approving  
it as such; and that such Certificate has not been revoked.



Notary Public

Grace Ackerson  
Notary Public, State of New York  
No. 01AC6111590  
Qualified in Nassau County  
Commission Expires 6/14/2024



TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

HARTFORD, CONNECTICUT 06183

FINANCIAL STATEMENT AS OF DECEMBER 31, 2020

CAPITAL STOCK \$ 6,480,000

ASSETS		LIABILITIES & SURPLUS	
CASH AND INVESTED CASH	\$ 239,403,348	UNEARNED PREMIUMS	\$ 1,121,070,380
BONDS	3,831,158,861	LOSSES	1,003,200,686
STOCKS	109,074,035	LOSS ADJUSTMENT EXPENSES	163,346,678
INVESTMENT INCOME DUE AND ACCRUED	36,856,709	COMMISSIONS	48,805,893
OTHER INVESTED ASSETS	4,870,512	TAXES, LICENSES AND FEES	13,561,421
PREMIUM BALANCES	277,653,788	OTHER EXPENSES	42,508,558
NET DEFERRED TAX ASSET	55,188,715	CURRENT FEDERAL AND FOREIGN INCOME TAXES	4,865,484
REINSURANCE RECOVERABLE	32,553,518	REMITTANCES AND ITEMS NOT ALLOCATED	8,646,391
RECEIVABLES FROM PARENT, SUBSIDIARIES AND AFFILIATES	34,876,347	AMOUNTS WITHHELD / RETAINED BY COMPANY FOR OTHERS	42,228,250
OTHER ASSETS	4,155,794	POLICYHOLDER DIVIDENDS	12,353,304
		PROVISION FOR REINSURANCE	7,930,280
		ADVANCE PREMIUM	1,867,512
		CEDED REINSURANCE NET PREMIUMS PAYABLE	63,102,972
		RETROACTIVE REINSURANCE RESERVE ASSUMED	800,763
		OTHER ACCRUED EXPENSES AND LIABILITIES	568,668
		TOTAL LIABILITIES	\$2,534,865,020
		CAPITAL STOCK	\$6,480,000
		PAID IN SURPLUS	433,803,760
		OTHER SURPLUS	1,650,750,847
		TOTAL SURPLUS TO POLICYHOLDERS	\$2,091,034,607
TOTAL ASSETS	\$ 4,625,889,627	TOTAL LIABILITIES & SURPLUS	\$4,625,889,627

STATE OF CONNECTICUT )  
COUNTY OF HARTFORD ) SS.  
CITY OF HARTFORD )

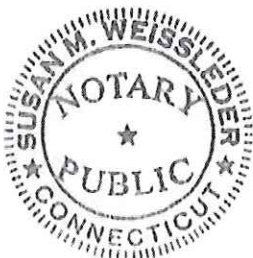
MICHAEL J. DOODY, BEING DULY SWORN, SAYS THAT HE IS VICE PRESIDENT - FINANCE, OF TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA, AND THAT TO THE BEST OF HIS KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT STATEMENT OF THE FINANCIAL CONDITION OF SAID COMPANY AS OF THE 31ST DAY OF DECEMBER, 2020.

*Michael J. Doody*  
VICE PRESIDENT - FINANCE

SUBSCRIBED AND SWORN TO BEFORE ME THIS  
28TH DAY OF MARCH, 2021

*Susan M. Weissleder*  
NOTARY PUBLIC

SUSAN M. WEISSLEDER  
Notary Public  
My Commission Expires November 30, 2022



**Payment Bond (Pages 108 to 111): Use for any contract for which a Payment Bond is required.**

PAYMENT BOND (Page 1)

Bond No. 107423061

PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS, That we, Citnalta Construction Corp.

1601 Locust Avenue, Bohemia, NY 11716

hereinafter referred to as the "Principal", and Travelers Casualty and Surety Company of America

One Tower Square, Hartford, CT 06183

hereinafter referred to as the "Surety" ("Sureties") are held and firmly bound to THE CITY OF NEW YORK,  
hereinafter referred to as the "City" or to its successors and assigns, in the penal sum of

Seventy Seven Million Nine Hundred Seventy One Thousand Nine Hundred Sixty Two and 00/100

(\$77,971,962.00) Dollars, lawful money of the United States, for the payment of which said sum of money well  
and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, successors and  
assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal is about to enter, or has entered, into a Contract in writing with the City for  
PO002-116 Precinct Station House, Borough of Queens, City of New York

a copy of which Contract is annexed to and hereby made a part of this bond as though herein set forth in full;

NOW, THEREFORE, the conditions of this obligation are such that if the Principal, his or its  
representatives or assigns and other Subcontractors to whom Work under this Contract is sublet and his or their  
successors and assigns shall promptly pay or cause to be paid all lawful claims for

(a) Wages and compensation for labor performed and services rendered by all persons engaged in  
the prosecution of the Work under said Contract, and any amendment or extension thereof or addition thereto,  
whether such persons be agents servants or employees of the Principal or any such Subcontractor, including all  
persons so engaged who perform the work of laborers or mechanics at or in the vicinity of the site



**Payment Bond (Pages 108 to 111): Use for any contract for which a Payment Bond is required.**

PAYMENT BOND (Page 2)

of the Project regardless of any contractual relationship between the Principal or such Subcontractors, or his or their successors or assigns, on the one hand and such laborers or mechanics on the other, but not including office employees not regularly stationed at the site of the project; and

(b) Materials and supplies (whether incorporated in the permanent structure or not), as well as teams, fuels, oils, implements or machinery furnished, used or consumed by said Principal or any subcontractor at or in the vicinity of the site of the Project in the prosecution of the Work under said Contract and any amendment or extension thereof or addition thereto; then this obligation shall be void, otherwise to remain in full force and effect.

This bond is subject to the following additional conditions, limitations and agreements:

(a) The Principal and Surety (Sureties) agree that this bond shall be for the benefit of any materialmen or laborer having a just claim, as well as the City itself.

(b) All persons who have performed labor, rendered services or furnished materials and supplies, as aforesaid, shall have a direct right of action against the Principal and his, its or their successors and assigns, and the Surety (Sureties) herein, or against either or both or any of them and their successors and assigns. Such persons may sue in their own name, and may prosecute the suit to judgment and execution without the necessity of joining with any other persons as party plaintiff.

(c) The Principal and Surety (Sureties) agree that neither of them will hold the City liable for any judgment for costs of otherwise, obtained by either or both of them against a laborer or materialman in a suit brought by either a laborer or materialman under this bond for moneys allegedly due for performing work or furnishing material.

(d) The Surety (Sureties) or its successors and assigns shall not be liable for any compensation recoverable by an employee or laborer under the Workmen's Compensation Law.

(e) In no event shall the Surety (Sureties), or its successors or assigns, be liable for a greater sum than the penalty of this bond or be subject to any suit, action or proceeding hereon that is instituted by any person, firm, or corporation hereunder later than two years after the complete performance of said Contract and final settlement thereof.

The Principal, for himself and his successors and assigns, and the Surety (Sureties), for itself and its successors and assigns, do hereby expressly waive any objection that might be interposed as to the right of the City to require a bond containing the foregoing provisions, and they do hereby further expressly waive any defense which they or either of them might interpose to an action brought hereon by any person, firm or corporation, including subcontractors, materialmen and third persons, for work, labor, services, supplies or material performed rendered, or furnished as aforesaid upon the ground that there is no law authorizing the City to require the foregoing provisions to be place in this bond.

And the Surety (Sureties), for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of said Surety (Sureties), and its bonds shall be in no way impaired or affected by any extension of time, modification, omission, addition, or change in or of the said Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any part thereof, or of any Work to be performed, or any moneys due to become due thereunder and said Surety (Sureties) does hereby waive notice of any and all of such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers, and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, Subcontractors, and other transferees shall have the same effect as to said Surety (Sureties) as though done or omitted to be done or in relation to said Principal.

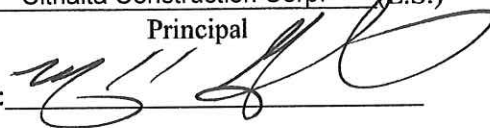


**Payment Bond (Pages 108 to 111): Use for any contract for which a Payment Bond is required.**

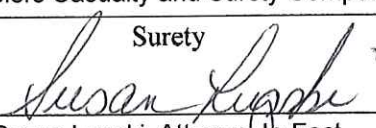
PAYMENT BOND (Page 3)

IN WITNESS WHEREOF, the Principal and the Surety (Sureties) have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereunto affixed and these presents to be signed by their proper officers, this 5th day of May, 2021.

(Seal)

Citnalta Construction Corp. (L.S.)  
Principal  
By: 

(Seal)

Travelers Casualty and Surety Company of America  
Surety  
By:   
Susan Lupski, Attorney-in-Fact

(Seal)

\_\_\_\_\_  
Surety  
By: \_\_\_\_\_

(Seal)

\_\_\_\_\_  
Surety  
By: \_\_\_\_\_

(Seal)

\_\_\_\_\_  
Surety  
By: \_\_\_\_\_

If the Contractor (Principal) is a partnership, the bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a corporation, the bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of the bond corresponding to the number of counterparts of the Contract.

**Payment Bond (Pages 108 to 111): Use for any contract for which a Payment Bond is required.**

PAYMENT BOND (Page 4)

**ACKNOWLEDGMENT OF PRINCIPAL, IF A CORPORATION**

State of New York County of Suffolk ss:

On this 7th day of May, 2021, before me personally came Michael Gargiulo to me known, who, being by me duly sworn did depose and say that he resides at 22 Wood Lot Rd. St. James, NY 11780 that he is the President of the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation, and that he signed his name thereto by like order.

Christina M. Lewis  
NOTARY PUBLIC-STATE OF NEW YORK  
Registration 01LE6392847  
Qualified in Suffolk County  
Commission Expires 6/03/2023

Christina Lewis  
Notary Public or Commissioner of Deeds

**ACKNOWLEDGMENT OF PRINCIPAL, IF A PARTNERSHIP**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, before me personally appeared \_\_\_\_\_ to me known, and known to me to be one of the members of the firm of \_\_\_\_\_ described in and who executed the foregoing instrument; and he acknowledged to me that he executed the same as and for the act and deed of said firm.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds

**ACKNOWLEDGMENT OF PRINCIPAL, IF AN INDIVIDUAL**

State of \_\_\_\_\_ County of \_\_\_\_\_ ss:

On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, before me personally appeared \_\_\_\_\_ to me known, and known to me to be the person described in and who executed the foregoing instrument; and acknowledged that he executed the same.

\_\_\_\_\_  
Notary Public or Commissioner of Deeds

Each executed bond should be accompanied by: (a) appropriate acknowledgments of the respective parties; (b) appropriate duly certified copy of Power of Attorney or other certificate of authority where bond is executed by agent, officer or other representative of Principal or Surety; (c) a duly certified extract from By-Laws or resolutions of Surety under which Power of Attorney or other certificate of authority of its agent, officer or representative was issued, and; (d) certified copy of latest published financial statement of assets and liabilities of Surety.

\*\*\*\*\*

Affix Acknowledgments and Justification of Sureties.





**Travelers Casualty and Surety Company of America  
Travelers Casualty and Surety Company  
St. Paul Fire and Marine Insurance Company**

**POWER OF ATTORNEY**

**KNOW ALL MEN BY THESE PRESENTS:** That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **Susan Lupski of Unlondale, New York**, their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

**IN WITNESS WHEREOF**, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this **3rd day of February, 2017**.



State of Connecticut

City of Hartford ss.

By: \_\_\_\_\_

*Robert L. Raney*  
Robert L. Raney, Senior Vice President

On this the **3rd day of February, 2017**, before me personally appeared **Robert L. Raney**, who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

**In Witness Whereof**, I hereunto set my hand and official seal.

My Commission expires the **30th day of June, 2021**



*Marie C. Tetreault*  
Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

**RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

**FURTHER RESOLVED**, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

**FURTHER RESOLVED**, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

**FURTHER RESOLVED**, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, **Kevin E. Hughes**, the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this **5th** day of **May**, **2021**



*Kevin E. Hughes*  
Kevin E. Hughes, Assistant Secretary

**To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.  
Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.**

ACKNOWLEDGEMENT OF SURETY COMPANY

STATE OF NEW YORK

COUNTY OF NASSAU

On this May 5, 2021, before me personally came  
Susan Lupski to me known, who, being by me duly sworn,  
did depose and say; that he/she resides in Nassau County, State of New York that  
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the corporation described in which executed the above instrument; that he/she knows the seal of said  
corporation; that the seal affixed to said instrument is such corporate seal; that is was so affixed by the  
Board of Directors of said corporation; and that he/she signed his/her name thereto by like order; and  
the affiant did further depose and say that the Superintendent of Insurance of the State of New York,  
has, pursuant to Section 1111 of the Insurance Law of the State of New York, issued to  
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his/her certificate of qualification evidencing the qualification of said Company and its sufficiency under  
any law of the State of New York as surety and guarantor, and the propriety of accepting and approving  
it as such; and that such Certificate has not been revoked.



Notary Public

Grace Ackerson  
Notary Public, State of New York  
No. 01AC6111590  
Qualified in Nassau County  
Commission Expires 6/14/2024



TRAVELERS CASUALTY AND SURETY COMPANY OF AMERICA

HARTFORD, CONNECTICUT 06183

FINANCIAL STATEMENT AS OF DECEMBER 31, 2020

CAPITAL STOCK \$ 6,480,000

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		PAID IN SURPLUS	433,803,760
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TOTAL ASSETS	\$ 4,625,889,627	TOTAL LIABILITIES & SURPLUS	\$4,625,889,627

STATE OF CONNECTICUT )  
COUNTY OF HARTFORD ) SS.  
CITY OF HARTFORD )

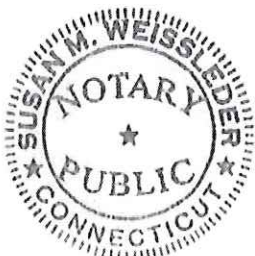
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*Michael J. Doody*  
VICE PRESIDENT - FINANCE

SUBSCRIBED AND SWORN TO BEFORE ME THIS  
26TH DAY OF MARCH, 2021

*Susan M. Weissleder*  
NOTARY PUBLIC

SUSAN M. WEISSLEDER  
Notary Public  
My Commission Expires November 30, 2022





# CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

5/6/2021

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must have **ADDITIONAL INSURED** provisions or be endorsed. If **SUBROGATION** IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

<b>PRODUCER</b> Alliant Insurance Services, Inc. 333 Earle Ovington Blvd. Suite 700 Uniondale NY 11553	<b>CONTACT NAME:</b> Melissa Gallo <b>PHONE (A/C. No. Ext):</b> (516) 414-8610 <b>E-MAIL ADDRESS:</b> MGallo@alliant.com <b>FAX (A/C. No):</b> 877-308-1070														
<b>INSURED</b> Citnalta Construction Corp. 1601 Locust Avenue Bohemia NY 11716	<table><tr><th>INSURER(S) AFFORDING COVERAGE</th><th>NAIC #</th></tr><tr><td>INSURER A : Travelers Indemnity Company</td><td>25658</td></tr><tr><td>INSURER B : Phoenix Insurance Company</td><td>25623</td></tr><tr><td>INSURER C : Starr Indemnity &amp; Liability Co</td><td>38318</td></tr><tr><td>INSURER D : Navigators Insurance Company</td><td>42307</td></tr><tr><td>INSURER E :</td><td></td></tr><tr><td>INSURER F :</td><td></td></tr></table>	INSURER(S) AFFORDING COVERAGE	NAIC #	INSURER A : Travelers Indemnity Company	25658	INSURER B : Phoenix Insurance Company	25623	INSURER C : Starr Indemnity & Liability Co	38318	INSURER D : Navigators Insurance Company	42307	INSURER E :		INSURER F :	
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INSURER F :															

**COVERAGES****CERTIFICATE NUMBER:** 1279213294**REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	<input checked="" type="checkbox"/> <b>COMMERCIAL GENERAL LIABILITY</b> <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input checked="" type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC OTHER:	Y	Y	DT-CO-3968R185-IND-20	6/29/2020	6/29/2021	EACH OCCURRENCE \$ 2,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 300,000 MED EXP (Any one person) \$ 10,000 PERSONAL & ADV INJURY \$ 2,000,000 GENERAL AGGREGATE \$ 4,000,000 PRODUCTS - COMP/OP AGG \$ 4,000,000 \$
B	<input checked="" type="checkbox"/> <b>AUTOMOBILE LIABILITY</b> <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> OWNED AUTOS ONLY <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS ONLY <input checked="" type="checkbox"/> NON-OWNED AUTOS ONLY	Y	Y	810-1N393429-20-26-G	6/29/2020	6/29/2021	COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000 BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE (Per accident) \$ \$
C	<input type="checkbox"/> <b>UMBRELLA LIAB</b> <input checked="" type="checkbox"/> OCCUR <input checked="" type="checkbox"/> <b>EXCESS LIAB</b> <input type="checkbox"/> CLAIMS-MADE DED RETENTION \$	Y	Y	1000585152201	6/29/2020	6/29/2021	EACH OCCURRENCE \$ 3,000,000 AGGREGATE \$ 3,000,000 \$
	<b>WORKERS COMPENSATION AND EMPLOYERS' LIABILITY</b> ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N	N/A				PER STATUTE OTH-ER E.L. EACH ACCIDENT \$ E.L. DISEASE - EA EMPLOYEE \$ E.L. DISEASE - POLICY LIMIT \$
D	Excess Liability	Y	Y	IS20EXC841648IV	6/29/2020	6/29/2021	Occurrence/Aggregate \$7,000,000

**DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)**

RE: Project ID# PO002-116; 116th Precinct Station House; Project Location: 244-04 NORTH CONDUIT AVENUE, QUEENS, NY 11422

The City of New York Department of Design and Construction, City of New York, including its officials and employees, The Long Island Railroad (LIRR), Metropolitan Transportation Authority (MTA), its subsidiaries and affiliated companies is included as Additional Insureds on a Primary and Non-Contributory basis as required by written contract as respects General Liability, Automobile Liability and Excess Liability as required by written contract. Waiver of Subrogation is included and applies in favor of the additional insureds as required by written contract.

**CERTIFICATE HOLDER****CANCELLATION**

THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS  
30-30 Thomson Ave.  
Long Island City NY 11101

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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**CITY OF NEW YORK**  
**CERTIFICATION BY INSURANCE BROKER OR AGENT**

The undersigned insurance broker or agent represents to the City of New York that the attached Certificate of Insurance is accurate in all material respects.

Alliant Insurance Serices, Inc.  
[Name of broker or agent (typewritten)]

333 Earle Ovington Blvd., Ste. 700, Uniondale, NY 11553  
[Address of broker or agent (typewritten)]

lauren.blackmore@alliant.com  
[Email address of broker or agent (typewritten)]

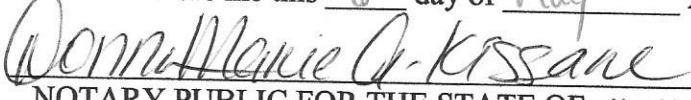
516-414-8279/877-308-1070  
[Phone number/Fax number of broker or agent (typewritten)]

  
[Signature of authorized official, broker, or agent]

Lauren Blackmore-Account Representative  
[Name and title of authorized official, broker, or agent (typewritten)]

State of ..... New York .....)  
County of ..... Nassau ..... ) ss.:

Sworn to before me this 6<sup>th</sup> day of May 2021

  
NOTARY PUBLIC FOR THE STATE OF New York

DONNAMARIE A. KISSANE  
Notary Public-State of New York  
No. 01K16297783  
Qualified in Nassau County  
Commission Expires March 3, 2022

**May 10, 2021**

Melissa Gallo  
Alliant Insurance Services Inc. - Uniondale, NY  
333 Earle Ovington Blvd  
Suite 700  
Uniondale, NY 11553

We are pleased to provide you with the following binder. The issuing company providing the coverage bound herein is **Fair American Insurance and Reinsurance Company**, an admitted carrier. The limits, coverages, terms and conditions of this binder may vary from the specifications submitted for our consideration and the specifications of your expiring policy. Please read this binder carefully, as any terms and conditions that are not specifically mentioned below are not included.

This binder is provided on the basis that all of the information and data given to the Insurer by or on behalf of the Insured in its underwriting submission and in its responses to underwriters' requests for information is reliable, truthful and complete. Any misrepresentation voids this binder.

**New Railroad Protective Liability Binder**  
**Policy Number RPL-7000396-00**

**Issuing Company:**

Fair American Insurance and Reinsurance Company

**Coverage:**

Railroad Protective Liability

**Name Insured:**

The City of New York (as Owner) and all other indemnified parties & The Long Island Railroad (LIRR), Metropolitan Transportation Authority (MTA), its subsidiaries and affiliated companies, the City of New York and all other indemnified parties  
2 Broadway, New York, NY 10004

**Policy Period:**

**Inception Date:** 5/5/2021

**Expiration Date:** 5/5/2024

**Job Location:**

244-04 North Conduit Ave.  
Queens, NY 11422

**Designated Contract Number:**

244-04 North Conduit Ave.

**Description of Work:**

Construction of new 116th Precinct Station House

**Designated Contractor:**

Citnalta Construction Corp.

**Designated Contractor's Mailing Address:**

1601 Locust Ave.  
Bohemia, NY 11716

**Governmental Authority or Other Contracting Party:**

New York City Department of Design and Construction

**Governmental Authority or Other Contracting Party's Mailing Address**

3030 Thomson Ave.  
Long Island City, NY 11101

**Each Occurrence Limit:**

\$2,000,000

**Aggregate Limit:**

\$6,000,000

**Rate:**

FLAT



**Premium:**

**Advance Premium (fully earned at inception):**

**TRIA Premium, if accepted:**

**Taxes:**

**Total Due:**

**This quote can only be bound if all of the following conditions are met.**

**Conditions:**

The contract's General Liability Program and Excess General Liability Program must have a combined occurrence limit equal to or greater than the occurrence limit stated above.

The railroad named above must be added as an additional insured on the contractor's General Liability Policy and Excess General Liability Policy.

Any exclusion for work performed within 50 feet of the railroad must be deleted from the contractor's General Liability Policy and Excess General Liability Policy.

The contract must hold harmless the railroad named above.

Evidence, in the form of insurance certificates or copies of relevant contracts, must be produced prior to binding.

**This quote can only be bound if all of the information outlined below has been received and is found to be acceptable upon our review.**

**Subjectivities:**

**Forms:**

Advisory Notice - Economic and Trade Sanctions U.S. Department of the Treasury Office of Foreign Assets Control (OFAC) FA-GP-114-A CW 06-2014

Notice of Producer Compensation Disclosure FA-GP-113-C CW 05-2019

Disclosure of Information Pursuant to the Terrorism Risk Insurance Act FA-GP-118-B CW 05-2020

Railroad Protective Liability Declarations FA-RRP-909-A-NY 12-2018

Notice – In Witness Clause FA-GP-104-B CW 08-2020

Railroad Protective Liability Coverage Form CG 00 35 04 13

Cap On Losses From Certified Acts of Terrorism CG 21 70 01 15

New York Changes - Railroad Protective Liability Coverage Form CG 26 15 04 09

New York Changes - Transfer of Duties When a Limit of Insurance Is Used Up CG 26 36 12 93

New York Changes - Cancellation and Nonrenewal CG 28 68 01 14

Nuclear Energy Liability Exclusion Endorsement (Broad Form) IL 00 23 07 02

Knowledge and Notice of Occurrence Endorsement FA-RRP-904-A-CW 11-2018

Physical Damage to Property Definition Amendment FA-RRP-906-A-CW 11-2018

Absolute Asbestos Exclusion FA-RRP-907-A-CW 11-2018

Absolute Lead Exclusion FA-RRP-908-A-CW 11-2018

Claims Reporting Endorsement FA-RRP-915-A-CW 04-2019

We thank you for placing your trust in us.

Your Balance Partners, LLC Underwriting Team

Balance Partners, LLC



# Project Specific Builders Risk Binder for:

Citnalta Construction Corp.

1601 Locust Ave  
Bohemia, NY 11716-2162

**Policy Term**  
May 05, 2021 – May 05, 2024

Submitted to  
Shirley Quan  
CRC INSURANCE SERVICES INC

**Binder release date**  
May 6, 2021

Zurich HelpPoint  
Here to help your world.

If you want to learn more about the compensation Zurich pays agents and brokers visit:  
<http://www.zurichnaproducercompensation.com> or call the following toll-free number: (866) 903-1192. This  
Notice is provided on behalf of Zurich American Insurance Company and its underwriting subsidiaries.



# Zurich Project Specific Builders Risk Program

Binder for Coverage

Date of Authorization: May 6, 2021

<b>To:</b>	Shirley Quan		
<b>Company:</b>	CRC INSURANCE SERVICES INC	<b>Total # Pages:</b>	12
<b>Tel:</b>	415.951.8480		
<b>E-mail:</b>	squan@crcgroup.com		
<b>Referenced Project:</b>	Citnalta Construction Corp. - 116th St Precinct- IM 1384035-00		

Based on your submission, we are pleased to offer the following terms subject to the additional Underwriting Information outlined at the conclusion of this letter. These terms are valid until June 19, 2021 and may only be extended in writing by the Company. Any extension or reinstatement of these terms, whether prior to or after the date stated, will be subject to the Company's review and re-confirmation of all terms and conditions expressed herein as well as the Company's ability to retain facultative reinsurance commitments, as applicable.

**Insuring Company:** Zurich American Insurance Company (A.M. Best rated A+/stable)

**Policy Form:** Zurich Completed Value Builders Risk Coverage Form

**Named Insured and Mailing Address:**

Citnalta Construction Corp.  
1601 Locust Ave  
Bohemia, NY 11716-2162

**Additional Insureds:**

Owners, contractors and subcontractors, tenants at the "project site", architects and engineers, all as required by any written contract or written subcontract made prior to the date of loss or damage to the Covered Property, and including any other entity as required by the first Named Insured and then only as to their respective financial interest in the Covered Property, are included as Additional Insureds under this Policy. As respects manufacturers and suppliers, their interest is limited to their respective financial interest in the Covered Property at the "project site" only.

**Mortgage Holders and Lender's Loss Payees:**

**Name and Mailing Address**

1. The City of New York  
Department of Design & Construction  
30-30 Thomson Ave
2. Long Island City NY 11101

**Interest**

- ☐ Mortgage Holder/Lender's Loss Payee
- ☐ Loss Payee
- ☐ Mortgage Holder/Lender's Loss Payee
- ☒ Loss Payee & AI

If not scheduled above, Mortgage Holders, Lender's Loss Payees or Loss Payees will be shown as per Schedule on file with the Company. Payment of any loss under this Policy shall be done in accordance with the terms stated within the **Zurich Completed Value Builders Risk General Conditions**.

**Policy Term of Insurance:**

From: May 05, 2021 To: May 05, 2024 12:01 A.M. at the mailing address of the Named Insured.

**Policy Territory:**

The United States of America (including its territories and possessions) and Puerto Rico. The territory is expanded to include Canada when property in transit via land and extended worldwide for property in transit when transported by aircraft and as more further stated within the **Zurich Completed Values Builders Risk General Conditions**.

**Project Site:**

244-04 North Conduit Ave  
Bohemia, NY 11422

**Project Details:** (Including description & Project Name or Contract Number as applicable)

Construction of 47,214 square ft 116<sup>th</sup> Precinct Station House adjacent to existing 105<sup>th</sup> Precinct annex. Building is 2 story, steel frame, metal deck with precast panel façade. Building will have a basement along with parking facilities and fueling stations. There is also a new public open space with access to the LIRR.

**Excluded Property and Work:** [Not Applicable]**Estimated Project Premium & Deposit Premium:**

	Rating Base	Annual Rate	Length of Policy Term	Deposit Premium
<b>Builders Risk Property</b>	<b>\$78,057,574</b>		<b>3.000 years</b>	
<b>Terrorism</b>	<b>\$78,057,574</b>		<b>3.000 years</b>	
<b>Local &amp; State Assessments, Taxes or Surcharges</b>				
<b>Total Deposit Premium</b>				
<b>Minimum and Earned Premium</b>				<b>50%</b>

**Commission:** 10%

**Premium Adjustment:**

If the final "total project value" varies by more than 5% of the estimated "total project value" declared at Policy inception, the final earned premium for this Policy will be calculated by applying the applicable rates shown on the Declarations for Estimated Project Premium for the actual term of coverage to the final "total project value". Based on the difference between the Total Deposit Premium and the final earned premium, the Company will charge additional premium or return any excess premium, subject to the minimum and earned premium shown on the Declarations. Any additional or return premium of \$250 or less will be waived.

If the final "total project value" varies by 5% or less of the estimated "total project value" declared at Policy inception, no premium adjustments will be made. The Total Deposit Premium will be considered the final earned premium.

**Total Project Value:**

<u>\$</u>	<u>78,057,574</u>	Complete cost of the "insured project", including materials and labor costs for the "insured project", "general conditions expense", construction management fees and contractor's profit and overhead; plus
<u>\$</u>	<u>0</u>	Value of all other property, not included above, that is part of the "insured project" and owned by others, for which the Insured has assumed responsibility; plus
<u>\$</u>		"Temporary works" not included above.
<u>\$</u>	<u>78,057,574</u>	Total estimated "total project value".

**Participation:**

This Binder is for 100% interest in the 100% Policy Limit of Liability, Sublimits of Liability, Annual Aggregates and Premium as herein specified.

**Limits of Liability:**

The applicable Limit of Liability for any specific coverage or Coverage Extension is the most we will pay for that coverage or Coverage Extension. If 'NCP' is shown, then no coverage is provided for that coverage.

**Policy Limit of Liability** \$ 78,057,574 Per "occurrence"

**Builders Risk Property Limits of Liability**

<b>Project Site</b>	<b>\$</b>	<b><u>78,057,574</u></b>	Per "occurrence"
Escalation Clause – Insured Project		<u>5</u>	%
Transit	<b>\$</b>	<b><u>2,000,000</u></b>	Per "occurrence"
"Temporary Offsite Location"	<b>\$</b>	<b><u>2,000,000</u></b>	Per Location
"Water Damage"	<b>\$</b>	<b><u>78,057,574</u></b>	Per "occurrence"

**Delay In Completion Aggregate Limit of Liability** \$ NCP Aggregate

**As respect Delay in Completion, the Named Insured is as follows:**

**Named Insured**  
[Named Insured Addr]  
[City, State Zip]

**Anticipated Date of Completion** **NCP**

**Period of Indemnity** **NCP** Days

**Gross Earnings** \$ NCP per "occurrence" and in the aggregate

☐ Monthly Limitation applies at \$        per Month

**Rental Income** \$ NCP per "occurrence and in the aggregate

☐ Monthly Limitation applies at \$        per Month

**Soft Costs** \$ NCP per "occurrence" and in the aggregate

**Additional Interest and Financing Expense** \$ NCP per "occurrence" and in the aggregate

**Coverage Extensions:**

The Coverage Extensions Limits of Liability shown below apply as per "occurrence", unless stated otherwise. These Coverage Extension Limits of Liability are subject to, the Policy Limit of Liability. If 'NCP' is shown under the Limits of Liability for a Coverage Extension, then no coverage is provided for that Coverage Extension.

	<b>Limits of Liability</b>	
Claim Preparation Expense	\$	<b>50,000</b>
Construction Documentation And Records	\$	<b>500,000</b>
Construction Trailers	\$	<b>100,000</b>
Contract Penalties	\$	<b>100,000</b>
Contractor Expenses - <b>20%</b> of the amount of covered loss of or damage to "builders risk property", prior to the application of any applicable Deductible, up to the Limit of Liability of :	\$	<b>1,000,000</b>
Crane Re-Erection Expense	\$	<b>50,000</b>
Damage to Existing Real Property - Limited	\$	<b>Not Covered</b>
Debris Removal – <b>25%</b> of the amount of covered loss of or damage to Covered Property, prior to the application of any applicable Deductible, up to the Limit of Liability of:	\$	<b>2,000,000</b>
Design Professional Fees	\$	<b>1,000,000</b>
Emergency Property Protection Expense – Annual Aggregate	\$	<b>200,000</b>
Fire Protective Equipment Refills	\$	<b>250,000</b>
Off Premises Service Interruption – Direct Damage	\$	<b>200,000</b>
Ordinance or Law – Demolition and Increase Cost of Construction	\$	<b>2,000,000</b>
Ordinance or Law – Undamaged Portion of the Insured Project	Included in Project Site Limit of Liability	
Pollutant Clean-Up and Decontamination – Policy Aggregate	\$	<b>200,000</b>
Prevention of Access – Ingress or Egress	\$	<b>200,000</b>
Protection Service Charges	\$	<b>250,000</b>
Reward Payments – 25% of the amount of covered loss of or damage to Covered Property, prior to the application of any applicable Deductible, up to the Limit of Liability of	\$	<b>50,000</b>
Spare Construction Materials	\$	<b>500,000</b>

As respect to **Delay in Completion Coverage**, the following shall apply per "occurrence":

Civil Authority	\$	<b>NCP</b>	Number of Days: <b>NCP</b>
Ingress or Egress	\$	<b>NCP</b>	Number of Days: <b>NCP</b>
Ordinance and Law	Included		
Additional Soft Costs:	<b>[None]</b>		

### Catastrophe Limits of Liability:

With respect to the Causes of Loss below, the most the Company will pay for all loss of or damage to Covered Property in any one "occurrence" and as an Annual Aggregate are the following Limits of Liability. These Limits of Liability are subject to, the Policy Limit of Liability. If 'NCP' is shown under the Limit of Liability for any of these Causes of Loss, then no coverage is provided for that Cause of Loss.

	Limits of Liability
"Earthquake"	\$ <u>78,057,574</u>
"Flood"	\$ <u>78,057,574</u>
"Named Storm"	\$ <u>78,057,574</u>

☐ If checked, the Annual Aggregate Limit of Liability does not apply to "named storm".

### Deductibles:

#### Builders Risk Property:

The following deductibles apply in any one "occurrence":

\$ <u>50,000</u>	Physical loss of or damage to Covered Property, unless otherwise shown below.
\$ <u>150,000</u>	as respects "water damage";
\$ <u>50,000</u>	0.00 % as respects "earthquake";
\$ <u>100,000</u>	0.00 % as respects "flood";
\$ <u>100,000</u>	2.00 % as respects "named storm";

#### Delay in Completion: - No Coverage Provided

The following Waiting Period applies in any one "occurrence" for all coverage provided under this endorsement:

<u>NCP</u>	Days	unless specifically noted below:
<u>NCP</u>	Days	as respects "Soft Costs"
<u>NCP</u>	Days	as respects "earthquake"
<u>NCP</u>	Days	as respects "flood";
<u>NCP</u>	Days	as respects "named storm";
<u>NCP</u>	Days	as respects "hot testing"

In the event that more than one deductible shown above or specified in any endorsement shall apply to insured physical loss of or damage to Covered Property in any one occurrence, only the largest shall be applied.

If Delay In Completion Coverage is provided, the **Deductible Period(s)** stated below will always be applied in addition to any dollar deductible stated for physical damage.

### Insuring Agreement:

Subject to the terms, exclusions, limitations and conditions, the Company will pay for direct physical loss of or damage to "builders risk property" caused by a "covered cause of loss" while such "builders risk property" is (1) at the "project site"; (2) In transit; or (3) at a "temporary offsite location".

### Covered Property:

**Property under construction** means materials and supplies, fill, backfill or fill additives, equipment and machinery, furniture and fixtures, electronic hardware and software and other property as included in the written construction contract that is intended to become a permanent part of the insured project.

**Landscaping materials** means trees, plants, shrubs, grass, lawns, and other landscaping materials to be installed and made a permanent part of the insured project, including those incorporated into any vegetative roof or wall systems. It does not mean such materials that existed at the project site prior to the start of the insured project.

**Temporary works** means installations or engineered solutions used in the course of construction to provide access, protection, support or services to the Insured at the insured project and temporary service, repair or support for the insured project until the permanent works have achieved a state of completion allowing the temporary service, repair or support to be removed and as more explained in the policy coverage form.

**Property Excluded:**

Land, Land Values and cut, water, vehicles licensed for highway use, rolling stock, aircraft or watercraft, existing property (unless specifically endorsed), contractor's plant & equipment, prototypical or used equipment as respects testing, property located at other than the project site except while in transit or temporary offsite locations, and others per policy form

**Exclusions:**

Government Action; Nuclear Hazard; War and Military Action; Consequential Loss; Cost of Correcting or Making Good faulty or defective workmanship or material, or error/omission/deficiency In design, plans or specifications (Resultant Damage covered); Wear & tear, gradual deterioration, inherent vice (Resultant Damage covered); disappearance or shortage disclosed on taking inventory; Employee dishonesty, fraud & infidelity; Pollution; Fungus; Normal subsidence & settling; Disease & infestation as respects landscaping materials; Electronic vandalism, defects or errors; and others per policy form.

**Terrorism:**

Terrorism is offered as an option and depending on whether or not elected as well as which options are elected, a Terrorism Exclusion may apply as well.

**Coverage Extensions:**

Claim preparation expense, construction documentation and records, construction trailers, contract penalties (applies to general contractor's only), contractor expenses (inclusive of extra expense, expediting expense and general conditions expense), crane re-erection expense, damage to existing real property - limited, debris removal, design professional fees, emergency property protection expense, fire protective equipment refills, off premises service interruption – direct damage, ordinance or law, pollutant clean-up and decontamination, prevention of access – ingress or egress, protection service charges, reward payments and spare construction materials.

**Attaching Endorsements:**

**Terrorism Coverage:**

See attached Disclosure Notice (U-GU-632-D). Terrorism Coverage is provided at your option in accordance with the extension of the Terrorism Risk Insurance Act of 2002, as amended. If you elect not to buy this coverage, the premium will be deleted and a Terrorism Exclusion will be attached to your policy. *If you would prefer an alternate quotation for a sub-limit for this coverage( when allowed by state where project is domiciled), less than the full Policy limit of liability offered or a deductible larger than the All Other Perils deductible stated above, please advise accordingly and our Binder and premium will be adjusted accordingly.*

**Conditions:**

1. Zurich has prepared this Binder in response to your submission requesting insurance coverage for specific lines of business. This Binder is based on your submission; however our terms and conditions may be different than your original request. In the event you subsequently request a Binder that differs from a prior submission, Zurich reserves the right to review and revise the terms and pricing of this Binder.
2. All Local and State Assessments, taxes or surcharges beyond the policy premium are the responsibility of the Insured and maybe subject to change per State Requirements.



## **OTHER COVERAGE TERMS AND CONDITIONS**

### **Permission to Occupy:**

The policy does not limit coverage during occupancy unless otherwise excluded or limited as stated above in the endorsement section (if applicable).

### **Extension of Term of Insurance:**

With notification to, and agreement by, the Company prior to the expiration date of this Policy, the Policy Term may be extended for 90 days or less based on the rates stated on the Declarations, with the exception of the perils of "earthquake", "flood" and "named storm", which may be subject to different rates, deductibles, limits, terms and conditions determined by the Company at the time of the Company's agreement to the extension.

Any extensions for more than 90 days beyond the original Policy Term expiration date will be subject to payment of additional premiums at rates, deductibles, limits, terms and conditions determined by the Company at the time of the Company's agreement to the extension.

**Cancellation:** 60 Days except 10 Days for nonpayment of premium

**Valuation:** Refer to Policy

## **BINDER CONSIDERATIONS / COMMENTS**

1. Zurich shall have the right to inspect property and operations at any reasonable time. Insured agrees to comply with any reasonable Risk Engineering recommendations to avoid a loss.
2. ADDENDUM A (*attached below*) states the additional information that Zurich will require to provide a binding Binder.

## **COVERAGE IS NOT CONTEMPLATED UNLESS SPECIFICALLY ADDRESSED IN THE ABOVE BINDER**

Thank you for the opportunity for Zurich to be of service to your customer. Should you have any questions please do not hesitate to ask.

## CERTIFICATE OF WORKERS' COMPENSATION INSURANCE



SCAN TO VALIDATE  
AND SUBSCRIBE

\*\*\*\*\* 112455116  
GCG RISK MANAGEMENT INC  
100 CHURCH STREET-SUITE 810  
NEW YORK NY 10007

<b>POLICYHOLDER</b> CITNALTA CONSTRUCTION CORP 1601 LOCUST AVENUE BOHEMIA NY 117162162		<b>CERTIFICATE HOLDER</b> THE CITY OF NEW YORK DEPART- MENT OF DESIGN & CONSTRUCTION 30-30 THOMSON AVNUE LONG ISLAND CITY NY 11101	
<b>POLICY NUMBER</b> Z 827 431-8	<b>CERTIFICATE NUMBER</b> 508463	<b>POLICY PERIOD</b> 12/01/2020 TO 12/01/2021	<b>DATE</b> 5/10/2021

THIS IS TO CERTIFY THAT THE POLICYHOLDER NAMED ABOVE IS INSURED WITH THE NEW YORK STATE INSURANCE FUND UNDER POLICY NO. 827 431-8, COVERING THE ENTIRE OBLIGATION OF THIS POLICYHOLDER FOR WORKERS' COMPENSATION UNDER THE NEW YORK WORKERS' COMPENSATION LAW WITH RESPECT TO ALL OPERATIONS IN THE STATE OF NEW YORK, EXCEPT AS INDICATED BELOW.

**IF YOU WISH TO RECEIVE NOTIFICATIONS REGARDING SAID POLICY, INCLUDING ANY NOTIFICATION OF CANCELLATIONS, OR TO VALIDATE THIS CERTIFICATE, VISIT OUR WEBSITE AT [HTTPS://WWW.NYSIF.COM/CERT/CERTVAL.ASP](https://www.nysif.com/cert/certval.asp). THE NEW YORK STATE INSURANCE FUND IS NOT LIABLE IN THE EVENT OF FAILURE TO GIVE SUCH NOTIFICATIONS.**

THIS CERTIFICATE DOES NOT APPLY TO THOSE JOB SITES WHICH ARE COVERED BY OTHER INSURANCE AND ARE SPECIFICALLY EXCLUDED BY ENDORSEMENT.

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS NOR INSURANCE COVERAGE UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICY.

BY CAUSING THIS CERTIFICATE TO BE ISSUED TO THE CERTIFICATE HOLDER, THE POLICYHOLDER UNDERTAKES TO PROVIDE THE CERTIFICATE HOLDER 30 CALENDAR DAYS' NOTICE OF ANY CANCELLATION OF THE POLICY.

NEW YORK STATE INSURANCE FUND



DIRECTOR, INSURANCE FUND UNDERWRITING

VALIDATION NUMBER: 651561274

# CERTIFICATE OF INSURANCE COVERAGE

## DISABILITY AND PAID FAMILY LEAVE BENEFITS LAW

### PART 1. To be completed by Disability and Paid Family Leave Benefits Carrier or Licensed Insurance Agent of that Carrier

<p>1a. Legal Name &amp; Address of Insured (use street address only)  <b>CITNALTA CONSTRUCTION CORP</b></p> <p><b>1601 LOCUST AVENUE</b>  <b>BOHEMIA, NY 11716</b></p> <p><small>Work Location of Insured (Only required if coverage is specifically limited to certain locations in New York State, i.e., Wrap-Up Policy)</small></p>	<p>1b. Business Telephone Number of Insured  <b>631-563-1110</b></p> <p>1c. Federal Employer Identification Number of Insured          or Social Security Number  <b>112455116</b></p>
<p>2. Name and Address of Entity Requesting Proof of Coverage          (Entity Being Listed as the Certificate Holder)  <b>THE CITY OF NY DEPT OF DESIGN</b>  <b>&amp; CONSTRUCTION DIV OF PUBLIC</b>  <b>BLDGS 30-30 THOMSON AVENUE</b>  <b>LONG ISLAND CITY, NY 11101-3045</b></p>	<p>3a. Name of Insurance Carrier  <b>ShelterPoint Life Insurance Company</b></p> <p>3b. Policy Number of Entity Listed in Box "1a"  <b>DBL587430</b></p> <p>3c. Policy effective period  <b>01/01/2021</b> to <b>12/31/2021</b></p>

4. Policy provides the following benefits:

☒ A. Both disability and paid family leave benefits.

☐ B. Disability benefits only.

☐ C. Paid family leave benefits only.

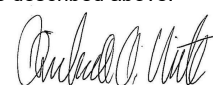
5. Policy covers:

☒ A. All of the employer's employees eligible under the NYS Disability and Paid Family Leave Benefits Law.

☐ B. Only the following class or classes of employer's employees:

\_\_\_\_\_

Under penalty of perjury, I certify that I am an authorized representative or licensed agent of the insurance carrier referenced above and that the named insured has NYS Disability and/or Paid Family Leave Benefits insurance coverage as described above.

Date Signed 5/10/2021 By   
(Signature of insurance carrier's authorized representative or NYS Licensed Insurance Agent of that insurance carrier)

Telephone Number 516-829-8100 Name and Title Richard White, Chief Executive Officer

**IMPORTANT:** If Boxes 4A and 5A are checked, and this form is signed by the insurance carrier's authorized representative or NYS Licensed Insurance Agent of that carrier, this certificate is COMPLETE. Mail it directly to the certificate holder.

If Box 4B, 4C or 5B is checked, this certificate is NOT COMPLETE for purposes of Section 220, Subd. 8 of the NYS Disability and Paid Family Leave Benefits Law. It must be mailed for completion to the Workers' Compensation Board, Plans Acceptance Unit, PO Box 5200, Binghamton, NY 13902-5200.

### PART 2. To be completed by the NYS Workers' Compensation Board (Only if Box 4C or 5B of Part 1 has been checked)

**State of New York**

**Workers' Compensation Board**

According to information maintained by the NYS Workers' Compensation Board, the above-named employer has complied with the NYS Disability and Paid Family Leave Benefits Law with respect to all of his/her employees.

Date Signed \_\_\_\_\_ By \_\_\_\_\_  
(Signature of Authorized NYS Workers' Compensation Board Employee)

Telephone Number \_\_\_\_\_ Name and Title \_\_\_\_\_

**Please Note:** Only insurance carriers licensed to write NYS disability and paid family leave benefits insurance policies and NYS licensed insurance agents of those insurance carriers are authorized to issue Form DB-120.1. **Insurance brokers are NOT authorized to issue this form.**



**OFFICE OF THE COMPTROLLER**

**CITY OF NEW YORK**

**CONSTRUCTION APPRENTICE  
PREVAILING WAGE SCHEDULE**

Pursuant to Labor Law § 220 (3-e), only apprentices who are individually registered in a bona fide program to which the employer contractor is a participant and registered with the New York State Department of Labor, may be paid at the apprentice rates in this schedule. Apprentices who are not so registered must be paid as journey persons in accordance with the trade classification of the work they actually performed.

Apprentice ratios are established to ensure the proper safety, training and supervision of apprentices. A ratio establishes the number of journey workers required for each apprentice in a program and on a job site. Ratios are interpreted as follows: in the case of a 1:1, 1:4 ratio, there must be one journey worker for the first apprentice, and four additional journey workers for each subsequent apprentice.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

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OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

## **BOILERMAKER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

### **Boilermaker (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 65% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$31.76

### **Boilermaker (Second Year: 1st Six Months)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 70% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$33.59

### **Boilermaker (Second Year: 2nd Six Months)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 75% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$35.43

### **Boilermaker (Third Year: 1st Six Months)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$37.25

### **Boilermaker (Third Year: 2nd Six Months)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 85% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$39.08

### **Boilermaker (Fourth Year: 1st Six Months)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 90% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$40.93

### **Boilermaker (Fourth Year: 2nd Six Months)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 95% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$42.75

(Local #5)

## **BRICKLAYER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)

### **Bricklayer (First 750 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.61

### **Bricklayer (Second 750 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 60% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.61

### **Bricklayer (Third 750 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 70% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.61

### **Bricklayer (Fourth 750 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.61

### **Bricklayer (Fifth 750 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 90% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.61

### **Bricklayer (Sixth 750 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 95% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.61

(Bricklayer District Council)

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OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

## **CARPENTER**

**Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)**

### **Carpenter (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 40% of Journeyperson's rate

Supplemental Benefit Rate Per Hour For Building Apprentice: \$31.44

Supplemental Benefit Rate Per Hour For Heavy Apprentice: \$33.49

### **Carpenter (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Rate Per Hour For Building Apprentice: \$31.44

Supplemental Benefit Rate Per Hour For Heavy Apprentice: \$33.49

### **Carpenter (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 65% of Journeyperson's rate

Supplemental Benefit Rate Per Hour For Building Apprentice: \$31.44

Supplemental Benefit Rate Per Hour For Heavy Apprentice: \$33.49

### **Carpenter (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Benefit Rate Per Hour For Building Apprentice: \$31.44

Supplemental Benefit Rate Per Hour For Heavy Apprentice: \$33.49

(Carpenters District Council)

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## **CARPENTER - HIGH RISE CONCRETE FORMS**

**(Ratio of Apprentice to Journeyperson: 1 to 1, 2 to 5)**

### **Carpenter - High Rise (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$17.52

Supplemental Benefit Rate per Hour: \$16.30

### **Carpenter - High Rise (Second Year)**



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$23.95  
Supplemental Benefit Rate per Hour: \$16.43

**Carpenter - High Rise (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$30.53  
Supplemental Benefit Rate per Hour: \$16.56

**Carpenter - High Rise (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$38.15  
Supplemental Benefit Rate per Hour: \$16.71

(Carpenters District Council)

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**CEMENT MASON**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)

**Cement Mason (First Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 50% of Journeyperson's Rate

**Cement Mason (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 60% of Journeyperson's Rate

**Cement Mason (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 70% of Journeyperson's Rate

(Local #780)

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## **CEMENT AND CONCRETE WORKER**

**Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)**

### **Cement & Concrete Worker (First 1333 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.00

### **Cement & Concrete Worker (Second 1333 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 65% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$25.45

### **Cement & Concrete Worker (Last 1334 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$26.95

### **Cement & Concrete Worker (Hired after 2/6/2016 - First 1334 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 53% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$14.04

### **Cement & Concrete Worker (Hired after 2/6/2016 - Second 1334 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 69% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$18.97

### **Cement & Concrete Worker (Hired after 2/6/2016 - Last 1334 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 85% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.05

(Cement Concrete Workers District Council)

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## **DERRICKPERSON & RIGGER (STONE)**

**(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Derrickperson & Rigger (stone) - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: 50% of Journeyperson's rate

**Derrickperson & Rigger (stone) - Second Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 70% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: 75% of Journeyperson's rate

**Derrickperson & Rigger (stone) - Second Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: 75% of Journeyperson's rate

**Derrickperson & Rigger (stone) - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 90% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: 75% of Journeyperson's rate

(Local #197)

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**DOCKBUILDER/PILE DRIVER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 6)

**Dockbuilder/Pile Driver (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 40% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$34.12

**Dockbuilder/Pile Driver (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$34.12

**Dockbuilder/Pile Driver (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Wage Rate Per Hour: 65% of Journeyperson's rate  
Supplemental Benefit Rate Per Hour: \$34.12

**Dockbuilder/Pile Driver (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 80% of Journeyperson's rate  
Supplemental Benefit Rate Per Hour: \$34.12

(Carpenters District Council)

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**ELECTRICIAN**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Electrician (First Term: 0-6 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$15.75  
Supplemental Benefit Rate per Hour: \$14.03  
Overtime Supplemental Rate Per Hour: \$15.07

**Electrician (First Term: 7-12 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$16.25  
Supplemental Benefit Rate per Hour: \$14.28  
Overtime Supplemental Rate Per Hour: \$15.36

**Electrician (Second Term: 0-6 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$17.25  
Supplemental Benefit Rate per Hour: \$14.79  
Overtime Supplemental Rate Per Hour: \$15.94

**Electrician (Second Term: 7-12 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$18.25  
Supplemental Benefit Rate per Hour: \$15.30  
Overtime Supplemental Rate Per Hour: \$16.51

**Electrician (Third Term: 0-6 Months)**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$19.25  
Supplemental Benefit Rate per Hour: \$15.81  
Overtime Supplemental Rate Per Hour: \$17.09

**Electrician (Third Term: 7-12 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$20.25  
Supplemental Benefit Rate per Hour: \$16.32  
Overtime Supplemental Rate Per Hour: \$17.67

**Electrician (Fourth Term: 0-6 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$21.25  
Supplemental Benefit Rate per Hour: \$16.83  
Overtime Supplemental Rate Per Hour: \$18.24

**Electrician (Fourth Term: 7-12 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$23.25  
Supplemental Benefit Rate per Hour: \$17.85  
Overtime Supplemental Rate Per Hour: \$19.39

**Electrician (Fifth Term: 0-12 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$24.50  
Supplemental Benefit Rate per Hour: \$21.07  
Overtime Supplemental Rate Per Hour: \$22.62

**Electrician (Fifth Term: 13-18 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$29.00  
Supplemental Benefit Rate per Hour: \$23.43  
Overtime Supplemental Rate Per Hour: \$25.26

**Overtime Description**

Overtime Wage paid at time and one half the regular rate

(Local #3)

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## **ELEVATOR CONSTRUCTOR**

**Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 2)**

### **Elevator (Constructor) - First Year**

Effective Period: 7/1/2019 - 3/16/2020  
Wage Rate Per Hour: 50% of Journeyperson's rate  
Supplemental Rate Per Hour: \$31.52

Effective Period: 3/17/2020 - 6/30/2020  
Wage Rate Per Hour: 50% of Journeyperson's rate  
Supplemental Rate Per Hour: \$32.14

### **Elevator (Constructor) - Second Year**

Effective Period: 7/1/2019 - 3/16/2020  
Wage Rate Per Hour: 55% of Journeyperson's rate  
Supplemental Rate Per Hour: \$32.03

Effective Period: 3/17/2020 - 6/30/2020  
Wage Rate Per Hour: 55% of Journeyperson's rate  
Supplemental Rate Per Hour: \$32.67

### **Elevator (Constructor) - Third Year**

Effective Period: 7/1/2019 - 3/16/2020  
Wage Rate Per Hour: 65% of Journeyperson's rate  
Supplemental Rate Per Hour: \$33.06

Effective Period: 3/17/2020 - 6/30/2020  
Wage Rate Per Hour: 65% of Journeyperson's rate  
Supplemental Rate Per Hour: \$33.74

### **Elevator (Constructor) - Fourth Year**

Effective Period: 7/1/2019 - 3/16/2020  
Wage Rate Per Hour: 75% of Journeyperson's rate  
Supplemental Rate Per Hour: \$34.08

Effective Period: 3/17/2020 - 6/30/2020  
Wage Rate Per Hour: 75% of Journeyperson's rate  
Supplemental Rate Per Hour: \$34.80

(Local #1)

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## **ELEVATOR REPAIR & MAINTENANCE**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 2)

### **Elevator Service/Modernization Mechanic (First Year)**

Effective Period: 7/1/2019 - 3/16/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Per Hour: \$31.47

Effective Period: 3/17/2020 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Per Hour: \$32.09

### **Elevator Service/Modernization Mechanic (Second Year)**

Effective Period: 7/1/2019 - 3/16/2020

Wage Rate Per Hour: 55% of Journeyperson's rate

Supplemental Benefit Per Hour: \$31.98

Effective Period: 3/17/2020 - 6/30/2020

Wage Rate Per Hour: 55% of Journeyperson's rate

Supplemental Benefit Per Hour: \$32.62

### **Elevator Service/Modernization Mechanic (Third Year)**

Effective Period: 7/1/2019 - 3/16/2020

Wage Rate Per Hour: 65% of Journeyperson's rate

Supplemental Benefit Per Hour: \$32.99

Effective Period: 3/17/2020 - 6/30/2020

Wage Rate Per Hour: 65% of Journeyperson's rate

Supplemental Benefit Per Hour: \$33.67

### **Elevator Service/Modernization Mechanic (Fourth Year)**

Effective Period: 7/1/2019 - 3/16/2020

Wage Rate Per Hour: 75% of Journeyperson's rate

Supplemental Benefit Per Hour: \$34.01

Effective Period: 3/17/2020 - 6/30/2020

Wage Rate Per Hour: 75% of Journeyperson's rate

Supplemental Benefit Per Hour: \$34.73

(Local #1)

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## **ENGINEER**

**Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 5)**

### **Engineer - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$25.38

Supplemental Benefit Rate per Hour: \$26.69

### **Engineer - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$31.72

Supplemental Benefit Rate per Hour: \$26.69

### **Engineer - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$34.89

Supplemental Benefit Rate per Hour: \$26.69

### **Engineer - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$38.06

Supplemental Benefit Rate per Hour: \$26.69

(Local #15)

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## **ENGINEER - OPERATING**

**(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 5)**

### **Operating Engineer - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour 40% of Journeyperson's Rate

Supplemental Benefit Per Hour: \$22.45

### **Operating Engineer - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's Rate



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Supplemental Benefit Per Hour: \$22.45

**Operating Engineer - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 60% of Journeyman's Rate

Supplemental Benefit Per Hour: \$22.45

(Local #14)

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**FLOOR COVERER**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 4)

**Floor Coverer (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 40% of Journeyman's rate

Supplemental Rate Per Hour: \$31.24

**Floor Coverer (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyman's rate

Supplemental Rate Per Hour: \$31.24

**Floor Coverer (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 65% of Journeyman's rate

Supplemental Rate Per Hour: \$31.24

**Floor Coverer (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyman's rate

Supplemental Rate Per Hour: \$31.24

(Carpenters District Council)

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OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**GLAZIER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Glazier (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 40% of Journeyperson's rate

**Glazier (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Glazier (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 60% of Journeyperson's rate

**Glazier (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 80% of Journeyperson's rate

(Local #1281)

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**HAZARDOUS MATERIAL HANDLER**

(Ratio of Apprentice Journeyperson: 1 to 1, 1 to 3)

**Handler (First 1000 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 78% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$14.25

**Handler (Second 1000 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$14.25

**Handler (Third 1000 Hours)**

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Wage Rate Per Hour: 83% of Journeyperson's rate  
Supplemental Benefit Rate Per Hour: \$14.25

**Handler (Fourth 1000 Hours)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 89% of Journeyperson's rate  
Supplemental Benefit Rate Per Hour: \$14.25

(Local #78)

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**HEAT & FROST INSULATOR**  
(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Heat & Frost Insulator (First Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 35% of Journeyperson's rate

**Heat & Frost Insulator (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 45% of Journeyperson's rate

**Heat & Frost Insulator (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 55% of Journeyperson's rate

**Heat & Frost Insulator (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage and Supplemental Rate Per Hour: 65% of Journeyperson's rate

(Local #12)

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**HOUSE WRECKER**  
(TOTAL DEMOLITION)  
(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**House Wrecker - First Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$21.17  
Supplemental Benefit Rate per Hour: \$19.09

**House Wrecker - Second Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$22.32  
Supplemental Benefit Rate per Hour: \$19.09

**House Wrecker - Third Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$23.97  
Supplemental Benefit Rate per Hour: \$19.09

**House Wrecker - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$26.53  
Supplemental Benefit Rate per Hour: \$19.09

(Mason Tenders District Council)

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**IRON WORKER - ORNAMENTAL**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)

**Iron Worker (Ornamental) - 1st Ten Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 50% of Journeyperson's rate  
Supplemental Rate Per Hour: \$40.20

**Iron Worker (Ornamental) - 11 -16 Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 55% of Journeyperson's rate  
Supplemental Rate Per Hour: \$41.44

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Iron Worker (Ornamental) - 17 - 22 Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 60% of Journeyperson's rate  
Supplemental Rate Per Hour: \$42.68

**Iron Worker (Ornamental) - 23 - 28 Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 70% of Journeyperson's rate  
Supplemental Rate Per Hour: \$45.17

**Iron Worker (Ornamental) - 29 - 36 Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 80% of Journeyperson's rate  
Supplemental Rate Per Hour: \$47.65

(Local #580)

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**IRON WORKER - STRUCTURAL**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 6)

**Iron Worker (Structural) - 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$26.62  
Supplemental Benefit Rate per Hour: \$53.09

**Iron Worker (Structural) - 7- 18 Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$27.22  
Supplemental Benefit Rate per Hour: \$53.09

**Iron Worker (Structural) - 19 - 36 months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$27.83  
Supplemental Benefit Rate per Hour: \$53.09

(Local #40 and #361)

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**LABORER (FOUNDATION, CONCRETE, EXCAVATING, STREET PIPE LAYER & COMMON)**

(Ratio Apprentice to Journeyman: 1 to 1, 1 to 3)

**Laborer (Foundation, Concrete, Excavating, Street Pipe Layer & Common) - First 1000 hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyman's rate

Supplemental Rate Per Hour: \$44.48

**Laborer (Foundation, Concrete, Excavating, Street Pipe Layer & Common) - Second 1000 hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 60% of Journeyman's rate

Supplemental Rate Per Hour: \$44.48

**Laborer (Foundation, Concrete, Excavating, Street Pipe Layer & Common) - Third 1000 hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 75% of Journeyman's rate

Supplemental Rate Per Hour: \$44.48

**Laborer (Foundation, Concrete, Excavating, Street Pipe Layer & Common) - Fourth 1000 hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 90% of Journeyman's rate

Supplemental Rate Per Hour: \$44.48

(Local #731)

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**MARBLE MECHANICS**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 4)

**Cutters & Setters - First 750 Hours**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 40% of Journeyperson's rate

NO BENEFITS PAID DURING THE FIRST TWO MONTHS (PROBATIONARY PERIOD)

**Cutters & Setters - Second 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 45% of Journeyperson's rate

**Cutters & Setters - Third 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Cutters & Setters - Fourth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 55% of Journeyperson's rate

**Cutters & Setters - Fifth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 60% of Journeyperson's rate

**Cutters & Setters - Sixth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 65% of Journeyperson's rate

**Cutters & Setters - Seventh 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 70% of Journeyperson's rate

**Cutters & Setters - Eighth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 75% of Journeyperson's rate

**Cutters & Setters - Ninth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 85% of Journeyperson's rate

**Cutters & Setters - Tenth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 95% of Journeyperson's rate

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Polishers & Finishers - First 900 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 70% of Journeyperson's rate

NO BENEFITS PAID DURING THE FIRST TWO MONTHS (PROBATIONARY PERIOD)

**Polishers & Finishers - Second 900 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 80% of Journeyperson's rate

**Polishers & Finishers - Third 900 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 90% of Journeyperson's rate

(Local #7)

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**MASON TENDER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Mason Tender - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$21.39

Supplemental Benefit Rate per Hour: \$19.90

**Mason Tender - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$22.54

Supplemental Benefit Rate per Hour: \$19.90

**Mason Tender - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$24.29

Supplemental Benefit Rate per Hour: \$19.90

**Mason Tender - Fourth Year**



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$26.95

Supplemental Benefit Rate per Hour: \$19.90

(Local #79)

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## **METALLIC LATHER**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 3)

### **Metallic Lather (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$23.04

Supplemental Benefit Rate per Hour: \$20.00

### **Metallic Lather (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$28.38

Supplemental Benefit Rate per Hour: \$20.66

### **Metallic Lather (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$34.68

Supplemental Benefit Rate per Hour: \$21.32

### **Metallic Lather (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$37.18

Supplemental Benefit Rate per Hour: \$21.82

(Local #46)

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## **MILLWRIGHT**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 4)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Millwright (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$29.16

Supplemental Benefit Rate per Hour: \$34.66

**Millwright (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$34.46

Supplemental Benefit Rate per Hour: \$38.31

**Millwright (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$39.76

Supplemental Benefit Rate per Hour: \$42.61

**Millwright (Fourth Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$50.36

Supplemental Benefit Rate per Hour: \$49.27

(Local #740)

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**PAINTER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Painter - Brush & Roller - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$17.20

Supplemental Benefit Rate per Hour: \$15.05

**Painter - Brush & Roller - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$21.50

Supplemental Benefit Rate per Hour: \$19.39

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Painter - Brush & Roller - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$25.80

Supplemental Benefit Rate per Hour: \$22.79

**Painter - Brush & Roller - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$34.40

Supplemental Benefit Rate per Hour: \$29.16

(District Council of Painters)

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**PAINTER - METAL POLISHER**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 3)

**Metal Polisher (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$13.00

Supplemental Benefit Rate per Hour: \$5.13

**Metal Polisher (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$13.00

Supplemental Benefit Rate per Hour: \$5.13

**Metal Polisher (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$15.75

Supplemental Benefit Rate per Hour: \$5.13

(Local 8A-28)

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## **PAINTER - STRUCTURAL STEEL**

**Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)**

### **Painters - Structural Steel (First Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 40% of Journeyperson's rate

### **Painters - Structural Steel (Second Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 60% of Journeyperson's rate

### **Painters - Structural Steel (Third Year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 80% of Journeyperson's rate

(Local #806)

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## **PAVER AND ROADBUILDER**

**(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)**

### **Paver and Roadbuilder - First Year (Minimum 1000 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$28.86

Supplemental Benefit Rate per Hour: \$21.40

### **Paver and Roadbuilder - Second Year (Minimum 1000 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$30.50

Supplemental Benefit Rate per Hour: \$21.40

(Local #1010)

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## **PLASTERER**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 3)

### **Plasterer - First Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 40% of Journeyman's rate

Supplemental Rate Per Hour: \$13.88

### **Plasterer - First Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 45% of Journeyman's rate

Supplemental Rate Per Hour: \$14.36

### **Plasterer - Second Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 55% of Journeyman's rate

Supplemental Rate Per Hour: \$16.44

### **Plasterer - Second Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 60% of Journeyman's rate

Supplemental Rate Per Hour: \$17.53

### **Plasterer - Third Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 70% of Journeyman's rate

Supplemental Rate Per Hour: \$19.72

### **Plasterer - Third Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 75% of Journeyman's rate

Supplemental Rate Per Hour: \$20.81

(Local #530)

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## **PLASTERER - TENDER**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 3)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Plasterer Tender - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$21.39

Supplemental Benefit Rate per Hour: \$19.90

**Plasterer Tender - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$22.54

Supplemental Benefit Rate per Hour: \$19.90

**Plasterer Tender - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$24.29

Supplemental Benefit Rate per Hour: \$19.90

**Plasterer Tender - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$26.95

Supplemental Benefit Rate per Hour: \$19.90

(Local #79)

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**PLUMBER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Plumber - First Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$16.28

Supplemental Benefit Rate per Hour: \$5.43

**Plumber - First Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$19.28

Supplemental Benefit Rate per Hour: \$6.43

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Plumber - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$27.23

Supplemental Benefit Rate per Hour: \$19.80

**Plumber - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$29.33

Supplemental Benefit Rate per Hour: \$19.80

**Plumber - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$32.18

Supplemental Benefit Rate per Hour: \$19.80

**Plumber - Fifth Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$33.58

Supplemental Benefit Rate per Hour: \$19.80

**Plumber - Fifth Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$45.65

Supplemental Benefit Rate per Hour: \$19.80

(Plumbers Local #1)

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**POINTER, WATERPROOFER, CAULKER, SANDBLASTER,  
STEAMBLASTER**

(Exterior Building Renovation)

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 4)

**Pointer, Waterproofer, Caulker, Sandblaster, Steamblaster - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$26.36

Supplemental Benefit Rate per Hour: \$14.00

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Pointer, Waterproof, Caulker, Sandblaster, Steamblaster - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$29.42

Supplemental Benefit Rate per Hour: \$18.97

**Pointer, Waterproof, Caulker, Sandblaster, Steamblaster - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$34.80

Supplemental Benefit Rate per Hour: \$21.72

**Pointer, Waterproof, Caulker, Sandblaster, Steamblaster - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$41.93

Supplemental Benefit Rate per Hour: \$22.72

(Bricklayer District Council)

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**ROOFER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 2)

**Roofer - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 35% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$3.36

**Roofer - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 50% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$16.92

**Roofer - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 60% of Journeyperson's rate

Supplemental Benefit Rate Per Hour: \$20.29

**Roofer - Fourth Year**



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 75% of Journeyperson's rate  
Supplemental Benefit Rate Per Hour: \$25.37

(Local #8)

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## **SHEET METAL WORKER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

### **Sheet Metal Worker (0-6 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 25% of Journeyperson's rate  
Supplemental Rate Per Hour: \$6.51

### **Sheet Metal Worker (7-18 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 35% of Journeyperson's rate  
Supplemental Rate Per Hour: \$18.57

### **Sheet Metal Worker (19-30 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 45% of Journeyperson's rate  
Supplemental Rate Per Hour: \$25.40

### **Sheet Metal Worker (31-36 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 55% of Journeyperson's rate  
Supplemental Rate Per Hour: \$29.95

### **Sheet Metal Worker (37-42 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 55% of Journeyperson's rate  
Supplemental Rate Per Hour: \$29.95

### **Sheet Metal Worker (43-48 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 70% of Journeyperson's rate  
Supplemental Rate Per Hour: \$36.83

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Sheet Metal Worker (49-54 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 70% of Journeyman's rate  
Supplemental Rate Per Hour: \$36.83

**Sheet Metal Worker (55-60 Months)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 80% of Journeyman's rate  
Supplemental Rate Per Hour: \$41.42

(Local #28)

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**SIGN ERECTOR**

(Ratio of Apprentice to Journeyman: 1 to 1, 1 to 4)

**Sign Erector - First Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 35% of Journeyman's rate  
Supplemental Rate Per Hour: \$15.75

**Sign Erector - First Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 40% of Journeyman's rate  
Supplemental Rate Per Hour: \$17.86

**Sign Erector - Second Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 45% of Journeyman's rate  
Supplemental Rate Per Hour: \$19.98

**Sign Erector - Second Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 50% of Journeyman's rate  
Supplemental Rate Per Hour: \$22.12

**Sign Erector - Third Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Wage Rate Per Hour: 55% of Journeyperson's rate  
Supplemental Rate Per Hour: \$29.92

**Sign Erector - Third Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 60% of Journeyperson's rate  
Supplemental Rate Per Hour: \$32.56

**Sign Erector - Fourth Year: 1st Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 65% of Journeyperson's rate  
Supplemental Rate Per Hour: \$35.92

**Sign Erector - Fourth Year: 2nd Six Months**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 70% of Journeyperson's rate  
Supplemental Rate Per Hour: \$38.65

**Sign Erector - Fifth Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 75% of Journeyperson's rate  
Supplemental Rate Per Hour: \$41.33

**Sign Erector - Sixth Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 80% of Journeyperson's rate  
Supplemental Rate Per Hour: \$44.01

(Local #137)

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**STEAMFITTER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 3)

**Steamfitter - First Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate and Supplemental Per Hour: 40% of Journeyperson's rate

**Steamfitter - Second Year**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate and Supplemental Rate Per Hour: 50% of Journeyperson's rate.

**Steamfitter - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate and Supplemental Rate per Hour: 65% of Journeyperson's rate.

**Steamfitter - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate and Supplemental Rate Per Hour: 80% of Journeyperson's rate.

**Steamfitter - Fifth Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate and Supplemental Rate Per Hour: 85% of Journeyperson's rate.

(Local #638)

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**STONE MASON - SETTER**

(Ratio Apprentice of Journeyperson: 1 to 1, 1 to 2)

**Stone Mason - Setters - First 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Stone Mason - Setters - Second 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 60% of Journeyperson's rate

Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Stone Mason - Setters - Third 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 70% of Journeyperson's rate

Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Stone Mason - Setters - Fourth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 80% of Journeyperson's rate

Supplemental Rate Per Hour: 50% of Journeyperson's rate

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Stone Mason - Setters - Fifth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 90% of Journeyperson's rate

Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Stone Mason - Setters - Sixth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 100% of Journeyperson's rate

Supplemental Rate Per Hour: 50% of Journeyperson's rate

(Bricklayers District Council)

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**TAPER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)

**Drywall Taper - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 40% of Journeyperson's rate

**Drywall Taper - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 60% of Journeyperson's rate

**Drywall Taper - Third Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 80% of Journeyperson's rate

(Local #1974)

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**TILE LAYER - SETTER**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 4)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

**Tile Layer - Setter - First 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 50% of Journeyperson's rate

**Tile Layer - Setter - Second 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 55% of Journeyperson's rate

**Tile Layer - Setter - Third 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 65% of Journeyperson's rate

**Tile Layer - Setter - Fourth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 75% of Journeyperson's rate

**Tile Layer - Setter - Fifth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 85% of Journeyperson's rate

**Tile Layer - Setter - Sixth 750 Hours**

Effective Period: 7/1/2019 - 6/30/2020

Wage and Supplemental Rate Per Hour: 95% of Journeyperson's rate

(Local #7)

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**TIMBERPERSON**

(Ratio of Apprentice to Journeyperson: 1 to 1, 1 to 6)

**Timberperson - First Year**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate Per Hour: 40% of Journeyperson's rate

Supplemental Rate Per Hour: \$33.76

**Timberperson - Second Year**

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION APPRENTICE PREVAILING WAGE SCHEDULE

Wage Rate Per Hour: 50% of Journeyperson's rate  
Supplemental Rate Per Hour: \$33.76

**Timberperson - Third Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 65% of Journeyperson's rate  
Supplemental Rate Per Hour: \$33.76

**Timberperson - Fourth Year**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate Per Hour: 80% of Journeyperson's rate  
Supplemental Rate Per Hour: \$33.76

(Local #1536)

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**LABOR LAW ARTICLE 8 - NYC PUBLIC WORKS**

Workers, Laborers and Mechanics employed on a public work project must receive not less than the prevailing rate of wage and benefits for the classification of work performed by each upon such public work. Pursuant to Labor Law Article 8 the Comptroller of the City of New York has promulgated this schedule solely for Workers, Laborers and Mechanics engaged by private contractors on New York City public work projects. Prevailing rates are required to be annexed to and form part of the public work contract pursuant to § 220 (3).

This schedule is a compilation of separate determinations of the prevailing rate of wage and supplements made by the Comptroller for each trade classification listed herein pursuant to New York State Labor Law section § 220 (5). The source of the wage and supplement rates, whether a collective bargaining agreement, survey data or other, is listed at the end of each classification.

Agency Chief Contracting Officers should contact the Bureau of Labor Law's Classification Unit with any questions concerning trade classifications, prevailing rates or prevailing practices with respect to procurement on New York City public work contracts. Contractors are advised to review the Comptroller's Prevailing Wage Schedule before bidding on public work contracts. Contractors with questions concerning trade classifications, prevailing rates or prevailing practices with respect to public work contracts in the procurement stage must contact the contracting agency responsible for the procurement.

Any error as to compensation under the prevailing wage law or other information as to trade classification, made by the contracting agency in the contract documents or in any other communication, will not preclude a finding against the contractor of prevailing wage violation.

Any questions concerning trade classifications, prevailing rates or prevailing practices on New York City public work contracts that have already been awarded may be directed to the Bureau of Labor Law's Classification Unit by calling (212) 669-4443. All callers must have the agency name and contract registration number available when calling with questions on public work contracts. Please direct all other compliance issues to: Bureau of Labor Law, Attn: Wasyl Kinach, P.E., Office of the Comptroller, 1 Centre Street, Room 651, New York, N.Y. 10007; Fax (212) 669-4002.

The appropriate schedule of prevailing wages and benefits must be posted at all public work sites pursuant to Labor Law § 220 (3-a) (a).

This schedule is applicable to work performed during the effective period, unless otherwise noted. Changes to this schedule are published on our web site [comptroller.nyc.gov/wages](http://comptroller.nyc.gov/wages). Contractors must pay the wages and supplements in effect when the worker, laborer, mechanic performs the work. Preliminary schedules for future one-year periods appear in the City Record on or about June 1 each succeeding year. Final schedules appear on or about July 1 in the City Record and on our web site [comptroller.nyc.gov/wages](http://comptroller.nyc.gov/wages).

The Comptroller's Office has attempted to include all overtime, shift and night differential, Holiday, Saturday, Sunday or other premium time work. However, this schedule does not set forth every prevailing practice with respect to such rates with which employers must comply. All such practices are nevertheless part of the employer's prevailing wage obligation and contained in the collective bargaining agreements of the prevailing wage unions. These collective bargaining agreements are available for inspection by appointment. Requests for appointments may be made by calling (212) 669-4443, Monday through Friday between the hours of 9 a.m. and 5 p.m.



**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

Prevailing rates and ratios for apprentices are published in the Construction Apprentice Prevailing Wage Schedule. Pursuant to Labor Law § 220 (3-e), only apprentices who are individually registered in a bona fide program to which the employer contractor is a participant, registered with the New York State Department of Labor, may be paid at the apprentice rates. Apprentices who are not so registered must be paid as journey persons.

New York City public work projects awarded pursuant to a Project Labor Agreement ("PLA") in accordance with Labor Law section 222 may have different labor standards for shift, premium and overtime work. Please refer to the PLA's pre-negotiated labor agreements for wage and benefit rates applicable to work performed outside of the regular workday. More information is available at the Mayor's Office of Contract Services (MOCS) web page at:

<https://www1.nyc.gov/site/mocs/legal-forms/project-labor-agreements.page>

All the provisions of Labor Law Article 8 remain applicable to PLA work including, but not limited to, the enforcement of prevailing wage requirements by the Comptroller in accordance with the trade classifications in this schedule; however, we will enforce shift, premium, overtime and other non-standard rates as they appear in a project's pre-negotiated labor agreement.

In order to meet their obligation to provide prevailing supplemental benefits to each covered employee, employers must either:

- 1) Provide bona fide fringe benefits which cost the employer no less than the prevailing supplemental benefits rate; or
- 2) Supplement the employee's hourly wage by an amount no less than the prevailing supplemental benefits rate; or
- 3) Provide a combination of bona fide fringe benefits and wage supplements which cost the employer no less than the prevailing supplemental benefits rate in total.

Although prevailing wage laws do not require employers to provide bona fide fringe benefits (as opposed to wage supplements) to their employees, other laws may. For example, the Employee Retirement Income Security Act, 29 U.S.C. § 1001 et seq., the Patient Protection and Affordable Care Act, 42 U.S.C. § 18001 et seq., and the New York City Paid Sick Leave Law, N.Y.C. Admin. Code § 20-911 et seq., require certain employers to provide certain benefits to their employees. Labor agreements to which employers are a party may also require certain benefits. The Comptroller's Office does not enforce these laws or agreements.

**Employers must provide prevailing supplemental benefits at the straight time rate for each hour worked unless otherwise noted in the classification.**

**Paid Holidays, Vacation and Sick Leave when listed must be paid or provided in addition to the prevailing hourly supplemental benefit rate.**

For more information, please refer to the Comptroller's Prevailing Wage Law Regulations in Title 44 of the Rules of the City of New York, Chapter 2, available at [comptroller.nyc.gov/wages](http://comptroller.nyc.gov/wages).

**Wasył Kinach, P.E.**  
Director of Classifications  
Bureau of Labor Law

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

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**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
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**ASBESTOS HANDLER  
SEE HAZARDOUS MATERIAL HANDLER**

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**BLASTER**

**Blaster**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$55.86  
Supplemental Benefit Rate per Hour: \$44.48

**Blaster- Hydraulic Trac Drill**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$50.00  
Supplemental Benefit Rate per Hour: \$44.48

**Blaster - Wagon: Air Trac: Quarry Bar: Drillrunners**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$49.17  
Supplemental Benefit Rate per Hour: \$44.48

**Blaster - Journeyperson**

(Laborer, Chipper/Jackhammer including Walk Behind Self Propelled Hydraulic Asphalt and Concrete Breakers and Hydro (Water) Demolition, Powder Carrier, Hydraulic Chuck Tender, Chuck Tender and Nipper)

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$42.65  
Supplemental Benefit Rate per Hour: \$44.48

**Blaster - Magazine Keepers: (Watch Person)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$21.33  
Supplemental Benefit Rate per Hour: \$44.48

**Overtime**

Time and one half the regular rate after an 8 hour day.  
Time and one half the regular rate for Saturday.  
Double time the regular rate for Sunday.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Thanksgiving Day  
Christmas Day

### Paid Holidays

Labor Day  
Thanksgiving Day

### Shift Rates

When two shifts are employed, single time rate shall be paid for each shift. When three shifts are found necessary, each shift shall work seven and one half hours (7 ½), but shall be paid for eight (8) hours of labor, and be permitted one half hour for lunch.

(Local #731)

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## BOILERMAKER

### Boilermaker

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$59.17

Supplemental Benefit Rate per Hour: \$44.59

Supplemental Note: For time and one half overtime - \$66.44 For double overtime - \$88.28

### Overtime Description

For Repair and Maintenance work:

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

For New Construction work:

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day  
President's Day  
Memorial Day  
Independence Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Columbus Day  
Election Day  
Veteran's Day  
Thanksgiving Day  
Christmas Day

Quadruple time the regular rate for work on the following holiday(s).

Labor Day

### **Paid Holidays**

Good Friday  
Day after Thanksgiving  
Day before Christmas  
Day before New Year's Day

### **Shift Rates**

When shifts are required, the first shift shall work eight (8) hours at the regular straight-time hourly rate. The second shift shall work seven and one-half (7 ½) hours and receive eight hours at the regular straight time hourly rate plus twenty-five cents (\$0.25) per hour. The third shift shall work seven (7) hours and receive eight hours at the regular straight time hourly rate plus fifty cents (\$0.50) per hour. A thirty (30) minute lunch period shall not be considered as time worked. Work in excess of the above shall be paid overtime at the appropriate new construction work or repair work overtime wage and supplemental benefit hourly rate.

(Local #5)

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## **BRICKLAYER**

### **Bricklayer**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$56.32**

Supplemental Benefit Rate per Hour: **\$33.11**

### **Overtime**

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Thanksgiving Day  
Christmas Day

**Paid Holidays**

None

**Shift Rates**

Overtime rates to be paid outside the regular scheduled work day.

(Bricklayer District Council)

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**CARPENTER - BUILDING COMMERCIAL**

**Building Commercial**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$52.50

Supplemental Benefit Rate per Hour: \$46.38

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

Washington's Birthday

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Paid Holidays**

None

**Shift Rates**

The employer may work two (2) shifts with the first shift at the straight time wage rate starting at the established time between 7 a.m. and 9 a.m. The second shift will receive one hour at the double time rate of pay for the last hour of the shift; eight (8) hours pay for seven (7) hours of work, nine (9) hours pay for eight (8) hours of work.



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

When it is not possible to conduct alteration work during regular working hours in a building occupied by tenants, the rule for the second shift will apply.

(Carpenters District Council)

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**CARPENTER - HEAVY CONSTRUCTION WORK**  
(Construction of Engineering Structures and Building Foundations)

**Heavy Construction Work**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$54.68

Supplemental Benefit Rate per Hour: \$51.73

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

**Shift Rates**

Off shift work commencing between 5:00 P.M. and 11:00 P.M. shall work eight and one half hours allowing for one half hour for lunch. The wage rate shall be 113% of the straight time hourly wage rate.

(Carpenters District Council)

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## **CARPENTER - HIGH RISE CONCRETE FORMS** (Excludes Engineering Structures and Building Foundations)

### **Carpenter High Rise A**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$50.78**

Supplemental Benefit Rate per Hour: **\$43.44**

### **Carpenter High Rise B**

Carpenter High Rise B worker is excluded from high risk operations such as erection decking, perimeter debris netting, leading edge work, self-climbing form systems, and the installation of cocoon systems unless directly supervised by a Carpenter High Rise A worker.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$40.19**

Supplemental Benefit Rate per Hour: **\$16.75**

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

### **Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

### **Paid Holidays**

None

### **Shift Rates**

The second shift wage rate shall be 113% of the straight time hourly wage rate. There must be a first shift in order to work a second shift.

Carpenters District Council)

## **CARPENTER - SIDEWALK SHED, SCAFFOLD AND HOIST**

### **Carpenter - Hod Hoist**

(Assisted by Mason Tender)

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$50.50**

Supplemental Benefit Rate per Hour: **\$39.56**

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### **Paid Holidays**

None

### **Shift Rates**

The second shift will receive one hour at the double time rate of pay for the last hour of the shift; eight hours pay for seven hours of work, nine hours pay for eight hours of work. There must be a first shift in order to work a second shift.

(Carpenters District Council)

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## **CARPENTER - WOOD WATER STORAGE TANK**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Tank Mechanic**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$34.14**

Supplemental Benefit Rate per Hour: **\$19.00**

**Tank Helper**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$27.30**

Supplemental Benefit Rate per Hour: **\$19.00**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Time and one half the regular rate for work on a holiday plus the day's pay.

**Paid Holidays**

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Thanksgiving Day

Day after Thanksgiving

1/2 day on Christmas Eve if work is performed in the A.M.

1/2 day on New Year's Eve if work is performed in the A.M.

**Vacation**

Employed for one (1) year.....one (1) week vacation (40 hours)

Employed for three (3) years.....two (2) weeks vacation (80 hours)

Employed for more than twenty (20) years.....three (3) weeks vacation (120 hours)

**SICK LEAVE:**

Two (2) sick days after being employed for twenty (20) years.

(Carpenters District Council)

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**CEMENT & CONCRETE WORKER**

**Cement & Concrete Worker**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$43.53**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Supplemental Benefit Rate per Hour: **\$28.95**

Supplemental Note: \$32.45 on Saturdays; \$35.95 on Sundays & Holidays

**Cement & Concrete Worker - (Hired after 2/6/2016)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$33.05**

Supplemental Benefit Rate per Hour: **\$20.95**

Supplemental Note: \$22.45 on Saturdays; \$23.95 on Sundays & Holidays

**Overtime Description**

Time and one half the regular rate after 7 hour day (time and one half the regular rate after an 8 hour day when working with Dockbuilders on pile cap forms and for work below street level to the top of the foundation wall, not to exceed 2 feet or 3 feet above the sidewalk-brick shelf, when working on the foundation and structure.)

**Overtime**

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

1/2 day before Christmas Day

1/2 day before New Year's Day

**Shift Rates**

On shift work extending over a twenty-four hour period, all shifts are paid at straight time.

(Cement Concrete Workers District Council)

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**CEMENT MASON**

**Cement Mason**

Effective Period: 7/1/2019 - 6/30/2020

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Wage Rate per Hour: \$44.97**

**Supplemental Benefit Rate per Hour: \$40.56**

**Supplemental Note:** Supplemental benefit time and one half rate: \$71.19; Double time rate: double the base supplemental benefit rate.

### **Overtime Description**

Time and one-half the regular rate after an 8 hour day, double time the regular rate after 10 hours. Time and one-half the regular rate on Saturday, double time the regular rate after 10 hours. Double time the regular rate on Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day  
President's Day  
Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Presidential Election Day  
Thanksgiving Day  
Christmas Day

### **Paid Holidays**

Any worker who reports to work on Christmas Eve or New Year's Eve pursuant to his employer's instruction shall be entitled to three (3) hours afternoon pay without working.

### **Shift Rates**

For an off shift day, (work at times other than the regular 7:00 A.M. to 3:30 P.M. work day) a cement mason shall be paid at the regular hourly rate plus a 25% per hour differential. Four Days a week at Ten (10)hour day.

(Local #780) (BCA)

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## **CORE DRILLER**

### **Core Driller**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$40.44**

**Supplemental Benefit Rate per Hour: \$26.70**

### **Core Driller Helper**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$32.12**

**Supplemental Benefit Rate per Hour: \$26.70**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Core Driller Helper(Third year in the industry)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$28.91**

Supplemental Benefit Rate per Hour: **\$26.70**

**Core Driller Helper (Second year in the industry)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$25.70**

Supplemental Benefit Rate per Hour: **\$26.70**

**Core Driller Helper (First year in the industry)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$22.48**

Supplemental Benefit Rate per Hour: **\$26.70**

**Overtime Description**

Time and one half the regular rate for work on a holiday plus Holiday pay when worked.

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Time and one half the regular rate for work on the following holiday(s).

**Paid Holidays**

New Year's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

**Shift Rates**

The shift day shall be the continuous eight and one-half (8½) hours from 6:00 A.M. to 2:30 P.M. and from 2:30 P.M. to 11:00 P.M., including one-half (½) hour of employees regular rate of pay for lunch. When two (2) or more shifts are employed, single time shall be paid for each shift, but those employees employed on a shift other than from 8:00 A.M. to 5:00 P.M. shall, in addition, receive seventy-five cents (\$0.75) per hour differential for each hour worked. When three (3) shifts are needed, each shift shall work seven and one-half (7 ½) hours paid for eight (8) hours of labor and be permitted one-half (½) hour for mealtime.

(Carpenters District Council)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

## **DERRICKPERSON AND RIGGER**

### **Derrick Person & Rigger**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$50.91**

Supplemental Benefit Rate per Hour: **\$54.11**

Supplemental Note: The above supplemental rate applies for work performed in Manhattan, Bronx, Brooklyn and Queens. \$55.53 - For work performed in Staten Island.

### **Derrick Person & Rigger - Site Work**

Assists the Stone Mason-Setter in the setting of stone and paving stone.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$42.59**

Supplemental Benefit Rate per Hour: **\$42.37**

### **Overtime Description**

The first two hours of overtime on weekdays and the first seven hours of work on Saturdays are paid at time and one half for wages and supplemental benefits. All additional overtimes is paid at double time for wages and supplemental benefits. Deduct \$1.42 from the Staten Island hourly benefits rate before computing overtime.

### **Overtime**

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

Washington's Birthday

Good Friday

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

### **Paid Holidays**

1/2 day on Christmas Eve if work is performed in the A.M.

(Local #197)

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## **DIVER**

### **Diver (Marine)**



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$69.22**

Supplemental Benefit Rate per Hour: **\$51.73**

**Diver Tender (Marine)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$49.14**

Supplemental Benefit Rate per Hour: **\$51.73**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

**Shift Rates**

When three shifts are utilized each shift shall work seven and one half-hours (7 1/2 hours) and paid for 8 hours, allowing for one half hour for lunch.

(Carpenters District Council)

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**DOCKBUILDER - PILE DRIVER**

**Dockbuilder - Pile Driver**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$54.63**

Supplemental Benefit Rate per Hour: **\$51.73**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

**Shift Rates**

Off shift work commencing between 5:00 P.M. and 11:00 P.M. shall work eight and one half hours allowing for one half hour for lunch. The wage rate shall be 113% of the straight time hourly wage rate.

(Carpenters District Council)

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**DRIVER: TRUCK (TEAMSTER)**

**Driver - Dump Truck**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$41.18

Supplemental Benefit Rate per Hour: \$49.65

Supplemental Note: Over 40 hours worked: at time and one half rate - \$22.08; at double time rate - \$29.44

**Driver - Tractor Trailer**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$43.84

Supplemental Benefit Rate per Hour: \$49.03

Supplemental Note: Over 40 hours worked: at time and one half rate - \$19.80; at double time rate - \$26.40

**Driver - Euclid & Turnapull Operator**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$44.40**

**Supplemental Benefit Rate per Hour: \$49.03**

**Supplemental Note: Over 40 hours worked: at time and one half rate - \$19.80; at double time rate - \$26.40**

### **Overtime Description**

For Paid Holidays: Holiday pay for all holidays shall be prorated based two hours per day for each day worked in the holiday week, not to exceed 8 hours of holiday pay. For Thanksgiving week, the prorated share shall be 5 1/3 hours of holiday pay for each day worked in Thanksgiving week.

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### **Paid Holidays**

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### **Shift Rates**

Off single shift work commencing between 6:00 P.M. and 5:00 A.M. shall work eight and one half (8 1/2) hours allowing for one half hour for lunch and be paid 117.3% of the straight time hourly wage rate.

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### **Driver Redi-Mix (Sand & Gravel)**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$39.00**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Supplemental Benefit Rate per Hour: **\$45.52**

Supplemental Note: Over 40 hours worked: time and one half rate \$16.78; double time rate \$22.37

### **Overtime Description**

For Paid Holidays: Employees working two (2) days in the calendar week in which the holiday falls are to paid for these holidays, provided they shape each remaining workday during that calendar week.

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

President's Day

Columbus Day

Veteran's Day

Triple time the regular rate for work on the following holiday(s).

New Year's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

### **Paid Holidays**

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Election Day

Thanksgiving Day

Christmas Day

(Local #282)

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## **ELECTRICIAN**

(Including installation of low voltage cabling carrying data, video and/or voice on building construction/alteration/renovation projects.)

### **Electrician "A" (Regular Day / Day Shift)**

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Wage Rate per Hour: \$56.00

Supplemental Benefit Rate per Hour: \$56.54

**Electrician "A" (Regular Day Overtime after 7 hrs / Day Shift Overtime after 8 hrs)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$84.00

Supplemental Benefit Rate per Hour: \$60.07

**Electrician "A" (Swing Shift)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$65.71

Supplemental Benefit Rate per Hour: \$64.36

**Electrician "A" (Swing Shift Overtime After 7.5 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$98.57

Supplemental Benefit Rate per Hour: \$68.51

**Electrician "A" (Graveyard Shift)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$73.60

Supplemental Benefit Rate per Hour: \$70.94

**Electrician "A" (Graveyard Shift Overtime After 7 hours)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$110.40

Supplemental Benefit Rate per Hour: \$75.59

**Overtime**

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

**Overtime Holidays**

Time and one half the regular rate for work on a holiday.

New Year's Day

Martin Luther King Jr. Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Christmas Day

**Paid Holidays**

None

**Shift Rates**

When so elected by the Employer, one or more shifts of at least five days duration may be scheduled as follows:  
Day Shift: 8:00 am to 4:30 pm, Swing Shift 4:30 pm to 12:30 am, Graveyard Shift: 12:30 am to 8:00 am.

For multiple shifts of temporary light and/or power, the temporary light and/or power employee shall be paid for 8 hours at the straight time rate. For three or less workers performing 8 hours temporary light and/or power the supplemental benefit rate is \$24.92.

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**Electrician "M" (First 8 hours)**

"M" rated work shall be defined as jobbing: electrical work of limited duration and scope, also consisting of repairs and/or replacement of electrical and tele-data equipment. Includes all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls and washing and cleaning of foregoing fixtures.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$29.00**

Supplemental Benefit Rate per Hour: **\$23.43**

First and Second Year "M" Wage Rate Per Hour: **\$24.50**

First and Second Year "M" Supplemental Rate: **\$21.07**

**Electrician "M" (Overtime After First 8 hours)**

"M" rated work shall be defined as jobbing: electrical work of limited duration and scope, also consisting of repairs and/or replacement of electrical and tele-data equipment. Includes all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls and washing and cleaning of foregoing fixtures.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$43.50**

Supplemental Benefit Rate per Hour: **\$25.26**

First and Second Year "M" Wage Rate Per Hour: **\$36.75**

First and Second Year "M" Supplemental Rate: **\$22.62**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

**Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

Martin Luther King Jr. Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

President's Day  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

**Paid Holidays**

None

(Local #3)

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**ELECTRICIAN - ALARM TECHNICIAN**

(Scope of Work - Inspect, test, repair, and replace defective, malfunctioning, or broken devices, components and controls of Fire, Burglar and Security Systems)

**Alarm Technician**

Effective Period: 7/1/2019 - 3/9/2020

Wage Rate per Hour: **\$33.40**

Supplemental Benefit Rate per Hour: **\$17.68**

Supplemental Note: \$16.06 only after 8 hours worked in a day

Effective Period: 3/10/2020 - 6/30/2020

Wage Rate per Hour: **\$33.90**

Supplemental Benefit Rate per Hour: **\$18.43**

Supplemental Note: \$16.80 only after 8 hours worked in a day

**Overtime Description**

Time and one half the regular rate for work on the following holidays: Columbus Day, Veterans Day, Day after Thanksgiving.

Double time the regular rate for work on the following holidays: New Year's day, Martin Luther King Jr. Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day.

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

**Paid Holidays**

New Year's Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Martin Luther King Jr. Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

### Shift Rates

Night Differential is based upon a ten percent (10%) differential between the hours of 4:00 P.M. and 12:30 A.M. and a fifteen percent (15%) differential for the hours 12:00 A.M. to 8:00 A.M.

### Vacation

At least 1 year of employment.....ten (10) days  
5 years or more of employment.....fifteen (15) days  
10 years of employment.....twenty (20) days  
Plus one Personal Day per year

#### Sick Days:

One day per Year. Up to 4 vacation days may be used as sick days.

(Local #3)

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## ELECTRICIAN-STREET LIGHTING WORKER

### Electrician - Electro Pole Electrician

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$56.00

Supplemental Benefit Rate per Hour: \$58.44

### Electrician - Electro Pole Foundation Installer

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$42.66

Supplemental Benefit Rate per Hour: \$43.52

### Electrician - Electro Pole Maintainer

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$36.61

Supplemental Benefit Rate per Hour: \$39.16

### Overtime Description



**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Electrician - Electro Pole Electrician:** Time and one half the regular rate after a 7 hour day and after 5 consecutive days worked per week.

**Electrician - Electro Pole Foundation Installer:** Time and one half the regular rate after 8 hours within a 24 hour period and Saturday and Sunday.

**Electrician - Electro Pole Maintainer:** Time and one half the regular rate after a 7 hour day and after 5 consecutive days worked per week. Saturdays and Sundays may be used as a make-up day at straight time when a day is lost during the week to inclement weather.

### **Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day  
Martin Luther King Jr. Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

### **Paid Holidays**

None

(Local #3)

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## **ELEVATOR CONSTRUCTOR**

### **Elevator Constructor**

**Effective Period: 7/1/2019 - 3/16/2020**

**Wage Rate per Hour: \$66.95**

**Supplemental Benefit Rate per Hour: \$36.65**

**Effective Period: 3/17/2020 - 6/30/2020**

**Wage Rate per Hour: \$69.56**

**Supplemental Benefit Rate per Hour: \$37.47**

### **Overtime Description**

**For New Construction:** work performed after 7 or 8 hour day, Saturday, Sunday or between 4:30pm and 7:00am shall be paid at double time rate.

**Existing buildings:** work performed after an 8 hour day, Saturday, Sunday or between 5:30pm and 7:00 am shall be paid time and one half.

### **Overtime**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Double time the regular rate for work on the following holiday(s).

**Paid Holidays**

New Year's Day  
President's Day  
Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

**Vacation**

Employer contributes 8% of regular basic hourly rate as vacation pay for employees with more than 15 years of service, and 6% for employees with 5 to 15 years of service, and 4% for employees with less than 5 years of service.

(Local #1)

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**ELEVATOR REPAIR & MAINTENANCE**

**Elevator Service/Modernization Mechanic**

Effective Period: 7/1/2019 - 3/16/2020

Wage Rate per Hour: **\$52.44**

Supplemental Benefit Rate per Hour: **\$36.55**

Effective Period: 3/17/2020 - 6/30/2020

Wage Rate per Hour: **\$54.56**

Supplemental Benefit Rate per Hour: **\$37.37**

**Overtime Description**

For Scheduled Service Work: Double time - work scheduled in advance by two or more workers performed on Sundays, Holidays, and between midnight and 7:00am.

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

Time and one half the regular rate for work on a holiday plus the day's pay.

**Paid Holidays**

New Year's Day  
President's Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

### Shift Rates

Afternoon shift - regularly hourly rate plus a (15%) fifteen percent differential. Graveyard shift - time and one half the regular rate.

### Vacation

Employer contributes 8% of regular basic hourly rate as vacation pay for employees with more than 15 years of service, and 6% for employees with 5 to 15 years of service, and 4% for employees with less than 5 years of service.

(Local #1)

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## ENGINEER

### Engineer - Heavy Construction Operating Engineer I

Cherry pickers 20 tons and over and Loaders (rubber tired and/or tractor type with a manufacturer's minimum rated capacity of six cubic yards and over).

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$70.71

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

Shift Wage Rate: \$113.14

### Engineer - Heavy Construction Operating Engineer II

Backhoes, Basin Machines, Groover, Mechanical Sweepers, Bobcat, Boom Truck, Barrier Transport (Barrier Mover) & machines of similar nature. Operation of Churn Drills and machines of a similar nature, Stetco Silent Hoist and machines of similar nature, Vac-Alls, Meyers Machines, John Beam and machines of a similar nature, Ross Carriers and Travel Lifts and machines of a similar nature, Bulldozers, Scrapers and Turn-a-Pulls: Tugger Hoists (Used exclusively for handling excavated material); Tractors with attachments, Hyster and Roustabout Cranes, Cherry pickers. Austin Western, Grove and machines of a similar nature, Scoopmobiles, Monorails, Conveyors, Trenchers: Loaders-Rubber Tired and Tractor: Barber Greene and Eimco Loaders and Eimco Backhoes; Mighty Midget and similar breakers and Tampers, Curb and Gutter Pavers and Motor Patrol, Motor Graders and all machines of a similar nature. Locomotives 10 Tons or under. Mini-Max, Break-Tech and machines of a similar nature; Milling machines, robotic and demolition machines and machines of a similar nature, shot blaster, skid steer machines and machines of a similar nature including bobcat, pile rig rubber-tired excavator (37,000 lbs. and under), 2 man auger.

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$68.58**

**Supplemental Benefit Rate per Hour: \$39.74**

**Supplemental Note: \$72.08 on overtime**

**Shift Wage Rate: \$109.73**

**Engineer - Heavy Construction Operating Engineer III**

Minor Equipment such as Tractors, Post Hole Diggers, Ditch Witch (Walk Behind), Road Finishing Machines, Rollers five tons and under, Tugger Hoists, Dual Purpose Trucks, Fork Lifts, and Dempsey Dumpers, Fireperson.

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$65.00**

**Supplemental Benefit Rate per Hour: \$39.74**

**Supplemental Note: \$72.08 on overtime**

**Shift Wage Rate: \$104.00**

**Engineer - Heavy Construction Maintenance Engineer I**

Installing, Repairing, Maintaining, Dismantling and Manning of all equipment including Steel Cutting, Bending and Heat Sealing Machines, Mechanical Heaters, Grout Pumps, Bentonite Pumps & Plants, Screening Machines, Fusion Coupling Machines, Tunnel Boring Machines Moles and Machines of a similar nature, Power Packs, Mechanical Hydraulic Jacks; all drill rigs including but not limited to Churn, Rotary Caisson, Raised Bore & Drills of a similar nature; Personnel, Inspection & Safety Boats or any boats used to perform functions of same, Mine Hoists, Whirlies, all Climbing Cranes, all Tower Cranes, including but not limited to Truck Mounted and Crawler Type and machines of similar nature; Maintaining Hydraulic Drills and machines of a similar nature; Well Point System-Installation and dismantling; Burning, Welding, all Pumps regardless of size and/or motor power, except River Cofferdam Pumps and Wells Point Pumps; Motorized Buggies (three or more); equipment used in the cleaning and televising of sewers, but not limited to jet-rodder/vacuum truck, vacall/vactor, closed circuit television inspection equipment; high powered water pumps, jet pumps; screed machines and concrete finishing machines of a similar nature; vermeers.

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$68.25**

**Supplemental Benefit Rate per Hour: \$39.74**

**Supplemental Note: \$72.08 on overtime**

**Shift Wage Rate: \$109.20**

**Engineer - Heavy Construction Maintenance Engineer II**

**On Base Mounted Tower Cranes**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$90.00**

**Supplemental Benefit Rate per Hour: \$39.74**

**Supplemental Note: \$72.08 on overtime**

**Shift Wage Rate: \$144.00**

**Engineer - Heavy Construction Maintenance Engineer III**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

On Generators, Light Towers

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$44.64

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

Shift Wage Rate: \$71.42

**Engineer - Heavy Construction Maintenance Engineer IV**

On Pumps and Mixers including mud sucking

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$45.83

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

Shift Wage Rate: \$73.33

**Engineer - Steel Erection Maintenance Engineers**

Derrick, Travelers, Tower, Crawler Tower and Climbing Cranes

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$65.31

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

Shift Wage Rate: \$104.50

**Engineer - Steel Erection Oiler I**

On a Truck Crane

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$61.05

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

Shift Wage Rate: \$97.68

**Engineer - Steel Erection Oiler II**

On a Crawler Crane

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$46.18

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

Shift Wage Rate: \$73.89

**Overtime Description**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

On jobs of more than one shift, if the next shift employee fails to report for work through any cause over which the employer has no control, the employee on duty who works the next shift continues to work at the single time rate.

**Overtime**

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

Double time the regular rate for work on the following holiday(s).

**Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

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**Engineer - Building Work Maintenance Engineers I**

Installing, repairing, maintaining, dismantling (of all equipment including: Steel Cutting and Bending Machines, Mechanical Heaters, Mine Hoists, Climbing Cranes, Tower Cranes, Linden Peine, Lorain, Liebherr, Mannes, or machines of a similar nature, Well Point Systems, Deep Well Pumps, Concrete Mixers with loading Device, Concrete Plants, Motor Generators when used for temporary power and lights), skid steer machines of a similar nature including bobcat.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$62.45

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

**Engineer - Building Work Maintenance Engineers II**

On Pumps, Generators, Mixers and Heaters

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$48.26

Supplemental Benefit Rate per Hour: \$39.74

Supplemental Note: \$72.08 on overtime

**Engineer - Building Work Oilers I**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

All gasoline, electric, diesel or air operated Gradealls: Concrete Pumps, Overhead Cranes in Power Houses: Their duties shall be to assist the Engineer in oiling, greasing and repairing of all machines; Driving Truck Cranes: Driving and Operating Fuel and Grease Trucks, Cherrypickers (hydraulic cranes) over 70,000 GVW, and machines of a similar nature.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$59.33**

Supplemental Benefit Rate per Hour: **\$39.74**

Supplemental Note: \$72.08 on overtime

### **Engineer - Building Work Oilers II**

Oilers on Crawler Cranes, Backhoes, Trenching Machines, Gunit Machine, Compressors (three or more in Battery).

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$43.78**

Supplemental Benefit Rate per Hour: **\$39.74**

Supplemental Note: \$72.08 on overtime

### **Overtime Description**

On jobs of more than one shift, if an Employee fails to report for work through any cause over which the Employer has no control, the Employee on duty will continue to work at the rate of single time.

### **Overtime**

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

Double time the regular rate for work on the following holiday(s).

### **Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

### **Shift Rates**

Off Shift: double time the regular hourly rate.

(Local #15)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

## **ENGINEER - CITY SURVEYOR AND CONSULTANT**

### **Party Chief**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$40.41**

Supplemental Benefit Rate per Hour: **\$22.75**

Supplemental Note: Overtime Benefit Rate - \$27.25 per hour (time & one half) \$31.75 per hour (double time).

### **Instrument Person**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$33.13**

Supplemental Benefit Rate per Hour: **\$22.75**

Supplemental Note: Overtime Benefit Rate - \$27.25 per hour (time & one half) \$31.75 per hour (double time).

### **Rodperson**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$28.54**

Supplemental Benefit Rate per Hour: **\$22.75**

Supplemental Note: Overtime Benefit Rate - \$27.25 per hour (time & one half) \$31.75 per hour (double time).

### **Overtime Description**

Time and one half the regular rate after an 8 hour day, Time and one half the regular rate for Saturday for the first eight hours worked, Double time the regular time rate for Saturday for work performed in excess of eight hours, Double time the regular rate for Sunday and Double time the regular rate for work on a holiday.

### **Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

(Operating Engineer Local #15-D)

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OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**ENGINEER - FIELD (BUILDING CONSTRUCTION)**  
(Construction of Building Projects, Concrete Superstructures, etc.)

**Field Engineer - BC Party Chief**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$65.44**

Supplemental Benefit Rate per Hour: **\$35.12**

Supplemental Note: Overtime Benefit Rate - \$49.33 per hour (time & one half) \$63.54 per hour (double time).

**Field Engineer - BC Instrument Person**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$50.83**

Supplemental Benefit Rate per Hour: **\$35.12**

Supplemental Note: Overtime Benefit Rate - \$49.33 per hour (time & one half) \$63.54 per hour (double time).

**Field Engineer - BC Rodperson**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$32.84**

Supplemental Benefit Rate per Hour: **\$35.12**

Supplemental Note: Overtime Benefit Rate - \$49.33 per hour (time & one half) \$63.54 per hour (double time).

**Overtime Description**

Time and one half the regular rate after a 7 hour work and time and one half the regular rate for Saturday for the first seven hours worked, Double time the regular time rate for Saturday for work performed in excess of seven hours, Double time the regular rate for Sunday and Double time the regular rate for work on a holiday.

**Paid Holidays**

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

(Operating Engineer Local #15-D)

## **ENGINEER - FIELD (HEAVY CONSTRUCTION)**

(Construction of Roads, Tunnels, Bridges, Sewers, Building Foundations, Engineering Structures etc.)

### **Field Engineer - HC Party Chief**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$74.18**

Supplemental Benefit Rate per Hour: **\$36.51**

Supplemental Note: Overtime benefit rate - \$51.29 per hour (time & one half), \$66.07 per hour (double time).

### **Field Engineer - HC Instrument Person**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$54.47**

Supplemental Benefit Rate per Hour: **\$36.51**

Supplemental Note: Overtime benefit rate - \$51.29 per hour (time & one half), \$66.07 per hour (double time).

### **Field Engineer - HC Rodperson**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$45.70**

Supplemental Benefit Rate per Hour: **\$36.51**

Supplemental Note: Overtime benefit rate - \$51.29 per hour (time & one half), \$66.07 per hour (double time).

### **Overtime Description**

Time and one half the regular rate after an 8 hour day, Time and one half the regular rate for Saturday for the first eight hours worked, Double time the regular time rate for Saturday for work performed in excess of eight hours, Double time the regular rate for Sunday and Double time the regular rate for work on a holiday.

### **Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

(Operating Engineer Local #15-D)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

## **ENGINEER - FIELD (STEEL ERECTION)**

### **Field Engineer - Steel Erection Party Chief**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$69.15**

Supplemental Benefit Rate per Hour: **\$36.01**

Supplemental Note: Overtime benefit rate - \$50.54 per hour (time & one half), \$65.07 per hour (double time).

### **Field Engineer - Steel Erection Instrument Person**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$53.88**

Supplemental Benefit Rate per Hour: **\$36.01**

Supplemental Note: Overtime benefit rate - \$50.54 per hour (time & one half), \$65.07 per hour (double time).

### **Field Engineer - Steel Erection Rodperson**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$36.04**

Supplemental Benefit Rate per Hour: **\$36.01**

Supplemental Note: Overtime benefit rate - \$50.54 per hour (time & one half), \$65.07 per hour (double time).

### **Overtime Description**

Time and one half the regular rate for Saturday for the first eight hours worked.

Double time the regular rate for Saturday for work performed in excess of eight hours.

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Double time the regular rate for Sunday.

Double time the regular rate for work on the following holiday(s).

### **Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

(Operating Engineer Local #15-D)

## **ENGINEER - OPERATING**

### **Operating Engineer - Road & Heavy Construction I**

Back Filling Machines, Cranes, Mucking Machines and Dual Drum Paver.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$81.17

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$129.87

### **Operating Engineer - Road & Heavy Construction II**

Backhoes, Power Shovels, Hydraulic Clam Shells, Steel Erection, Moles and machines of a similar nature.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$84.01

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$134.42

### **Operating Engineer - Road & Heavy Construction III**

Mine Hoists, Cranes, etc. (Used as Mine Hoists)

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$86.69

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$138.70

### **Operating Engineer - Road & Heavy Construction IV**

Gradealls, Keystones, Cranes on land or water (with digging buckets), Bridge Cranes, Vermeer Cutter and machines of a similar nature, Trenching Machines.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$84.62

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$135.39

### **Operating Engineer - Road & Heavy Construction V**

Pile Drivers & Rigs (employing Dock Builder foreperson): Derrick Boats, Tunnel Shovels.

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$82.96**  
Supplemental Benefit Rate per Hour: **\$32.95**  
Supplemental Note: \$59.95 overtime hours  
Shift Wage Rate: **\$132.74**

**Operating Engineer - Road & Heavy Construction VI**

Mixers (Concrete with loading attachment), Concrete Pavers, Cableways, Land Derricks, Power Houses (Low Air Pressure Units).

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$78.85**  
Supplemental Benefit Rate per Hour: **\$32.95**  
Supplemental Note: \$59.95 overtime hours  
Shift Wage Rate: **\$126.16**

**Operating Engineer - Road & Heavy Construction VII**

Barrier Movers , Barrier Transport and Machines of a Similar Nature.

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$63.81**  
Supplemental Benefit Rate per Hour: **\$32.95**  
Supplemental Note: \$59.95 overtime hours  
Shift Wage Rate: **\$102.10**

**Operating Engineer - Road & Heavy Construction VIII**

Utility Compressors

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$49.67**  
Supplemental Benefit Rate per Hour: **\$32.95**  
Supplemental Note: \$59.95 overtime hours  
Shift Wage Rate: **\$62.44**

**Operating Engineer - Road & Heavy Construction IX**

Horizontal Boring Rig

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$75.02**  
Supplemental Benefit Rate per Hour: **\$32.95**  
Supplemental Note: \$59.95 overtime hours  
Shift Wage Rate: **\$120.03**

**Operating Engineer - Road & Heavy Construction X**

Elevators (manually operated as personnel hoist).

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$69.01

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$110.42

**Operating Engineer - Road & Heavy Construction XI**

Compressors (Portable 3 or more in battery), Driving of Truck Mounted Compressors, Well-point Pumps, Tugger Machines Well Point Pumps, Churn Drill.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$53.74

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$85.98

**Operating Engineer - Road & Heavy Construction XII**

All Drills and Machines of a similar nature.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$79.68

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$127.49

**Operating Engineer - Road & Heavy Construction XIII**

Concrete Pumps, Concrete Plant, Stone Crushers, Double Drum Hoist, Power Houses (other than above).

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$77.19

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$123.50

**Operating Engineer - Road & Heavy Construction XIV**

Concrete Mixer

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$73.82

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$118.11

**Operating Engineer - Road & Heavy Construction XV**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Compressors (Portable Single or two in Battery, not over 100 feet apart), Pumps (River Cofferdam) and Welding Machines, Push Button Machines, All Engines Irrespective of Power (Power-Pac) used to drive auxiliary equipment, Air, Hydraulic, etc.**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$49.99**

**Supplemental Benefit Rate per Hour: \$32.95**

**Supplemental Note: \$59.95 overtime hours**

**Shift Wage Rate: \$79.98**

**Operating Engineer - Road & Heavy Construction XVI**

**Concrete Breaking Machines, Hoists (Single Drum), Load Masters, Locomotives (over ten tons) and Dinkies over ten tons, Hydraulic Crane-Second Engineer.**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$70.53**

**Supplemental Benefit Rate per Hour: \$32.95**

**Supplemental Note: \$59.95 overtime hours**

**Shift Wage Rate: \$112.85**

**Operating Engineer - Road & Heavy Construction XVII**

**On-Site concrete plant engineer, On-site Asphalt Plant Engineer, and Vibratory console.**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$71.06**

**Supplemental Benefit Rate per Hour: \$32.95**

**Supplemental Note: \$59.95 overtime hours**

**Shift Wage Rate: \$113.70**

**Operating Engineer - Road & Heavy Construction XVIII**

**Tower Crane**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$101.71**

**Supplemental Benefit Rate per Hour: \$32.95**

**Supplemental Note: \$59.95 overtime hours**

**Shift Wage Rate: \$162.74**

**Operating Engineer - Paving I**

**Asphalt Spreaders, Autogrades (C.M.I.), Roto/Mil**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$78.85**

**Supplemental Benefit Rate per Hour: \$32.95**

**Supplemental Note: \$59.95 overtime hours**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Shift Wage Rate: \$126.16

**Operating Engineer - Paving II**

Asphalt Roller

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$76.83

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$122.93

**Operating Engineer - Paving III**

Asphalt Plants

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$65.08

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

Shift Wage Rate: \$104.13

**Operating Engineer - Concrete I**

Cranes

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$84.25

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Concrete II**

Compressors

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$50.37

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Concrete III**

Micro-traps (Negative Air Machines), Vac-All Remediation System.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$67.45

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Operating Engineer - Steel Erection I**

Three Drum Derricks

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$87.14**

Supplemental Benefit Rate per Hour: **\$32.95**

Supplemental Note: **\$59.95** overtime hours

Shift Wage Rate: **\$139.42**

**Operating Engineer - Steel Erection II**

Cranes, 2 Drum Derricks, Hydraulic Cranes, Fork Lifts and Boom Trucks.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$83.75**

Supplemental Benefit Rate per Hour: **\$32.95**

Supplemental Note: **\$59.95** overtime hours

Shift Wage Rate: **\$134.00**

**Operating Engineer - Steel Erection III**

Compressors, Welding Machines.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$49.95**

Supplemental Benefit Rate per Hour: **\$32.95**

Supplemental Note: **\$59.95** overtime hours

Shift Wage Rate: **\$79.92**

**Operating Engineer - Steel Erection IV**

Compressors - Not Combined with Welding Machine.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$47.58**

Supplemental Benefit Rate per Hour: **\$32.95**

Supplemental Note: **\$59.95** overtime hours

Shift Wage Rate: **\$76.13**

**Operating Engineer - Building Work I**

Forklifts, Plaster (Platform machine), Plaster Bucket, Concrete Pump and all other equipment used for hoisting material.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$69.51**

Supplemental Benefit Rate per Hour: **\$32.95**

Supplemental Note: **\$59.95** overtime hours

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Operating Engineer - Building Work II**

Compressors, Welding Machines (Cutting Concrete-Tank Work), Paint Spraying, Sandblasting, Pumps (with the exclusion of Concrete Pumps), All Engines irrespective of Power (Power-Pac) used to drive Auxiliary Equipment, Air, Hydraulic, Jacking System, etc.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$52.21

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Building Work III**

Double Drum

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$79.02

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Building Work IV**

Stone Derrick, Cranes, Hydraulic Cranes Boom Trucks.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$83.68

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Building Work V**

Dismantling and Erection of Cranes, Relief Engineer.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$77.15

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Building Work VI**

4 Pole Hoist, Single Drum Hoists.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$76.35

Supplemental Benefit Rate per Hour: \$32.95

Supplemental Note: \$59.95 overtime hours

**Operating Engineer - Building Work VII**

Jack & Pinion and House Cars

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$60.84**

**Supplemental Benefit Rate per Hour: \$32.95**

**Supplemental Note: \$59.95 overtime hours**

**For New House Car projects Wage Rate per Hour \$48.70**

### **Overtime Description**

On jobs of more than one shift, if an Employee fails to report for work through any cause over which the Employer has no control, the Employee on duty will continue to work at the rate of single time.

For House Cars and Rack & Pinion only: Overtime paid at time and one-half for all hours in excess of eight hours in a day, Saturday, Sunday and Holidays worked.

### **Overtime**

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

Double time the regular rate for work on the following holiday(s).

### **Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

### **Shift Rates**

For Steel Erection Only: Shifts may be worked at the single time rate at other than the regular working hours (8:00 A.M. to 4:30 P.M.) on the following work ONLY: Heavy construction jobs on work below the street level, over railroad tracks and on building jobs.

(Operating Engineer Local #14)

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## **FLOOR COVERER**

(Interior vinyl composition tile, sheath vinyl linoleum and wood parquet tile including site preparation and synthetic turf not including site preparation)

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Floor Coverer**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$50.50**

Supplemental Benefit Rate per Hour: **\$45.98**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Paid Holidays**

1/2 day on Christmas Eve if work is performed in the A.M.

1/2 day on New Year's Eve if work is performed in the A.M.

**Shift Rates**

Two shifts may be utilized with the first shift working 8 a.m. to the end of the shift at straight time rate of pay. The wage rate for the second shift consisting of 7 hours shall be paid at 114.29% of straight time wage rate. The wage rate for the second shift consisting of 8 hours shall be paid 112.5% of the straight time wage rate. There must be a first shift to work the second shift.

(Carpenters District Council)

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**GLAZIER**

**(New Construction, Remodeling, and Alteration)**

**Glazier**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$46.05**

Supplemental Benefit Rate per Hour: **\$43.39**

Supplemental Note: Supplemental Benefit Overtime Rate: **\$65.10**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

### Overtime Holidays

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### Paid Holidays

None

### Shift Rates

Shifts shall be any 8 consecutive hours after the normal working day for which the Glazier shall receive 9 hours pay for 8 hours worked.

(Local #1281)

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## GLAZIER - REPAIR & MAINTENANCE

(For the Installation of Glass - All repair and maintenance work on a particular building, whenever performed, where the total cumulative contract value is under \$141,750)

### Craft Jurisdiction for repair, maintenance and fabrication

Plate glass replacement, Residential glass replacement, Residential mirrors and shower doors, Storm windows and storm doors, Residential replacement windows, Herculite door repairs, Door closer repairs, Retrofit apartment house (non-commercial buildings), Glass tinting.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$25.64

Supplemental Benefit Rate per Hour: \$22.29

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Sunday.

Time and one half the regular rate for work on the following holiday(s).

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Time and one half the regular hourly rate after 40 hours in any work week.

**Paid Holidays**

New Year's Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

Employees must work at least one day in the payroll week in which the holiday occurs to receive the paid holiday

(Local #1281)

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**HAZARDOUS MATERIAL HANDLER**

(Removal, abatement, encapsulation or decontamination of asbestos, lead, mold, or other toxic or hazardous waste/materials)

**Handler**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$36.50

Supplemental Benefit Rate per Hour: \$16.45

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Sunday.

Time and one half the regular hourly rate after 40 hours in any work week.

**Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day  
Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Christmas Day  
Easter

**Paid Holidays**

None

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

(Local #78 and Local #12A)

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## HEAT AND FROST INSULATOR

### Heat & Frost Insulator

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$61.46

Supplemental Benefit Rate per Hour: \$40.46

### Overtime Description

Double time shall be paid for supplemental benefits during overtime work.  
8th hour paid at time and one half.

### Overtime

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

Martin Luther King Jr. Day

President's Day

Memorial Day

Independence Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

Triple time the regular rate for work on the following holiday(s).

Labor Day

### Paid Holidays

None

### Shift Rates

The first shift shall work seven hours at the regular straight time rate. The second and third shift shall work seven hours the regular straight time hourly rate plus a fourteen percent wage and benefit premium.

(Local #12) (BCA)

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OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**HOUSE WRECKER  
(TOTAL DEMOLITION)**

**House Wrecker - Tier A**

On all work sites the first, second, eleventh and every third House Wrecker thereafter will be Tier A House Wreckers (i.e. 1st, 2nd, 11th, 14th etc). Other House Wreckers may be Tier B House Wreckers.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$37.18

Supplemental Benefit Rate per Hour: \$29.77

**House Wrecker - Tier B**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$26.41

Supplemental Benefit Rate per Hour: \$22.18

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

(Mason Tenders District Council)

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**IRON WORKER - ORNAMENTAL**

**Iron Worker - Ornamental**

Effective Period: 7/1/2019 - 6/30/2020



**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Wage Rate per Hour: \$45.15**

**Supplemental Benefit Rate per Hour: \$55.62**

**Supplemental Note:** Supplemental benefits are to be paid at the applicable overtime rate when overtime is in effect.

### **Overtime Description**

Time and one half the regular rate after a 7 hour day for a maximum of two hours on any regular work day (the 8th and 9th hour) and double time shall be paid for all work on a regular work day thereafter, time and one half the regular rate for Saturday for the first seven hours of work and double time shall be paid for all work on a Saturday thereafter.

### **Overtime**

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

### **Paid Holidays**

None

### **Shift Rates**

For off shift work - 8 hours pay for 7 hours of work. When two or three shifts are employed on a job, Monday through Friday, the workday for each shift shall be seven hours and paid for ten and one-half hours at the single time rate. When two or three shifts are worked on Saturday, Sunday or holidays, each shift shall be seven hours and paid fifteen and three-quarters hours.

(Local #580)

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## **IRON WORKER - STRUCTURAL**

### **Iron Worker - Structural**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$51.05**

**Supplemental Benefit Rate per Hour: \$76.89**

**Supplemental Note:** Supplemental benefits are to be paid at the applicable overtime rate when overtime is in effect.

### **Overtime Description**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

Monday through Friday- the first eight hours are paid at straight time, the 9th and 10th hours are paid at time and one-half the regular rate, all additional weekday overtime is paid at double the regular rate. Saturdays- the first eight hours are paid at time and one-half the regular rate, double time thereafter. Sunday-all shifts are paid at double time.

### **Overtime**

Time and one half the regular rate after an 8 hour day.  
Time and one half the regular rate for Saturday.  
Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Christmas Day

### **Paid Holidays**

1/2 day on Christmas Eve if work is performed in the A.M.  
1/2 day on New Year's Eve if work is performed in the A.M.

### **Shift Rates**

Monday through Friday - First Shift: First eight hours are paid at straight time, the 9th & 10th hours are paid at time and a half, double time paid thereafter. Second and third Shifts: First eight hours are paid at time and one-half, double time thereafter. Saturdays: All shifts, first eight hours paid at time and one-half, double time thereafter: Sunday all shifts are paid at double time.

(Local #40 & #361)

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## **LABORER**

**(Foundation, Concrete, Excavating, Street Pipe Layer and Common)**

### **Laborer**

Excavation and foundation work for buildings, heavy construction, engineering work, and hazardous waste removal in connection with the above work. Landscaping tasks in connection with heavy construction work, engineering work and building projects. Projects include, but are not limited to pollution plants, sewers, parks, subways, bridges, highways, etc.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$42.65**

Supplemental Benefit Rate per Hour: **\$44.48**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

### **Overtime**

Time and one half the regular rate after an 8 hour day.  
Time and one half the regular rate for Saturday.  
Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Thanksgiving Day  
Christmas Day

### **Paid Holidays**

Labor Day  
Thanksgiving Day

### **Shift Rates**

When two shifts are employed, single time rate shall be paid for each shift. When three shifts are found necessary, each shift shall work seven and one half hours (7 ½), but shall be paid for eight (8) hours of labor, and be permitted one half hour for lunch.

(Local #731)

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## **LANDSCAPING**

(Landscaping tasks, as well as tree pruning, tree removing, spraying and maintenance in connection with the planting of street trees and the planting of trees in city parks but not when such activities are performed as part of, or in connection with, other construction or reconstruction projects.)

### **Landscaper (Year 6 and above)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$31.75**  
Supplemental Benefit Rate per Hour: **\$16.05**

### **Landscaper (Year 3 - 5)**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: **\$30.72**  
Supplemental Benefit Rate per Hour: **\$16.05**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Landscaper (up to 3 years)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$28.14

Supplemental Benefit Rate per Hour: \$16.05

**Groundperson**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$28.14

Supplemental Benefit Rate per Hour: \$16.05

**Tree Remover / Pruner**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$36.92

Supplemental Benefit Rate per Hour: \$16.05

**Landscaper Sprayer (Pesticide Applicator)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$26.59

Supplemental Benefit Rate per Hour: \$16.05

**Watering - Plant Maintainer**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$21.40

Supplemental Benefit Rate per Hour: \$16.05

**Overtime Description**

For all overtime work performed, supplemental benefits shall include an additional seventy-five (\$0.75) cents per hour.

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Time and one half the regular rate for work on a holiday plus the day's pay.

**Paid Holidays**

New Year's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

**Shift Rates**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Work performed on a 4pm to 12am shift has a 15% differential. Work performed on a 12am to 8am shift has a 20% differential.

(Local #175)

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## **MARBLE MECHANIC**

### **Marble Setter**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$54.44**

Supplemental Benefit Rate per Hour: **\$40.77**

### **Marble Finisher**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$42.86**

Supplemental Benefit Rate per Hour: **\$38.22**

### **Marble Polisher**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$39.81**

Supplemental Benefit Rate per Hour: **\$30.35**

### **Marble Maintenance Finisher**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$24.31**

Supplemental Benefit Rate per Hour: **\$13.34**

## **Overtime Description**

Supplemental Benefit contributions are to be made at the applicable overtime rates. Time and one half the regular rate after a 7 hour day or time and one half the regular rate after an 8 hour day - chosen by Employer at the start of the project and then would last for the full duration of the project.

## **Overtime**

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

## **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Good Friday

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

**Paid Holidays**

None

(Local #7)

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**MASON TENDER**

**Mason Tender**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$38.40**

Supplemental Benefit Rate per Hour: **\$31.04**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

**Shift Rates**

The employer may work two (2) shifts with the first shift at the straight time wage rate and the second shift receiving eight (8) hours paid for seven (7) hours work at the straight time wage rate. When it is not possible to conduct alteration work during regular working hours in a building occupied by tenants, the rule for the second shift will apply.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

(Local #79)

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## MASON TENDER (INTERIOR DEMOLITION WORKER)

### Mason Tender Tier A

Tier A Interior Demolition Worker performs all burning, chopping, and other technically skilled tasks related to interior demolition work.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$36.44**

Supplemental Benefit Rate per Hour: **\$24.50**

### Mason Tender Tier B

Tier B Interior Demolition Worker performs manual work and work incidental to demolition work, such as loading and carting of debris from the work site to an area where it can be loaded in to bins/trucks for removal. Also performs clean-up of the site when demolition is completed.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$25.63**

Supplemental Benefit Rate per Hour: **\$18.82**

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

### **Paid Holidays**

None

(Local #79)

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OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

## **METALLIC LATHER**

### **Metallic Lather**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$46.23**

Supplemental Benefit Rate per Hour: **\$46.67**

Supplemental Note: Overtime Supplemental Benefit rate - \$57.92

### **Overtime Description**

Overtime would be time and one half the regular rate after a seven (7) or eight (8) hours workday, which would be set at the start of the job.

### **Overtime**

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day  
Washington's Birthday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Thanksgiving Day  
Christmas Day

### **Paid Holidays**

1/2 day on Christmas Eve if work is performed in the A.M.

1/2 day on New Year's Eve if work is performed in the A.M.

### **Shift Rates**

There will be no shift differential paid on the first shift if more than one shift is employed. The shift differential will remain \$12/hour on the second and third shift for the first eight (8) hours if worked. There will be no pyramiding on overtime worked on second and third shifts. The time and one half (1.5x) rate will be against the base wage rate, not the shift differential

(Local #46)

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## **MILLWRIGHT**

### **Millwright**

Effective Period: 7/1/2019 - 6/30/2020



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Wage Rate per Hour: \$54.20

Supplemental Benefit Rate per Hour: \$53.81

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

### Paid Holidays

1/2 day on Christmas Eve if work is performed in the A.M.

1/2 day on New Year's Eve if work is performed in the A.M.

### Shift Rates

The first shift shall receive the straight time rate of pay. The second shift receives the straight time rate of pay plus fifteen (15%) per cent. Members of the second shift shall be allowed one half hour to eat, with this time being included in the hours of the workday established. There must be a first shift to work a second shift. All additional hours worked shall be paid at the time and one-half rate of pay plus fifteen (15%) per cent for weekday hours.

(Local #740)

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## MOSAIC MECHANIC

### Mosaic Mechanic - Mosaic & Terrazzo Mechanic

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$49.91

Supplemental Benefit Rate per Hour: \$43.24

### Mosaic Mechanic - Mosaic & Terrazzo Finisher

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$48.31

Supplemental Benefit Rate per Hour: \$43.24

**Mosaic Mechanic - Machine Operator Grinder**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$48.31

Supplemental Benefit Rate per Hour: \$43.24

**Overtime**

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

Washington's Birthday

Good Friday

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Paid Holidays**

None

(Local #7)

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**PAINTER**

**Painter - Brush & Roller**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$43.00

Supplemental Benefit Rate per Hour: \$32.49

Supplemental Note: \$ 37.75 on overtime

**Spray & Scaffold / Decorative / Sandblast**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$46.00

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Supplemental Benefit Rate per Hour: \$32.49

Supplemental Note: \$ 37.75 on overtime

### Overtime

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

### Overtime Holidays

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Thanksgiving Day

Christmas Day

### Paid Holidays

None

(District Council of Painters #9)

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## PAINTER - LINE STRIPING (ROADWAY)

### Striping - Machine Operator

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$35.00

Supplemental Benefit Rate per Hour: \$12.37

Supplemental Note: Overtime Supplemental Benefit rate - \$8.02; New Hire Rate (0-3 months) - \$0.00

### Lineperson (Thermoplastic)

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$39.00

Supplemental Benefit Rate per Hour: \$12.37

Supplemental Note: Overtime Supplemental Benefit rate - \$8.02; New Hire Rate (0-3 months) - \$0.00

### Overtime Description

For Paid Holidays: Employees will only receive Holiday Pay for holidays not worked if said employee worked both the weekday before and the weekday after the holiday.

### Overtime

Time and one half the regular rate after an 8 hour day.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

Time and one half the regular rate for work on the following holiday(s).

### **Paid Holidays**

New Year's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### **Shift Rates**

Four (4), ten (10) hour days may be worked at straight time during a week, Monday thru Thursday.

Friday may be used as a make-up day.

### **Vacation**

Employees with one to two years service shall accrue vacation based on hours worked: 250 hours worked - 1 day vacation; 500 hours worked - 2 days vacation; 750 hours worked - 3 days vacation; 900 hours worked - 4 days vacation; 1,000 hours worked - 5 days vacation. Employees with two to five years service receive two weeks vacation. Employees with five to twenty years service receive three weeks vacation. Employees with twenty to twenty-five years service receive four weeks vacation. Employees with 25 or more years service receive five weeks vacation. Vacation must be taken during winter months.

(Local #1010)

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## **PAINTER - METAL POLISHER**

### **METAL POLISHER**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$30.58

Supplemental Benefit Rate per Hour: \$7.16

### **METAL POLISHER - NEW CONSTRUCTION**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$31.53

Supplemental Benefit Rate per Hour: \$7.16

### **METAL POLISHER - SCAFFOLD OVER 34 FEET**

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Wage Rate per Hour: \$34.08

Supplemental Benefit Rate per Hour: \$7.16

### Overtime Description

All work performed on Saturdays shall be paid at time-in-a half. The exception being; for suspended scaffold work and work deemed as a construction project; an eight (8) hour shift lost during the week due to circumstances beyond the control of the employer, up to a maximum of eight (8) hours per week, may be worked on Saturday at the straight time rate.

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

Triple time the regular rate for work on the following holiday(s).

### Paid Holidays

New Year's Day

Martin Luther King Jr. Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### Shift Rates

Four Days a week at Ten (10) hours straight a day.

Local 8A-28A

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## PAINTER - SIGN

### Sign Painter

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$41.98

Supplemental Benefit Rate per Hour: \$20.10

### Assistant Sign Painter

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Wage Rate per Hour: \$35.67

Supplemental Benefit Rate per Hour: \$18.47

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

Double time the regular rate for work on the following holiday(s).

### Paid Holidays

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Election Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### Vacation

At least 1 year of employment.....1 week

2 years or more of employment.....2 weeks

8 years or more of employment.....3 weeks

(Local #8A-28A)

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## PAINTER - STRUCTURAL STEEL

### Painters on Structural Steel

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$49.50

Supplemental Benefit Rate per Hour: \$41.83

### Painter - Power Tool

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$55.50

Supplemental Benefit Rate per Hour: \$41.83

Overtime Wage Rate: \$6.00 above the "Painters on Structural Steel" overtime rate.

### Overtime Description

Supplemental Benefits shall be paid for each hour worked, up to forty (40) hours per week for the period of May 1st to November 15th or up to fifty (50) hours per week for the period of November 16th to April 30th.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

### Overtime

Time and one half the regular rate after a 7 hour day.  
Time and one half the regular rate for Saturday.  
Time and one half the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Christmas Day

### Paid Holidays

None

### Shift Rates

Regular hourly rates plus a ten per cent (10%) differential

(Local #806)

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## PAPERHANGER

### Paperhanger

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$45.40

Supplemental Benefit Rate per Hour: \$34.74

Supplemental Note: Supplemental benefits are to be paid at the appropriate straight time and overtime rate.

### Overtime

Time and one half the regular rate after a 7 hour day.  
Time and one half the regular rate for Saturday.  
Time and one half the regular rate for Sunday.

### Overtime Holidays

Time and one half the regular rate for work on the following holiday(s).

New Year's Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Paid Holidays**

None

**Shift Rates**

Evening shift - 4:30 P.M. to 12:00 Midnight (regular rate of pay); any work performed before 7:00 A.M. shall be at time and one half the regular base rate of pay.

(District Council of Painters #9)

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**PAVER AND ROADBUILDER**

**Paver & Roadbuilder - Formsetter**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$46.85**

Supplemental Benefit Rate per Hour: **\$44.86**

Supplemental Note: For time and one half overtime - \$48.74 For double overtime - \$52.61

**Paver & Roadbuilder - Laborer**

Paving and road construction work, regardless of material used, including but not limited to preparation of job sites, removal of old surfaces, asphalt and/or concrete, by whatever method, including but not limited to milling; laying of concrete; laying of asphalt for temporary, patchwork, and utility paving (but not production paving); site preparation and incidental work for installation of rubberized materials and similar surfaces; installation and repair of temporary construction fencing; slurry/seal coating, paving stones, maintenance of safety surfaces; play equipment installation, and other related work.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$42.98**

Supplemental Benefit Rate per Hour: **\$44.86**

Supplemental Note: For time and one half overtime - \$48.74 For double overtime - \$52.61

**Production Paver & Roadbuilder - Screed Person**

(Production paving is asphalt paving when using a paving machine or on a project where a paving machine is traditionally used)

Adjustment of paving machinery on production paving jobs.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$47.45**

Supplemental Benefit Rate per Hour: **\$44.86**

Supplemental Note: For time and one half overtime - \$48.74 For double overtime - \$52.61

**Production Paver & Roadbuilder - Raker**



**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$46.85**

**Supplemental Benefit Rate per Hour: \$44.86**

**Supplemental Note: For time and one half overtime - \$48.74 For double overtime - \$52.61**

**Production Paver & Roadbuilder - Shoveler**

**General laborer (except removal of surfaces - see Paver and Roadbuilder-Laborer) including but not limited to tamper, AC paint and liquid tar work.**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$42.98**

**Supplemental Benefit Rate per Hour: \$44.86**

**Supplemental Note: For time and one half overtime - \$48.74 For double overtime - \$52.61**

**Overtime Description**

**If an employee works New Year's Day or Christmas Day, they receive the single time rate plus 25%.**

**For Paid Holidays: Holiday pay for all holidays shall be prorated based two hours per day for each day worked in the holiday week, not to exceed 8 hours of holiday pay.**

**Overtime**

**Time and one half the regular rate after an 8 hour day.**

**Time and one half the regular rate for Saturday.**

**Double time the regular rate for Sunday.**

**Overtime Holidays**

**Double time the regular rate for work on the following holiday(s).**

**Memorial Day**

**Independence Day**

**Labor Day**

**Columbus Day**

**Thanksgiving Day**

**Paid Holidays**

**Memorial Day**

**Independence Day**

**Labor Day**

**Thanksgiving Day**

**Shift Rates**

**When two shifts are employed, the work period for each shift shall be a continuous eight (8) hours. When three shifts are employed, each shift will work seven and one half (7 ½) hours but will be paid for eight (8) hours since only one half (1/2) hour is allowed for meal time.**

**When two or more shifts are employed, single time will be paid for each shift.**

**Night Work - On night work, the first eight (8) hours of work will be paid for at the single time rate, except that production paving work shall be paid at 10% over the single time rate for the screed person, rakers and shovelers directly involved only. This differential is to be paid when there is only one shift and the shift works at night. All other workers will be exempt. Hours worked over eight (8) hours during said shift shall be paid for at the time and one-half rate.**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

(Local #1010)

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## PLASTERER

### Plasterer

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$45.93**

Supplemental Benefit Rate per Hour: **\$26.52**

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

### Paid Holidays

None

### Shift Rates

When it is not possible to conduct work during regular working hours (between 6:30am and 4:30pm), a shift differential shall be paid at the regular hourly rate plus a twelve per cent (12%) per hour differential. Workers on shift work shall be allowed a paid one-half hour meal break.

(Local #262)

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## PLASTERER - TENDER

### Plasterer - Tender

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$38.40**

Supplemental Benefit Rate per Hour: **\$31.04**

## Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

## Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

Washington's Birthday

Memorial Day

Independence Day

Labor Day

Presidential Election Day

Thanksgiving Day

Christmas Day

## Paid Holidays

None

## Shift Rates

When work commences outside regular work hours, workers receive an hour additional (differential) wage and supplement payment. Eight hours pay for seven hours work or nine hours pay for eight hours work.

(Mason Tenders District Council)

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# PLUMBER

## Plumber

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$69.00**

Supplemental Benefit Rate per Hour: **\$37.20**

Supplemental Note: Supplemental benefit contributions are to be made at the applicable overtime rates.

## Plumber - Temporary Services

Temporary Services - When there are no Plumbers on the job site, there may be three shifts designed to cover the entire twenty-four hour period, including weekends if necessary, at the following rate straight time.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$55.28

Supplemental Benefit Rate per Hour: \$29.68

### Overtime Description

Double time the regular rate after a 7 hour day - unless for new construction site work where the plumbing contract price is \$1.5 million or less, the hours of labor can be 8 hours per day at the employers option. On Alteration jobs when other mechanical trades at the site are working an eighth hour at straight time, then the plumber shall also work an eighth hour at straight time.

### Overtime

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### Shift Rates

Shift work, when directly specified in public agency or authority documents where plumbing contract is \$8 million or less, will be permitted. 30% shift premium shall be paid for wages and fringe benefits for 4:00 pm and midnight shifts Monday to Friday. 50% shift premium shall be paid for wages and fringe benefits for 4:00 pm and midnight shift work performed on weekends. For shift work on holidays, double time wages and fringe benefits shall be paid.

(Plumbers Local #1)

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## PLUMBER (MECHANICAL EQUIPMENT AND SERVICE)

(Mechanical Equipment and Service work shall include any repair and/or replacement of the present plumbing system.)

### Plumber

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$43.05

Supplemental Benefit Rate per Hour: \$17.71

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

**Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Paid Holidays**

None

(Plumbers Local # 1)

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**PLUMBER (RESIDENTIAL RATES FOR 1, 2 AND 3 FAMILY HOME  
CONSTRUCTION)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$47.89**

Supplemental Benefit Rate per Hour: **\$26.74**

**Overtime**

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Paid Holidays**

None

**Shift Rates**

30% shift premium shall be paid for wages and fringe benefits for 4:00 pm and midnight shifts Monday to Friday.  
50% shift premium shall be paid for wages and fringe benefits for 4:00 pm and midnight shift work performed on weekends. For shift work on holidays, double time wages and fringe benefits shall be paid.

(Plumbers Local #1)

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**PLUMBER: PUMP & TANK**

Oil Trades (Installation and Maintenance)

**Plumber - Pump & Tank**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$67.45

Supplemental Benefit Rate per Hour: \$25.26

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

**Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Paid Holidays**

None

**Shift Rates**

All work outside the regular workday (8:00 A.M. to 3:30 P.M.) is to be paid at time and one half the regular hourly rate

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

(Plumbers Local #1)

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**POINTER, WATERPROOFER, CAULKER, SANDBLASTER,  
STEAMBLASTER**  
(Exterior Building Renovation)

**Journey person**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$53.42**

Supplemental Benefit Rate per Hour: **\$26.52**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

**Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

Martin Luther King Jr. Day

President's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

**Shift Rates**

All work outside the regular work day (an eight hour workday between the hours of 6:00 A.M. and 4:30 P.M.) is to be paid at time and one half the regular rate.

(Bricklayer District Council)

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**ROOFER**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Roofer**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$43.50**

Supplemental Benefit Rate per Hour: **\$33.81**

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

**Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day

Memorial Day

Independence Day

Labor Day

Thanksgiving Day

Christmas Day

**Paid Holidays**

None

**Shift Rates**

Second shift - Regular hourly rate plus a 10% differential. Third shift - Regular hourly rate plus a 15% differential.

(Local #8)

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**SHEET METAL WORKER**

**Sheet Metal Worker**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$50.15**

Supplemental Benefit Rate per Hour: **\$50.55**

Supplemental Note: Supplemental benefit contributions are to be made at the applicable overtime rates.

**Sheet Metal Worker - Fan Maintenance**

(The temporary operation of fans or blowers in new or existing buildings for heating and/or ventilation, and/or air conditioning prior to the completion of the project.)

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$40.12**

Supplemental Benefit Rate per Hour: **\$50.55**



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Sheet Metal Worker - Duct Cleaner**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$16.08

Supplemental Benefit Rate per Hour: \$11.63

**Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

**Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

Martin Luther King Jr. Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Paid Holidays**

None

**Shift Rates**

Work that can only be performed outside regular working hours (eight hours of work between 7:30 A.M. and 3:30 P.M.) - First shift (work between 3:30 P.M. and 11:30 P.M.) - 10% differential above the established hourly rate.

Second shift (work between 11:30 P.M. and 7:30 A.M.) - 15% differential above the established hourly rate.

For Fan Maintenance: On all full shifts of fan maintenance work the straight time hourly rate of pay will be paid for each shift, including nights, Saturdays, Sundays, and holidays.

(Local #28)

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**SHEET METAL WORKER - SPECIALTY**  
**(Decking & Siding)**

**Sheet Metal Specialty Worker**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

The first worker to perform this work must be paid at the rate of the Sheet Metal Worker. The second and third workers shall be paid the Specialty Worker Rate. The ratio of One Sheet Metal Worker, then Two Specialty Workers shall be utilized thereafter.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$46.30**

Supplemental Benefit Rate per Hour: **\$25.95**

Supplemental Note: Supplemental benefit contributions are to be made at the applicable overtime rates.

### **Overtime**

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

Martin Luther King Jr. Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Christmas Day

### **Paid Holidays**

None

(Local #28)

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## **SHIPYARD WORKER**

### **Shipyard Mechanic - First Class**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$28.50**

Supplemental Benefit Rate per Hour: **\$3.95**

### **Shipyard Mechanic - Second Class**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$19.07**

Supplemental Benefit Rate per Hour: **\$3.59**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Shipyard Laborer - First Class**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$23.40  
Supplemental Benefit Rate per Hour: \$3.75

**Shipyard Laborer - Second Class**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$17.38  
Supplemental Benefit Rate per Hour: \$3.52

**Shipyard Dockhand - First Class**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$21.57  
Supplemental Benefit Rate per Hour: \$3.68

**Shipyard Dockhand - Second Class**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$17.28  
Supplemental Benefit Rate per Hour: \$3.52

**Overtime Description**

Work performed on holiday is paid double time the regular hourly wage rate plus holiday pay.

**Overtime**

Time and one half the regular rate after an 8 hour day.  
Time and one half the regular rate for Saturday.  
Double time the regular rate for Sunday.  
Time and one half the regular hourly rate after 40 hours in any work week.

**Paid Holidays**

New Year's Day  
Martin Luther King Jr. Day  
President's Day  
Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Day after Thanksgiving  
Christmas Day

Based on Survey Data

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**SIGN ERECTOR**  
(Sheet Metal, Plastic, Electric, and Neon)

**Sign Erector**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$49.35

Supplemental Benefit Rate per Hour: \$54.63

**Overtime**

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

Time and one half the regular rate for work on the following holiday(s).

**Paid Holidays**

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Election Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

**Shift Rates**

Time and one half the regular hourly rate is to be paid for all hours worked outside the regular workday either (7:00 A.M. through 2:30 P.M.) or (8:00 A.M. through 3:30 P.M.)

(Local #137)

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**STEAMFITTER**

**Steamfitter I**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$57.50

Supplemental Benefit Rate per Hour: \$57.29

Supplemental Note: Overtime supplemental benefit rate: \$113.84

**Steamfitter -Temporary Services**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

The steamfitters shall not do any other work and shall not be permitted to work more than one shift in a twenty-four hour day. When steamfitters are present during the regular working day, no temporary services steamfitter will be required

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$43.70**

Supplemental Benefit Rate per Hour: **\$46.54**

### **Overtime**

Double time the regular rate after a 7 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### **Paid Holidays**

None

### **Shift Rates**

Work performed between 3:30 P.M. and 7:00 A.M. and on Saturdays, Sundays and Holidays shall be at double time the regular hourly rate and paid at the overtime supplemental benefit rate above.

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### **Steamfitter II**

For heating, ventilation, air conditioning and mechanical public work contracts with a dollar value not to exceed \$30,000,000 and for fire protection/sprinkler public work contracts not to exceed \$3,000,000.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$57.50**

Supplemental Benefit Rate per Hour: **\$57.29**

Supplemental Note: Overtime supplemental benefit rate: \$113.84

### **Steamfitter -Temporary Services**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

The steamfitters shall not do any other work and shall not be permitted to work more than one shift in a twenty-four hour day. When steamfitters are present during the regular working day, no temporary services steamfitter will be required.

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$43.70**

Supplemental Benefit Rate per Hour: **\$46.54**

### **Overtime**

Double time the regular rate after an 8 hour day.

Double time the regular time rate for Saturday.

Double time the regular rate for Sunday.

### **Overtime Holidays**

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### **Paid Holidays**

None

### **Shift Rates**

May be performed outside of the regular workday except Saturday, Sunday and Holidays. A shift shall consist of eight working hours. All work performed in excess of eight hours shall be paid at double time. No shift shall commence after 7:00 P.M. on Friday or 7:00 P.M. the day before holidays. All work performed after 12:01 A.M. Saturday or 12:01 A.M. the day before a Holiday will be paid at double time. When shift work is performed the wage rate for regular time worked is a 15% percent premium on wage and 15% percent premium on supplemental benefits.

On Transit Authority projects, where work is performed in the vicinity of tracks all shift work on weekends and holidays may be performed at the regular shift rates.

Local #638

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## **STEAMFITTER - REFRIGERATION AND AIR CONDITIONER (Maintenance and Installation Service Person)**

### **Refrigeration and Air Conditioner Mechanic**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$42.35  
Supplemental Benefit Rate per Hour: \$17.46

**Refrigeration and Air Conditioner Service Person V**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$34.80  
Supplemental Benefit Rate per Hour: \$15.59

**Refrigeration and Air Conditioner Service Person IV**

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$28.83  
Supplemental Benefit Rate per Hour: \$14.05

**Refrigeration and Air Conditioner Service Person III**

Filter changing and maintenance thereof, oil and greasing, tower and coil cleaning, scraping and painting, general housekeeping, taking of water samples.

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$24.74  
Supplemental Benefit Rate per Hour: \$12.91

**Refrigeration and Air Conditioner Service Person II**

Filter changing and maintenance thereof, oil and greasing, tower and coil cleaning, scraping and painting, general housekeeping, taking of water samples.

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$20.51  
Supplemental Benefit Rate per Hour: \$11.83

**Refrigeration and Air Conditioner Service Person I**

Filter changing and maintenance thereof, oil and greasing, tower and coil cleaning, scraping and painting, general housekeeping, taking of water samples.

Effective Period: 7/1/2019 - 6/30/2020  
Wage Rate per Hour: \$15.01  
Supplemental Benefit Rate per Hour: \$10.60

**Overtime**

Time and one half the regular rate after an 8 hour day.  
Time and one half the regular rate for Saturday.  
Double time the regular rate for Sunday.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day  
Independence Day  
Labor Day  
Veteran's Day  
Thanksgiving Day  
Christmas Day

Double time and one half the regular rate for work on the following holiday(s).

Martin Luther King Jr. Day  
President's Day  
Memorial Day  
Columbus Day

### Paid Holidays

New Year's Day  
Martin Luther King Jr. Day  
President's Day  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Veteran's Day  
Thanksgiving Day  
Christmas Day

(Local #638B)

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## STONE MASON - SETTER

### Stone Mason - Setter

(Assisted by Derrickperson and Rigger)

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$54.17**

Supplemental Benefit Rate per Hour: **\$42.65**

### Overtime

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Washington's Birthday  
Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Thanksgiving Day  
Christmas Day

### **Paid Holidays**

1/2 day on Christmas Eve if work is performed in the A.M.

### **Shift Rates**

For all work outside the regular workday (8:00 A.M. to 3:30 P.M. Monday through Friday), the pay shall be straight time plus a ten percent (10%) differential.

(Bricklayers District Council)

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## **TAPER**

### **Drywall Taper**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$47.82

Supplemental Benefit Rate per Hour: \$26.81

### **Overtime**

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

### **Overtime Holidays**

Time and one half the regular rate for work on the following holiday(s).

New Year's Day  
Martin Luther King Jr. Day  
President's Day  
Good Friday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Thanksgiving Day  
Christmas Day

### **Paid Holidays**

Any worker who reports to work on Christmas Eve or New Year's Eve pursuant to his employer's instruction shall be entitled to three (3) hours afternoon pay without working.

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

(Local #1974)

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## TELECOMMUNICATION WORKER

(Install/maintain/repair telecommunications cables carrying data, video, and/or voice except for installation on building construction/alteration/renovation projects.)

### Telecommunication Worker

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$44.75**

Supplemental Benefit Rate per Hour: **\$23.15**

Supplemental Note: The above rate applies for Manhattan, Bronx, Brooklyn, Queens. \$22.84 for Staten Island only.

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Time and one half the regular rate for Sunday.

### Overtime Holidays

Time and one half the regular rate for work on the following holiday(s).

New Year's Day  
Lincoln's Birthday  
Washington's Birthday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Election Day  
Veteran's Day  
Thanksgiving Day  
Christmas Day

### Paid Holidays

New Year's Day  
Lincoln's Birthday  
Washington's Birthday  
Memorial Day  
Independence Day  
Labor Day  
Columbus Day  
Election Day  
Veteran's Day  
Thanksgiving Day  
Christmas Day

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Employees have the option of observing either Martin Luther King's Birthday or the day after Thanksgiving instead of Lincoln's Birthday

### Shift Rates

For any workday that starts before 8A.M. or ends after 6P.M. there is a 10% differential for the applicable worker's hourly rate.

### Vacation

After 6 months.....one week.  
After 12 months but less than 7 years.....two weeks.  
After 7 or more but less than 15 years.....three weeks.  
After 15 years or more but less than 25 years.....four weeks.

(C.W.A.)

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## TILE FINISHER

### Tile Finisher

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$42.72

Supplemental Benefit Rate per Hour: \$33.57

### Overtime

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### Paid Holidays

None

### Shift Rates

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Off shift work day (work performed outside the regular 8:00 A.M. to 3:30 P.M. workday): shift differential of one and one quarter (1¼) times the regular straight time rate of pay for the seven hours of actual off-shift work.

(Local #7)

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## TILE LAYER - SETTER

### Tile Layer - Setter

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$54.84

Supplemental Benefit Rate per Hour: \$38.32

### Overtime

Time and one half the regular rate after a 7 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Good Friday

Memorial Day

Independence Day

Labor Day

Columbus Day

Veteran's Day

Thanksgiving Day

Day after Thanksgiving

Christmas Day

### Shift Rates

Off shift work day (work performed outside the regular 8:00 A.M. to 3:30 P.M. workday): shift differential of one and one quarter (1¼) times the regular straight time rate of pay for the seven hours of actual off-shift work.

(Local #7)

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## TIMBERPERSON

### Timberperson

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$50.05

Supplemental Benefit Rate per Hour: \$51.03

### Overtime

Time and one half the regular rate after an 8 hour day.

Time and one half the regular rate for Saturday.

Double time the regular rate for Sunday.

Saturday may be used as a make-up day at straight time when a day is lost during that week to inclement weather.

Time and one half the regular hourly rate after 40 hours in any work week.

### Overtime Holidays

Double time the regular rate for work on the following holiday(s).

New Year's Day

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Presidential Election Day

Thanksgiving Day

Christmas Day

### Paid Holidays

None

### Shift Rates

Off shift work commencing between 5:00 P.M. and 11:00 P.M. shall work eight and one half hours allowing for one half hour for lunch. The wage rate shall be 113% of the straight time hourly wage rate.

(Local #1536)

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## TUNNEL WORKER

### Blasters, Mucking Machine Operators (Compressed Air Rates)

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$65.42

Supplemental Benefit Rate per Hour: \$56.42

### Tunnel Workers (Compressed Air Rates)

Includes shield driven liner plate portions or solidification portions work (8 hour shift) during excavation phase.

Effective Period: 7/1/2019 - 6/30/2020

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Wage Rate per Hour: \$63.21

Supplemental Benefit Rate per Hour: \$54.60

**Top Nipper (Compressed Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$62.02

Supplemental Benefit Rate per Hour: \$53.57

**Outside Lock Tender, Outside Gauge Tender, Muck Lock Tender (Compressed Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$60.84

Supplemental Benefit Rate per Hour: \$52.63

**Bottom Bell & Top Bell Signal Person: Shaft Person (Compressed Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$60.84

Supplemental Benefit Rate per Hour: \$52.63

**Changehouse Attendant: Powder Watchperson (Compressed Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$53.40

Supplemental Benefit Rate per Hour: \$49.60

**Blasters (Free Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$62.41

Supplemental Benefit Rate per Hour: \$54.17

**Tunnel Workers (Free Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$59.72

Supplemental Benefit Rate per Hour: \$51.89

**All Others (Free Air Rates)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: \$55.18

Supplemental Benefit Rate per Hour: \$48.03

**Microtunneling (Free Air Rates)**

**OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$47.78**

**Supplemental Benefit Rate per Hour: \$41.51**

**Overtime Description**

For work performed during excavation and primary concrete tunnel lining phases - Double time the regular rate after an 8 hour day and Saturday, Sunday and on the following holiday(s) listed below.

For Repair-Maintenance Work on Existing Equipment and Facilities - Time and one half the regular rate after a 7 hour day, Saturday, Sunday and double time the regular rate for work on the following holiday(s) listed below.

For Small-Bore Micro Tunneling Machines - Time and one-half the regular rate shall be paid for all overtime.

For work not listed above - Time and one half the regular rate after an 8 hour day and Saturday and double time the regular rate on Sunday and on the following holiday(s) listed below.

**Paid Holidays**

New Year's Day

Lincoln's Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Election Day

Veteran's Day

Thanksgiving Day

Christmas Day

(Local #147)

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**UTILITY LOCATOR**

**(Locate & mark underground utilities for street excavation.)**

**Utility Locator (Year 7 and above)**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$31.56**

**Supplemental Benefit Rate per Hour: \$1.93**

**Utility Locator (Year 5 - 6)**

**Effective Period: 7/1/2019 - 6/30/2020**

**Wage Rate per Hour: \$22.85**

**Supplemental Benefit Rate per Hour: \$1.93**

**Utility Locator (Year 4)**

OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$21.54**

Supplemental Benefit Rate per Hour: \$1.93

**Utility Locator (Year 3)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$20.30**

Supplemental Benefit Rate per Hour: \$1.93

**Utility Locator (Year 2)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$19.13**

Supplemental Benefit Rate per Hour: \$1.93

**Utility Locator (Year 1)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$18.04**

Supplemental Benefit Rate per Hour: \$1.93

**Utility Locator (Up to 1 year)**

Effective Period: 7/1/2019 - 6/30/2020

Wage Rate per Hour: **\$17.00**

Supplemental Benefit Rate per Hour: \$1.93

Supplemental Note: No benefits for the first 90 days of employment.

**Overtime**

Time and one half the regular rate for work on the following Paid Holiday(s).

Time and one half the regular hourly rate after 40 hours in any work week.

**Paid Holidays**

New Year's Day

Memorial Day

Independence Day

Thanksgiving Day

Christmas Day

**Shift Rates**

10% shift differential to employees working any shift starting between noon and 5 AM.

**Vacation**

For up to 1 year ..... 0 hours

For year 1 - 2 ..... 48 hours per year

For year 3 - 9 ..... 96 hours per year

For year 10 or more ..... 144 hours per year



OFFICE OF THE COMPTROLLER, CITY OF NEW YORK  
CONSTRUCTION WORKER PREVAILING WAGE SCHEDULE

**Sick Days:**

For up to 1 year employee receives 40 hours paid sick leave.

For year 1 employee earns 2 hours of paid sick leave for every 100 overtime hours worked.

For year 2 - 9 years employee earns 4 hours of paid sick leave for every 100 overtime hours worked.

For year 10 or more employee earns 6 hours of paid sick leave for every 100 overtime hours worked.

(C.W.A.)

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**WELDER**

**TO BE PAID AT THE RATE OF THE JOURNEYPERSON IN THE TRADE  
PERFORMING THE WORK.**



**Department of  
Design and  
Construction**

Issue Date: July 1, 2019

**DDC STANDARD GENERAL CONDITIONS  
FOR SINGLE CONTRACT PROJECTS**



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**SECTION 01 10 00  
SUMMARY**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].
- B. Addendum to the General Conditions: These General Conditions include and are supplemented by the Addendum to the General Conditions (the "Addendum"). The Addendum includes the following: (1) schedules referred to in these General Conditions (Schedule A through F), (2) information regarding the applicability of various articles, and (3) amended articles, if any.

**1.2 SUMMARY:**

- A. This section includes the following:
  - 1. Scope and Intent
  - 2. Provisions Referenced in the Contract
  - 3. Performance of Work During Non-Regular Work Hours (Pursuant to a Change Order)
  - 4. Interruption of Services at Existing Facilities

**1.3 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

**1.4 SCOPE AND INTENT:**

- A. Description of Project: Refer to the Addendum for a description of the project.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 1.4 B**

- B. LEED: The City of New York will seek U.S. Green Building Council (USGBC) LEED (Leadership in Energy and Environmental Design) certification for this Project as specified in Section 01 81 13.03 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS"; or Section 01 81 13.04 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS", and the Addendum to the General Conditions.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 1.4 C**

- C. **COMMISSIONING:** The project will be commissioned by an independent third party under separate contract with the City of New York. Commissioning shall be in accordance with ASHRAE and USGBC LEED-NC procedures, as described in Section 01 91 13, **GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS**, and/ or Section 01 91 15, **GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE** and the Addendum to the General Conditions. The Contractor shall cooperate with the commissioning agent and provide whatever assistance is required.
- D. **PROGRESS SCHEDULE:** Refer to Section 01 32 00 **CONSTRUCTION PROGRESS DOCUMENTATION** for requirements of the project.
- E. **COMPLETION OF WORK:** Work to be done under the Contract is comprised of the furnishing of all labor, materials, equipment and other appurtenances, and obtaining all regulatory agency approvals necessary and required to complete the construction work in accordance with the Contract.
- F. **OMISSION OF DETAILS:** All work called for in the Specifications applicable to the Contract but not shown on the Contract Drawings in their present form, or vice versa, is required, and shall be performed by the Contractor as though it were originally delineated or described. The cost of such work shall be deemed included in the total Contract Price.
- G. **WORK NOT IN SPECIFICATIONS OR CONTRACT DRAWINGS:** Work not particularly specified in the Specifications nor detailed on the Contract Drawings but involved in carrying out their intent or in the complete and proper execution of the work, is required, and shall be performed by the Contractor. The cost of such work shall be deemed included in the total Contract Price.
- H. **SILENCE OF THE SPECIFICATIONS:** The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best practice is to prevail and that only the best material and workmanship is to be used and interpretation of the Specifications shall be made upon that basis.
- I. **CONFLICT BETWEEN CONTRACT DRAWINGS AND SPECIFICATIONS:** Should any conflict occur in or between the Drawings and Specifications, the Contractor shall be deemed to have estimated the most expensive way of doing the work unless the Contractor shall have asked for and obtained a decision in writing from the Commissioner before the submission of the bid as to what shall govern.

**1.5 CONTRACT DRAWINGS AND SPECIFICATIONS:**

- A. **SCHEDULE C -** The Contract Drawings are listed in Schedule C, which is set forth in the Addendum. Such drawings referred to in the Contract, and in the applicable Specifications for the Contract, bear the general title:

City of New York  
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Division of Public Buildings
- B. **DOCUMENTS FURNISHED TO THE CONTRACTOR -** After the award of the Contract, the Contractor will be furnished with five (5) complete sets of paper prints of all Contract Drawings mentioned in Paragraph A above, as well as a copy of the Specifications.
- C. **ADDITIONAL COPIES** of Drawings and Specifications, when requested, will be furnished to the Contractor if available.
- D. **SUPPLEMENTARY DRAWINGS -** When, in the opinion of the Commissioner, it becomes necessary to more fully explain the work to be done, or to illustrate the work further, or to show any changes which may be required, drawings known as Supplementary Drawings will be prepared by the Commissioner.



- E. **COMPENSATION** - Where Supplementary Drawings entail extra work, compensation therefore to the Contractor shall be subject to the terms of the Contract. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Contract Drawings.
- F. **SUPPLEMENTARY DRAWING PRINTS** - Three (3) copies of prints of these Supplementary Drawings will be furnished to the Contractor.
- G. **COPIES TO SUBCONTRACTORS** - The Contractor shall furnish each of its subcontractors and material suppliers such copies of Contract Drawings, Supplementary Drawings, or copies of the Specifications as may be required for its work.

**1.6 COORDINATION:**

- A. **COORDINATION AND COOPERATION** - The Contractor shall consult and study the requirements of the Contract Drawings and Specifications for all required work, including all work to be performed by trade subcontractors, so that the Contractor may become acquainted with the work of the project as a whole in order to achieve the proper coordination and cooperation necessary for the efficient and timely performance of the work.
- B. **CONTRACTOR TO CHECK DRAWINGS:** - The Contractor shall verify all dimensions, quantities and details shown on the Contract Drawings, Schedules, or other data received from the Commissioner, and shall notify the Commissioner of all errors, omissions, conflicts and discrepancies found therein. Notice of such errors shall be given before the Contractor proceeds with any work. Figures shall be used in preference to scale dimensions and large-scale drawings in preference to small-scale drawings.

**1.7 SHOP DRAWINGS AND RECORD DRAWINGS:**

- A. Refer to Division I Section 01 33 00 – SUBMITTAL PROCEDURES and Section 01 78 39 – PROJECT RECORD DRAWINGS for requirements applicable to shop drawings and record drawings.

**1.8 TEMPORARY FACILITIES, SERVICES AND CONTROLS:**

- A. Refer to Division I Section 01 50 00 – TEMPORARY FACILITIES SERVICES AND CONTROLS for the responsibilities of the Contractor.

**1.9 DUST CONTROL:**

- A. The Contractor shall prepare, execute and manage a "Dust Control Plan" for the prevention of the emission of dust from construction related activities in compliance with 15 RCNY 13-01 et. seq.

**1.10 PROVISIONS REFERENCED IN THE CONTRACT:**

- A. **SCHEDULE A** - Various Articles of the Contract refer to requirements set forth in Schedule A of the General Conditions. Schedule A, which is included in the Addendum, sets forth (1) the referenced Articles of the Contract, and (2) the specific requirements applicable to the Contract.
- B. **EXTENSION OF TIME** - Applications for Extensions of Time, as indicated in Article 13 of the Contract, shall be made in accordance with the Rules of the Procurement Policy Board.
- C. **PARTIAL PAYMENTS FOR MATERIALS IN ADVANCE OF THEIR INCORPORATION IN THE WORK PURSUANT TO ARTICLE 42 OF THE CONTRACT** – In order to better insure the availability of materials, fixtures and equipment when needed for the work, the Commissioner may authorize partial payment for certain materials, fixtures and equipment, prior to their incorporation in the work, but only in





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strict accordance with, and subject to, all the terms and conditions set forth in the Specifications, unless an alternate method of payment is elsewhere provided in the Specifications for specified materials, fixtures or equipment.

1. The Contractor shall submit to the Commissioner a written request, in quadruplicate, for payment for materials purchased or to be purchased for which the Contractor needs to be paid prior to their actual incorporation in the work. The request shall be accompanied by a schedule of the types and quantities of materials, and shall state whether such materials are to be stored on or off the site.
2. Where the materials are to be stored off the site, they shall be stored at a place other than the Contractor's premises (except with the written consent of the Commissioner) and under the conditions prescribed or approved by the Commissioner. The Contractor shall set apart and separately store at the place or places of storage all materials and shall clearly mark same "PROPERTY OF THE CITY OF NEW YORK", and further, shall not at any time move any of said materials to another off-site place of storage without the prior written consent of the Commissioner. Materials may be removed from their place of storage off the site for incorporation in the work upon approval of the Resident Engineer.
3. Where the materials are to be stored at the site, they shall be stored at such locations as shall be designated by the Resident Engineer and only in such quantities as, in the opinion of the Resident Engineer, will not interfere with the proper performance of the work by the Contractor or by other Contractors then engaged in performing work on the site. Such materials shall not be removed from their place of storage on the site except for incorporation in the work, without the approval of the Resident Engineer.
4. **INSURANCE**
  - a. **STORAGE OFF-SITE** – Where the materials are stored off the site and until such time as they are incorporated in the work, the Contractor shall fully insure such materials against any and all risks of destruction, damage or loss including but not limited to fire, theft, and any other casualty or happening. The policy of insurance shall be payable to the City of New York. It shall be in such terms and amounts as shall be approved by the Commissioner and shall be placed with a company duly licensed to do business in the State of New York. The Contractor shall deliver the original and one (1) copy of such policy or policies marked "Fully Paid" to the Commissioner.
  - b. **STORAGE ON THE SITE** – Where the materials are stored at the site, the Contractor shall furnish satisfactory evidence to the Commissioner that they are properly insured against loss, by endorsements or otherwise, under the policy or policies of insurance obtained by the Contractor to cover losses to materials owned or installed by the Contractor. The policy of insurance shall cover fire and extended coverage against windstorm, hail, explosion and riot attending a strike, civil commotion, aircraft, vehicles and smoke.
5. All costs, charges and expenses arising out of the storage of such materials, shall be paid by the Contractor and the City hereby reserves the right to retain out of any partial or final payment made under the Contract an amount sufficient to cover such costs, charges and expenses with the understanding that the City shall have and may exercise any and all other remedies at law for the recovery of such cost, charges and expenses. There shall be no increase in the Contract price for such costs, charges and expenses and the Contractor shall not make any claim or demand for compensation therefore.
6. The Contractor shall pay any and all costs of handling and delivery of materials, to the place of storage and from the place of storage to the site of the work; and the City shall have the right to retain from any partial or final payment an amount sufficient to cover the cost of such handling and delivery.



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7. In the event that the whole or any part of these materials are lost, damaged or destroyed in advance of their satisfactory incorporation in the work, the Contractor, at the Contractor's own cost, shall replace such lost, damaged or destroyed materials of the same character and quality. The City will reimburse the Contractor for the cost of the replaced materials to the extent, and only to the extent, of the funds actually received by the City under the policies of insurance hereinbefore referred to. Until such time as the materials are replaced, the City will deduct from the value of the stored materials or from any other money due under the Contract, the amount paid to the Contractor for such lost, damaged or destroyed materials.
8. Should any of the materials paid for the City hereunder be subsequently rejected or incorporated in the work in a manner or by a method not in accordance with the Contract Documents, the Contractor shall remove and replace, at Contractor's own cost, such defective or improperly incorporated material with materials complying with the Contract Documents. Until such materials are replaced, the City will deduct from the value of the stored materials or from any other money due the Contractor, the amount paid by the City for such rejected or improperly incorporated materials.
9. Payments for the cost of materials made hereunder shall not be deemed to be an acceptance of such materials as being in accordance with the Contract Documents, and the Contractor always retains and must comply with the Contractor's duty to deliver to the site and properly incorporate in the work only materials which comply with the Contract Documents.
10. The Contractor shall retain any and all risks in connection with the damage, destruction or loss of the materials paid for hereunder to the time of delivery of the same to the site of the work and their proper incorporation in the work in accordance with the Contract Documents.
11. The Contractor shall comply with all laws and the regulations of any governmental body or agency pertaining to the priority purchase, allocation and use of the materials.
12. When requesting payment for such materials, the Contractor shall submit with the partial estimate duly authenticated documents of title, such as bills of sale, invoices or warehouse receipts, all in quadruplicate. The executed bills of sale shall transfer title to the materials from the Contractor to the City. (In the event that the invoices state that the material has been purchased by a subcontractor, bills of sale in quadruplicate will also be required transferring title to the materials from subcontractor to the Contractor).
13. Where the Contractor, with the approval of the Commissioner, has purchased unusually large quantities of materials in order to assure their availability for the work, the Commissioner, at the Commissioner's option, may waive the requirements of Paragraph 12 provided the Contractor furnishes evidence in the form of an affidavit from the Contractor in quadruplicate, and such other proof as the Commissioner may require, that the Contractor is the sole owner of such materials and has purchased them free and clear of all liens and other encumbrances. In such event, the Contractor shall pay for such materials and submit proof thereof, in the same manner as provided in Paragraph 12 hereof, within seven (7) days after receipt of payment therefore from the Comptroller. Failure on the part of the Contractor to submit satisfactory evidence that all such materials have been paid for in full, shall preclude the Contractor from payments under the Contract.
14. The Contractor shall include in each succeeding partial estimate requisition a summary of materials stored which shall set forth the quantity and value of materials in storage, on or off the site, at the end of each preceding estimate period; the amount removed for incorporation in the work; the quantity and value of materials delivered during the current period and the total value of materials on hand for which payment thereof will be included in the current payment estimate.
15. Upon proof to the satisfaction of the Commissioner of the actual cost of such materials and upon submission of proper proof of title as required under Paragraph 12 or Paragraph 13 hereof, payment will be made therefore to the extent of 85%, provided however, that the cost so verified,



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established and approved shall not exceed the estimated cost of such materials included in the approved detailed breakdown estimate submitted in accordance with Article 41 of the Contract; if it does, the City will pay only 85% approved estimated cost.

16. Upon the incorporation in the work of any such materials, which have been paid for in advance of such incorporation in accordance with the foregoing provisions, payment will be made for such materials incorporated in the work pursuant to Article 42 of the Contract, less any sums paid pursuant to Paragraph 15 herein.

- D. **MOBILIZATION PAYMENT** – A line item for mobilization shall be allowed on the Contractor's Detailed Bid Breakdown submitted in accordance with Article 41 of the Contract. The Mobilization Payment is intended to include the cost of required bonds, insurance coverage and/or any other expenses required for the initiation of the Contract Work. All costs for mobilization shall be deemed included in the total Contract Price. The Detailed Bid Breakdown shall reflect, and the Mobilization Payment shall be made, in accordance with the following schedule:

Contract Amount	Percent	Mobilization
Less than - \$ 50,000	x 0 =	0
\$ 50,000 - \$ 100,000	x =	\$ 6,000
\$ 100,001 - \$ 500,000	x 6 =	\$ 6,000 (min) - \$ 30,000 (max)
\$ 500,000 - \$ 2,500,000	x 5 =	\$ 30,000 (min) - \$ 125,000 (max)
Over - \$ 2,500,000	x 4 =	\$ 125,000 (min) - \$ 300,000 (max)

The Contractor may requisition for one-half (1/2) of the Mobilization Payment upon satisfactory completion of the following:

1. Installation of any required field office(s).
2. Submission of all required insurance certificates and bonds.
3. Approval by the Department of Design and Construction of the coordinated progress schedule for the project and the Contractor's Shop Drawing schedule.

The remaining balance of the Mobilization Payment may be requisitioned only after 10 percent (10%) of the Contract price, exclusive of the total amount of Mobilization Payments made or to be made hereunder, shall have been approved for payment.

- E. **ULTRA LOW SULFUR DIESEL FUEL AND BEST AVAILABLE TECHNOLOGY REPORTING:** The Contractor shall submit reports to the Commissioner regarding the use of Ultra Low Sulfur Diesel Fuel in Non-Road Vehicles, and the implementation of Best Available Technology (BAT), as set forth in Article 5.4 of the Contract. Such reports shall be submitted in accordance with the schedule, format, directions and procedures established by the Commissioner.

**1.11 PERFORMANCE OF WORK DURING NON-REGULAR WORK HOURS:**

- A. **NON-REGULAR WORK HOURS:** The Commissioner may issue a change order in accordance with Article 25 of the Contract which (1) directs the Contractor to perform the Work, or specific components thereof, during other than regular work hours (i.e., evenings, weekends and holidays), and (2) provide



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compensation to the Contractor for costs in connection with the performance of Work during other than regular work hours. The Commissioner may issue a change order if a delay has occurred and such delay is not the fault of the Contractor, or if the work is of such an important nature that delay in completing such work would result in serious disadvantage to the public.

- B. **PROCEDURE:** The Contractor shall (1) obtain whatever permits may be required for performance of the work during other than regular business hours, and (2) pay all necessary fees in connection with such permits. In addition, if directed by the Commissioner, the Contractor shall make immediate application to the Commissioner of the Department of Labor, State of New York, for dispensation in accordance with Subdivision 2 of Section 220 of the Labor Law.

**1.12 INTERRUPTION OF SERVICES AT EXISTING FACILITIES:**

- A. **EVENING AND WEEKEND WORK** - Where performance of the Work requires the temporary shutdown(s) of services, such shutdown(s) shall be made at night or on weekends or at such times that will cause no interference with the established routines and operations of the facility in question.
- 1 Where weekend or evening work is required due to unavoidable service shutdowns, such work shall be performed at no extra cost to the City. Components of the Work that must be performed during other than regular work hours are indicated in the Drawings and/or the Specifications.
- B. **INTERRUPTION OF EXISTING FACILITIES:**
- 1 The Contractor shall not interrupt any of the services of the facility nor interfere with such services in any way without the permission of the Commissioner. Such interruption or interferences shall be made as brief as possible, and only at such time stated.
  - 2 Under no circumstances shall the Contractor, its subcontractors, or its workers, be permitted to use any part of the project as a shop, without the permission of the Commissioner.
  - 3 Unnecessary noise shall be avoided at all times and necessary noise shall be reduced to a minimum.
  - 4 Toilet facilities, water and electricity must be operational at all times (i.e. 24/7). No services of the facility can be interrupted in any way without the permission of the Commissioner. Careful coordination of all work with the Resident Engineer must be done to maintain the operational level of the project personnel at the facility.
  - 5 The Contractor shall schedule the work to avoid noise interference that will affect the normal functions of the facility. In particular, construction operations producing noises that are objectionable to the functions of the facility must be scheduled at times of day or night, day of the week, or weekend, which will not interfere with personnel at the facility. Any additional cost resulting from this scheduling shall be borne by the Contractor.
  - 6 The Contractor shall arrange to work continuously, including evening and weekend hours, if required, to assure that services will be shut down only during the time actually required to make the necessary connections to the existing facility.
  - 7 The Contractor shall give ample written notice in advance to the Commissioner and personnel at the facility of any required shutdown.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**



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**END OF SECTION 01 10 00**



**SECTION 01 31 00  
PROJECT MANAGEMENT AND COORDINATION**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].
- B. LEED: Refer to the Addendum to identify whether this project is designed to comply with a Certification Level according to the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) Rating System, as specified in Section 01 81 13.03, "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS", or Section 01 81 13.04 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS.
- C. COMMISSIONING: Refer to the Addendum to identify whether this project will be commissioned by an independent third party under separate contract with the City of New York. Commissioning shall be in accordance with ASHRAE and USGBC LEED-NC procedures, as described in Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS, and/ or Section 01 91 15 GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE COMMISSIONING. The Contractor shall cooperate with the commissioning agent and provide whatever assistance is required.

**1.2 SUMMARY:**

- A. This Section includes administrative provisions for coordinating construction operations on the Project including without limitation the following.
  - 1. Coordination Drawings.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
  - 4. Requests for Interpretation (RFIs).
- B. This section includes the following:
  - 1. Definitions
  - 2. Coordination
  - 3. Submittals
  - 4. Administrative and Supervisory Personnel
  - 5. Project Meetings
  - 6. Requests for Interpretation (RFI's)
  - 7. Correspondence
  - 8. Contractor's Daily Reports
  - 9. Alternate and Substitute Equipment
- C. RELATED SECTIONS: include without limitation the following:
  - 1. Section 01 10 00 SUMMARY
  - 2. Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION
  - 3. Section 01 33 00 SUBMITTALS
  - 4. Section 01 35 26 SAFETY REQUIREMENTS
  - 5. Section 01 73 00 EXECUTION REQUIREMENTS



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- 6. Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
- 7. Section 01 77 00 CLOSEOUT PROCEDURES

**1.3 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

**1.4 COORDINATION:**

- A. Coordination: The Contractor shall coordinate its construction operations, including those of its subcontractors, with other entities to ensure the efficient and orderly installation of each part of the Work. The Contractor shall coordinate the various operations required by different Sections of the Specifications that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence in order to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. The Contractor shall prepare memoranda for distribution to its subcontractors and other involved entities, outlining special procedures required for coordination. Such memoranda shall include required notices, reports, and meeting minutes as applicable.
- C. Administrative Procedures: The Contractor shall coordinate scheduling and timing of required administrative procedures with other construction activities and activities of its subcontractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include without limitation the following:
  - 1. Preparation of Contractor's Construction Schedule.
  - 2. Installation and removal of temporary facilities and controls.
  - 3. Delivery and processing of submittals.
  - 4. Progress meetings.
  - 5. Pre-installation conferences.
  - 6. Startup and adjustment of systems.
  - 7. Project closeout activities.
- D. Conservation: The Contractor shall coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.



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- E. Salvaged Items, Material and/or Equipment: The Specifications may identify certain items, materials or equipment which must be salvaged by the Contractor and handled or disposed of as directed. The Contractor shall comply with all directions in the Specifications regarding the salvaging and handling of identified items, material or equipment.

**1.5 SUBMITTALS:**

- A. Submit shop drawings, product data, samples etc. in compliance with Section 01 33 00, SUBMITTAL PROCEDURES.
- B. Coordination Drawings: The Contractor shall prepare applicable Coordination Drawings in compliance with the requirements for Coordination Drawings in Section 01 33 00, SUBMITTAL PROCEDURES.
- C. Safety Plan in compliance with Section 01 35 26, SAFETY REQUIREMENTS PROCEDURES.
- D. Waste Management Plan in compliance with Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
- E. Key Personnel Names: Within 15 days after the Notice to Proceed, the Contractor shall submit a list of key personnel assignments of the Contractor and its subcontractors, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in case of the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
  2. In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work. Include special personnel required for coordinating all operations by its subcontractors.

**1.6 PROJECT MEETINGS:**

- A. General: The Resident Engineer will hold regularly scheduled construction progress meetings at the site, at which time the Contractor and appropriate subcontractors shall have their representatives present to discuss all details relative to the execution of the work. The Resident Engineer shall preside over these meetings.
1. Agenda: Prior to each meeting, the Resident Engineer will consult with the Contractor and will prepare an agenda of items to be discussed. In general, after informal discussion of any item on the agenda, the Resident Engineer will summarize the discussion in a brief written statement, and the Contractor will then dictate a brief statement for the record.
  2. Coordination: In addition to construction progress meetings called by the Resident Engineer, the Contractor shall hold regularly scheduled meetings for the purpose of coordinating; expediting and scheduling the work in accordance with the master coordinated Job Progress Chart. The Contractor and its subcontractors, material suppliers or vendors whose presence is necessary, are required to attend. These meetings may, at the discretion of the Contractor, be held at the same place and immediately following the project meetings held by the Resident Engineer. Minutes of these meetings shall be recorded, typed and printed by the Contractor and distributed to all parties concerned.
- B. PRECONSTRUCTION KICK-OFF MEETING:
1. The Resident Engineer will schedule a preconstruction kick-off meeting either at DDC's main office or at the Project site to review responsibilities and personnel assignments and clarify the





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role of each participant. Unless otherwise directed the Design Consultant will record and distribute meeting minutes.

2. Attendees: Authorized representative of the Client Agency; Design Consultant; the Contractor and its superintendents, subcontractor(s) and their superintendent(s); LEED sub-consultant and Commissioning Authority /Agent (CxA) as applicable and other concerned parties. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Contract Work.
3. Agenda: Includes without limitation the following as applicable:
  - a. Establishing construction schedule
  - b. Schedule for regular construction meetings
  - c. Phasing
  - d. Critical work sequencing and long-lead items
  - e. Designation of key personnel and their duties
  - f. Reviewing Application for Payment and Change Order Procedures
  - g. Procedures for Requests for Information (RFIs.)
  - h. Review Permits and Approval requirements
  - i. Review all recent Administrative Code reporting requirements relating to the project, (i.e. LL 77, LL86 etc.)
  - j. Procedures for testing and inspecting
  - k. Reviewing special conditions at the Project site
  - l. Distribution of the Contract Documents
  - m. Submittal procedures
  - n. Safety Procedures
  - o. LEED requirements
  - p. Commissioning Requirements
  - q. Preparation of Record Documents
  - r. Historic Treatment requirements
  - s. Use of the premises
  - t. Work restrictions
  - u. Client Agency occupancy requirements
  - v. Responsibility for temporary facilities, services and controls
  - w. Construction Waste Management and Disposal
  - x. Indoor Air Quality Management Plan
  - y. Dust Mitigation Plan
  - z. Office, work, and storage areas
  - aa. Equipment deliveries and priorities
  - bb. Security
  - cc. Progress cleaning
  - dd. Working hours



**C. CONSTRUCTION PROGRESS MEETINGS:**

1. The Resident Engineer will schedule and conduct construction progress meetings at bi-weekly intervals or as otherwise determined. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work. Unless otherwise directed the Design Consultant will record and distribute meeting minutes.
2. Attendees:
  - a. Design Consultant and applicable sub-consultants
  - b. Client Agency Representative
  - c. Representatives from the Contractor, sub-contractor(s), suppliers or other entities involved in the current progress, planning, coordination or future activities of the Work
  - d. Other appropriate DDC personnel, DDC consultants and concerned parties
3. Agenda: Includes without limitation the following:
  - a. Review the Construction Schedule and progress of the Work. Determine if the Work is on time, ahead of schedule or behind schedule. Determine actions to be taken to maintain or accelerate the schedule
  - b. Review and approve prior meeting minutes and follow up open issues
  - c. Coordinate work between each subcontractor
  - d. Sequence of Operations
  - e. Status of submittals, deliveries and off-site fabrication
  - f. Status of inspections and approvals by governing agencies
  - g. Temporary facilities and controls
  - h. Review Site Safety
  - i. Quality and work standards
  - j. Field observations
  - k. Status of correction of deficient items
  - l. RFI's
  - m. Pending changes
  - n. Status of outstanding Payments and Change Orders
  - o. LEED requirements including Construction Waste Management, Indoor Air Quality Plan, Dust Mitigation and Commissioning
  - p. Status of Administrative Code reporting requirements related to the project

**1.7 REQUESTS FOR INFORMATION (RFI):**

- A. Procedure: Immediately on discovery of the need for information or interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, the Contractor shall prepare and submit an RFI in the form specified by the Resident Engineer.
1. RFI shall originate with the Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  2. Coordinate and submit RFI in a prompt manner to the Resident Engineer so as to avoid delays in Contractor's work or work of its subcontractors.
  3. RFI Log: The Contractor shall prepare, maintain, and submit a tabular log of RFIs organized by the RFI number monthly to the Resident Engineer.



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4. On receipt of responses and action to the RFI, the Contractor shall update the RFI log and immediately distribute the RFI response to affected parties. Review response(s) and notify the Resident Engineer immediately if the Contractor disagrees with response(s).

**1.8 CORRESPONDENCE:**

- A. Copies of all correspondence to DDC shall be sent directly to the Resident Engineer at the job site.

**1.9 CONTRACTOR'S DAILY REPORTS:**

- A. The Contractor shall prepare and submit Daily Construction Progress Reports as outlined in Section 01 32 00, CONSTRUCTION PROGRESS DOCUMENTATION.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 31 00**



**SECTION 01 32 00  
CONSTRUCTION PROGRESS DOCUMENTATION**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for establishing an effective base line schedule for the project and documenting the progress of construction during performance of the Work by developing, revising as necessary, various documents including but not limited to the following:
1. Baseline Construction Schedule.
  2. Composite Schedule for entire project
  3. Recovery Composite Schedule
  4. Revised and/or updated Composite Schedule
  5. Submittals Schedule.
  6. Daily construction reports.
  7. Material location reports.
  8. Field condition reports.
  9. Special reports.
- B. RELATED SECTIONS: include without limitation the following:
1. Section 01 10 00 SUMMARY
  2. Section 01 32 22 PHOTOGRAPHIC DOCUMENTATION
  3. Section 01 33 00 SUBMITTAL PROCEDURES
  4. Section 01 40 00 QUALITY REQUIREMENTS

**1.3 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.



- C. **Baseline Construction Schedule:**
1. A horizontal bar chart type schedule (Microsoft Project OR similar program) listing all the activities and their duration for entire contract duration OR construction period, including logical ties and interrelations between the activities necessary for the timely and successful completion of the project. Critical path activities shall be clearly marked. The Baseline construction schedule is a preliminary schedule that must be reviewed and approved by the Resident Engineer.
- D. **Composite Schedule:**
1. A composite horizontal bar chart type schedule (Microsoft Project OR similar program) listing all activities to be performed by the Contractor and its subcontractors, the duration of each activity including logical ties and interrelations between activities, and the sequence of each of necessary activities for the timely and successful completion of the project within the stipulated contract duration. Critical path activities shall be clearly marked. The Composite schedule must be signed and submitted by the Contractor within thirty (30) calendar days after the date established for commencement of the Contract, unless otherwise directed. The Composite Schedule must be reviewed and approved by the Resident Engineer.
- E. **Recovery Composite Schedule:** A Recovery Composite Schedule is not required unless the City issues an Acceleration Change Order.
1. A Composite Schedule outlining and incorporating extraordinary efforts required to recover lost time with the aim of achieving completion of the project within the stipulated contract duration, plus authorized time extensions. In such case special attention must be given to keep the delays as minimum as possible and must establish the nature of efforts such as extended hours of work, weekend work, accelerated fabrication, required action(s) or effort(s) by the Contractor, its subcontractors, consultants, clients, end users and/or other concerned parties.
  2. Such schedule must be prepared and submitted within Five (5) calendar days of request by the Resident Engineer. The Recovery Composite Schedule must be reviewed and approved by the Resident Engineer.
- F. **Revised and/or Updated Composite Schedule:**
1. A Baseline construction schedule OR Composite Schedule OR Recovery Composite Schedule for the project that shows the actual duration of all the completed activities, including duration of and the reasons for delays, if any has occurred, AND revisions to all remaining activities of the Contractor and its subcontractors, including changes, if any, to logical ties, interrelations and the sequence of each of the outlined activities. Any such revisions should be shown on the row just below the approved schedule of the respective activity so that revisions can be compared.
  2. The Revised and/or updated Composite Schedule must be reviewed and approved by the Resident Engineer.
- G. **Activity:** A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
- H. **Event:** The starting or ending point of an activity.
- I. **Fragment:** A part of the activity that breaks down activities into smaller activities for greater detail.



- J. Milestone: A key or critical point in time for reference or measurement.
- K. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

## **PART II – PRODUCTS**

### **2.1 BASELINE CONSTRUCTION SCHEDULE:**

- A. The Contractor shall prepare a Baseline horizontal bar-chart-type construction schedule for the project. Submit the Baseline Construction Schedule to the Resident Engineer within (15) fifteen calendar days after the date established for commencement of the Contract, unless directed otherwise. The Baseline Schedule must be reviewed and approved by the Resident Engineer.
  - 1. Provide a separate time bar for each significant construction activity. Coordinate each activity on the schedule with other construction activities for proper interrelationship & sequence.
  - 2. Duration: The duration of each activity on the schedule besides installation must clearly show required duration of filing for permits, inspections, testing, approvals, shop drawings and materials submittals and approvals, fabrication, delivery, phasing for each construction activity.
  - 3. Schedule shall be time-scaled in not more than weekly increments, with the dates of the first day (Monday) of each week indicated.
  - 4. Completion of all the project activities shall be indicated in advance of the date established for completion of the Contract, allowing time for required inspection and punch list work.
  - 5. Clearly show time bar for all the tasks, to be completed before start of physical work of scheduled activities, including but not limited to obtaining required permit, subcontractor approval, submission and approval of shop drawings, field verification, time for fabrication and delivery, testing of materials and/or samples, preparation and approval of mock-up sample, curing, pre-testing of soil, pre-testing of equipment - including start up, testing & adjusting, filing for inspection by regulatory agencies, training, final use, etc. required to maintain orderly progress of the activity. A special consideration must be given to those activities requiring early approvals because of long lead-time for manufacture or fabrication.
  - 6. Phasing: Arrange all activities in proper sequence to reflect requirements for phased completion, work by other entities, work by the City, City furnished items, coordination with existing work, limitations arising due to continued occupancies, non-interruptible services, partial completion for occupancy, site restrictions, provisions for future work, seasonal variations, environmental control, and similar conditions of the project.
  - 7. Arrange all activities and/or show interrelationship and logical sequence of all activities, determine and mark all critical path activities including any phasing reflecting actual project condition.
  - 8. Keep at least two blank horizontal bars between all activities for recording actual progress and submitting Revised Schedule as defined in Sub-Section 1.3 G
  - 9. If necessary a new revised schedule shall be prepared in the same manner as outlined above.

### **2.2 COMPOSITE SCHEDULE FOR THE PROJECT:**

- A. The Contractor shall prepare a Composite Schedule based on the approved Baseline Schedule. Such schedule shall indicate graphically and chronologically the start and completion of each and every activity, including all the pre-activity and post activity tasks. Keep at least two blank horizontal bars between all activities for recording actual progress and/or revisions.
  - 1. If necessary the Contractor shall meet with each subcontractor and with the Resident Engineer to review and make warranted adjustments and finalize the Composite Schedule. Once the schedule is finalized, the Contractor shall sign and date a reproducible form of the Composite Schedule. The Composite Schedule must be finalized and signed by the Contractor within (30) thirty calendar days



after the date established for commencement of the Contract, unless directed otherwise. The Composite Schedule must be reviewed and approved by the Resident Engineer.

### **2.3 RECOVERY COMPOSITE SCHEDULE:**

- A. A Recovery Composite Schedule is not required unless the City issues an Acceleration Change Order. A Recovery Composite Schedule outlining and incorporating extraordinary efforts required to recover lost time with the aim of achieving completion of the project within the stipulated contract duration, plus authorized time extensions, must be developed and submitted within (5) five calendar days of the request by the Resident Engineer. Such Recovery Composite Schedule shall include all information as defined in Article 1.3 F and shall be prepared in the same manner as outlined in Sub-Sections 2.1 and 2.2. The Recovery Composite Schedule must be reviewed and approved by the Resident Engineer.

### **2.4 REVISED AND/OR UPDATED COMPOSITE SCHEDULE:**

- A. The Contractor shall revise and/or update the approved Composite Schedule as directed. The Revised schedule shall be prepared in the same manner as outlined above in Sub-Sections 2.1 and 2.2.
- B. The Contractor shall mark actual progress, delays, work stoppage etc. in the row just below the approved schedule for the respective activity so that revisions can be compared.
- C. Such schedule also shall indicate graphically and chronologically any revisions to the start and completion of the remaining activities including revisions to all the pre-activity and post activity tasks for all subcontractors.
- D. If necessary, the Contractor shall meet with each subcontractor and with the Resident Engineer to review and make warranted adjustments and finalize the Revised Composite Schedule. Once the schedule is finalized, the Contractor shall sign and date a reproducible form of the Schedule. Such schedule must be prepared and submitted by the Contractor within Five (5) calendar days of request by the Resident Engineer. The Revised Composite Schedule must be reviewed and approved by the Resident Engineer.

### **2.5 SUBMITTALS SCHEDULE:**

- A. Preparation: The Contractor shall submit a schedule of submittals, arranged in chronological order by dates required by the construction schedule. Include time required for review, re-submittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
- B. SCHEDULE F: Schedule F sets forth all submittal requirements for shop drawings and material samples. Schedule F is included in the Addendum. At the kick-off meeting, the Contractor must review this Schedule with the Resident Engineer and the Design Consultant. Within 10 days after the kick-off meeting, the Contractor must complete information on Schedule F concerning the submission date, the required delivery date and the fabrication time. For all required submittals of shop drawings and material samples, the Schedule F provided by the Contractor must indicate a submission date which is at least 20 business days prior to the date of the manufacture of the item or materials to be installed. In addition, if so directed by the Commissioner, the Schedule F provided by the Contractor must indicate a submission date for shop drawings and/or material samples of specified items or materials which is within 60 business days after the kick-off meeting. In the event of any conflict between the Specifications and Schedule F, Schedule F shall take precedence; provided, however, in the event of an omission from Schedule F (i.e., Schedule F omits either a reference to or information concerning a submittal requirement which is set forth in the Specifications), such omission from Schedule F shall have no effect and the Contractor's submittal obligation, as set forth in the Specifications, shall remain in full force and effect.



- C. Review: The Resident Engineer will review the Schedule F submitted by Contractor. Upon acceptance, the Resident Engineer will date and sign the schedule as approved and transmit it to the Consultant, Contractor and others within DDC as he/she deems appropriate.

## **2.6 REPORTS:**

- A. Daily Construction Reports: The Contractor shall submit to the Resident Engineer written Daily Construction Reports at the end of each work day, recording basic information such as the date, day, weather conditions, and contract days passed, remaining contract duration/days and the following information concerning the Project.

Information: The reports shall be prepared by the Contractor's Superintendent and shall bear the Contractor's Superintendents signature. Each report shall contain the following information:

1. List name of Contractor, subcontractors, their work force in each category, and details of activities performed.
2. The type of materials and/or major equipment being installed by the Contractor and/or by each subcontractor.
3. The major construction equipment being used by the Contractor and/or subcontractors.
4. Material and Equipment deliveries.
5. High and low temperatures and general weather conditions.
6. Accidents.
7. Meetings and significant decisions.
8. Unusual events.
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings
11. Emergency procedures.
12. Orders and/or requests of authorities having jurisdiction.
13. Approved Change Orders received and implemented.
14. Field Orders and Directives received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial Completions and occupancies.
18. Substantial Completions authorized.

NOTE: If there is NO ACTIVITY at site, a daily report indicating so and the reason for no activity at the site must be submitted.

- B. Material Location Reports: The contractor shall submit a Material Location Report at weekly OR monthly intervals as determined and established by the Resident Engineer. Such report shall include a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit a Request For Information (RFI) form with a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.





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**2.7 SPECIAL REPORTS:**

- A. Accident report, incident report, special condition report for the conditions out of control of any party involved with the project effecting project progress, explaining impact on the project schedule and cost if any.

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 32 00**



**SECTION 01 32 33  
PHOTOGRAPHIC DOCUMENTATION**

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SECTION 01 32 33**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes the following:
1. Photographic Media
  2. Construction Photographs
  3. Pre-construction Photographs
  4. Periodic Construction Progress Photographs
  5. Special Photographs
  6. DVD Recordings
  7. Final Completion Construction Photographs
- B. RELATED SECTIONS: include without limitation the following:
1. Section 01 10 00 SUMMARY
  2. Section 01 33 00 SUBMITTAL PROCEDURES
  3. Section 01 35 91 HISTORIC TREATMENT PROCEDURES
  4. Section 01 78 39 CONTRACT RECORD DOCUMENTS
  5. Section 01 81 19 INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. PHOTOGRAPHER - The Contractor shall employ and pay for the services of a professional photographer who shall take photographs showing the progress of the work for all Contracts.

**1.3 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

**1.4 SUBMITTALS:**

- A. Qualification Data: For photographer.



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- B. Key Plan: With each Progress Photograph Submittal include a key plan of Project site and building with notation of vantage points marked for location and direction of each image. Indicate location, elevation or story of construction. Include same label information as corresponding set of photographs.
- C. Construction Progress Photograph Prints: Take Progress Photographs bi-weekly and submit four color prints of each photographic view for each trade to the Resident Engineer. Such photographs shall be included in each monthly progress report or as otherwise directed by the Resident Engineer.
- D. Construction Photograph Negatives: Submit a complete set of photographic negatives in individually protected negative sleeves with each submittal of prints. Identify negatives with label matching photographic prints.
- E. Digital Images: If Digital Media is used, submit a complete set of digital color image electronic files on USB drive or other electronic media requested by the Commissioner with each submittal of prints. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, un-cropped.

**1.5 QUALITY ASSURANCE:**

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

**1.6 COORDINATION:**

- A. The Contractor and its subcontractor(s) shall cooperate with the photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

**1.7 COPYRIGHT:**

- A. The Contractor shall include the provisions set forth below in the agreement between the Contractor and the Photographer who will provide the construction photographs described in this section. The Contractor shall submit to the Resident Engineer a copy of its agreement with the Photographer.
- B. Any photographs, images and/or other materials produced pursuant to this Agreement, and any and all drafts and/or other preliminary materials in any format related to such items produced pursuant to this Agreement, shall upon their creation become the exclusive property of the City.
- C. Any photographs, images and/or other materials provided pursuant to this Agreement ("Copyrightable Materials") shall be considered "work-made-for-hire" within the meaning and purview of Section 101 of the United States Copyright Act, 17 U.S.C. § 101, and the City shall be the copyright owner thereof and of all aspects, elements and components thereof in which copyright protection might exist. To the extent that the Copyrightable Materials do not qualify as "work-made-for-hire," the Photographer hereby irrevocably transfers, assigns and conveys exclusive copyright ownership in and to the Copyrightable Materials to the City, free and clear of any liens, claims, or other encumbrances. The Photographer shall retain no copyright or intellectual property interest in the Copyrightable Materials. The Copyrightable Materials shall be used by the Photographer for no purpose other than in the performance of this Agreement without the prior written permission of the City. The Department may grant the Photographer a license to use the Copyrightable Materials on such terms as determined by the Department and set forth in the license.
- D. The Photographer acknowledges that the City may, in its sole discretion, register copyright in the Copyrightable Materials with the United States Copyright Office or any other government agency authorized to grant copyright registrations. The Photographer shall fully cooperate in this effort, and agrees to provide any and all documentation necessary to accomplish this.



- E. The Photographer represents and warrants that the Copyrightable Materials: (i) are wholly original material not published elsewhere (except for material that is in the public domain); (ii) do not violate any copyright Law; (iii) do not constitute defamation or invasion of the right of privacy or publicity; and (iv) are not an infringement, of any kind, of the rights of any third party. To the extent that the Copyrightable Materials incorporate any non-original material, the Photographer has obtained all necessary permissions and clearances, in writing, for the use of such non-original material under this Agreement, copies of which shall be provided to the City.

## **PART II – PRODUCTS**

### **2.1 PHOTOGRAPHIC MEDIA:**

- A. Photographic Film: Medium format, 2-1/4 by 2-1/4 inches (60 by 60 mm).
- B. Digital Images:
1. Construction Progress Images: Color images in JPEG format with minimum sensor size of 1.3 megapixels.
  2. Presentation Quality Images: Provide Color images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 with 8"x10" original capture at 300 dpi or greater.
- C. Prints:
1. Format: 8-by-10-inch (203-by-254-mm) smooth-surface matte color prints on single-weight commercial-grade stock paper, with 1inch wide margins and punched for standard 3-ring binder.
  2. Identification: On the front of each photograph affix a label in the margin with Project name and date photograph was taken. On the back of each print, provide an applied label or rubber-stamped impression with the following information:
    - a. Project Contract I.D. Number.
    - b. Project Contract Name.
    - c. Name of Contractor. (and Subcontractor Trade Represented)
    - d. Subject of Image Taken.
    - e. Date and time photograph was taken if not date stamped by camera.
    - f. Description of vantage point, indicating location, direction and other pertinent information.
    - g. Unique sequential identifier.
    - h. Name and address of photographer.

## **PART III – EXECUTION**

### **3.1 CONSTRUCTION PHOTOGRAPHS:**

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
1. Maintain key plan with each set of construction photographs that identifies each photographic location and direction of view.
- B. Film Images:
1. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.



2. Field Office Prints: Retain one set of prints of progress photographs in the field office at Project site, available at all times for reference. Identify photographs same as for those submitted to Commissioner.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  1. Date and Time: Include date and time in filename for each image.
  2. Field Office Images: Maintain one set of images on USB drive or other electronic media requested by the Commissioner in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Commissioner.

### **3.2 PRE-CONSTRUCTION & PRE-DEMOLITION PHOTOGRAPHS:**

- A. Before commencement of Contract work at the site, take color photographs of Project site and surrounding properties, including existing structures or items to remain during construction, from different vantage points, as directed by the Resident Engineer.
  1. Flag applicable excavation areas and construction limits before taking construction photographs.
  2. Take photographs of minimum eight (8) views to show existing conditions adjacent to property before starting the Work.
  3. Take applicable photographs of minimum eight (8) views of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  4. Take additional photographs as required or directed by the Resident Engineer to record settlement or cracking of adjacent structures, pavements, and improvements.
- B. Demolition Operations: Take photographs as directed by the Resident Engineer of minimum of eight (8) views each before commencement of demolition operations, at mid-point of operations and at completion of operations.
- C. Pre-Demolition Photographs: Take archival quality color photographs, to include all exterior building facades, of all structures at the Project site designated to be fully demolished or removed in compliance with NYC Building Code requirements. Submit four (4) complete sets of pre-demolition photographs, in the format specified herein, to the Resident Engineer for submission to the Department of Buildings.

### **3.3 PERIODIC CONSTRUCTION PROGRESS PHOTOGRAPHS:**

- A. Take photographs of minimum eight (8) views bi-weekly as directed by the Resident Engineer of construction progress for each contract trade. Select vantage points to show status of construction and progress since last photographs were taken.

### **3.4 SPECIAL PHOTOGRAPHS:**

- A. The photographer shall take special photographs of subject matter or events as specified in other sections of the Project Specifications from vantage points specified or as otherwise directed by the Resident Engineer.
- B. Historical Elements: As required in Section 01 35 91, HISTORIC TREATMENT PROCEDURES, for Contract work at designated landmark structures or sites the photographer, as specified and required by individual sections of the Contract documents or at the direction of the Commissioner, shall take images of existing elements scheduled to be removed for replacement, repair or replication in quantities as directed, including post-construction photographs of completed work as directed by the Commissioner.
  1. Take Presentation Quality Photographs of designated landmark structures as directed by the Commissioner for submission to the New York City Landmarks Preservation Commission. Provide a minimum of four color photographic prints of each view as directed.



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**3.5 VIDEO RECORDING:**

- A. When Video Recording of Demonstration and Orientation sessions is required, the Contractor shall provide the services of a Videographer as indicated in Section 01 79 00, DEMONSTRATION AND OWNER'S PRE-ACCEPTANCE ORIENTATION.

**3.6 FINAL COMPLETION CONSTRUCTION PHOTOGRAPHS:**

- A. Take color photographs of minimum eight (8) unobstructed views of the completed project or project and site, as directed by the Commissioner and after all scaffolding, hoists, shanties, field offices or other temporary work has been removed and final cleaning is done after date of Substantial Completion for submission as Project Record Documents. Submit four (4) sets of each view of Presentation Quality photographic prints including negatives and/or digital images electronic file.

**END OF SECTION 01 32 33**



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**SECTION 01 33 00  
SUBMITTAL PROCEDURES**

**PART 1 – GENERAL:**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Coordination Drawings, Catalogue Cuts, Material Samples and other submittals required by the Contract Documents.
- B. Review of submittals does not relieve the Contractor of responsibility for any Contractor's errors or omissions in such submittals, nor from responsibility for complying with the requirements of the Contract.
- C. Responsibility of the Contractor: The approval of Shop Drawings will be general and shall not relieve the Contractor of responsibility for the accuracy of such Shop Drawings, nor for the proper fitting and construction of the work, nor of the furnishing of materials or work required by the Contract and not indicated on the Shop Drawings. Approval of Shop Drawings shall not be construed as approving departures from the Contract Drawings, Supplementary Drawings or Specifications.
- D. This Section includes the following:
1. Definitions
  2. Submission Procedures
  3. Coordination Drawings
  4. LEED Submittals
  5. Ultra Low Sulfur Diesel Fuel Reporting
  6. Construction Photographs and Recordings
  7. As-Built Documents

**1.3 RELATED SECTIONS:** Include without limitation the following:

- |    |                     |   |
|----|---------------------|---|
| A. | Section 01 10 00    | SUMMARY   |
| B. | Section 01 31 00    | PROJECT MANAGEMENT AND COORDINATION                   |
| C. | Section 01 32 00    | CONSTRUCTION PROGRESS DOCUMENTATION                   |
| D. | Section 01 32 33    | PHOTOGRAPHIC DOCUMENTATION                            |
| E. | Section 01 77 00    | CLOSEOUT PROCEDURES                                   |
| F. | Section 01 78 39    | CONTRACT RECORD DOCUMENTS                             |
| G. | Section 01 81 13.03 | SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS |
| H. | Section 01 81 13.04 | SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS |

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and





specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

- C. Submittals: Written and graphic information that requires responsive actions and includes without limitation all shop drawings, product data, letters of certification, tests and other information required for quality control and as required by the Contract Documents.
- D. Informational Submittals: Written information that does not require responsive action. Submittals may be rejected for non-compliance with the Contract.
- E. Shop Drawings: Include drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data, except for coordination drawings, specifically prepared for the project by the Contractor or any subcontractor, manufacturer, supplier or distributor, which illustrates how specific portions of the work shall be fabricated and/or installed.
- F. Coordination Drawings: As required in Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION.
- G. Product Data and Quality Assurance Submittals: Includes manufacturer's standard catalogs, pamphlets and other printed materials including without limitation the following:
  - 1. Catalogue and Product specifications
  - 2. Installation instructions
  - 3. Color charts
  - 4. Catalog cuts
  - 5. Rough-in diagrams and templates
  - 6. Wiring diagrams
  - 7. Performance curves
  - 8. Operational range diagrams
  - 9. Mill reports
  - 10. Design data and calculations
  - 11. Certification of compliance or conformance
  - 12. Manufacturer's instructions and field reports

## **1.5 COORDINATION DRAWINGS:**

- A. The Contractor shall provide reproducible Coordination Drawing(s) of the reflective ceiling showing the integration of all applicable contract work, including general construction work as well as trade work (Plumbing, HVAC, and Electrical) to be performed by subcontractors. The Coordination Drawing(s) shall include, without limitation, the following information:
  - 1. General Construction work showing the reflective ceiling plan including starting points, ceiling and beam soffits elevations, ceiling heights, roof openings, etc.
  - 2. HVAC Contract work showing ductwork, heating and sprinkler piping, location of grilles, registers etc. and access doors in hung ceilings. Locations shall be fixed by elevations and dimensions from column centerlines and/or walls.
  - 3. Plumbing Contract work including piping, valves, cleanouts etc., indicating locations and elevations and shall indicate the necessary access doors.
  - 4. Electrical Contract work indicating fixtures, large conduit runs, clearances, pull boxes, junction boxes, sound system speakers, etc.



- B. The Contractor shall issue the completed Coordination Drawing(s) to the Resident Engineer for his/her review. The Resident Engineer may call as many meetings as necessary with the Contractor, including attendance by applicable subcontractors, and may call on the services of the Design Consulting where necessary, to resolve any conflicts that become apparent.
- C. Upon resolution of any conflicts, the Contractor shall provide a final Coordination Drawing(s) which will become the Master Coordination Drawing(s). The Master Coordination Drawing(s) shall be signed and dated by the Contractor to indicate acceptance of the arrangement of the work.
- D. A reproducible copy of the Master Coordination Drawing(s) shall be provided by the Contractor to each of the appropriate subcontractor(s), the Resident Engineer and the Design Consultant for information.
- E. Shop Drawings shall not be submitted prior to acceptance of the final coordinated drawings and shall be prepared in accordance with the Master Coordination Drawing(s). No work will be permitted without accepted Shop Drawings. It is therefore essential that this procedure be instituted as quickly as possible.

#### **1.6 SUBMITTAL PROCEDURES:**

- A. Refer to Section 01 35 03 GENERAL MECHANICAL REQUIREMENTS and Section 01 35 06 GENERAL ELECTRICAL REQUIREMENTS for additional submittal requirements involving electrical and mechanical work or equipment of any nature called for the project.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activities, with the Submittal Schedule specified in Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
  - 3. The Commissioner reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: The Submittals Schedule is set forth in Schedule F, which is included in the Addendum.
- D. Identification: Place a permanent label or title block on each submittal for identification.
  - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
  - 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Design Consultant.
  - 3. Include the following minimum information on label for processing and recording action taken:
    - a. Project name, DDC Project Number and Contract Number
    - b. Date
    - c. Name and address of Design Consultant
    - d. Name and address of Contractor
    - e. Name and address of subcontractor
    - f. Name and address of supplier
    - g. Name of manufacturer
    - h. Submittal number or other unique identifier, including revision identifier
    - i. Number and title of appropriate Specification Section
    - j. Drawing number and detail references, as appropriate
    - k. Location(s) where product is to be installed, as appropriate
    - l. Other necessary identification
- E. Transmittal:



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1. Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form in triplicate. Transmittals received from sources other than the Contractor will be returned without review. Re-submission of the same drawings or product data shall bear the original number of the prior submission and the original titles.
2. Transmittal Form: Provide locations on form for the following information:
  - a. Project name, DDC Project number and Contract Number
  - b. Date
  - c. Destination (To:)
  - d. Source (From:)
  - e. Names of Contractor, subcontractor, manufacturer, and supplier
  - f. Category and type of submittal
  - g. Submittal purpose and description
  - h. Specification Section number and title
  - i. Drawing number and detail references, as appropriate
  - j. Transmittal number, numbered consecutively
  - k. Submittal and transmittal distribution record
  - l. Remarks
  - m. Signature of transmitter

**F. Shop Drawings:**

1. Procedures for Preparing, Forwarding, Checking and Returning all Shop Drawings shall be, generally, as follows:
  - a. The Contractor shall make available to its subcontractors the necessary Contract Documents and shall instruct such subcontractor to determine dimensions and conditions in the field, particularly with reference to coordination between the trade subcontractors. The Contractor shall direct its subcontractors to prepare Shop Drawings for submission to the Design Consultant in accordance with the requirements of these General Conditions. The Contractor shall also direct its subcontractors to "Ring Up" corrections made on all re-submissions for approval, so as to be readily seen, and that the symbol "sub" be used to identify the source of the correction or information that has been added.

The Contractor shall:

1. Review and be responsible to the Commissioner, for information shown on its subcontractor's Shop and Installation drawings and manufacturers' data, and also for conformity to Contract Documents.
  2. "Ring Up" corrections made on all submissions for approval, so as to be readily seen, and that the symbol "GC", "PL", "HVAC" or "EL" be used to indicate that the correction and/or information added was made by the Contractor and/or its subcontractor(s).
  3. Clearly designate which entity is to perform the work when the term, "work by others" or other similar phrases are indicated on the Contract Drawings before submission to the Design Consultant.
  4. Stamp submissions "Recommended for Acceptance", date and forward to the Design Consultant.
2. The Contractor shall promptly prepare and submit project specific layout detail and Shop Drawings of such parts of the work as are indicated in the Specifications, Schedule F of the Addendum or as required. These Shop Drawings shall be made in accordance with the Contract Drawings, Specifications and Supplementary Drawings, if any. The Shop Drawings shall be accurate and distinct and give all the dimensions required for the fabrication, erection and installation of the work.
3. Size of Drawings: The Shop Drawings, unless otherwise directed, shall be on sheets of the same size as the Contract Drawings, drawn accurately and of sufficient scale to be legible, with a one ha



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(1/2) inch marginal space on each side and a two (2) inch marginal space for binding on the left side.

4. Scope of Drawings: Shop Drawings shall be numbered consecutively and shall accurately and distinctly represent all aspects of the work, including without limitation the following:
  - a. All working and erection dimensions
  - b. Arrangements and sectional views
  - c. Necessary details, including performance characteristics, and complete information for making necessary connections with other work
  - d. Kinds of materials including thickness and finishes
  - e. Identification of products
  - f. Fabrication and installation drawings
  - g. Roughing-in and setting diagrams
  - h. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
  - i. Shop work manufacturing instructions
  - j. Templates and patterns
  - k. Schedules
  - l. Design calculations
  - m. Compliance with specified standards
  - n. Notation of coordination requirements
  - o. Notation of dimensions established by field measurement
  - p. Relationship to adjoining construction clearly indicated
  - q. Seal and signature of professional engineer if specified
  - r. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring
  - s. All other information necessary for the work and/or required by the Commissioner
5. Titles and Reference: Shop Drawings shall be dated and contain:
  - a. Name of the Project, DDC Project Number and Contract Number
  - b. The descriptive names of equipment, or materials covered by the Contract Drawings and the classified item number or numbers, if any, under which it is, or they are required
  - c. The locations or points and sequence at which materials, or equipment, are to be installed in the work
  - d. Cross references to the section number, detail number and paragraph number of the Contract Specifications
  - e. Cross references to the sheet number, detail number, etc., of the Contract Drawings
6. Field Measurements: In addition to the above requirements, the Shop Drawings shall be signed by the Contractor and, if applicable, the subcontractor responsible for preparation of the Shop Drawings. Each Shop Drawing shall be stamped with the following wording:

**FIELD MEASUREMENTS:** The Contractor certifies that it has verified and supplemented the Contract Drawings by taking all required field measurements, which said measurements correctly reflect all field conditions and that this Shop Drawing incorporates said measurements.
7. Contractor's Statement with Submittal: Any Submittal by the Contractor for acceptance, including without limitation, all dimensional drawings of equipment, blueprints, catalogues, models, samples and other data relative to the equipment, the materials, the work or any part thereof, must be accompanied by a statement that the Submittal has been examined by the Contractor and that everything shown in the Submittal is in accordance with the requirements of the Contract Drawings and Specifications. If there is any discrepancy between what is shown in the Submittal and the requirements of the Contract Drawings and Specifications, the Contractor shall, in its statement, list and clearly describe each such discrepancy.



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Acceptance will be given based upon the Contractor's representation that what is shown in the Submittal is in accordance with the requirements of the Contract Drawings and Specifications. If the Contractor's statement indicates any discrepancy between what is shown in the Submittal and the requirements of the Contract Drawings and Specifications, such change is subject to review and prior written acceptance by the Design Consultant. In addition, such change may require a change order in accordance with Article 25 of the Contract. In the event any such change is approved, any additional expense or increased cost in connection with the change is the sole responsibility of the Contractor.

8. Submission of Shop Drawings:

- a. Initial Submission: The Contractor shall submit seven (7) copies of each Shop Drawing to the Design Consultant for his/her review and acceptance. The Design Consultant will transmit Shop Drawings to appropriate sub-consultants for review and acceptance, including Commissioning Authority/Agent as applicable. A satisfactory Shop Drawing will be stamped "No Exceptions Taken", be dated and distributed by the Design Consultant as follows:
  - 1) Two (2) copies thereof will be returned to the Contractor by letter
  - 2) Three (3) copies of the approved Shop Drawing and copy of the transmittal letter to the Contractor will be forwarded to DDC
  - 3) One copy will be retained by the Design Consultant
  - 4) One copy will be forwarded / retained by sub-consultant(s) as appropriate

Should the Shop Drawing(s) be "Rejected" or noted "Revise and Resubmit" by the Design Consultant, the Design Consultant will return the Shop Drawings to the Contractor with the necessary corrections and changes to be made as indicated thereon.

- b. Revisions: The Contractor must make such corrections and changes and again submit seven (7) copies of each shop drawing to the Design Consultant. The Contractor shall revise and resubmit the Shop Drawing as required by the Design Consultant until the Shop Drawings are stamped "No Exceptions Taken". However, Shop Drawings which have been stamped "Make Corrections Noted" shall be considered an "Acceptable" Shop Drawing and NEED NOT be resubmitted.
- c. Commencement of Work: No work or fabrication called for by the Shop Drawings shall be done until the acceptance of the said drawings by the Design Consultant is given. In addition to the foregoing Shop Drawing transmissions, a copy of any Shop Drawing prepared by any of the Contractor's subcontractors which Shop Drawing indicated work related to, adjacent to, impinging upon, or affecting work to be done by other subcontractors shall be transmitted to the subcontractors so affected. [These accepted Shop Drawings shall be distributed to the affected subcontractors when required with a copy of the transmittal to the Resident Engineer.]
- d. Variations: If the Shop Drawings show variations from the Contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in its letter of submittal. Acceptance of the Shop Drawings shall constitute acceptance of the subject matter thereof only and not of any structural apparatus shown or indicated.

G. Product Data:

1. General: Except as otherwise prescribed herein, the submission, review and acceptance of Product Data and Catalogue cuts shall conform to the procedures specified in Sub-Section 1.6 F, Shop Drawings.
2. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
3. Mark each copy of each submittal to show which products and options are applicable.



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4. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Standard color charts.
    - e. Manufacturer's catalog cuts.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Mill reports.
    - j. Standard product operation and maintenance manuals.
    - k. Compliance with specified referenced standards.
    - l. Testing by recognized testing agency.
    - m. Application of testing agency labels and seals.
    - n. Notation of coordination requirements.
  5. Submit Product Data before or concurrent with Samples.
  6. Submission of Product Data:
    - a. Initial Submission: The Contractor shall submit seven (7) sets of Product Data to the Design Consultant for his/her review and acceptance. The Design Consultant will transmit Product Data to appropriate sub-consultants for review and acceptance, including Commissioning Authority/Agent as applicable. A satisfactory catalogue cut will be stamped "No Exception Taken", be dated and distributed as follows:
      - 1) Two (2) copies thereof will be returned to the Contractor by letter
      - 2) Three (3) copies of the Product Data and copy of the transmittal letter to the Contractor will be forwarded to DDC
      - 3) One copy will be retained by the Design Consultant
      - 4) One copy will be forwarded / retained by sub-consultant(s) as appropriateShould the Product Data be "Rejected" or noted "Revise and Resubmit" by the Design Consultant, the Design Consultant will return one (1) set of such Product Data to the Contractor with the necessary corrections and changes to be made indicated and one (1) set to DDC.
  7. Revisions: The Contractor must make such corrections and changes and again submit seven (7) copies of each Product Data for the review of the Design Consultant. The Contractor shall revise and resubmit the Product Data as required by the Design Consultant until the submission is stamped "No Exceptions Taken" by the Design Consultant. However, Product Data which has been stamped "Make Corrections Noted" shall be considered an "Accepted" Product Data and NEED NOT be resubmitted.
- H. Samples of Materials:
1. For samples of materials involving electrical work of any nature, refer to Section 00 35 06 - General Electrical Requirements.
  2. Samples shall be in triplicate, of sufficient size to show the quality, type, range of color, finish and texture of the material.
  3. Each of the samples shall be labeled as follows:
    - a. Name of the Project, DDC Project Number and Contract Number
    - b. Name and quality of the material



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- c. Date
- d. Name of Contractor, subcontractor, manufacturer and supplier
- e. Related Specification or Contract Drawing reference to the samples submitted
4. A letter of transmittal, in triplicate, from the Contractor requesting acceptance must accompany all such samples.
5. Transportation charges to the Design Consultant's office must be prepaid on all samples forwarded.
6. Samples for testing purposes shall be as required in the Specifications.
7. Samples on Display: When samples are specified to be equal to approved product, they shall be carefully examined by the Contractor and by those whom the Contractor expects to employ for the furnishing of such materials.
8. Timely Submissions Log/Schedule: Samples shall be submitted in accordance with approved Shop Drawing log so as to permit proper consideration without delaying any operation under the project. Materials should not be ordered until acceptance is received, in writing, from the Design Consultant. All materials shall be furnished equal in every respect to the accepted samples.
9. The Acceptance of any samples will be given as promptly as possible, and shall be only for the characteristic color, texture, strength, or other feature of the material named in such approval, and no other. When this approval is issued by the Design Consultant, it is done with the distinct understanding that the materials to be furnished will fully and completely comply with the Specifications, the determination of which may be made at some later date by a laboratory test or by other procedure. Use of materials will be permitted only so long as the quality remains equal to the approved samples and complies in every respect with the Specifications, and the colors and textures of the samples on file in the office of the Design Consultant, for the project.
10. Acceptability of test Data: The Commissioner will be the final judge as to acceptability of laboratory test data and performance in service of materials submitted.
11. Valuable Samples: Valuable samples, such as hardware, plumbing and electrical fixtures, etc., not destroyed by inspection or test, will be returned to the Contractor and may be incorporated into the work after all questions of acceptability have been settled, providing suitable permanent records are made as to the location of the samples, their properties, etc.
12. Equivalent Quality: Any material, article and/or equipment which is designated in the Drawings and/or Specifications by a number in the catalogue of any manufacturer or by a manufacturer's grade or trade name is designated for the purpose of describing the material, article and/or equipment and fixing the standard of performance and/or function, as well as the quality and/or finish. Any material, article and/or equipment which is other than what is specified in the Drawings and/or Specifications will only be accepted if the Commissioner makes a written determination that such material, article and/or equipment is equivalent to that which is specified in the Drawings and/or Specifications.
13. The submission of any material, article and/or equipment as the equal of any material, article and/or equipment set forth in the Drawings and/or Specifications as a standard shall be accompanied by any and all information essential for determining whether such proposed material, article and/or equipment is equivalent to that which is specified. Such information shall include, without limitation, illustrations, drawings, descriptions, catalogues, records of tests, samples, as well as information regarding the finish, durability and satisfactory use of such proposed material, article and/or equipment under similar operating conditions.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 1.7**

**1.7 LEED SUBMITTALS:**

- A. Comply with submittal requirements specified in Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL; Section 01 81 13.03, SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS; or Section 01 81 13.04 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS, as applicable; Section 01 81 13.13, VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS FOR LEED v3 BUILDINGS; Section 01 81 19, INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS and Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS, and/or section 01 91 15 BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS.
- B. LEED Building submittal information shall be assembled into one package per each applicable specification section, separate from all other non-LEED submittals. Each submittal package shall have a separate transmittal and identification as described in Sub-Section 1.5 herein.
- C. Number of Copies: Submit FOUR (4) copies of LEED submittals, in accordance with procedure described in Article 1.5 herein, unless otherwise indicated.
- D. Material Safety Data Sheets (MSDSs) for LEED Certification: Submit information necessary to show compliance with LEED certification requirements, which will be the limit of the Design Consultant's review for LEED compliance.
  - 1. Designated LEED submittals that include non-LEED MSDS data will not be reviewed. The entire submittal will be returned for re-submission.
- E. Product Cut Sheets and/or Shop Drawings for LEED Certification: Provide product cut sheets and/or shop drawings with the Contractor's or sub-contractor's stamp, confirming that the submitted products are the products installed in the Project. For detailed requirements refer to Sub-Section 1.6 of Section 01 81 13.03 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 PROJECTS, or Section 01 81 13.04 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS.
  - 1. Provide the quantity, length, area, volume, weight, and/or cost of each product submitted as required to satisfy LEED documentation requirements. Refer to Sub-Section 1.6 of Section 01 81 13.03 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 PROJECTS.

**1.8 ULTRA LOW SULFUR DIESEL FUEL AND BEST AVAILABLE TECHNOLOGY REPORTING:**

- A. In accordance with Section 01 10 00 Summary, Sub-Section 1.5 E, the Contractor shall submit reports to the Commissioner regarding the use of Ultra Low Sulfur Diesel Fuel and Best Available Technology (BAT) in Non road Vehicles. Submission of such reports shall be in accordance with the schedule, format, directions and procedures established by the Commissioner.

**1.9 CONSTRUCTION PHOTOGRAPHS AND VIDEO RECORDINGS:**

- A. Submit construction progress photographs and Video recordings in accordance with requirements of Section 01 32 33, PHOTOGRAPHIC DOCUMENTATION

**1.10 AS-BUILT DOCUMENTS:**

- A. Submit all as-built documents in accordance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.





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**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 33 00**



**SECTION 01 35 03**

**GENERAL MECHANICAL REQUIREMENTS**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 35 03**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. The General Mechanical Requirements contained herein shall be followed by the Contractor, as well as its subcontractor for HVAC work. This Section sets forth the General Requirements applicable to mechanical work for the Project. Such requirements are intended to be read in conjunction with the Specifications and Contract Drawings for the Project. In the event of any conflict between the requirements set forth in this Section and the requirements of the Specifications and/or the Contract Drawings, whichever requirement is the most stringent, as determined by the Commissioner, shall take precedence.

**1.3 RELATED SECTIONS:** Include without limitation the following:

- A. Section 01 10 00 SUMMARY
- B. Section 01 33 00 SUBMITTAL PROCEDURES
- C. Section 01 35 06 GENERAL ELECTRICAL REQUIREMENTS
- D. Section 01 42 00 REFERENCES
- E. Section 01 77 00 CLOSEOUT PROCEDURES
- F. Section 01 78 39 CONTRACT RECORD DOCUMENTS

**1.4 DEFINITIONS:**

- A. **CONCEALED PIPING AND DUCTS** -: shall mean piping and ducts hidden from sight in masonry or other construction, in floor fill, trenches, partitions, hung ceilings, furred spaces, pipe shafts and in service tunnels not used for passage. Where piping and ducts run in areas that have hung ceilings, such piping and ducts shall be installed in the hung ceilings. For work on existing piping any insulation on such existing piping is to be tested for asbestos and abated, if found to be positive by a certified asbestos contractor. Such testing and abatement shall occur prior to the performance of any work on these pipes.

**1.5 SUBMITTALS:**

- A. **INTENT OF MECHANICAL CONTRACT DRAWINGS** – Mechanical Contract Drawings are in part diagrammatic and show the general arrangement of the equipment, ducts and piping included in the Contract and the approximate size and location of the equipment.
- B. The Contractor shall follow these Contract Drawings in laying out the work and verify the spaces in which it will be installed. The Contractor shall submit, as directed, Mechanical Shop Drawings, roughing drawings, manufacturer's Shop Drawings, field drawings, cuts, bulletins, etc., of all materials, equipment and methods of installation shown or specified in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.



1. Submit sheet metal shop standards. Submit manufacturer's product data including gauges, materials, types of joints, scaling materials and installations for metal ductwork materials and products.
2. Submit scaled layout drawing (3/8"=1') of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, slopes of horizontal runs, wall and floor penetrations and connections. Show modifications of indicated requirements made to conform to local shop practice and how those modifications ensure that free area, materials and rigidity are not reduced. Layouts should include all the room plans, mechanical equipment rooms and penthouses. Method of attachment of duct hangers to building construction all with the support details. Coordinate shop drawings with related trades prior to submission.
3. Indicate duct fittings, particulars such as gauges, sizes, welds and configuration prior to start of work for low-pressure systems.
4. Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data and shop drawings in maintenance manual.

**1.6 ACCESSIBILITY:**

- A. All work shall be installed by the Contractor so as to be readily accessible for inspection, operation, maintenance and repair. Minor deviations from the arrangement indicated on the Contract Drawings may be made to accomplish this, but they shall not be made without approval by the Commissioner.

**1.7 CHANGES IN PIPING, DUCTS, AND EQUIPMENT:**

- A. Wherever field conditions are such that for proper execution of the work, reasonable changes in location of piping, ducts and equipment are necessary and required, the Contractor shall make such changes as directed and approved, without extra cost to the City.

**1.8 CLEANING OF PIPING, DUCTS, AND EQUIPMENT:**

- A. Piping, ducts and equipment shall be thoroughly cleaned by the Contractor of all dirt, cuttings and other foreign substances. Should any pipe, duct or other part of the several systems be obstructed by any foreign matter, the Contractor will be required to pay for disconnecting, cleaning and reconnecting wherever necessary for the purpose of locating and removing obstructions. The Contractor shall pay for repairs to other work damaged in the course of removing obstructions. For work on existing piping, ducts and equipment the Contractor shall pay special attention during this task so as not to disturb the insulation on such piping, ducts or equipment.

**1.9 STANDARDIZATION OF SIMILAR EQUIPMENT:**

- A. Unless otherwise particularly specified, all equipment of the same kind, type or classification, and used for identical purposes, shall be the product of one (1) manufacturer.

**1.10 SUPPORTING STRUCTURES DESIGNED BY THE CONTRACTOR:**

- A. Unless otherwise specified, supporting structures for equipment to be furnished by the Contractor shall be designed by an Engineer licensed in New York State retained by the Contractor. Supporting structures shall be built by the Contractor of sufficient strength to safely withstand all stresses to which they may be subjected, within permissible deflections, and shall meet the following standards:



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1. Structural Steel - ASTM Standard Specifications, AISC and New York City Construction Codes.
2. Concrete for supports for equipment shall conform to the Specifications for concrete herein, but in no case shall be less than the requirements of the New York City Construction Codes for average concrete.
3. Steel reinforcement for concrete shall be of intermediate grade and shall meet the requirements of the Standard Specifications for Billet Steel-Concrete Reinforcement Bars, ASTM.
4. Drawings and calculations shall be submitted for review and acceptance in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

**1.11 ELIMINATION OF NOISE:**

- A. All systems and/or equipment provided under the Contract shall operate without objectionable noise or vibration.
- B. Should operation of any one or more of the several systems produce noise or vibration which is, in the opinion of the Commissioner, objectionable, the Contractor shall at its own expense make changes in piping, equipment, etc. and do all work necessary to eliminate objectionable noise or vibration.
- C. Should noise or vibration found objectionable by the Commissioner be transmitted by any pipe or portions of the structure from systems and/or equipment installed under the Contract, the Contractor shall at its own expense install such insulators and make such changes in or additions to the installations as may be necessary to prevent transmission of this noise or vibration.

**1.12 PRELIMINARY FIELD TEST:**

- A. As soon as conditions permit, the Contractor shall furnish all necessary labor and materials for, and shall make, preliminary field tests of the equipment to ascertain compliance with the requirements of the Contract. If the preliminary field tests disclose equipment that does not comply with the Contract, the Contractor shall, prior to the acceptance test, make all changes, adjustments and replacements required.

**1.13 INSTRUCTIONS ON OPERATION:**

- A. At the time the equipment is placed in permanent operation by the City, the Contractor shall make all adjustments and tests required by the Commissioner to prove that such equipment is in proper and satisfactory operating condition. The Contractor shall instruct the City's operating personnel on the proper maintenance and operation of the equipment for the period of time called for in the Specifications.

**1.14 CERTIFICATES:**

- A. On completion of the work, the Contractor shall obtain certificates of inspection, approval, acceptance and of compliance with all laws from all agencies and/or entities having jurisdiction over the work and shall deliver these certificates to the Commissioner in accordance with Section 01 77 00 CLOSEOUT PROCEDURES. The work shall not be deemed substantially complete until the certificates have been delivered. See General Comments regarding problems with specifying items required for substantial completion.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 35 03**



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**SECTION 01 35 06  
GENERAL ELECTRICAL REQUIREMENTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section sets forth the General Requirements applicable to electrical work for the Project. Such requirements are intended to be read in conjunction with the Specifications and Contract Drawings for the Project. In the event of any conflict between the requirements set forth in this Section and the requirements of the Project Specifications and/or the Contract Drawings, whichever requirement is the most stringent, as determined by the Commissioner, shall take precedence.
- B. This Section includes the following:
1. Procedure for Electrical Approval
  2. Submittals
  3. Electrical Installation Procedures
  4. Electrical Conduit System Including Boxes (Pull, Junction and Outlet)
  5. Electrical Wiring Devices
  6. Electrical Conductors and Terminations
  7. Circuit Protective Devices
  8. Distribution Centers
  9. Motors
  10. Motor Control Equipment
  11. Schedule of Electrical Equipment

**1.3 RELATED SECTIONS:** Include without limitation the following:

- |    |                  |                                 |
|----|------------------|---------------------------------|
| A. | Section 01 10 00 | SUMMARY                         |
| B. | Section 01 33 00 | SUBMITTAL PROCEDURES            |
| C. | Section 01 35 03 | GENERAL MECHANICAL REQUIREMENTS |
| D. | Section 01 42 00 | REFERENCES                      |
| E. | Section 01 77 00 | CLOSEOUT PROCEDURES             |
| F. | Section 01 78 39 | CONTRACT RECORD DOCUMENTS       |

**1.4 DEFINITIONS:**

- A. **WIRING:** means both wire and raceway (rigid steel, heavy wall conduit unless specifically indicated otherwise).
- B. **POWER WIRING:** means wiring from a panel board or other specified source to a starter (if required) then to a disconnect (if required), then to the final point of usage such as a motor, unit or device.



- C. **CONTROL and/or INTERLOCK WIRING:** means that wiring that signals the device to operate or shut down in response to a signal from a remote control device such as a temperature, smoke, pressure, float, etc. device (starters and disconnect switches are not included in this definition) regardless of the voltage required for the controlling device.
- D. **RIGID STEEL CONDUIT:** shall mean rigid steel, heavy wall conduit that is hot dipped galvanized inside and outside. The conduit shall meet the requirements of the latest edition, as amended, of the "Standard for Rigid Steel Conduit" of the Underwriters' Laboratories, Inc. Unless otherwise specified in the Specifications or indicated on the Contract Drawings, rigid steel conduit shall be used for all exposed work, for all underground conduits in contact with earth and for fire alarms systems, as required by the New York City Construction Codes.
- E. **ELECTRICAL METALLIC TUBING (EMT):** shall mean industry standard thin wall conduit of galvanized steel only. All elbows, bends, couplings and similar fittings which are installed as a part of the conduit system shall be compatible for use with electric metallic tubing. Couplings and terminating fittings shall be of the pressure type as approved by the Commissioner. Set screw fittings will not be acceptable. EMT shall meet the requirements of the latest edition, as amended, of the "Standard for Electrical Metallic Tubing of the Underwriters Laboratories Inc." EMT may only be used where specifically indicated. In no case will EMT be permitted in spaces other than hung ceilings and dry wall partitions.
- F. **FLEXIBLE METALLIC CONDUIT (FMC):** Shall mean a conduit made through the coiling of a self-interlocking ribbed strip of aluminum or steel, forming a hollow tube through which wires can be pulled. For final connections to motors and motorized equipment, not more than a 4' - 0" length of flexible conduit may be used. For watertight installations, this conduit shall be of a watertight type, attached with watertight glands or fittings for final connections from outlet box to recessed lighting fixtures and in locations only where specifically permitted by the Specifications or Contract Drawings.

#### **1.5 PROCEDURE FOR ELECTRICAL APPROVAL:**

This Sub-Section sets forth General Electrical information, as well as required approvals for all electrical work required for the Project, including ancillary electrical work which may be included in the work of other trade subcontractors.

- A. **ELECTRIC SERVICE:** The electric service supply is subject to commercial and operating variation of the utility company. Proper provision shall be made to have all apparatus operate normally under these conditions.
- B. **ACCEPTANCE:** Acceptance and approval of the work will be contingent upon the inspection and test of the installation by the City regulatory agency.
- C. **TESTS:** The Contractor shall notify the Commissioner when the Contractor has completed the work and is ready to have it inspected and tested. Upon completion of the work tests shall be made as required by the Commissioner of all electrical materials, electrical and associated mechanical equipment, and of appliances installed hereunder. The Contractor shall furnish all labor and material for such tests. Should the tests show that any of the material, appliances or workmanship is not first class or not in compliance with the Contract, the Contractor on written notice shall remove and promptly replace them with other materials in conformity with the Contract.
- D. **CERTIFICATE OF THE BUREAU OF ELECTRICAL CONTROL, OF THE DEPARTMENT OF BUILDINGS (B.E.C.):** The Contractor must file prior to requesting a substantial completion inspection a Certificate of Inspection issued by B.E.C. On completion of the work the Contractor shall obtain certificates of inspection, approval, acceptance and compliance from all agencies and/or entities having jurisdiction over the work and shall deliver these certificates to the Commissioner in accordance with Section 01 77 00 CLOSEOUT PROCEDURES.
- E. **RESPONSIBILITY FOR CARE AND PROTECTION OF EQUIPMENT:**



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1. The Contractor furnishing any equipment shall be responsible for the equipment until it has been finally inspected, tested and accepted, in accordance with the requirements of the Contract.
  2. After delivery and before and after installation, the Contractor shall protect all equipment against theft, injury or damage from all causes. The Contractor shall carefully store all equipment received for work, which is not immediately installed. If any equipment has been subject to possible injury by water, it shall be thoroughly dried out and put through a special dielectric test as directed by the Commissioner, at the expense of the Contractor or replaced by the Contractor without additional cost to the City.
- F. **UNIFORMITY OF EQUIPMENT:** Any two (2) or more pieces of equipment, apparatus or materials of the same kind, type or classification which are intended to be used for identical types of service, shall be made by the same manufacturer.

**1.6 SUBMITTALS:**

**A. CONTRACTOR'S ELECTRICAL DRAWINGS AND SAMPLES FOR APPROVAL:**

1. The Contractor shall submit to the Commissioner for approval, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, complete dimensional drawings of all equipment, wiring diagrams, motor test data, details of control, installation layouts showing all details and locations and including all schedules, and descriptions and supplementary data to comprise complete working drawings and instructions for the performance of the work. A description of the operation of the equipment and controls shall be included. A letter, in triplicate, shall accompany each submittal.
2. The Contractor shall submit in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, duplicate samples of such materials and appliances as may be requested by the Commissioner for approval. These samples shall be properly tagged for identification and submitted for examination and test. After the samples are approved, one (1) sample will be returned to the Contractor and the other sample will be filed in the office of the Commissioner's representative for inspection use. After the Contract is completed, the second set of samples will be returned to the Contractor.

- B. **TIMELINESS:** All material shall be submitted in accordance with the submittal schedule in sufficient time for the progress of construction. Failure to promptly submit acceptable samples and dimensional drawings of equipment will not be accepted as grounds for an extension of time. The Commissioner may decline to consider submittals unless all related items are submitted at the same time.
- C. **CONTRACTOR'S STATEMENT WITH SUBMITTALS:** Contractor shall submit statement in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.
- D. **BULLETINS AND INSTRUCTIONS:** The Contractor shall furnish and deliver to the Commissioner in accordance with Section 01 78 39, CONTRACT RECORD DOCUMENTS and Section 01 77 00, CLOSEOUT PROCEDURES, after acceptance of the work, four (4) complete sets of instructions, technical bulletins and any other printed matter (diagrams, prints, or drawings) required to provide complete information for the proper operation, maintenance and repair of the equipment and the ordering of spare parts.





**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION**

**3.1 ELECTRICAL INSTALLATION PROCEDURES:**

This Sub-Section sets forth the General Installation Procedure that shall apply to all electrical work and electrical equipment appearing in the Contract.

(Refer to Sub-Section 1.4 DEFINITIONS for terms used in this section)

- A. **INTENT OF CONTRACT DOCUMENTS:** The Drawings and Specifications are to be interpreted as a means of conveying the scope and intent of the work without giving every minor electrical detail. It is intended, nevertheless, that the Contractor shall provide whatever labor and materials are found necessary, within the scope of the Contract, for the successful operation of the installation. Specific details of individual installations are to be finally decided upon when the Contractor submits Working or Shop Drawings for approval to DDC. Whenever there are two (2) or more methods to complete project work within the Contract scope, the Commissioner reserves the right to choose that method which, in the Commissioner's opinion, will afford the most satisfactory performance, lasting qualities, and accessibility for repairs, even though this selection is the most costly.
- B. **SCHEMATIC PLANS – APPROXIMATE LOCATIONS:** Conduits and wiring are shown on the plans for diagrammatic purposes only. Therefore, conduit layouts may not necessarily give the actual physical route of the conduits. The Contractor who installs a conduit system will also be required, as part of the work, to furnish and install all hangers and pull-boxes, including any special pull-boxes found necessary to overcome interferences, and to facilitate the pulling of electrical cables. Similarly, the locations of equipment, appliances, outlets and other items shown on Contract Drawings are only approximate and are to be definitively established when equipment Shop Drawings are submitted and approved by DDC during construction.
- C. **SLEEVES:** required for conduits passing through walls or floors, shall be furnished and set by the Contractor installing the conduits. Sleeves in waterproofed floors shall be provided with flashing extending 12 inches in all directions from sleeve and secured to waterproofing. Flashing shall be turned down into space between pipe and sleeve and caulked watertight. Flashing shall be 20 oz. cold rolled copper. Sleeves shall be supplied with welded flanges similar to those supplied by the subcontractor for Plumbing Work and shall extend one (1) inch above finished floor.
- D. **COORDINATION:** The Contractor shall keep in close touch with the construction progress and obtain the necessary information for the accurate placement of its work in ample time before project construction operations obstruct its work. The Contractor is to consult all other Contract Drawings, as well as approved equipment Shop Drawings on file in the Resident Engineer's Field Office. This will aid in avoiding interferences, omissions and errors in the electrical installation.
- E. **RESTORATION:** If drilling or cutting is done on finished surfaces of equipment or the structure, any marring of the surface shall be repaired or replaced by the Contractor. The Contractor shall be held responsible for corrective restoration due to its cutting or drilling, and for any damage to the project or its contents caused by the Contractor or the Contractor's workers. If any piercing of waterproofing occurs because of the installation of the work, the Contractor shall restore the waterproofing, at its own expense, to the satisfaction of the Commissioner.
- F. **ELECTRICAL WORK AT SITE:** The Contractor furnishing equipment consisting of a number of related electrical devices or appliances, mounted in a single enclosure, or on a common base, shall furnish this unit complete with internal wiring, connections, terminal boxes with copper connectors and/or lugs and ample electrical leads, ready for connection and operation. The cost of any wiring, re-wiring or other work



required to be done on this unit in the field, shall be borne by the Contractor, without additional cost to the City.

- G. **COOPERATION AMONG SUBCONTRACTORS:** Whenever an electrically operated unit or system involves the combined work of several subcontractors for its installation and successful operation, the Contractor shall require each subcontractor to exercise the utmost diligence in cooperating with others to produce a complete, harmonious installation.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.2**

**3.2 ELECTRICAL CONDUIT SYSTEM INCLUDING BOXES (PULL, JUNCTION AND OUTLET):**

This Sub-Section sets forth the requirements applying to the installation of electrical conduits, boxes or fittings. Rigid steel conduit shall be used throughout, unless otherwise directed by the Commissioner. Where the word 'conduit', without a modifier such as, rigid steel, EMT, etc., is specified to be used, it shall be interpreted to mean, rigid steel, heavy wall, threaded conduit.

(Refer to Sub-Section 1.4 DEFINITIONS for terms used in this section)

**A. INSTALLATIONS AND APPLICATIONS:**

1. Unless otherwise specified or indicated on the Contract Drawings, conduit runs shall be installed concealed in finished spaces.
2. **CONDUIT SIZES:** The sizes of conduit shall be as indicated on the Contract Drawings. Wherever conduit sizes are not indicated, the conduit shall meet the requirements of the New York City Electrical Code to accommodate the conductors to be installed therein.
3. Conduits shall be reamed smooth after cutting. No running threads will be permitted. Universal type couplings shall be used where required. Conduit joints shall be screwed up to butt. Empty conduits after installation shall have all open ends temporarily plugged to prevent the entrance of water or other foreign matter.
4. Conduits being installed in concrete or masonry shall be securely held in place during pouring and construction operations. A group of conduits terminating together shall be held in place by a template.
5. **UNDERGROUND STEEL CONDUITS:** Unless otherwise specified, all underground steel conduits in contact with earth shall be encased by the Contractor who installs them, in a covering of not less than two (2) inches of an approved concrete mixture. Concrete mix shall be one (1) part cement to four and one-half (4 ½) parts of fine and coarse aggregate.
6. **EXCAVATION RESTORATION PERMITS:** When installing underground conduits, duct banks or manholes the Contractor shall perform the work of cutting pavement, excavation shoring, keeping trenches or holes pumped dry, backfilling, restoration of surfaces to original condition and removal of excess earth and rubbish from premises. During the work, the Contractor shall provide adequate crossovers, protective barriers, lamps, flags, etc., to safeguard traffic and the public. When the work is in a public highway or street, the Contractor shall secure and pay for all necessary permits and inspection fees and pay the cost of repaving.
7. **EXPOSED CONDUIT SUPPORTS:** Exposed conduit shall be supported by Galvanized hangers with necessary inserts, beam clamps of approved design or attached to walls or ceilings by



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- expansion bolts. Exposed conduits shall be supported or fastened at intervals not more than five (5) feet.
8. Exposed conduit shall be installed parallel or at right angles to ceiling, walls and partitions. Where direction changes of exposed conduit cannot be made with neat bends, such as required around beams or columns, conduit type fitting shall be used.
  9. The conduit shall be installed with an approved expansion joint:
    - a. Wherever the conduit crosses a building expansion joint the Contractor will be held responsible for determining where the building expansion joints are located.
    - b. Every 200 feet, when in straight runs of 200 feet or longer.
  10. Conduit may only enter and leave a floating slab in the vertical direction, and then only in an approved manner. Horizontal entries into floating slabs are not permitted.
  11. Conduit installed in pipe shafts shall be properly supported to carry the total weight of the raceway system complete with cable. In addition at least one (1) horizontal brace per 10 ft. section shall be provided to assure stability of the raceway system.
  12. **BUSHINGS AND LOCKNUTS:** Approved bushings and locknuts shall be used wherever conduits enter outlet boxes, switch boxes, pull boxes, panel board cabinets, etc.
  13. **CONDUIT BENDS:** shall be made without kinking conduit or appreciably reducing the internal diameter. All bends in conduit of two (2) inch in diameter or larger shall be made with an hydraulic or power pipe bender. The radius of the inner edge of any bend shall not be less than six (6) times the internal diameter of the conduit where rubber covered conductors are to be installed, and not less than 10 times the internal diameter of the conduit where lead covered conductors are to be used. Long gradual sweeps will be required, rather than sharp bends, when changes of direction are necessary.
  14. **EMPTY CONDUITS**
    - a. **TESTS:** All conduits and ducts required to be installed and left empty shall be tested for clear bore and correct installation by the Contractor using a ball mandrel and a brush and snake before the installation will be accepted. The ball shall be turned to approximately 85% of the internal diameter of the raceway to be tested. Two (2) short wire brushes shall be included in the mandrel assembly. Snaking of conduits, ducts, etc., shall be performed by the Contractor in the presence of the Resident Engineer. Any conduits or ducts which reject the mandrel shall be cleared at once with the Contractor bearing all costs, such as chopping concrete, to replace the defective conduit and restore the surface to its original condition.
    - b. **TAGS:** Numbers or letters shall be assigned to the various conduit runs, and as they test clear they shall be identified by a fiber tag not less than 1-¼ inch width, attached by means of a nylon cord. All conduit terminations in panel, splice or pull boxes as well as those out of the floor or ceiling shall be tagged.
    - c. **TEST RECORDS:** As the conduit runs clear, a record shall be kept under the heading of "Empty Conduit Tested, Left Clear, Tagged and Capped" showing conduit designation, diameter, location, date tested and by whom. When complete, this record shall be signed by the Resident Engineer and submitted in triplicate for approval. This record shall be entered on the Contract Record Drawings under Section 01 78 39, CONTRACT RECORD DOCUMENTS.
    - d. **CAPPING:** All empty conduit and duct openings, after test, shall be capped or plugged by the Contractor as directed.
    - e. **DRAG LINES:** A drag line shall be left in all empty conduit.



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**B. BOXES:**

1. The Contractor shall furnish and erect all pull boxes indicated on the plans or where required. Sides, top and bottom of pull boxes shall be Galvanized coated and shall be built of No. 12 USSG steel reinforced at corners by substantial angle irons and riveted or welded to plates. Bottom or side of pull boxes shall be removable and held in place by corrosion resistant machine screws. Pull boxes in damp locations shall have threaded hubs and gaskets and be NEMA 4X. All pull boxes shall be suspended from ceiling or walls in the most substantial manner.
2. In centering outlets, the Contractor is cautioned to allow for overhead pipes, ducts and other obstructions, and for variations in arrangement and thickness of fireproofing, soundproofing and plastering. Precaution should be exercised regarding the location of window and door trims, paneling, etc. Mistakes resulting from failure to exercise precaution must be corrected by the Contractor at no additional cost to the City. Outlets in hung ceilings shall be supported from the black iron or structure.
3. The exact location of all outlets in finished rooms shall be as directed. When the interior finish has been applied, the Contractor shall make any necessary adjustment of its work to properly center the outlets. All outlet boxes for local switches near doors shall be located at the strike side of doors as finally hung, whether so indicated on the drawings or not.
4. Exposed wall outlet boxes shall be erected neatly and tight against the walls and securely anchored to same.
5. All wall outlets of each type shall be set accurately at the same level on each floor, except where otherwise specified or directed. Where special conditions occur, outlets shall be located as directed.
6. **MOUNTING HEIGHTS:** The following heights are standard heights and are subject to correction due to coordination with Contract Drawings. All such changes must be approved by the Resident Engineer. Heights given are from finished floor to center line of outlet or device on wall or partition, unless otherwise indicated.

a. General Convenience Outlets	
(mount vertical)	1'-6"
b. Clock Outlets	8'-6" or 1'-6" below ceiling
c. Wall Lighting Switches	4'-0"
d. Motor Controllers	5'-0"
e. Motor Push-button	4'-2"
f. Telephone Outlets	As Directed
g. Fire Alarm Bells	8'-6" or 1'-6" below ceiling
h. Fire Alarm Stations	4'-0"
i. Intercom Outlet	1'-6"
j. Cooking and Refrigerator Unit	As Directed
7. Outlet boxes shall be of approved design and construction; of form and dimensions suited and adapted to its specific location; the kind of fixture to be used and the number and arrangements of conduits, etc., connecting therewith. All ferrous outlet boxes shall meet the requirements for zinc coating as specified under Electrical Conduit Systems.
8. There shall be knockouts opened only for the insertion of conduit. Any outlet boxes with more openings than are necessary for conduit insertion shall be sealed by the Contractor without additional charge.



9. All outlet boxes and junction boxes for exposed work shall be galvanized cast iron or cast aluminum with threaded openings. Outlet boxes for exposed inside work in damp locations shall be galvanized cast iron or cast aluminum with threaded hubs and neoprene gaskets.
10. Junction boxes shall not be less than 4 11/16" square and shall be equipped with zinc coated plates. Where plates are exposed they shall be finished to match the room decor.
11. **FIXTURE SUPPORTS:** Outlet boxes supporting lighting fixtures shall be equipped with fixture studs held by approved galvanized stove bolts or integral with the box. Cast iron or malleable boxes shall have four (4) tapped holes for mounting required cover or fixtures.
12. Outlet boxes exposed to the weather or indicated W.P. shall be cast iron or cast aluminum and the covers made watertight with neoprene gaskets. The boxes shall have external lugs for mounting. Drilling of the body of the fitting for mounting will not be permitted. The cover screws shall be appropriate in size, non-corrodible and not less than four (4) in number for each box opening.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.3**

**3.3 ELECTRICAL WIRING DEVICES:**

- A. **WALL SWITCHES** shall be of the best specification grade, quiet type, and shall have a rating of 20 Amperes at 277 volts, as manufactured by Bryant, Hubbell or approved equal. The mechanism shall be equipped with arc snuffers. They shall be of the tumbler type, single pole. Switches of the 3-way type shall have a similar rating.
- B. **RECEPTACLES:**
  1. **CONVENIENCE OUTLETS:** shall be of the best specification grade, duplex, two-pole, 3-wire, 20 Amperes at 125 volts. It shall have a grounding pole that shall be grounded to the conduit system. Receptacles shall be capable of both back and side wiring and shall have only one (1) grounding screw. Receptacles shall be Hubbell Cat. #5262 or approved equal.
  2. **HEAVY DUTY RECEPTACLE OUTLETS:** shall have the Ampere rating and the number of poles specified on the Contract Drawings and shall be Hubbell, Russell-Stoll, Bryant, AH & H or approved equal. Each outlet shall have a grounding pole, which shall be grounded to the conduit system.
  3. **FLOOR RECEPTACLES:** shall be Russell & Stoll #3040 or approved equal, to fit into floor box previously specified.
  4. **NAMEPLATES:** are required for all receptacles other than 120V.
- C. **CLOCK HANGERS:** Clock outlets for surface type clocks shall be equipped with a supporting hook and recessed faceplate to conceal the electrical cord.
- D. **WATERTIGHT DEVICES:** For installations exposed to weather or in damp locations, the devices shall be in a gasketed, cast iron enclosure.
- E. **PLATES:**
  1. Every convenience outlet and switch outlet shall be covered by means of a stainless steel No. 302 - 0.4" antimagnetic plate with an approved finish, unless provided otherwise in the detailed Specifications.
  2. Where two (2) or three (3) switches are grouped together, a single faceplate shall be used. Where more than three (3) switches are located at one (1) point, the faceplates may be made up in multiple units.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4**

**3.4 ELECTRICAL CONDUCTORS AND TERMINATIONS:**

- A. **CONDUCTORS FOR LIGHT AND POWER** - All wire and cable shall be of annealed copper of 98% conductivity. Aluminum wire or cable will not be permitted. The insulation shall be flame retardant, moisture and heat resistant, thermoplastic, type THW or THWN rated for 600 volts at 75 degrees C. for both wet and dry locations. Wires No. 8 or larger shall be stranded. Wires and cables shall also be subject to the requirements of the NYCEC. Cables for incoming service or wire in conduits contiguous with the earth or in concrete or other damp or wet locations shall be synthetic rubber insulated with neoprene jacket, heat and moisture resistant and shall be equal to UL Type USE and rated for 600 volts at 75 degrees C. for both wet and dry locations.
- B. **FIXTURE WIRE:** Lighting fixtures shall be wired with No. 14 gauge wire designated as AWM and rated at 105 degrees C.
- C. **OTHER TYPES:** Cables and wires for interior communication systems are described in applicable detailed Specifications.
- D. **MINIMUM SIZE:** Conductors smaller than No. 12 AWG shall not be used for light or power.
- E. **COLOR CODE:** Wires shall have a phase color code, and multiple conductor cables shall be color coded.
- F. **CABLE DATA:** The Contractor shall submit for approval the following information for each size and type of cable to be furnished.
  - 1. Manufacture of Cable - Location of Plant.
  - 2. Minimum insulation resistance at standard test temperature.
  - 3. Days required for delivery to site of work after order to proceed with manufacture.
- G. **ORIGINAL REELS:** Cable and wire shall be delivered to the site of the work on original sealed factory reels.
- H. **WIRE INSTALLATION:**
  - 1. **INSTALL WIRES AFTER PLASTERING** - Feeder and branch circuits wiring shall not be installed in conduit before the rough plastering work is completed. No conductors shall be pulled into floor conduits before floor is poured.
  - 2. **CONDUIT SECURED IN PLACE** - No conductor shall be pulled into any conduit run before all joints are made up tightly and the entire run rigidly secured in place.
  - 3. **WIRE ENDS** - All wires shall be left with sufficiently long ends for proper connection and stowing.
  - 4. **PULLING COMPOUNDS** - When required to ease the pulling-in of wires into conduit, only approved compounds as recommended by cable manufacturers shall be used.
  - 5. **PRESSURE CONNECTORS** - for wires shall be of the cast copper or forged copper pressure plate type. Connectors shall be O.Z., Burndy, National Electric Products or approved equal.
  - 6. Splices and feeder taps in the gutters of panel boxes shall be made by means of pressure plate type connectors encased in composition covers as manufactured by O.Z., Burndy, National Electric Products or approved equal.
  - 7. Splices in branch wiring for sound systems and fire systems, shall be first made mechanically secure, then soldered and taped.
  - 8. In lieu of soldered splices (except for sound and Fire Systems, which must have soldered splices) the following alternates are acceptable for operating temperatures up to 105 degrees C., for



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fluorescent fixtures and for the splicing of branch circuit wiring up to No. 8 AWG wire:

- a. Mechanical splices made with mechanical connectors as manufactured by the Minnesota Manufacturing Company "Scotchlock" or approved equal. Mechanical connectors requiring a special tool (pressure connectors, insulators and locking rings) by Buchanan or approved equal. The tool used for connector application shall be as approved by the connector manufacturer.
  - b. For wire and cable No. 6 AWG and larger for branch circuit wiring the seamless tubular connector will only be accepted. Application of this connector shall be with a tool recommended by the connector manufacturer.
9. TAGS: All feeders and risers shall be tagged at both ends, and in all pull and junction boxes and gutter spaces through which they pass. Such tags shall be of fiber and have the feeder designation and size stamped thereon.
10. BRANCH CIRCUIT WIRING:
- a. The Contractor installing branch circuit wiring shall test the work for correct connections and leave all loop splices in the fixture outlet boxes properly spliced and taped. The Contractor shall provide wire ends long enough for convenient connection to device.
  - b. NEUTRALS: No common neutrals shall be used except for lighting branch circuits. Each neutral wire shall be terminated separately on a neutral busbar in the panelboard. No common neutrals will be permitted for convenience receptacle branch circuits.

## I. TERMINATIONS

1. LUGS: All lugs for all devices and all cable terminations shall be copper. AL/CU rated lugs will not be permitted. The only exception to this requirement is when the particular device is not manufactured with copper lugs by any manufacturer. Lugs for No. 6 AWG cable and larger shall be cast copper or forged copper pressure plate type. Lugs for 1/0 and larger shall be fastened with two (2) bolts.
2. All lugs shall be of the proper size to accept the cable connected to them. Any subcontractor furnishing a device containing lugs is to coordinate with the Contractor to ensure that the device terminations are adequate for the wire or cable (whose size may be larger than expected due to voltage drop considerations) connected to the device.

<b>REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.5</b>
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## 3.5 CIRCUIT PROTECTIVE DEVICES:

This Section sets forth the circuit protective devices such as circuit breakers and safety switches, used in connection with Motor Control Equipment, Distribution Centers, Panel boards and Service Entrance.

### A. CIRCUIT BREAKERS:

1. CIRCUIT BREAKERS: shall be operable in any position and shall be of the quick-make, quick-break type on manual operation. The handle shall be trip free, preventing contacts from being held in closed position against abnormal overloads or short circuits. Positive visual indication of automatic tripped position of breaker shall be provided, in addition to the "On" and "Off" indication. All circuit breakers shall be of the bolted type.
2. TRIP RATING: Circuit breakers shall be provided with the required number of trip elements, calibrated at 40 degrees C., ambient temperature, in accordance with wire sizes or motor currents as shown on Contract Drawings or indicated in the Specifications.
3. POLE BARRIER: Multipole pole breakers shall be designed to break all poles simultaneously.



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They shall be provided with barriers between poles and arc suppressing devices.

4. **ELEMENTS:** Multipole circuit breakers shall have frames of not less than a 100 Ampere rating. Multipole circuit breakers for 480 volts AC operation shall have an NEMA interrupting rating of 18,000 Amperes, unless a higher rating is specified in the Specific Requirements or indicated on the Contract Drawings.
5. For circuit breakers with frame size up to and including 225 Amperes, the breakers may be provided with non-interchangeable trip elements. For frame ratings above 225 Amperes, the breakers shall be provided with interchangeable trip elements, which can be replaced readily.
6. Single pole circuit breakers for branch circuits shall have a frame size of no less than 100 Amperes, and shall be rated at 125 volt A.C. with a NEMA interrupting rating of 10,000 Amperes, unless a higher rating is specified in the Specifications or indicated on the Contract Drawings.
7. **INVERSE TIME ACTION:** The circuit breakers shall be dual element type, one (1) element with time limit characteristics, so that tripping will be prevented on momentary overloads, but will occur before dangerous values are reached and the other with instantaneous trip action. Inverse time delay action shall be effective between a minimum tripping point of 125% of rating of breaker and an instantaneous tripping point between 600% and 700% of rated current.
8. **CONSTANCY OF CALIBRATION:** The tripping elements shall insure constant calibration and be capable of withstanding excessive short circuit conditions without injury.
9. **CONTACTS:** shall be non-welding under operating conditions and of the silver to silver type.
10. **TEMPERATURE RISE:** Current carrying parts, except thermal elements, shall not rise in temperature in excess of 30 degrees C. while carrying rated current at rated frequency.
11. **NUMBERING:** Each circuit breaker shall be distinctly numbered when installed in a group with other breakers. The calibration of trip element shall be indicated on each breaker.

### B. SAFETY SWITCHES:

**NEMA TYPE HD:** When safety switches are permitted to be used for service entrance, motor disconnecting means or to control other types of electrical equipment, they shall be of the type HD of a rating not less than 30 Amperes. Enclosures shall be provided with means for locking. For ratings above 60 Amperes terminals shall have double studs.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.6**

### 3.6 DISTRIBUTION CENTERS:

This Section sets forth the construction and installation procedure for Switchboards, Panel boards and Cabinets.

- A. **PANELBOARDS-GENERAL TYPE:** The panel boards shall be of the automatic circuit breaker type with individual breakers for each circuit, removable without disturbing the other units. Circuit breakers shall be in accordance with the requirements outlined under "Circuit Protective Devices."
- B. **NUMBER AND RATING OF CIRCUIT BREAKERS:** The Contract Drawings show a layout of each panel, giving the number, frame, size and trip setting of circuit breakers and number of branch circuits and spare breakers. Each branch circuit shall be distinctly numbered.
- C. **BUS-BAR CONSTRUCTION AND SUPPORT:** Panel Boards shall be of the dead front type and shall have bus bars and branch circuits designed to suit the system and voltage. Current carrying parts, exclusive of circuit breakers shall be copper and based on a maximum density of 1,000 Amperes per square inch. Bus bars for the main switchboard shall be designed for the frame rating of the Service Breaker. Bus bars shall run up the center of the panel, unless otherwise indicated, and shall have





connected thereto the various branch circuits. Unless otherwise specified, bus bars for each panel board shall be equipped with main lugs only and capacity as required on Contract Drawings. Where main protection is required, automatic circuit breakers shall be used. A neutral bus of at least the same capacity as a live bus bar shall be provided for the connection of all neutral conductors. Each terminal shall be identified. All current carrying parts, exclusive of circuit breakers, shall be of copper with a minimum number of joints. The bus bar structure shall be a self-supporting unit, firmly fastened to a ½ inch plastic board, extending the full length and width of assembly which shall serve to insulate the bus structure from the back of panel box. Other methods affording equally effective bus structure support and insulation will be given consideration. An insulating barrier shall separate neutral bus from other parts of panel.

- D. **CIRCUIT BREAKER ASSEMBLY:** The entire circuit breaker and bus bar assembly shall be mounted on an adjustable metal base or pan and secured to the back of panel box. The panel shall have edges flanged for rigidity.
- E. **PANEL MOUNTING:** The panel shall be centered in the panel box to line up with door openings and set level and plumb so that no live parts are exposed with the door open.
- F. **PANEL CABINET:**
  - 1. **PANEL CABINET INSTALLATION:** When installed surface mounted in panel closets they shall be mounted on Kindorf channel.
  - 2. Where cabinets cannot be set entirely flush due to shallow walls or partitions or where cabinet is extra deep, the protruding sides of cabinet shall be trimmed with a metal or hardwood return molding of approved design and fastened to cabinet so as to conceal the intersection between the wall and cabinet.
- G. **NAMEPLATES:** Nameplates where required, shall be made of engraved Lamicaid sheet, or approved equal. Letters and numbers shall be engraved white on a black background (except for Firehouse projects which shall have white letters on a red background). The Contractor shall submit an engraved sample for approval as to design and style of lettering before proceeding with the manufacture of the nameplate. Nameplates shall be of suitable size and shall also be provided at the top of the switchboard or section thereof and on the trim at the top of all lighting and power panels. Similar nameplates shall also be provided for each distribution circuit breaker giving the breaker number, the number of the feeder, and the name of the equipment fed.
- H. **SHOP DRAWINGS:** showing all details of boxes, panels, etc., shall be submitted for approval.
- I. **DIRECTORIES:** A directory shall be fastened with brass screws and consist of a noncorrosive metal frame with dimensions not less than five (5) inches x eight (8) inches and a transparent window of Plasticile, Plexiglass, Lucite, Polycarbonate or approved equal that is not less than 1/16 inch thick over cardboard or heavy paper. The directory shall be typewritten and show the number of each circuit, the name of circuit and lighting or equipment supplied. The size of riser feeder shall be as indicated on directory. The dimensions of directory shall be submitted for approval for each size of panel.
- J. **CONSTRUCTION**
  - 1. **FINISH:** Panel boxes, doors and trim for installation in dry locations, shall be zinc coated after fabrication by the hot-dip galvanizing or electroplate process on inside and outside surfaces. In damp locations, panel boards shall be enclosed and gasketed NEMA 3R type. Panel boards located outdoors or exposed to the weather shall be NEMA 3X type.
  - 2. **PAINTING:** Panel boxes, doors and trim shall receive a coat of approved priming paint and a second coat of approved paint in the field after installation. Paint shall be applied to the inside and outside of boxes and on both sides of trim. Panel trims and doors shall receive a third or finishing coat on the outside after installation. Approval as to texture and color must be obtained before the final coat is applied.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.7**

**3.7 MOTORS:**

This Section sets forth the general design, construction and performance requirements, which shall apply to all motors furnished in the Contract.

- A. **MOTOR DESIGN:** All motors shall be designed to comply with the New York State Energy Conservation Construction Code and the New York City Energy Conservation Code. In the event of any conflict or inconsistency between such codes, the New York City Energy Conservation Code shall prevail. Motors shall have standard NEMA frames and shall have nameplate ratings adequate to meet the specified conditions of operation. Motor performance under variable conditions of voltage and frequency shall be within the limits set in NEMA standards, unless modified in the Specifications. Motors shall be expressly designed for the hazard duty load, voltage and frequency as specified in the Contract. All motor windings shall be copper. All motors intended to operate on a 208 volt system shall be designed and rated for 200 volts.
- B. **STANDARDS OF COMPARISON:** In the absence of specific motor specifications, in general, the best standard products of the leading motor manufacturers shall be considered as a standard for comparison. The requirements of the NEMA standards for motors and generators shall be deemed to contain the minimum requirements of performance and design.
- C. **OBJECTIONABLE NOISES:** Objectionable noises will not be tolerated and exceptionally quiet motors may be required for certain specified locations. Noise control tests as per the New York City Construction Codes may be performed as directed by the Commissioner. Such motors shall bear a nameplate lettered "Quiet Motor." Springs and slip rings shall be of approved non-ferrous material.
- D. **BEARINGS:**
  - 1. Bearings, unless specified otherwise, shall be of the ball or roller type. Motors one (1) horsepower and larger that are equipped with ball roller bearings shall also have lubrication of the pressure-relief greasing type. The Contractor furnishing four (4) or more such motors shall also furnish, as part of the Contract, a pressure grease gun of rugged design, of approximately 10 ounce capacity, complete with necessary adapters. The Contractor shall also provide 10 pounds of approved gun grease.
  - 2. For any particular unit where sleeve bearings are deemed desirable, permission for their use may be granted by the Commissioner. Motors one (1) horsepower and larger that are equipped with sleeve type bearings shall in addition to having protected accessible fittings for oiling be provided with visible means for determining normal oil level. Lubrication shall be positive, automatic and continuous.
- E. **MOTOR TERMINALS AND BOXES:** Each motor shall be furnished with flexible leads of sufficient length to extend for a distance of not less than three (3) inches beyond the face of the conduit terminal box. This box shall be furnished of ample size to make and house motor connections. These requirements shall be met irrespective of any other standards or practices. Size of cable terminals and conduit terminal box holes shall be subject to approval. For motors five (5) horsepower or larger, each terminal shall come with two (2) cast or forged copper pressure type connectors with bolts, nuts and washers. For motors of smaller ratings, connectors of other acceptable types may be furnished. For installations exposed to the weather or moist locations, terminal boxes shall be of cast iron with threaded hubs and gasketed covers. Cover screws shall be of non-corrosive material.
- F. **MOTOR TEMPERATURE RISES:** The motor nameplate temperature rises for the various types of motor enclosures shall be as listed below:
  - 1. Open Frame 40 degrees C.
  - 2. Totally enclosed and enclosed fan cooled 55 degrees C.



- 3. Explosion proof and submersible 55 degrees C.
- 4. Partially enclosed and drip proof 40 degrees C.

The temperature of the various parts of a motor shall meet the requirements of NEMA standards for the size and type of the motors. Tests for heating shall be made by loading the motor to its rated horsepower and keeping it so loaded for the rated time interval or until the temperature becomes constant.

- G. SPECIAL CODE INSTALLATIONS: Electrical installations covered by special publications of NBFU and by special City rulings and regulations shall comply in design and safety features with such applicable codes, regulations and rulings, and shall be furnished and installed complete with all accessories and safety devices as therein specified.
- H. MOTORS ON LIGHTING PANELS: The largest A.C. motor permitted on branch circuits of lighting panels shall not exceed 1/4 horsepower.
- I. MOTORS RATED: ½ horsepower and larger shall be polyphase.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.8**

**3.8 MOTOR CONTROL EQUIPMENT:**

This Section sets forth the requirements for motor controllers and associated devices. Such requirements are applicable to all motor control equipment furnished or installed.

- A. MANUFACTURER: All control equipment furnished under the Contract shall be the product of a single manufacturer. Exceptions to this rule may be granted in the case of controllers for fractional horsepower motors driving special equipment, the various units of which have been engineered to obtain specific performance.
- B. CONTROL ITEMS REQUIRED: The Contractor furnishing motors shall also furnish therewith complete disconnecting, starting and control equipment as required by the detailed Specifications, the various code authorities and for the successful operation of the driven equipment. These items include circuit breaker, magnetic starter with overload protection and low voltage release or protection, push button stations, pilot lights and alarms, float, pressure, temperature and limit switches, load transfer switches, devices for manual operation and speed controllers, etc. The Contractor shall furnish as many of these items as are required for the successful operation of the driven unit.
  - 1. Where a motor is to be located out of sight of the controller, the Contractor shall furnish an approved disconnecting means to be mounted near motor.
- C. TYPES OF STARTERS:
  - 1. SQUIRREL CAGE: A.C. motors of the squirrel cage type, rated from one (1) to 30 horsepower, shall have magnetic across the line starters; motors rated above 30 horsepower shall be furnished with reduced voltage (autotransformer type) starter or part winding start with time delay to reduce inrush current. Size of starters shall be based on 200V operation.
  - 2. SLIP RING: A.C. Motors of the slip-ring type shall be furnished with primary across the line starters interlocked with secondary starting and regulating equipment. The interlocking feature shall prevent starting of the motor when the secondary controller is off the initial starting point.
  - 3. MAGNETIC: For fractional horsepower motors, magnetic type starters are not required unless the particular method of controlling the driven equipment makes them necessary. Where individual single phase fractional horsepower motors or the sum of fractional horsepower motors controlled by an automatic device are ½ horsepower or more, magnetic starters and circuit breakers shall be used. Single phase A.C. motors smaller than ½ horsepower or three-phase A.C. motors smaller than one (1) horsepower where manual control is specified may be furnished with starters of toggle



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switch or push button type with inbuilt thermal protection. No additional disconnecting means is required to be furnished with this type of starter. This type of starter may also be used in series with automatic control devices such as thermostats, float and pressure switches, provided the individual motor or the sum of fractional horsepower motors is less than ½ horsepower. Means for manual operation shall be provided.

- D. **DISCONNECTING BREAKER:** All motor starters, unless otherwise specified, shall be provided with a disconnecting means in the form of a circuit breaker of the type specified under Article 3.5 **CIRCUIT PROTECTIVE DEVICES**. This disconnecting means shall be contained in the same housing with the starter and shall be operable from outside. Means shall be provided for locking the handle of the circuit breaker in the "OFF" position if it is desired to take the equipment out of service and prevent unauthorized starting.
- E. **CONTROL CABINET: DRY LOCATIONS** - All starters shall be furnished with general purpose, NEMA Type 1, sheet metal enclosures with hinged covers and baked enamel finish.
- F. **CONTROL CABINET – WATERTIGHT:** In wet locations, cast iron watertight enclosures with threaded hubs, galvanized and gasketed hinged covers shall be provided.
- G.
  - 1. **PANELS:** Motor control devices and appliances shall be mounted on approved insulating slabs with all wiring and connections made on the back of the slabs.
  - 2. **WIRING AND TERMINALS:** Wiring connections for currents of 100 Amperes or less may be made with copper wire or cable with special flameproof insulating coverings. Such wires shall be installed in a neat workmanlike manner, flat against the slab, and held in place by clips. Connections shall be made with pressure connectors for No. 8 AWG and larger wires, and with grommets for small stranded wires. Except for incoming and outgoing main leads, all connections shall terminate on approved connector blocks, which may be installed on the face of the slab. For small, across the line starters, the above requirements may be modified if satisfactory connections are provided.
  - 3. **COPPER BUS:** For currents exceeding 100 Amperes, copper bus shall be used in place of wires. The bus shall be constructed of copper rods, tubing or flat strap, bent and shaped properly and securely attached to the slab in a neat and workmanlike manner. The cross section of copper shall provide sufficient areas to keep current density at not more than 1,000 Amperes per square inch.
- H. **COOPERATION:** The Contractor's subcontractor(s) who furnish electrically operated equipment shall give to the Contractor and the Contractor's electrical subcontractor full information relative to sizes and locations of apparatus furnished by them which require electrical connections.
- I. **SPARE PARTS:**
  - 1. **FURNISH:** The Contractor shall furnish the following spare parts pertaining to equipment furnished by each subcontractor.
    - One (1) set of contact fingers and springs and thermal elements for each three (3) (or fraction) of each size of magnetic contactor starter.
    - One (1) holding coil for each three (3) (or fraction) of each size of magnetic contactor starter.
  - 2. **WRAPPER MARKING:** All parts shall be delivered to the Resident Engineer neatly wrapped and boxed and plainly tagged and marked for identification and reordering.

**END OF SECTION 01 35 06**



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**SECTION 01 35 26  
SAFETY REQUIREMENTS PROCEDURES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].
- B. The Contractor shall comply with the requirements of "*The City of New York Department of Design and Construction Safety Requirements*". This document is included in the Information for Bidders.

**1.2 SUMMARY:**

- A. This Section includes administrative and general procedural requirements for Safety and Health Requirements, including:
  - 1. Definitions
  - 2. Required Safety Meeting
  - 3. Compliance with Regulations
  - 4. Submittals
  - 5. Personnel Protective Equipment
  - 6. Hazardous and / or Contaminated Materials
  - 7. Emergency Suspension of Work
  - 8. Protection of Personnel
  - 9. Environmental Protection

**1.3 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

**1.4 REQUIRED SAFETY MEETINGS:**

- A. Prior to commencing construction, the Resident Engineer will schedule and hold a preconstruction kick-off meeting either at DDC's main office or at the Project site with representatives of the Contractor, including the principal on-site project representative and one or more safety representatives, Commissioner's designated representatives and other concerned parties for the purpose of reviewing the Contract Safety requirements. The Contractor's safety requirements shall be reviewed, and implementation of safety provisions pertinent to the Work shall be discussed.
- B. The Contractor is responsible for conducting weekly documented jobsite safety meetings, given to all jobsite personnel including all subcontractors on the project, with the purpose of discussing safety topics and job specific requirements at the DDC worksite.



**1.5 COMPLIANCE WITH REGULATIONS:**

- A. The Work, including contact with or handling of hazardous materials, disturbance or dismantling of structures containing hazardous materials, and disposal of hazardous materials, shall comply with the applicable requirement for CFR Parts 1910 and 1926, and 40 CFR, Parts 61, 261, 761 and 763.
- B. Work involving disturbance or dismantling of asbestos or asbestos containing materials, demolition of structures containing asbestos and removal of asbestos, shall comply with 40 CFR Part 61, Subparts A and M, and 40 CFR Part 763, as applicable.
- C. Work shall additionally comply with all applicable federal, state and local safety and health regulations.
- D. In case of a conflict between applicable regulations, the more stringent requirements shall apply.
- E. All workers working on the DDC project site are required by NYC Local Law 41 to complete the OSHA 10 –hour training course.

**1.6 SUBMITTALS:**

- A. The Contractor shall submit, to the Resident Engineer, copies of the Safety Program, Site Safety Plan and other required documentation in accordance with the *"New York City Department of Design and Construction Safety Requirements."*
- B. Permits: If hazardous materials are disposed of off-site submit copies of shipping manifests and permits from applicable federal, state or local authorities and disposal facilities, and submit certificates that the material has been disposed of in accordance with regulations to the Resident Engineer.
- C. Accident Reporting: Submit a copy of each accident report to the Resident Engineer in accordance with the *"New York City Department of Design and Construction Safety Requirements."*
- D. All Asbestos and Lead project regulatory notifications are to be submitted to DDC's Office of Environmental and Geotechnical Services (OEGS) through the Resident Engineer.
- E. Request for Subcontractor Approval: Any subcontractor performing environmental work shall submit required documentation for approval to perform such work as required by DDC's OEGS.

**PART II – PRODUCTS**

**2.1 PERSONNEL PROTECTIVE EQUIPMENT:**

- A. Special facilities, devices, equipment and similar items used by the Contractor in execution of the Work shall comply with 29 CFR Part 1910, subpart I, Part 1926, subpart E and other applicable regulations.

**2.2 HAZARDOUS AND / OR CONTAMINATED MATERIALS:**

- A. The Contractor shall bring to the attention of the Commissioner, any material encountered during execution of the Work that the Contractor suspects to be hazardous and / or contaminated.
- B. The Commissioner shall determine whether the Contractor shall perform tests to determine if the material is hazardous and / or contaminated. A change to the Contract price may be provided, subject to the applicable provisions of the Contract.
- C. If the material is found to be hazardous, the Commissioner may direct the Contractor to remediate the hazard and a change to the Contract price may be provided, subject to the applicable provisions of the Contract.



### **PART III – EXECUTION**

#### **3.1 EMERGENCY SUSPENSION OF WORK:**

- A. When the Contractor is notified by the Commissioner of noncompliance with the safety provisions of the Contract, the Contractor shall immediately, unless otherwise instructed, correct the unsafe condition, at no additional cost to the City.
- B. If the Contractor fails to comply promptly, all or part of the Work may be stopped by notice from the Commissioner.
- C. When, in the opinion of the Commissioner, the Contractor has taken satisfactory corrective action, the Commissioner shall provide written notice to the Contractor that work may resume.
- D. The Contractor shall not be allowed any extension of time or compensation for damages in connection with a work stoppage for an unsafe condition.

#### **3.2 PROTECTION OF PERSONNEL:**

- A. The Contractor shall take all necessary precautions to prevent injury to the public, occupants, or damage to property of others. The public and occupants includes all persons not employed by the Contractor or a subcontractor.
- B. Whenever practical, the work area shall be fenced, barricaded or otherwise blocked off from the Public or occupants to prevent unauthorized entry into the work area, in compliance with the requirements of Section 01 50 00, TEMPORARY FACILITIES, SERVICES AND CONTROLS, and including, without limitation, the following:
  - 1. Provide traffic barricades and traffic control signage where construction activities occur in vehicular areas.
  - 2. Corridors, aisles, stairways, doors and exit ways shall not be obstructed or used in a manner to encroach upon routes of ingress or egress utilized by the public or occupants, or to present an unsafe condition to the public or occupants.
  - 3. Store, position and use equipment, tools, materials, scraps and trash in a manner that does not present a hazard to the public or occupant by accidental shifting, ignition or other hazardous activity.
  - 4. Store and transport refuse and debris in a manner to prevent unsafe and unhealthy conditions for the public and occupants. Cover refuse containers, and remove refuse on a frequent regular basis acceptable to the Resident Engineer. Use tarpaulins or other means to prevent loose transported materials from dropping from trucks or other vehicles.

#### **3.3 ENVIRONMENTAL PROTECTION:**

- A. Dispose of solid, liquid and gaseous contaminants in accordance with local codes, laws, ordinances and regulations.
- B. Comply with applicable federal, state and local noise control laws, ordinances and regulations, including but not limited to 29 CFR 1910.95, 29 CFR 1926.52 and NYC Administrative Code Chapter 28 of Title 15.

**END OF SECTION 01 35 26**





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**SECTION 01 35 91  
HISTORIC TREATMENT PROCEDURES**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 35 91**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes administrative and procedural requirements for the treatment of Landmark Structures and Landmark Quality Structures, as identified in the Addendum. Specific requirements are indicated in other sections of the Specifications.
- B. This Section includes, without limitation, the following:
1. Storage and protection of existing historic materials
  2. Temporary protection of historic materials during construction
  3. General Protection
  4. Protection during use of heat-generating equipment
  5. Photographic Documentation
  6. NYC Landmarks Preservation Commission Final Approval signoffs

**1.3 RELATED SECTIONS: include without limitation the following:**

- |    |                  |                            |
|----|------------------|----------------------------|
| A. | Section 01 10 00 | SUMMARY                    |
| B. | Section 01 32 33 | PHOTOGRAPHIC DOCUMENTATION |
| C. | Section 01 33 00 | SUBMITTAL PROCEDURES       |
| D. | Section 01 77 00 | CLOSEOUT PROCEDURES        |
| E. | Section 01 78 39 | CONTRACT RECORD DOCUMENTS  |

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- C. Landmark Structure or Site: Any building or site which has been designated as a landmark, or any building or site within a landmark district, as designated by the New York City Preservation Commission or the New York State Historic Preservation Office.



- D. **Landmark Quality Structure:** Any building which has been determined by the City to be of landmark quality and/or historical significance.
- E. **Preservation:** To apply measures necessary to sustain the existing form, integrity, and materials of a historic property. Work may include preliminary measures to protect and stabilize the property.
- F. **Rehabilitation:** To make possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features that convey its historical, cultural, or architectural values.
- G. **Restoration:** To accurately depict the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and the reconstruction of missing features from the restoration period.
- H. **Reconstruction:** To reproduce in the exact form and detail a building, structure, or artifact as it appeared at a specific period in time.
- I. **Stabilize:** To apply measures designed to reestablish a weather-resistant enclosure and the structural reinforcement of an item or portion of the building while maintaining the essential form as it exists at present.
- J. **Protect and Maintain:** To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.
- K. **Repair:** To stabilize, consolidate, or conserve; to retain existing materials and features while employing as little new material as possible. Repair includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials. Within restoration, repair also includes limited replacement in kind, rehabilitation, and reconstruction, with compatible substitute materials for deteriorated or missing parts of features when there are surviving prototypes.
- L. **Replace:** To duplicate and replace entire features with new material in kind. Replacement includes the following conditions:
  - 1. **Duplication:** Includes replacing elements damaged beyond repair or missing. Original material is indicated as the pattern for creating new duplicated elements.
  - 2. **Replacement with New Materials:** Includes replacement with new material when original material is not available as patterns for creating new duplicated elements.
  - 3. **Replacement with Substitute Materials:** Includes replacement with compatible substitute materials. Substitute materials are not allowed, unless otherwise indicated.
- M. **Remove:** To detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- N. **Remove and Salvage:** To detach items from existing construction and deliver them to the City ready for reuse.
- O. **Remove and Reinstall:** To detach items from existing construction, repair and clean them for reuse, and reinstall them where indicated.
- P. **Existing to Remain or Retain:** Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled.



- Q. Material in Kind: Material that matches existing materials, as much as possible, in species, cut, color, grain, and finish.

**1.5 SUBMITTALS:**

- A. Historic Treatment Program: Submit a written plan for each phase or process, including protection of surrounding materials during operations. Describe in detail materials, methods, and equipment to be used for each phase of work.
- B. Alternative Methods and Materials: If alternative methods and materials to those indicated are proposed for any phase of work, submit for Commissioner's approval a written description including evidence of successful use on other comparable projects, and program of testing to demonstrate effectiveness for use on this Project.
- C. Qualification Data: For historic treatment specialists as specified and required by individual sections of the project specifications.
- D. Photographs for Designated Landmark Structures: Submit photographs in accordance with Section 01 32 33, PHOTOGRAPHIC DOCUMENTATION and as described in this section.
- E. Record Documents: Include modifications to manufacturer's written instructions and procedures, as documented in the historic treatment preconstruction conference and as the Work progresses.

**1.6 QUALITY ASSURANCE:**

- A. Special Experience Requirements: Special Experience Requirements may apply to the firm that will provide Historic Treatment Services. If applicable, such Special Experience Requirements are set forth in the Bid Booklet.
- B. Historic Treatment Preconstruction Conference: The Resident Engineer will schedule and hold a preconstruction meeting at the site in accordance with Section 01 31 00, PROJECT MANAGEMENT AND COORDINATION.
  - 1. Review manufacturer's written instructions for precautions and effects of products and procedures on building materials, components, and vegetation.
    - a. Record procedures established as a result of the review and distribute to affected parties.

**1.7 STORAGE AND PROTECTION OF HISTORIC MATERIALS:**

- A. Removed and Salvaged Historic Materials: As specified and required by individual sections of the project specifications.
- B. Removed and Reinstalled Historic Materials: As specified and required by individual sections of the project specifications.
- C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling during historic treatment. When permitted by the Commissioner, items may be removed to a suitable, protected storage location during historic treatment and reinstalled in their original locations after historic treatment operations are complete.
- D. Storage and Protection: When removed from their existing location, store historic materials, at a location acceptable to the Commissioner, within a weather tight enclosure where they are protected from wetting by rain, snow, or ground water, and temperature variations. Secure stored materials to protect from theft.
  - 1. Identify removed items with an inconspicuous mark indicating their original location.



**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION**

**3.1 PROTECTION, GENERAL:**

- A. Comply with manufacturer's written instructions for precautions and effects of products and procedures on adjacent building materials, components, and vegetation.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Temporary Protection of Historic Materials during Construction:
  - 1. Protect existing materials during installation of temporary protections and construction. Do not deface or remove existing materials.
  - 2. Attachments of temporary protection to existing construction shall be approved by the Commissioner prior to installation.
- D. Protect landscape work adjacent to or within work areas as follows:
  - 1. Provide barriers to protect tree trunks.
  - 2. Bind spreading shrubs.
  - 3. Use coverings that allow plants to breathe and remove coverings at the end of each day. Do not cover plant material with a waterproof membrane for more than 8 hours at a time.
  - 4. Set scaffolding and ladder legs away from plants.
- E. Existing Drains: Prior to the start of work or any cleaning operations, test drains and other water removal systems to ensure that drains and systems are functioning properly. Notify Commissioner immediately of drains or systems that are stopped or blocked. Do not begin Work of this Section until the drains are in working order.
  - 1. Provide a method to prevent solids, including stone or mortar residue, from entering the drains or drain lines. Clean out drains and drain lines that become blocked or filled by sand or any other solids because of work performed under this Contract.
  - 2. Protect storm drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

**3.2 PROTECTION DURING USE OF HEAT-GENERATING EQUIPMENT:**

- A. No roofing work requiring the use of an open flame shall be permitted on any Landmark Structure or any Landmark Quality Structure, whose roof or wall structure is made of wood or primarily of wood.
- B. Comply with the following procedures while performing work with heat-generating equipment, including welding, cutting, soldering, brazing, paint removal with heat, and other operations where open flames or implements utilizing heat are used:
  - 1. Obtain Commissioner's approval for operations involving use of open-flame or welding equipment. Notification shall be given for each occurrence and location of work with heat-generating equipment.
  - 2. As far as practical, use heat-generating equipment in shop areas or outside the building.
  - 3. Before work with heat-generating equipment commences, furnish personnel to serve as a fire watch (or watches) for location(s) where work is to be performed.



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4. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  5. Remove and keep the area free of combustibles, including, rubbish, paper, waste, etc., within area of operations.
  6. If combustible material cannot be removed, provide fireproof blankets to cover such materials.
  7. Where possible, furnish and use baffles of metal or gypsum board to prevent the spraying of sparks or hot slag into surrounding combustible material.
  8. Prevent the extension of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  9. Inspect each location of the day's work not sooner than 30 minutes after completion of operations to detect hidden or smoldering fires and to ensure that proper housekeeping is maintained.
- C. Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to automatic sprinkler heads, shield the individual heads temporarily with guards.

**3.3 PHOTOGRAPHIC DOCUMENTATION:**

- A. Photographs for Designated Landmark Structures: Show existing conditions prior to any historic treatments, including one overall photograph and two close-up photographs of all areas of work affected. Show one overall photograph and two close-up photographs of all areas of work after the successful execution of all historical treatments.

**3.4 NEW YORK CITY LANDMARKS PRESERVATION COMMISSION FINAL APPROVALS SIGNOFF:**

- A. For all projects involving a Landmark Structure or Site, the Contractor, at the completion of the work, shall submit to the Commissioner, in accordance with Section 01 78 39, CONTRACT RECORD DOCUMENTS, all documentation concerning the successful execution of all historic treatments. This shall include, but not be limited to, copies of all before and after photographs of historic treatments, one copy of the Contractor's as-built drawings, copies of testing and analysis results, including cleaning, mortar analysis, pointing mortars and all other information pertaining to work performed under the New York City Landmarks Preservation Commission jurisdiction.

**END OF SECTION 01 35 91**



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**SECTION 01 40 00  
QUALITY REQUIREMENTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes the following:
1. Definitions
  2. Conflicting Requirements
  3. Quality Assurance
  4. Quality Control
  5. Approval of Materials
  6. Special Inspections (Controlled Inspection)
  7. Inspections by Other City Agencies
  8. Certificates of Approval
  9. Acceptance Tests
  10. Repair and Protection
- B. This Section includes administrative and procedural requirements for quality control to assure compliance with quality requirements specified in the Contract Documents.
- C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
- D. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
- E. Provisions of this Section do not limit requirements for the Contractor to provide quality-assurance and -control services required by the Commissioner or authorities having jurisdiction.
- F. Specific test and inspection requirements are specified in the individual sections of the Specifications.
- G. LEED: Refer to the Addendum to identify whether this project is designed to comply with a Certification Level according to the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) Rating System, as specified in Section 01 81 13.03, "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS" or Section 01 81 13.04 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS."
- H. COMMISSIONING: Refer to the Addendum to identify whether this project will be Commissioned by an independent third party under separate contract with the City of New York. Commissioning shall be in accordance with ASHRAE and USGBC LEED-NC procedures, as described in Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS, and/ or Section 01 91 15 GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE. The Contractor shall cooperate with the commissioning agent and provide whatever assistance is required.





**1.3 RELATED SECTIONS:** Include without limitation the following:

- A. Section 01 10 00 SUMMARY
- B. Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION
- C. Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION
- D. Section 01 33 00 SUBMITTAL PROCEDURES
- E. Section 01 77 00 CLOSEOUT PROCEDURES
- F. Section 01 78 39 CONTRACT RECORD DOCUMENTS

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- C. Commissioning: A Total Quality Assurance process that includes checking the design and installation of equipment, as well as performing functional testing of the same to confirm that the installed equipment is operating and in conformance with the Contract Documents and the City's requirements.

**1.5 CONFLICTING REQUIREMENTS:**

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, the Contractor shall comply with the most stringent requirement as determined by the Commissioner. The Contractor shall refer any uncertainties and/or conflicting requirements to the Commissioner for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. The Contractor shall refer any uncertainties to the Commissioner for a decision before proceeding.

**1.6 QUALITY ASSURANCE:**

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required. Individual Specification Sections specify additional requirements.
- B. Installer Qualifications: Special Experience Requirements may apply to the firm that will install, erect or assemble specified work required for the Project. If applicable, such Special Experience Requirements are set forth in the Bid Booklet.
- C. Manufacturer Qualifications: Special Experience Requirements may apply to the firm that will manufacture equipment, products or systems specified for the Project. If applicable, such Special Experience Requirements are set forth in the Bid Booklet.



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- D. Fabricator Qualifications: Special Experience Requirements may apply to the firm that will fabricate material, products or systems specified for the Project. If applicable, such Special Experience Requirements are set forth in the Bid Booklet.
- E. Professional Engineer Qualifications: A professional engineer who is licensed to practice in the State of New York and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- G. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by the Resident Engineer.
  - 2. Notify Resident Engineer seven (7) days in advance of dates and times when mockups will be constructed.
  - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 4. Obtain Design Consultant's approval of mockups before starting work, fabrication, or construction.
  - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. Demolish and remove mockups when directed, unless otherwise directed or indicated.

**1.7 QUALITY CONTROL:**

- A. City's Responsibilities: Where quality-control services are indicated as the City's responsibility in the Specifications, the City will engage a qualified testing agency to perform these services.
  - 1. COST OF TESTS BORNE BY THE CITY: Where the City directs tests to be performed to determine compliance with the Specifications regarding materials or equipment, and where such compliance is ascertained as a result thereof, the City will bear the cost of such tests.
  - 2. The City will furnish the Contractor with names, addresses, and telephone numbers of testing entities engaged and a description of the types of testing and inspecting they are engaged to perform.
  - 3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to the Contractor.
- B. Contractor's Responsibility: Tests and inspections not explicitly assigned to the City are the Contractor's responsibility. Unless otherwise indicated, the Contractor shall provide quality-control services as set forth in the Specifications and those required by Authorities having jurisdiction. The Contractor shall provide quality-control services required by Authorities having jurisdiction, whether specified or not.
  - 1. COST OF TESTS BORNE BY CONTRACTOR – In the case of tests which are specifically called for in the Specifications to be provided by the Contractor or tests which are required by any Authority having jurisdiction, but are not indicated as the responsibility of the City, the cost thereof shall be borne by the Contractor and shall be deemed to be included in the Contract price. The Contractor shall reimburse the City for expenditures incurred in providing tests on materials and equipment submitted by the Contractor as the equivalent of that specifically named in the Specifications and rejected for non-compliance.
  - 2. Where services are indicated as Contractor's responsibility, the Contractor shall engage a qualified testing agency to perform these quality-control services. Any testing agency engaged by the Contractor to perform quality control services is subject to prior approval by the Commissioner.



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3. The Contractor shall not employ same entity engaged by the City, unless agreed to in writing by the Commissioner.
  4. The Contractor shall notify testing agencies and the Resident Engineer at least 72 hours in advance of the date and time for the performance of Work that requires testing or inspecting.
  5. Where quality-control services are indicated as Contractor's responsibility, the Contractor shall submit a certified written report, in triplicate to the Commissioner, of each quality-control service.
  6. Testing and inspecting requested by the Contractor and not required by the Contract Documents are Contractor's responsibility.
  7. The Contractor shall submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Manufacturer's Field Services:** Where indicated, the Contractor shall engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Results shall be submitted in writing as specified in Section 01 33 00 SUBMITTAL PROCEDURES.
- D. **Retesting/Re-inspecting:** Regardless of whether the original tests or inspections were the Contractor's responsibility, the Contractor shall provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. **Associated Services:** The Contractor shall cooperate with entities performing required tests, inspections, and similar quality-control services, and shall provide reasonable auxiliary services as requested. The Contractor shall notify the testing agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist testing entity in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing entities.
  6. Design mix proposed for use for material mixes that require control by the testing entity.
  7. Security and protection for samples and for testing and inspecting equipment at the Project site.
- F. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
  2. Coordinate and cooperate with the Commissioning Authority/Agent as applicable for start-up, inspection and functional testing in the implementation of the Commissioning Plan.
- G. **Manufacturer's Directions:** Where the Specifications provide that the manufacturer's directions are to be used, such printed directions shall be submitted to the Commissioner.
- H. **Inspection of Material:** In the event that the Specifications require the Contractor to engage the services of an entity to witness and inspect any material especially manufactured or prepared for use in or part of the permanent construction, such entity shall be subject to prior written approval by the Commissioner.
1. **NOTICE** - The Contractor shall give notice in writing to the Commissioner sufficiently in advance of its intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, the Commissioner will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials, or the Commissioner will notify the Contractor that the inspection will be made at a point



other than the point of manufacture, or the Commissioner will notify the Contractor that inspection will be waived.

- I. No Shipping Before Inspection: The Contractor shall comply with the foregoing before shipping any material.
- J. Certificate of Manufacture: When the Commissioner so requires, the Contractor shall furnish to the Commissioner authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Specifications. These certificates shall include copies of the results of physical tests and chemical analyses where necessary, that have been made directly on the product, or on similar products being fabricated by the manufacturer. This may include such approvals as B.S.A., M.E.A., B.E.C. Advisory Board, etc.
- K. Acceptance: When materials or manufactured products shall comprise such quantity that it is not practical to make physical tests or chemical analyses directly on the product furnished, a certificate stating the results of such tests or analyses of similar materials which were concurrently produced may, at the discretion of the Commissioner, be considered as the basis for the acceptance of such material or manufactured product.
- L. Testing Compliance: The testing personnel shall make the necessary inspections and tests, and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Specifications, indicating thereon all analyses and/or test data and interpreted results thereof.
- M. Reports: Six (6) copies of the reports shall be submitted and authoritative certification thereof must be furnished to the Commissioner as a prerequisite for the acceptance of any material or equipment.
- N. Rejections: If, in making any test, it is ascertained by the Commissioner that the material or equipment does not comply with the Specifications, the Contractor will be notified thereof, and will be directed to refrain from delivering said materials or equipment, or to promptly remove it from the site or from the work and replace it with acceptable material at no additional cost to the City.
- O. Furnish Designated Materials: Upon rejection of any material or equipment submitted as the equivalent of that specifically named in the Specifications, the Contractor shall immediately proceed to furnish the designated material or equipment.

#### **1.8 APPROVAL OF MATERIALS:**

- A. Local Laws: All materials, appliances and types or methods of construction shall be in accordance with the Specifications and shall in no event be less than that necessary to conform to the requirements of the New York City Construction Codes, Administrative Code and Charter of the City of New York.
- B. Approval of Manufacturer: The names of proposed manufacturers, material suppliers, and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be submitted to the Commissioner for approval, as early as possible, to afford proper review and analysis. No manufacturer will be approved for any materials to be furnished under the Contract unless it shall have a plant of ample capacity and shall have successfully produced similar products. All approvals of materials or equipment that are legally required by the New York City Construction Codes and other governing Authorities must be obtained prior to installation.
- C. All Materials: Fixtures, fittings, supplies and equipment furnished under the Contract shall be new and unused, except as approved by the Commissioner, and of standard first-grade quality and of the best workmanship and design. The City of New York encourages the use of recycled products where practical.
- D. INFORMATION TO SUPPLIERS - In asking for prices on materials under any item of the Contract, the Contractor shall provide the manufacturer or dealer with such complete information from the



Specifications and Contract Drawings as may in any case be necessary, and in every case the Contractor shall inform the manufacturer or dealer of all the General Conditions and requirements herein contained.

#### **1.9 SPECIAL INSPECTIONS:**

##### **A. SPECIAL INSPECTIONS:**

1. Inspection of selected materials, equipment, installation, fabrication, erection or placement of components and connections made during the progress of the Work to ensure compliance with the Contract Documents and provisions of the New York City Construction Codes, shall be made by a Special Inspector. The City of New York will retain the services of the Special Inspector and bear the costs for the performance of Special Inspections in compliance with NYC Construction Codes requirements or as additionally may be called for in the project specifications, except as noted below for Form TR-3: Technical Report for Concrete Design Mix. The Special Inspector shall be an entity compliant with the requirements of the New York City Construction Codes. The Contractor shall notify the relevant Special Inspector in writing at least 72 hours before the commencement of any work requiring special inspection.
2. Form TR3: Technical Report Concrete Design Mix: The contractor shall be responsible for, and bear all costs associated with the filing and securing of approvals, if any, for Form TR3: Technical Report Concrete Design Mix, including, but not limited to, engaging the services of a New York City licensed Concrete Testing Lab for the review and approval of concrete design mix, testing, signatures and professional seals, etc., compliant with NYC Department of Buildings requirements, for each concrete design mix.
3. The Contractor shall notify the relevant Special Inspector in writing at least 72 hours before the commencement of any work requiring Special Inspection. The contractor shall be responsible for, and bear related costs to assure that all construction or work shall remain accessible and exposed for inspection purposes until the required inspection is completed.
4. Inspections and tests performed under "Special Inspection" shall not relieve the Contractor of the responsibility to comply with the Contract Documents, and that there is no warranty given to the Contractor by the City of New York in connection with such inspection and tests or certifications made under "Special Inspections".
5. The contractor must coordinate with the Resident Engineer or DDC Project Manager to provide access and schedule the work for inspection by the Special Inspector.

#### **1.10 INSPECTIONS BY OTHER CITY AGENCIES:**

- A. Letter of Completion: Just prior to substantial completion of this Project, the Commissioner will file with the Department of Buildings, an application for a Letter of Completion or a Certificate of Occupancy for the structure.
- B. Final Inspections: In connection with the above mentioned application for a Letter of Completion or a Certificate of Occupancy and before certificates of final payments are issued, the Contractor will be required to arrange for all final inspections by the inspection staff of the Department of Buildings, Fire Department or other Governmental Agencies having jurisdiction, and secure all reports, sign offs, certificates, etc., by such inspection staff or other governmental agencies, in order that a Letter of Completion or Certificate of Occupancy can be issued promptly.

#### **1.11 CERTIFICATES OF APPROVAL:**

- A. Responsibility: The Contractor shall be responsible for and shall obtain all final approvals for the work installed under the Contract in the form of such certificates that are required by all governmental agencies having jurisdiction over the work of the Contract.
- B. Transmittal: All such certificates shall be forwarded to the Commissioner through the Resident Engineer.



**1.12 ACCEPTANCE TESTS:**

- A. Government Agencies: All equipment and appliances furnished and installed under the Contract shall conform to the requirements of the Specifications, and shall in no event be less than that necessary to comply with the minimum requirements of the law and all of the governmental agencies having jurisdiction.
- B. Notice of Tests: Whenever the Specifications and/or any governmental agency having jurisdiction requires the acceptance test, the Contractor shall give written notice to all concerned of the time when these tests will be conducted.
- C. Energy: The City will furnish all energy, fuel, water and light required for tests.
- D. Labor and Materials: The Contractor shall furnish labor and all other material and instruments necessary to conduct the acceptance tests at no additional cost to the City.
- E. Certificates: The final acceptance by the Commissioner shall be contingent upon the Contractor delivering to the Commissioner all necessary certificates evidencing compliance in every respect with the requirements of the regulatory agencies having jurisdiction.
- F. Results: If the results of tests and Special Inspections indicate that the material or procedures do not meet requirements as set forth on the Contract Drawings or in the Specifications or are otherwise unsatisfactory, the Contractor shall only proceed as directed by the Resident Engineer. Additional costs resulting from retesting, re-inspecting, replacing of material and/or damage to the work and any delay caused to the schedule shall be borne by the Contractor.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION**

**3.1 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspecting, sample taking, and similar services, the Contractor shall repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

**END OF SECTION 01 40 00**



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**SECTION 01 42 00  
REFERENCES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 DEFINITIONS:**

**REFER TO THE ADDENDUM, Article IX, FOR ADDITIONAL DEFINITIONS AND REVISIONS TO THE CONTRACT AND SPECIFICATIONS**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. "APPROVED," ETC. - "Approved," "acceptable," "satisfactory," and words of similar import shall mean and intend approved, acceptable or satisfactory to the Commissioner.
- C. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- D. "DIRECTED," "REQUIRED," ETC.- Wherever reference is made in the Contract to the work or its performance, the terms "directed," "required," "permitted," "ordered," "designated," "prescribed," "determined," and words of similar import shall, unless expressed otherwise, imply the direction, requirements, permission, order, designation or prescription of the Commissioner.
- E. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings.





### **1.3 CODES, AGENCIES AND REGULATIONS:**

A.D.A.A.G.	Americans with Disabilities Act (ADA) – Architectural Barriers Act (ABA)
B.G. & E.	Bureau of Gas and Electricity of the City of New York
B.S. & A.	New York City Board of Standards and Appeals
DOE	Department of Energy
E.C.C.C.N.Y.S.	Energy Conservation Construction Code of New York State
EPA	Environmental Protection Administration
N.Y.C.C.C.	New York City Construction Codes – includes: New York City Plumbing Code New York City Building Code New York City Mechanical Code New York City Fuel Gas Code
N.Y.S.D.O.L	New York State Department of Labor
N.Y.C.D.E.P	New York City Department of Environmental Protection
N.Y.C.E.C.	New York City Electrical Code
N.Y.C.E.C.C	New York City Energy Conservation Code
N.Y.C.F.C	New York City Fire Code
N.Y.S...D.E.C.	New York State Department of Environmental Conservation
O.S.H.A.	Occupational Safety & Health Administration

### **1.4 INDUSTRY STANDARDS:**

- A. **STANDARD REFERENCES** – Unless otherwise specifically indicated in the Contract Documents, whenever reference is made to the furnishing of materials or testing thereof that conforms to the standards of any technical society, organization or body, it shall be construed to mean the latest standard, code, specification adopted and published by that technical society, organization or body, as of the date of the bid opening, Unless the provisions of the New York City Construction Codes adopts a different or earlier dated version of such standard.
- B. **APPLICABILITY OF STANDARDS:** Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect, to the extent referenced, as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
- C. **CONFLICTING REQUIREMENTS:** Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantity or quality, comply with the most stringent requirements. Immediately refer uncertainties, and requirements that are different but apparently equal, to the Commissioner in writing for a decision before proceeding.
- D. **STANDARD SPECIFICATIONS** - When no reference is made to a code, standard or specification, the Standard Specifications of the ASTM or the AIEE, as the case may be, shall govern.
- E. **REFERENCES** - Reference to a technical society, organization or body may be made in the Specifications by abbreviations. Abbreviations and acronyms used in the Specifications and other Contract Documents mean the associated name. The following names are subject to change and are



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believed, but are not assured, to be accurate and up-to-date as of the Issue Date of the Contract Documents.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists (The)
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	ACI International (American Concrete Institute)
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AGMA	American Gear Manufacturer Association
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AIEE	American Institute of Electrical Engineers



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AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSc	American Lumber Standard Committee, Incorporated
ALI	Automotive Lift Institute
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	APA - The Engineered Wood Association
APA	Architectural Precast Association
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASCE/SEI	American Society of Civil Engineers, Structural Engineering Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	AWCI International (Association of the Wall and Ceiling Industry International)



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AWCMA	American Window Covering Manufacturers Association (Now WCSC)
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWSC	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CIBSE	Chartered Institute of Building Services Engineers
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CGSB	Canadian General Standards Board
CIMA	Cellulose Insulation Manufacturers Association
CIPRA	Cast Iron Pipe Research Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute



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CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CPSC	Consumer Product Safety Commission
CRI	Carpet & Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DASMA	Door and Access Systems Manufacturer's Association International
DHI	Door and Hardware Institute
DOC	U.S. Department of Commerce – National Institute of Standards and Technology
EIA	Electronic Industries Alliance
DOJ	U.S. department of Justice
EIMA	EIFS Industry Members Association
DOL	U.S. Department of labor
EJCDC	Engineers Joint Contract Documents Committee
DOTn	U.S. Department of Transportation
EN	European Committee of Standards
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association
EVO	Efficiency Valuation Organization
FEMA	Federal Emergency Management Agency
FIBA	Federation Internationale de Basketball Amateur (The International Basketball Federation)



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FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FMG	FM Global (Formerly: FM - Factory Mutual System)
FMRC	Factory Mutual Research (Now FMG)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Now GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
HUD	U.S. Department of Housing and Urban Development
IAPMO	International Association of Plumbing and Mechanical Officials
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation
ICC	International Code Council, Inc.
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.



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IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IENT	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers



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NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NIS	National Institute of Standards and Technology
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)





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NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Acquired by ITS - Intertek)
PCI	Precast / Pre-stressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PPS	Power Piping Society
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
RMI	Rack Manufacturers Institute
RTI	(Formerly: NTRMA - National Tile Roofing Manufacturers Association) (Now TRI)
SAE	SAE International
SCAQMD	South Coast Air Quality Management District



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SCS	Scientific Certification System
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SGCC	Safety Glazing Certification Council
SHBI	Steel Heating Boiler Institute
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance



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TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute (Formerly: RTI - Roof Tile Institute)
UL	Underwriters Laboratories Inc.
ULC	Underwriters Laboratories of Canada
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USC	United States Code
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association (Now WCSC)
WCSC	Window Covering Safety <b>Council</b> (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WRI	Wire Reinforcement Institute, Inc.
USEPA	United States Environmental Protection Agency
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association



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**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 42 00**



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**SECTION 01 50 00  
TEMPORARY FACILITIES, SERVICES AND CONTROLS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This section includes the following:
1. Temporary Water System
  2. Temporary Sanitary Facilities
  3. Temporary Electric Power, Temporary Lighting System, And Site Security Lighting
  4. Temporary Heat
  5. Dewatering Facilities and Drains
  6. Temporary Field Office for Contractor
  7. Resident Engineer's Office
  8. Material Sheds
  9. Temporary Enclosures
  10. Temporary Partitions
  11. Temporary Fire Protection
  12. Work Fence Enclosure
  13. Rodent and Insect Control
  14. Plant Pest Control Requirements
  15. Project Identification Signage
  16. Security Guards/Fire Guards on Site
  17. Project Sign and Rendering
  18. Safety

**1.3 RELATED SECTIONS:** include without limitation the following:

- A. Section 01 10 00 SUMMARY
- B. Section 01 42 00 REFERENCES
- C. Section 01 54 11 TEMPORARY ELEVATORS AND HOISTS
- D. Section 01 54 23 TEMPORARY SCAFFOLDS AND SWING STAGING
- E. Section 01 77 00 CLOSE OUT PROCEDURES

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.



- B. Permanent Enclosure: As determined by Commissioner, permanent or temporary roofing that is complete, insulated, and weather tight; exterior walls which are insulated and weather tight; and all openings that are closed with permanent construction or substantial temporary closures.
- C. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

**1.5 SUBMITTALS:**

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Reports: Submit reports of tests, inspections, meter readings and similar procedures for temporary use.

**1.6 PROJECT CONDITIONS:**

- A. Temporary Use of Permanent Facilities and Services: The Contractor shall be responsible for the operation, maintenance, and protection of each permanent facility and service during its use as a construction facility before Final Acceptance by the City, regardless of previously assigned responsibilities.
- B. Install, operate, maintain and protect temporary facilities, services and controls.
  - 1. Keep temporary services and facilities clean and neat in appearance.
  - 2. Operate temporary services in a safe and efficient manner.
  - 3. Relocate temporary services and facilities as needed as Work progresses.
  - 4. Do not overload temporary services and facilities or permit them to interfere with progress.
  - 5. Provide necessary fire prevention measures.
  - 6. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on-site.

**1.7 NON-REGULAR WORK HOURS (OVERTIME):**

- A. The Contractor shall provide the temporary services, facilities and controls set forth in this Section during other than regular working hours if the Drawings and/or the Specifications indicate that the Work, or specific components thereof, must be performed during other than regular working hours. In such case, all costs for the provision of temporary services, facilities and controls during other than regular working hours shall be deemed included in the total Contract Price.
- B. The Contractor shall provide the temporary services, facilities and controls set forth in this Section during other than regular working hours if a change order is issued directing the Contractor to perform the Work, or specific components thereof, during other than regular working hours. In such case, compensation for the provision of temporary services, facilities and controls during other than regular working hours shall be provided through the change order.

**1.8 SERVICES BEYOND COMPLETION DATE:**

- A. The Contractor shall provide the temporary services, facilities and controls set forth in this Section until the date on which it completes all required work at the site, including all punch list work, as certified in writing by the Resident Engineer, or earlier if so directed in writing by the Commissioner. The Contractor shall provide such temporary services, facilities and controls even if completion of all required work at the



site occurs after the time fixed for such completion in Schedule A.

## **PART II – PRODUCTS**

### **2.1 MATERIALS:**

- A. Provide undamaged materials in serviceable condition and suitable for use intended.
- B. Tarpaulins: Waterproof, fire-resistant UL labeled with flame spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
- C. Water: Potable and in compliance with requirements of the Department of Environmental Protection.

### **2.2 EQUIPMENT:**

- A. Provide undamaged equipment in serviceable condition and suitable for use intended.
- B. Water Hoses: Heavy-duty abrasive-resistant flexible rubber hoses, 100 feet (30 m) long with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- C. Electric Power Cords: Grounded extension cords.
  - 1. Provide hard-service cords where exposed to abrasion or traffic.
  - 2. Provide waterproof connectors to connect separate lengths of electric cords where single lengths will not reach areas of construction activity.
  - 3. Do not exceed safe length-voltage ratio.
- D. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

## **PART III –EXECUTION:**

### **3.1 INSTALLATION, GENERAL:**

- A. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities as approved by the Resident Engineer.

### **3.2 TEMPORARY WATER SYSTEM:**

<b>REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.2 A</b>
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- A. TEMPORARY WATER SYSTEM - NEW FACILITIES: During construction, the Contractor shall furnish a Temporary Water System as set forth below.
  - 1. Immediately after the Commissioner has issued an order to start work, the Contractor shall file an application with the Dept. of Environmental Protection for the schedule of charges for water use during construction. The Contractor will be responsible for payment of water charges.
  - 2. Immediately after the Commissioner has issued an order to start work, the Contractor shall file an application with the Department of Environmental Protection's Bureau of Water Supply and obtain a permit to install the temporary water supply system. The system shall be installed and maintained for the use of the Contractor and its subcontractors. A copy of the above mentioned permit shall be filed with the Commissioner. The Contractor shall provide temporary water main, risers and waste stacks as directed and install on each floor, outlets with two (2) 3/4" hose valve connections over a





barrel installed on a steel pan. The Contractor shall provide drains from the pans to the stack and house sewer and hose bibs to drain the water supply risers and mains. During winter months, the Contractor shall take the necessary precautions to prevent the temporary water system from freezing. The Contractor shall provide repairs to the temporary water supply system for the duration of the project until said temporary system is dismantled and removed.

3. Disposition of Temporary Water System: The Contractor shall be responsible for dismantling the temporary water system when no longer required for the construction operations, or when replaced by the permanent water system installed for the project, or as otherwise directed by the Resident Engineer. All repair work resulting from the dismantling of the temporary water system shall be the responsibility of the Contractor.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.2 B**

- B. TEMPORARY WATER SYSTEM – PROJECTS IN EXISTING FACILITIES:
  1. When approved by the Commissioner, use of existing water system will be permitted for temporary water service during construction, as long as the system is cleaned and maintained in a condition acceptable to the Commissioner. At Substantial Completion, the Contractor shall restore the existing water system to conditions existing before initial use.
  2. The Contractor shall be responsible for all repairs to the existing water system permitted to be used for temporary water service during construction. The Contractor shall be responsible to maintain the existing system in a clean condition on a daily basis, acceptable to the Commissioner.
  3. The Contractor will be responsible for payment of water charges as directed by the Commissioner. Billing will be in accordance with the Department of Environmental Protection schedule of charges for Building Purposes.
- C. WASH FACILITIES: The Contractor shall install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition.
  1. Dispose of drainage properly.
  2. Supply cleaning compounds appropriate for each condition.
  3. Include safety showers, eyewash fountains and similar facilities for the convenience, safety and sanitation of personnel.
- D. DRINKING WATER FACILITIES: The Contractor shall provide drinking water fountains or containerized tap-dispenser bottled-drinking water units, complete with paper cup supplies. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg. F (7 to 13 deg. C).

**3.3 TEMPORARY SANITARY FACILITIES:**

- A. The Contractor shall provide toilets, wash facilities and drinking water fixtures in compliance with regulations and health codes for type, number, location, operation and maintenance of fixtures and facilities. Provide toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each facility, and provide covered waste containers for used materials.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.3 B**

- B. SELF-CONTAINED TOILET UNITS:
  1. The Contractor shall provide temporary single-occupant toilet units of the chemical, aerated re-circulation, or combustion type for use by all construction personnel. Units shall be properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material. Quantity of toilet units shall comply with the latest OSHA regulations.
  2. Toilets: Install separate self-contained toilet units for male and female personnel. Shield toilets to ensure privacy.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.3 C**

**C. EXISTING TOILETS:**

1. **TOILET FACILITIES:** When approved by the Commissioner, the Contractor shall arrange for the use of existing toilet facilities by all personnel during the execution of the work. The Contractor shall be responsible to clean and maintain facilities in a condition acceptable to the Resident Engineer and, at completion of construction, to restore facilities to their condition at the time of initial use.
2. **MAINTENANCE** - The Contractor shall maintain the temporary toilet facilities in a clean and sanitary manner and make all necessary repairs.
3. **NUISANCES** - The Contractor shall not cause any sanitary nuisance to be committed by its employees or the employees of its subcontractors in or about the work and shall enforce all sanitary regulations of the City and State Health Authorities.

**3.4 TEMPORARY ELECTRIC POWER, TEMPORARY LIGHTING SYSTEM, AND SITE SECURITY LIGHTING:**

- A. **SCOPE:** This Section sets forth the General Conditions and procedures relating to Temporary Electric Power, Temporary Lighting System and Site Security Lighting during the construction period.
- B. **TEMPORARY ELECTRIC POWER:**  
The Contractor shall provide and maintain a Temporary Electric Power service and distribution system of sufficient size, capacity and power characteristics required for construction operations for all required work by the Contractor and its subcontractors, including but not limited to power for the Temporary Lighting System, Site Security Lighting, construction equipment, hoists, temporary elevators and all field offices. Temporary Electric Power shall be provided as follows:

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4 B (1)**

1. **CONNECTION TO UTILITY LINES:**
  - a. **Temporary Electric Power Service** for use during construction shall be provided as follows: The Contractor shall make all necessary arrangements with the Public Utility Company and pay all charges for the Temporary Electric Power system. The Contractor shall include in its total Contract Price any charges for Temporary Electric Power, including charges that may be made by the Public Utility Company for extending its electrical facilities, and for making final connections. The Contractor shall make payment directly to the Public Utility Company.
  - b. **APPLICATIONS FOR METER:** The Contractor shall make application to the Public Utility Company and sign all documents necessary for, and pay all charges incidental to, the installation of a watt hour meter or meters for Temporary Electric Power. The Contractor shall pay to the Public Utility Company, all bills for Temporary Electric energy used throughout the work, as they become due.
  - c. **SERVICE AND METERING EQUIPMENT** - The Contractor shall furnish and install, at a suitable location on the site, approved service and metering equipment for the Temporary Electric Power System, ready for the installation of the Public Utility Company's metering devices. The temporary service mains to and from the metering location shall be not less than 100 Amperes, 3-phase, 4-wire and shall be of sufficient capacity to take care of all demands for all construction operations and shall meet all requirements of the NYCEC.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4 B (2)**

2. CONNECTION TO EXISTING ELECTRICAL POWER SERVICE:
- a. When approved by the Commissioner, electrical power service for the Temporary Lighting System and for the operation of small tools and equipment less than ¼ horsepower may be taken from the existing electric distribution system if the existing system is of adequate capacity for the temporary power load. The Contractor shall cooperate and coordinate with the facility custodian, so as not to interfere with the normal operation of the facility.
  - b. There will be no charge to the Contractor for the electrical energy consumed.
  - c. The Contractor shall provide, maintain and pay all costs for separate temporary electric power for any temporary power for equipment larger than 1/4 horsepower. When directed by the Commissioner, the Contractor shall remove its own temporary power system.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4 B (3)**

3. ELECTRICAL GENERATOR POWER SERVICE:
- a. When connection to Utility Lines or existing facility electric service is not available or is not adequate to supply the electric power need for construction operations, the Contractor shall provide self-contained generators to provide power beyond that available.
  - b. Pay for all energy consumed in the progress of the Work, exclusive of that available from the existing facility or Utility Company.
  - c. Provide for control of noise from the generators.
  - d. Comply with the Ultra Low Sulfur Fuel in Non-Road Vehicles requirements as set forth in Article 5.4 of the Contract.
- C. USE OF COMPLETED PORTIONS OF THE ELECTRICAL WORK:
- 1. USE OF MAIN DISTRIBUTION PANEL: As soon as the permanent electric service feeders and equipment, metering equipment and main distribution panel are installed and ready for operation, the Contractor shall have the temporary lighting and power system changed over from the temporary service points to the main distribution panel.
  - 2. COST OF CHANGE OVER - The Contractor shall be responsible for all costs due to this change over of service and it shall also make application to the Public Utility Company for a watt hour meter to be set on the permanent meter equipment.
  - 3. The requirements for temporary electric power service specified herein shall be adhered to after change over of service until final acceptance of the project.
  - 4. NO EXTRA COST - The operation of the service and switchboard equipment shall be under the supervision of the Contractor, but this shall in no way be interpreted to mean the acceptance of such part of the installation or relieve the Contractor from its responsibility for the complete work or any part thereof. There shall be no additional charge for supervision by the Contractor.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4 D**

- D. TEMPORARY LIGHTING SYSTEM:
- 1. The Contractor shall provide adequate service for the temporary lighting system, or a minimum of 100 Amperes, 3-phase, 4-wire service for the temporary lighting system, whichever is greater, and make all necessary arrangements with the Public Utility Company and pay all charges by them for the Temporary Lighting System



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2. The Contractor shall furnish and connect to the metered service point, a Temporary Lighting System to illuminate the entire area where work is being performed and points adjacent to the work, with separately fused circuits for stairways and bridges. Control switches for stairway circuits shall be located near entrance on ground floor.
3. ITEMS: The Temporary Lighting System provided by the Contractor shall consist of wiring, fixtures, left-hand double sockets, (one (1) double socket for every 400 square feet, with one (1) lamp and one (1) three-prong outlet) lamps, fuses, locked type guards, pigtails and any other incidental material. Additional details may be outlined in the detailed Specifications for the Electrical Work. Changes may be made, provided the full equivalent of those requirements is maintained.
4. The Temporary Lighting System shall be progressively installed as required for the advancement of the work under the Contract.
5. RELOCATION: The cost for the relocation or extension of the original Temporary Lighting System, required by the Contractor or its subcontractors, that is not required due to the normal advancement of the work, as determined by the Resident Engineer, shall be borne by the Contractor.
6. PIGTAILS: shall be furnished with left-hand sockets with locked type guards and 40 feet of rubber covered cable. The Contractor shall furnish and distribute a minimum of three (3) complete pigtails to each subcontractor. See the detailed Electrical Specifications for possible additional pigtails required.
7. LAMPS: The Contractor shall furnish and install one (1) complete set of lamps, including those for the trailers. Broken and burned out lamps in the temporary lighting system, DDC field office and construction trailers, shall be replaced by the Contractor. All lamps shall be compact fluorescent.
8. CIRCUIT PROTECTION: The Contractor shall furnish and install GFI protection for the Temporary Lighting and Site Security Lighting Systems.
9. MAINTENANCE OF TEMPORARY LIGHTING SYSTEM:
  - a. The Contractor shall maintain the Temporary Lighting System in good working order during the scheduled hours established.
  - b. The Contractor shall include in its total Contract Price all costs in connection with the Temporary Lighting System, including all costs for installation, maintenance and electric power.
10. REMOVAL OF TEMPORARY LIGHTING SYSTEM: The temporary lighting system shall be removed by the Contractor when authorized by the Commissioner.
11. HAND TOOLS: The temporary lighting system shall not be used for power purposes, except that light hand tools not larger than 1/4 horsepower may be operated from such system by the Contractor and its subcontractors.

<b>REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4 E</b>
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**E. SITE SECURITY LIGHTING (FOR NEW CONSTRUCTION ONLY):**

1. The Contractor shall furnish, install and maintain a system of site security lighting, as herein specified, to illuminate the construction site of the project, and it shall be connected to and energized from the Temporary Lighting System. All costs in connection with site security lighting shall be deemed included in the total Contract Price.
2. It is essential that the site security lighting system be completely installed and operating, at the earliest possible date. The Contractor shall direct its subcontractors to cooperate, coordinate and exert every effort to accomplish an early complete installation of the site security lighting system. After the system is installed and in operation, if a part of the system interferes with the work of any trade, the Contractor shall be completely responsible for the expense of removing, relocating and replacing all equipment necessary to reinstate the system to proper operating conditions.
3. The system shall consist of flood lighting by pole mounted guarded sealed-beam units. Floodlight units shall be mounted 16 feet above grade. Floodlights shall be spaced around the perimeter of the site to produce an illumination level of no less than one (1) foot candle around the perimeter of



the site, as well as in any potentially hazardous area or any other area within the site that might be deemed by the Resident Engineer to require security illumination. The system shall be installed in a manner acceptable to the Resident Engineer. The first lighting unit in each circuit shall be provided with a photoelectric cell for automatic control. The photoelectric cell shall be installed as per manufacturer's recommendations.

4. All necessary poles shall be furnished and installed by the Contractor.
5. The site security lighting shall be kept illuminated at all times during the hours of darkness. The Contractor shall, at its own expense, shall keep the system in operation, and shall furnish and install all material necessary to replace all damaged or burned out parts.
6. The Contractor shall be on telephone call alert for maintaining the system during the operating period stated above.
7. All materials and equipment furnished under this section shall remain the property of the Contractor and shall be removed and disposed of by the Contractor when authorized in writing by the Resident Engineer.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.5**

**3.5 TEMPORARY HEAT:**

**A. GENERAL:**

1. Definition: The provision of Temporary Heat shall mean the provision of heat in order to permit construction to be performed in accordance with the Progress Schedule during all seasons of the year and to protect the work from the harmful effects of low temperature. In the event the building, or any portion thereof, is occupied during construction, the provision of Temporary Heat shall include the provision of heat to permit normal operations in such occupied areas.
  - a. The provision of Temporary Heat shall be in accordance with the temperature requirements set forth in Sub-Section 3.5 C herein.
  - b. The provision of Temporary Heat shall include the provision of: 1) all fuel necessary and required, 2) all equipment necessary and required, and 3) all operating labor necessary and required. Operating labor shall mean that minimum force required for the safe day to day operation of the system for the provision of Temporary Heat and shall include, without limitation, heating maintenance labor and/or Fire Watch as required by NYC Fire Department regulations. Operating labor may be required seven (7) days per week and during other than normal working hours, for the period of time required by seasonal weather conditions.
  - c. In the event the building, or any portion thereof, is occupied and the Project involves the replacement, modification and/or shut down of the permanent heating system, or any key component thereof; and such system is a combined system which furnishes domestic hot water for the building occupants, the provision of Temporary Heat shall include the provision of domestic hot water at the same temperature as the system which is being replaced. Domestic hot water shall be provided in accordance with the phasing requirements set forth in the Contract Documents.
2. Responsibility: The Contractor's responsibility for the provision of Temporary Heat, including all expenses in connection therewith, shall be as set forth below:
  - a. Projects Involving Enclosure of the Building:
    - 1) Prior to Enclosure - Until the Commissioner determines that the building has been enclosed, as set forth in Sub-Section 3.5 B; the Contractor shall be responsible for the provision of Temporary Heat.
    - 2) Post Enclosure - Once the Commissioner determines that the building, or any portion thereof, has been enclosed, as set forth in Sub-Section 3.5 B, the Contractor shall be responsible for the provision of Temporary Heat by one or more of the following means: 1) by an existing heating system (if any), 2) by a permanent heating system which is being installed as part of the Project, or 3) by a temporary heating system(s).



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- 3) The Contractor shall, within two (2) weeks of the kick-off meeting, submit to DDC for review its proposed plan to provide Temporary Heat. Such plan is subject to approval by the Resident Engineer. The Contractor shall provide Temporary Heat in accordance with the approved plan until written acceptance by the Commissioner of the work of all Contractors, including punch list work, unless directed otherwise in writing by the Commissioner. The responsibility of the Contractor provided for herein is subject to the exception set forth in Sub-Section 3.5 A.2 (b) herein.
- b. Projects not involving Enclosure of the Building:
  - 1) If the Project involves the installation of a new permanent heating system if one did not exist previously, or the replacement, modification and/or shut down of the existing permanent heating system, or any key component thereof, the Contractor shall be responsible for the provision of Temporary Heat, except as otherwise provided in Sub-Section 3.5 H.3(b).2 herein.
  - 2) If the Project does not involve the installation of a new permanent heating system if one did not exist previously, or the replacement, modification and/or shut down of the existing permanent heating system, or any key component thereof; there is no Contractor responsibility of the provision of Temporary Heat, unless otherwise specified in the Contract Documents. However, if the Commissioner, pursuant to Sub-Section 3.5 H.3 (b).1 herein, determines that the provision of Temporary Heat is necessary due to special and/or unforeseen circumstances, the Contractor shall be responsible for the provision of Temporary Heat and shall be paid for the same in accordance with Sub-Section 3.5 H.3 (b).1 herein.
- B. ENCLOSURE OF STRUCTURES:
  1. Notification: The Contractor shall notify all its subcontractors and the Resident Engineer at least 30 days prior to the anticipated date that the building(s) will be enclosed.
  2. Commissioner Determination: The Commissioner shall determine whether the building, or any portion thereof, has been enclosed. As indicated in Sub-Section 3.5 A.2 above, once the building has been enclosed, the Contractor shall be responsible for the provision of Temporary Heat. The Commissioner's determination with respect to building enclosure shall be based upon all relevant facts and circumstances, including without limitation, 1) whether the building meets the criteria set forth in Paragraph 3 below, and 2) whether the openings in the building, such as doorways and windows, have been sufficiently covered so as to provide reasonable heat retention and protection from the elements.
  3. Criteria for enclosure:
    - a. Roof Area:
      - 1) A building shall be considered to be roofed when the area to be roofed is covered by a permanent structure and all openings through the permanent structure are covered and protected by temporary covers as described in Paragraph (c) below.
      - 2) Intermediate floor structures of multi-floor buildings shall be considered to be roofed subject to the same requirements of the building roof.
      - 3) The final roofing system need not be in place for the building or structure to be determined to be enclosed; provided, however, all openings through the permanent structure covering the roof must be covered and protected by temporary covers, as described in Paragraph (c) below.
    - b. Walls: For the walls to be determined to be enclosed permanent exterior wall elements or facing material must be in place and all openings must be covered and protected by temporary covers, as described in Paragraph (c) below.
    - c. Temporary Covers: In order to be acceptable, temporary covers must be securely fixed to prevent the entrance of rain, snow and direct wind. The minimum material requirements for temporary covers are as follows: 1) minimum 10 mil. Plastic 2) minimum 12 ounce waterproof canvas tarpaulins, or 3) a minimum three-eighths (3/8) inch thickness exterior grade plywood.



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- d. Temporary covers for openings shall be the responsibility of the Contractor and such work shall be deemed included in the Contract price.

**C. TEMPERATURE REQUIREMENTS:**

1. Unoccupied Buildings: The temperature requirement for the provision of Temporary Heat in unoccupied buildings shall be the GREATER of the following: 1) 50 degrees Fahrenheit, or 2) the temperature requirement for the particular type of work set forth in the Contract Documents.
2. Occupied Buildings: The temperature requirement for the provision of Temporary Heat in occupied buildings, or portions thereof, shall be the GREATER of the following: 68 degrees Fahrenheit or the temperature requirement for the particular type of work set forth in the Contract Documents.

**D. DURATION:**

1. The Contractor shall be required to provide Temporary Heat until the date on which it completes all required work at the site, including all punch list work, as certified in writing by the Resident Engineer, or earlier if so directed in writing by the Commissioner. The Contractor shall be responsible for the provision of Temporary Heat for the time specified herein, regardless of any delays in completion of the Project, including delays that result in the commencement of the provision of Temporary Heat during a season that is later than that which may have been originally anticipated. The Contractor shall include in its Total Contract Price all expenses in connection with the provision of Temporary Heat in accordance with the requirements specified herein.
2. The total Contract duration is set forth in consecutive calendar days in Schedule A of the Addendum. The Table set forth below indicates the number of full heating seasons that are deemed included in various contract durations, which are specified in consecutive calendar days (ccd)s. At a minimum, a full heating season shall extend from October 15<sup>th</sup> to April 15<sup>th</sup>.

Contract Duration	Full Heating Seasons Required
up to 360 ccds	1 full heating season
360 to 720 ccds	2 full heating seasons
more than 720 ccds	3 full heating seasons

**E. METHOD OF TEMPORARY HEAT:**

1. The method of temporary heat shall be in conformance with the New York City Fire Code and with all applicable laws, rules and regulations. Prior to implementation, such method shall be subject to the written approval of the Commissioner.
2. The method of temporary heat shall:
  - a. Not cause the deposition of dirt or smudges upon any finished work or cause any defacement or discoloration to the finished work.
  - b. Not be injurious or harmful to people or materials.
  - c. Portable fueled heating devices or equipment **SHALL NOT BE ALLOWED** for use as temporary heat other than construction-related curing or drying in conformance with the NYC Fire Code.
3. No open fires will be permitted.

**F. TEMPORARY HEATING SYSTEM:**

1. The temporary system for the provision of Temporary Heat provided by the Contractor following enclosure of the building shall be complete including, subject to provisions of paragraph E above, boilers pumps, radiators, space heaters, water and heating piping, insulation and controls. The temporary system for the provision of Temporary Heat shall be capable of maintaining the minimum temperature requirements set forth in Paragraph C above.



**G. COORDINATION:**

1. The Contractor, in the provision of Temporary Heat, shall coordinate its operations in order to insure sufficient and timely performance of all required work, including work performed by trade subcontractors. The Contractor shall supply and pay for all water required and used in the building for the operation of the heating system(s) for the purpose of Temporary Heat. The Contractor shall include all expenses in connection with the supply of water for Temporary Heat in its Total Contract Price. During the period in which Temporary Heat in an enclosed building is being furnished and maintained, the Contractor shall provide proper ventilating and drying, open and close the windows and other openings when necessary for the proper execution of the work and also when directed by DDC. The Contractor shall maintain all permanent or temporary enclosures at its own expense.

**H. USE OF PERMANENT HEATING SYSTEMS:**

1. Use of Permanent Heating System for Temporary Heat after Building Enclosure
  - a. The Contractor shall provide all labor and materials to promptly furnish and set all required equipment and convectors and/or radiators, piping, valves, fitting, etc., in ample time for their use for the provision of Temporary Heat after enclosure of the building.
  - b. New portions of the permanent heating system that are used for furnishing Temporary Heat shall be left in near perfect condition when delivered to the City for operation. Any repairs required, other than for ordinary wear and tear on the equipment, shall be made by the Contractor at his/her expense. The starting date for the warranty or guarantee period for such equipment shall be the date of Substantial Completion acceptance.
  - c. In the event that the Contractor does not advance the installation of the permanent heating system in sufficient time to permit its use for Temporary Heat as determined by DDC, the Contractor shall furnish and install a separate system for the provision of Temporary Heat as required to maintain the minimum temperature requirements set forth in Paragraph C above.
2. All equipment for the system for the provision of Temporary Heat shall be placed so as to comply with the requirements specified hereinbefore, and shall be connected, disconnected and suitably supported and located so as to permit construction work, including finish work such as wall plastering and painting, to proceed. The installation of the system for the provision of Temporary Heat by the Contractor, including the placing of ancillary system equipment, shall be coordinated with the operations of all trade subcontractors so as to insure sufficient and timely performance of the work. Once the permanent heating system is operating properly, the Contractor shall remove all portions of the system for Temporary Heat not part of the permanent heating system.
3. Temporary Heat Allowance for Special Conditions or and/or Unforeseen Circumstances.
  - a. The City may establish an allowance in the Contract for payment of costs and expenses in connection with the provision of Temporary Heat as set forth herein. If established, the City will include an amount for such allowance on the Bid Form, and the Contractor shall include such allowance amount in its Total Contract Price. The Contractor shall only be entitled to payment from this allowance under the conditions and in accordance with the requirements set forth below. In the event this allowance or any portion thereof remains unexpended at the conclusion of the Contract, such allowance shall remain the sole property of the City. Should the amount of the allowance be insufficient to provide payment for the expenses specified below, the City will increase the amount of the allowance.
  - b. The allowance set forth herein may be utilized only under the conditions set forth below.
    1. In the event the Project does not involve the installation of a new permanent heating system if one did not exist previously, or the replacement, modification and/or shut down of the existing permanent heating system, or any key component thereof, and the Commissioner determines that the provision of Temporary Heat is necessary due to special and/or unforeseen circumstances, the Contractor shall be responsible for the provision of Temporary Heat, as directed by the Commissioner. The City shall pay such Contractor for all costs for labor, material, and equipment necessary and required





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for the same. Payment shall be made in accordance with Article 26 of the Contract, except that the cost of fuel shall be as set forth in Paragraph (c) below.

2. In the event the Commissioner determines that there is a need for maintenance of the permanent heating system by the Contractor after written acceptance by the Commissioner of the work, and that the need for such maintenance is not the fault of the Contractor, the Contractor shall provide the required maintenance of the permanent heating system for the period of time directed by the Commissioner. The City shall pay the Contractor for the cost of direct labor and fuel necessary and required in connection with such maintenance, excluding the cost of any foremen or other supervision. Payment shall be made in accordance with Article 26 of the Contract, except that the cost of fuel shall be as set forth in Paragraph (c) below.
- c. Payment for Fuel Costs - Payment from the allowance set forth herein for the cost of fuel necessary and required to operate the system for the provision of Temporary Heat or to maintain the permanent heating system under the conditions set forth in Paragraph b above shall be limited to the direct cost of such fuel. The Contractor shall not be entitled to any overhead and/or profit for such fuel costs. In order to receive payment for such fuel costs, the Contractor must present original invoices for the same. DDC reserves the right to furnish the required fuel.

**I. RELATED ELECTRICAL WORK:**

1. The Contractor shall be responsible for providing the items set forth below and shall include all expenses in connection with such items in its Total Contract Price. The Contractor shall provide such items promptly when required and shall in all respects coordinate its work with the work performed by trade subcontractors in order to facilitate the provision of Temporary Heat.
  - a. The Contractor shall provide all labor, materials, equipment and power necessary and required to furnish and maintain any temporary or permanent electrical connections to all equipment specified to be connected as part of the work of the Contractor's Contract.
  - b. The Contractor shall supply and pay for all power necessary and required for the operation of the system for the provision of Temporary Heat and/or the permanent heating system used for Temporary Heat. Such power shall be provided by the Contractor for the duration the Contractor is required to provide Temporary Heat, as set forth in Sub-section 3.5 D herein.
2. In providing the items set forth in Paragraph 1 above, the Contractor is advised that labor may be required seven (7) days a week and/or during other than normal working hours for the period of time required by seasonal weather conditions.

**J. RELATED PLUMBING WORK:**

1. The Contractor shall be responsible for providing all labor, materials and equipment necessary and required to furnish and maintain all temporary or permanent connections to all equipment or plumbing outlets specified to be provided as part of the work of this Contract. The Contractor shall include all expenses in connection with such items of work in its Total Contract Price. The Contractor shall provide such items of work promptly when required and shall in all respects coordinate its work with the work performed by trade subcontractors in order to facilitate the provision of Temporary Heat.
2. In the event portions of the permanent plumbing equipment furnished by the Contractor as part of the work of this Contract are used for the provision of Temporary Heat either during construction or prior to acceptance by the City of the complete plumbing system, the Contractor shall be responsible to provide such plumbing equipment to the City in near perfect condition and shall make any repairs required, other than for ordinary wear and tear on the equipment, at Contractor's expense. The starting date for warranty and/or guarantee period for such plumbing equipment shall be the date of Substantial Completion acceptance by the City.
3. For Projects requiring the installation of new and/or modified gas service, as well as associated meter installations, the Contractor shall promptly perform all required filings and coordination with



the Utility Companies in order to expedite the installation, testing, and approval of the gas service and associated meter(s).

**3.6 STORM WATER CONTROL, DEWATERING FACILITIES AND DRAINS:**

**A. PUMPING:**

1. Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rainfall.
2. Contractor shall furnish and install all necessary automatically operated pumps of adequate capacity with all required piping to run-off agencies, so as to maintain the excavation, cellar floor, pits and exterior depressions and excavations free from accumulated water during the entire period of construction and up to the date of final acceptance of work of the Contract.
3. All pumps shall be maintained at all times in proper working order.
4. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
5. Remove snow and ice as required to minimize accumulations.

**3.7 TEMPORARY FIELD OFFICE FOR CONTRACTOR:**

- A. The Contractor shall establish a temporary field office for its own use at the site during the period of construction, at which readily accessible copies of all Contract Documents shall be kept.
- B. The field office shall be located where it will not interfere with the progress of any part of the work or with visibility of traffic control devices.
- C. **CONTRACTOR'S REPRESENTATIVE:** In charge of the office there shall be a responsible and competent representative of the Contractor, duly authorized to receive orders and directions and to put them into effect.
- D. Arrangements shall be made by the Contractor whereby its representative may be readily accessible by telephone.
- E. All temporary structures shall be of substantial construction and neat appearance, and shall be painted a uniform gray unless otherwise directed by the Commissioner.
- F. **CONTRACTOR'S SIGN** - The Contractor shall post and keep posted, on the outside of its field office, office or exterior fence or wall at site of work, a legible sign giving full name of the company, address of the company and telephone number(s) of responsible representative(s) of the firm who can be reached in event of an emergency at any time.
- G. **ADVERTISING PRIVILEGES** - The City reserves the right to all advertising privileges. The Contractor shall not cause any signs of any kind to be displayed at the site unless specifically required herein or authorized by the Commissioner.

**3.8 DDC FIELD OFFICE:**

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.8 A**

**A. OFFICE SPACE IN EXISTING BUILDING:**

1. The Resident Engineer will arrange for office space for sole use in the building where work is in progress. The Contractor shall provide and install a lockset for the door to secure the equipment in the room. The Contractor shall provide two (2) keys to the Resident Engineer. After completion of the project the Contractor shall replace the original lockset on the door and ensure its proper operation.
2. In addition to equipment specified in Sub-Section 3.8 D, the Contractor shall provide, for exclusive use of the DDC Field Office, the following:



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- a. Two (2) single pedestal desks, 42" x 32"; two (2) swivel chairs with arms and three (3) side chairs without arms to match desk. Two metal (2) lockers, single units, 15" x 18" x 78" overall including 6" legs. Lockers to have flat key locks with two (2) keys each, General Steel products or approved equal. Two (2) full ball bearing suspension four (4) drawer vertical legal filing cabinets with locks, approximately 52"H x 28 ½"D x 18"W.
  - b. One (1) 9000 B.T.U air conditioner or as directed by Commissioner. Wiring for the air conditioner shall be minimum No. 12 AWG fed from individual circuits in the fuse box.
  - c. One (1) folding conference table, 96" x 30" and ten (10) folding chairs.
  - d. Two (2) metal wastebaskets.
  - e. One (1) fire extinguisher, one (1) quart vaporizing liquid type, brass, wall mounted by Pyrene No. C21 or approved equal.
  - f. One (1) Crystal Springs water cooler with bottled water, Model No. LP14058 or approved equal to be furnished for the duration of the project as required.
3. The Contractor shall provide one (1) telephone, where directed and shall pay all costs for telephone service for calls within the New York City limits for the duration of the project.
  4. All furniture and equipment, except computer equipment specified in Sub-Section 3.8 D.3, shall remain the property of the Contractor.
  5. Computer Workstation quantities shall be provided as specified in Sub-Section 3.8 B 3-a for DDC Managed Projects, or Sub-Section 3.8 B 3-b for CM Managed Projects.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.8 B**

**B. DDC FIELD OFFICE TRAILER:**

1. **GENERAL:** The Contractor shall, for the time frame specified herein, provide and maintain at its own cost and expense a DDC Construction Field Office and all related items as specified herein [hereinafter collectively referred to as the "DDC Field Office"] for the exclusive use of the Resident Engineer. The DDC Field Office shall be located at the Project site and shall be solely dedicated to the Project. Provision of the DDC Field Office shall commence within THIRTY (30) days from Notice to proceed and shall continue through forty-five (45) days after Substantial Completion of the required construction at the Project site. The Contractor shall remove the DDC Field Office forty-five (45) days after Substantial Completion of the required construction, or as otherwise directed in writing by the Commissioner.
2. **TRAILER:** The Contractor shall provide at its own cost and expense a mobile office trailer for use as the DDC Field Office. The Contractor shall install and connect all utility services to the trailer within thirty (30) days from Notice to Proceed. The trailer shall have equipment in compliance with the minimum requirements hereinafter specified. Any permits and fees required for the installation and use of said trailer shall be borne by the Contractor. The trailer including furniture and equipment therein, except computer equipment specified in Sub-Section 3.8D.3 herein, shall remain the property of the Contractor.
3. Trailer shall be an office type trailer of the size specified herein, with exterior stairs at entrance. Trailer construction shall be minimum 2 x 4 wall construction fully insulated with paneled interior walls, pre-finished gypsum board ceilings and vinyl tile floors.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.8.B.3a or  
SUB-SECTION 3.8.B.3b.**

- a. DDC Managed Project Trailer: DDC Field Office Trailer Size, Layout and Computer Workstation:
  - 1) Overall length: 32 Feet  
Overall width: 10 Feet



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- 2) Interior Layout:  
Provide one (1) general office/conference room area and one (1) private office at one end of the trailer. Provide equipment and amenities as specified in Sub-Section 3.8.B herein.
  - 3) Computer Workstation: Provide one (1) complete computer workstation, as specified in Sub-Section 3.8.D herein, in the private office area as directed by the Resident Engineer.
- b. CM Managed Project Trailer: DDC Field Office Trailer Size, Layout and Computer Workstation:
- 1) Overall length: 50 Feet  
Overall width: 10 Feet
  - 2) Interior Layout:  
Provide one (1) large general office/conference room in the center of the trailer and two (2) private offices, one (1) each at either end of the trailer. Provide equipment and amenities as specified in Sub-Section 3.8.B herein.
  - 3) Computer Workstation:  
Provide three (3) complete computer workstations as specified in Sub-Section 3.8.D herein. Provide one (1) each complete computer workstation in each private office and one (1) complete computer workstation at the secretarial position as directed by the Resident Engineer.
4. The exterior of the trailer shall be lettered with black block lettering of the following heights with white borders:
- |                                       |        |
|---------------------------------------|--------|
| CITY OF NEW YORK                      | 2-1/2" |
| DEPARTMENT OF DESIGN AND CONSTRUCTION | 3-3/4" |
| DIVISION OF PUBLIC BUILDINGS          | 3-1/2" |
| DDC FIELD OFFICE                      | 2-1/2" |
- NOTE: In lieu of painting letters on trailer the Contractor may substitute a sign constructed of a good quality weatherproof material with the same type and size of lettering above.
5. All windows and doors shall have aluminum insect screens. Provide wire mesh protective guards at all windows.
  6. The interior shall be divided by partitions into general and private office areas as specified herein. Provide a washroom located adjacent to the private office and a built-in wardrobe closet opposite the washroom. Provide a built-in desk in the private office(s) with fixed overhead shelf and clearance below for two (2) file cabinets.
  7. Provide a built-in drafting or reference table, located in the general office/conference room, at least 60 inches long by 36 inches wide with cabinet below and wall type plan rack at least 42 inches wide.
  8. The washroom shall be equipped with a flush toilet, wash basin with two (2) faucets, medicine cabinet, complete with supplies and a toilet roll tissue holder. Plumbing and fixtures shall be approved house type, with each appliance trapped and vented and a single discharge connection. Five (5) gallon capacity automatic electric heater for domestic hot water shall be furnished.
  9. HVAC: The trailer shall be equipped with central heating and cooling adequate to maintain a temperature of 72 degrees during the heating season and 75 degrees during the cooling season when the outside temperature is 5 degrees F. winter and 89 degrees F. summer.
  10. Lighting shall be provided via ceiling mounted fluorescent lighting fixtures to a minimum level of 50 foot candles in the open and private office(s) along with sufficient lighting in the washroom. Broken and burned out lamps shall be replaced by the Contractor. A minimum of four (4) duplex convenience outlets shall be provided in the open office and two (2) each in the private office(s). These outlets shall be in addition to special outlet requirements for computer stations, copiers, HVAC unit, etc.



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11. Electrical service switch and panel shall be adequately sized for the entire trailer load. Provide dedicated circuits for HVAC units, hot water heater, copiers and other equipment as required. All wiring and installation shall conform to the New York City Electrical Code.
12. The following movable equipment shall be furnished:
  - a. Two (2) single pedestal desks, 42" x 32"; two (2) swivel chairs with arms and three (3) side chairs without arms to match desk. Two (2) full ball bearing suspension four (4) drawer vertical legal filing cabinets with locks and two (2) full ball bearing two (2) drawer vertical legal filing cabinets in each private office located below built-in desk.
  - b. One (1) folding conference table, 96" x 30" and ten (10) folding chairs.
  - c. Three (3) metal wastebaskets.
  - d. One (1) fire extinguisher one (1) quart vaporizing liquid type, brass, wall mounted by Pyrene No. C21 or approved equal.
  - e. One (1) Crystal Springs water cooler with bottled water, Model No. LP14058 or approved equal to be furnished for the duration of the Contract as required.
13. TRAILER TEMPORARY SERVICE: Plumbing and electrical work required for the trailer will be furnished and maintained as below.
  - a. PLUMBING WORK: The Contractor shall provide temporary water and drainage service connections to the DDC Field Office trailer for a complete installation. Provide all necessary soil, waste, vent and drainage piping.

Contractor to frost-proof all water pipes to prevent freezing.

    - 1) REPAIRS, MAINTENANCE: The Contractor shall provide repairs for the duration of the project until the trailer is removed from the site.
    - 2) DISPOSITION OF PLUMBING WORK: At the expiration of the time limit set forth in Sub-Section 3.8 B 1 herein, the temporary water and drainage connections and piping to the DDC Field Office trailer shall be removed by the Contractor and shall be plugged at the mains. All piping shall become the property of the Contractor for Plumbing Work and shall be removed from the site, all as directed. All repair work due to these removals shall be the responsibility of the Contractor.
  - b. ELECTRICAL WORK:
    - 1) The Contractor shall furnish, install and maintain a temporary electric feeder to the DDC Field Office trailer immediately after it is placed at the job site.
    - 2) The temporary electrical feeder and service switch/fuse shall be adequately sized based on the trailer load and installed per the New York City Electrical Code and complying with utility requirements.
    - 3) Make all arrangements and pay all costs to provide electric service.
    - 4) The Contractor shall pay all costs for current consumed and for maintenance of the system in operating condition, including the furnishing of the necessary bulb replacements lamps, etc., for the duration of the project and for a period of forty-five (45) days after the date of Substantial Completion.
    - 5) Disposition of Electric Work: At the expiration of the time limit set forth, the temporary feeder, safety switch, etc., shall be removed and disposed of as directed.
    - 6) All repair work due to these removals shall be the responsibility of the Contractor.
  - c. MAINTENANCE
    - 1) The Contractor shall provide and pay all costs for regular weekly janitor service and furnish toilet paper, sanitary seat covers, cloth towels and soap and maintain the DDC Field Office in first-class condition, including all repairs, until the trailer is removed from the site.
    - 2) Supplies: The Contractor shall be responsible for providing (a) all office supplies, including without limitation, pens, pencils, stationery, filtered drinking water and sanitary supplies, and (b) all supplies in connection with required computers and printers,



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- including without limitation, an adequate supply of blank CD's/DVD's, storage boxes for blank CDs/DVDs, and paper and toner cartridges for the printer.
- 3) Risk of Loss: The entire risk of loss with respect to the DDC Field Office and equipment shall remain solely and completely with the Contractor. The Contractor shall be responsible for the cost of any insurance coverage determined by the Contractor to be necessary for the Field Office.
  - 4) At forty-five (45) days after the date of Substantial Completion, or sooner as directed by the Commissioner, the Contractors shall have all services disconnected and capped to the satisfaction of the Commissioner. All repair work due to these removals shall be the responsibility of the Contractor.
- d. **TELEPHONE SERVICE**: The Contractor shall provide and pay all costs for the following telephone services for the DDC Field Office trailer:
- 1) Separate telephone lines for one (1) desk phone in each private office.
  - 2) One (1) wall phone (with six (6) foot extension cord) at plan table.
  - 3) Separate telephone lines for the fax machine and internet access in each private office. Telephone service shall include voice mail.
  - 4) A remote bell located on outside of trailer
  - 5) The telephone service shall continue until the trailer is removed from the site.
- e. **PERMITS**: The Contractor shall make the necessary arrangements and obtain all permits and pay all fees required for this work.
- C. **RENTED SPACE**: The Contractor has the option of providing, at its cost and expense, rented office or store space in lieu of trailer. Said space shall be in the immediate area of the Project and have adequate plumbing, heating and electrical facilities. Space chosen by the Contractor for the DDC Field Office must be approved by the Commissioner before the area is rented. All insurance, maintenance and equipment, including computer workstations specified in Sub-Section 3.8 D in quantities required as specified in Sub-Section 3.8 B 3 for the DDC Field Office trailer, shall also apply to rented spaces.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.8 D**

- D. **ADDITIONAL EQUIPMENT FOR THE DDC FIELD OFFICE**:
1. The Contractor shall provide a high volume copy machine (50 copies per minute) for paper sizes 8½ x 11, 8½ x 14 & 11 x 17. Copier shall remain at job site until the DDC Field office trailer is removed from the site.
  2. The Contractor shall furnish a fax machine and a telephone answering machine at commencement of the project for the exclusive use of the DDC Field Office. All materials shall be new, sealed in manufacturer's original packaging and shall have manufacturers' warranties. All items shall remain the property of the City of New York at the completion of the project.
  3. **COMPUTER WORKSTATION**: The Contractor shall provide one complete computer workstation, in quantities specified in Sub-Section 3.8.B.3, as specified herein:
    - a. **Hardware/Software Specification**:
      - 1) Computer Equipment - Computers shall be provided for all contracts that have a Total Consecutive Calendar Days for construction duration as set forth in Schedule "A" of 180 CCD's or greater. Contracts of lesser duration shall not require computers.
      - 2) Computers furnished by the Contractor for use by City Personnel, for the duration of the contract, shall be in accordance with Specific Requirements, contained herein, shall remain the property of the City of New York at the completion of the project and shall meet the following minimum requirements:
      - 3) **Personal Computer(s) – Each Workstation Configuration**.
        - a) **Make and Model**: Dell; HP; Gateway; Acer; or, an approved



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- equivalent. (Note: an approved equivalent requires written approval of the Assistant Commissioner of ITS.)
- b) Processor: i5-2400 (6MB Cache, 3.1GHz) or faster computer - Single Processor.
  - c) System RAM: Minimum of 4GB (Gigabytes) Dual Channel DDR3 SDRAM at 1333MHz – 2 DIMMSs
  - d) Hard Disk Drive(s): 500 GB (Gigabytes) Serial ATA (7200RPM) w/DataBurst Cache, or larger.
  - e) CD-RW: Internal CD-RW, 48x Speed or faster.
  - f) 16xDVD+/-RW DVD Burner (with double layer write capability) 16x Speed or faster
  - g) I/O Ports: Must have at least one (1) Serial Port, one (1) Parallel Port, and three (3) USB Ports.
  - h) Video Display Card: HD Graphics (VGA, HDMI) with a minimum of 64 MB of RAM.
  - i) Monitor: 22" W, 23.0 Inch VIS, Widescreen, VGA/DVI LCD Monitor.
  - j) Available Exp. Slots: System as configured above shall have at least two (2) full size PCI Slots available.
  - k) Network Interface: Integrated 10/100/1000 Ethernet card.
  - l) Other Peripherals: Optical scroll Mouse, 101 Key Keyboard, Mouse Pad and all necessary cables.
  - m) Software Requirement: Microsoft Windows 7 Professional SP1, 32 bit; Microsoft Office Professional 2010 or 2013; Microsoft Project 2010; Adobe Acrobat reader; Anti-Virus software package with 2 year updates subscription; and, either Auto Cad LT or Microsoft Visio Standard Edition, as directed by the Resident Engineer.
- 4) DDC Field Office Specs: DDC Field Offices requiring computers shall be provided with the following:
- a) One (1) broad-band internet service account. Wideband Internet connectivity at a minimum throughput of 15 Mbps download and 5 Mbps upload is required at each field office location with 1-5 staffers. For larger field offices see table below for minimum required upload speeds. Telephone service should be bundled together with Internet connectivity. Because of throughput requirements Verizon FIOS is the preferred connectivity provider where available.

Office Personnel #	Upload Speeds (Minimum)
1 – 5	5 Mbps
6 – 10	10 Mbps
11 – 15	15 Mbps
16 – 20 ...	20 Mbps



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This account will be active for the life of the project. The e-mail name for the account shall be the DDC Field Office/project Id (e.g. FLD K HWK666  
McGuinness@earthlink.com).

- b) One (1) 600 DPI HP Laser Jet Printer (twelve (12) pages per minute or faster) with one (1) Extra Paper (Legal Size)
  - c) All necessary cabling for equipment specified herein.
  - d) Storage Boxes for Blank CD's
  - e) Printer Table
  - f) UPS/Surge Suppressor combo
- 5) All computers required for use in the Engineer's Field Office shall be delivered, installed, and setup in the Field Office by the Contractor.
  - 6) All Computer Hardware shall come with a three (3) year warranty for on-site repair or replacement. Additionally, and notwithstanding any terms of the warranty to the contrary, the Contractor is responsible for rectifying all computer problems or equipment failures within one (1) business day.
  - 7) An adequate supply of blank CDs/DVDs, and paper and toner cartridges for the printer shall be provided by the Contractor and shall be replenished by the Contractor as required by the Resident Engineer.
  - 8) It is the Contractor's responsibility to ensure that electrical service and phone connections are also available at all times; that is, the Field Office Computer(s) is to be powered and turned on twenty-four (24) hours each day.
  - 9) Broadband connectivity is preferred at each field office location. Please take into consideration that an extra phone line dedicated to the modem must be ordered as part of the contract unless Internet broadband connectivity, via Cable or DSL, is available at the planned field office location. Any questions regarding this policy should be directed to the Assistant Commissioner of Information Technology Services at 718-391-1761.
  - 10) Ownership: The equipment specified above shall, unless otherwise directed by the Commissioner, be the sole property of the City of New York upon delivery to the DDC Field Office. The Contractor shall prepare and maintain an accurate inventory of all equipment which it purchases for the DDC Field Office. Such inventory shall be provided to the City of New York. Upon completion of the required services, as directed by the Commissioner, the Contractor shall turn such equipment over to the City of New York.

**E. HEAD PROTECTION (HARD HATS):**

- 1. The Contractor shall provide a minimum of 10 standard protective helmets for the exclusive use of Department of Design and Construction personnel and their visitors. Helmets shall be turned over to the Resident Engineer and kept in the DDC Field Office.
- 2. Upon completion of the project, the helmets shall become the property of the Contractor.

**3.9 MATERIAL SHEDS:**

- A. Material sheds used by the Contractor for the storage of its materials shall be kept at locations which will not interfere at any time with the progress of any part of the work or with visibility of traffic control devices.
- B. Store combustible materials apart from the facility.





### **3.10 TEMPORARY ENCLOSURES:**

- A. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weather tight enclosure for building exterior.
- B. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

### **3.11 TEMPORARY PARTITIONS:**

- A. Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate occupied tenant areas from fumes and noise.
  - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
  - 2. Construct dustproof partitions with 2 layers of 3-mil (0.07-mm) polyethylene sheet on each side. Cover floor with 2 layers of 3-mil (0.07-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
    - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
  - 3. Insulate partitions to provide noise protection to occupied areas.
  - 4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
  - 5. Protect air-handling equipment.
  - 6. Weather strip openings.
  - 7. Provide walk-off mats at each entrance through temporary partition.

### **3.12 TEMPORARY FIRE PROTECTION:**

- A. Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
- B. Prohibit smoking in all areas.
- C. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
- D. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
- E. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

<b>REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.13</b>
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### **3.13 WORK FENCE ENCLOSURE:**

- A. The Contractor shall furnish, erect and maintain a wood construction or chain-link fence to the extent shown on the drawings or required by the work enclosing the entire project on all sides. All materials used shall be new. Any permit required for the installation and use of said fence and costs shall be borne by the Contractor.
- B. WOOD FENCE shall be 7'-0" high with framing construction of yellow pine, using 4" x 4" approved preservative-treated posts on not more than 6'-0" centers, with three (3) rails of at least 2" x 4" size to which shall be secured minimum 1/2 inch thick exterior grade plywood. Posts shall be firmly fixed in the



ground at least 30" and thoroughly braced. Top edge of fence shall be trimmed with a rabbeted edge mould. Provide on the street traffic sides of fence, observation openings as directed.

1. **GATES** - Provide an adequate number of double gates, complete with hardware, located as approved by the Resident Engineer. Double gates shall have a total clear opening of 14'-0" with two (2) 7'-0" hinged swinging sections. Hanging posts shall be 6" x 6" and shall extend high enough to receive and be provided with tension or sag rods for the swinging sections.
  2. **PAINTING** - The fence and gates shall be entirely painted on the street and public sides with one (1) coat of exterior primer and one (1) top coat of exterior grade acrylic-latex emulsion paint. Black stenciled signs reading "POST NO BILLS" shall be painted on fence with three (3) inch high letters on 25 foot spacing for the entire length of fence on street traffic sides. Signs shall be stenciled five (5) feet above the sidewalk.
- C. **CHAIN-LINK FENCING** shall be minimum 2-inch thick, galvanized steel, chain-link fabric fencing; 8 feet high with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Fence shall be accurately aligned and plumb, adequately braced and complete with gates, locks and hardware as required. Under no condition shall fencing be attached or anchored to existing construction or trees.
- D. **ADDITIONAL REQUIREMENTS:**
1. It shall be the obligation of the Contractor to remove all posters, advertising signs, and markings, etc., immediately.
  2. Should the fencing be required to be relocated during the course of the Contract, it shall be done by the Contractor at no additional cost to the City.
  3. Where sidewalks are used for "drive over" purposes for Contractor vehicles, a suitable wood mat or pad shall be provided for protection of sidewalks and curbs.
  4. Where required, make provision for fire hydrants, lampposts, etc.
  5. **REMOVAL** - When directed by the Resident Engineer, the fence shall be removed.

### **3.14 RODENT AND INSECT CONTROL:**

- A. **DESCRIPTION:** The Contractor shall provide all labor, materials, plant and equipment, and incidentals required to survey and monitor rodent activity and to control any infestation or outbreak of rodents, rats, mice, water beetles, roaches and fleas within the project area. Special attention should be paid to the following conditions or areas:
- 1 Wet areas within the project area, including all temporary structures.
  - 2 All exterior and interior temporary toilet structures within the project area.
  - 3 All Field Offices and shanties within the project area of all subcontractors and DDC.
  - 4 Wherever there is evidence of food waste and/or discarded food or drink containers, in quantity, that would cause breeding of rodents or the insects herein specified.
  - 5 Any other portion of the premises requiring such special attention.
- B. **MATERIALS:**
- 1 All materials shall be approved by the New York State Department of Environmental Conservation and comply with the New York City Health Code, OSHA and the laws, ordinances and regulations of State and Federal agencies pertaining to such chemical and/or materials.
- C. **PERSONNEL:**
- 1 All pest control personnel must be supervised by an exterminator licensed in categories 7A and 8.
- D. **METHODS:**
1. Application and dosage of all materials shall be done in strict compliance with the manufacturer's recommendations.



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2. Any unsanitary conditions, such as uncollected garbage or debris, resulting from all Contractor's activities, which will provide food and shelter to the resident rodent population shall be corrected by the Contractor immediately after notification of such condition by the Resident Engineer.

**E. RODENT CONTROL WORK:**

- 1 In wetlands, woodlands and areas adjacent to a stream, special precautions must be taken to protect water quality and to ensure the safety of other wildlife. To prevent poisoned bait from entering streams, no poisoned bait shall be used in areas within seventy-five (75) feet of all stream banks. Live traps must be used in these seventy-five (75) foot buffer zone areas and within wetland and woodland areas.
- 2 In areas outside the seventy-five (75) foot zone of protection adjacent to streams, and in areas outside wetlands and woodlands, tamper proof bait stations with poisoned bait shall be placed during the period of construction and any consumed or decomposed bait shall be replenished as directed.
- 3 At least one month prior to initiation of the construction work, and periodically thereafter, live traps and/or rodenticide bait in tamper proof bait stations, as directed above, shall be placed at locations that are inaccessible to pets, human beings, children and other non-target species, particularly wildlife (for example-birds) in the project area.
- 4 The Contractor shall be responsible for collecting and disposing of all trapped and poisoned rodents found in live traps and tamper proof bait stations. The Contractor shall also be responsible for posting and maintaining signs announcing the baiting of each particular location. The Contractor shall be responsible for the immediate collection and disposal of any visible rodent remains found on streets or sidewalks within the project area.
- 5 It is anticipated that public complaints will be addressed to the Commissioner. The Contractor, where directed by the Commissioner, shall take appropriate actions, like baiting, trapping, proofing, etc., to remedy the source of complaint within the next six (6) hours of normal working time which is defined herein for the purposes of this section as 7 A.M. to 6 P.M. on Mondays through Saturdays.
- 6 Emergency service during the regular workday hours (Monday through Friday) shall be rendered within 24 hours, if requested by the Commissioner, at no additional cost to the City.

**F. EDUCATION & NOTICES:**

- 1 The Contractor shall post notices on all Construction Bulletin Boards advising workers, employees, and residents to call the Engineer's Field Office to report any infestation or outbreak of rodents, rats, mice, water beetles, roaches and fleas within the project area. The Contractor shall provide and distribute literature pertaining to IPM techniques of rodent control to affected businesses and superintendents of nearby residential buildings to ensure their participation in maintaining their establishments free of unsanitary conditions, harborage removal and rodent proofing.
- 2 Prior to application of any chemicals, the Contractor shall furnish to the Commissioner copies or sample labels for each pesticide, antidote information, and Material Data Safety Sheets (MSDS) for each chemical used.

**G. RECORDS**

1. The Contractor shall keep a record of all rodent and waterbug infestation surveys conducted by him/her and make available, upon request, to the Commissioner. The findings of each survey shall include, but not be limited to, recommended Integrated Pest Management (IPM) techniques, like baiting, trapping, proofing, etc., proposed for rodent and waterbug pest control.
2. The Contractor shall maintain records of all locations baited along with the type and quantity of rodenticide and insecticide bait used.



**3.15 PLANT PEST CONTROL REQUIREMENTS and TREE PROTECTION REQUIREMENTS:**

- A. Plant Pest Control Requirements: The Contractor and its subcontractors, including the Certified Arborist described below, shall comply with all Federal and New York State laws and regulations concerning Asian Longhorned Beetle (ALB) management, including protocols for ALB eradication and containment promulgated by the New York State Department of Agriculture and Markets (NYSDAM). The Contractor is referred to: (1) Part 139 of Title 1 NYCRR, Agriculture and Markets Law, Sections 18, 164 and 167, as amended, and (2) State Administrative Procedure Act, Section 202, as amended.
1. All tree work performed within the quarantine areas must be performed by New York State Department of Agriculture and Markets (NYSDAM) certified entities. Transportation of all host material, living, dead, cut or fallen, inclusive of nursery stock, logs, green lumber, stumps, roots, branches and debris of a half inch or more in diameter from the quarantine areas is prohibited unless the Contractor or its sub-contractor performing tree work has entered into a compliance agreement with NYSDAM. The terms of said compliance agreement shall be strictly complied with. Any host material so removed shall be delivered to a facility approved by NYSDAM. For the purpose of this contract host material shall be ALL species of trees.
  2. Any host material that is infested with the Asian Longhorned Beetle must be immediately reported to NYSDAM for inspection and subsequent removal by either State or City contracts, at no cost to the Contractor.
  3. Prior to commencement of tree work, the Contractor shall submit to the Commissioner a copy of a valid Asian Longhorned Beetle compliance agreement entered into with NYSDAM and the Contractor or its sub-contractor performing tree work. If any host material is transported from the quarantine area the Contractor shall immediately provide the Commissioner with a copy of the New York State 'Statement of Origin and Disposition' and a copy of the receipt issued by the NYSDAM approved facility to which the host materials are transported.
  4. Quarantine areas, for the purpose of this contract shall be defined as all five boroughs of the City of New York. In addition, prior to the start of any tree work, the Contractor shall contact the NYC Department of Parks & Recreation's Director of Landscape Management at (718) 699-6724, to determine the limits of any additional quarantine areas that may be in effect at the time when tree work is to be performed. The quarantine area may be expanded by Federal and State authorities at any time and the Contractor is required to abide by any revisions to the quarantine legislation while working on this contract. For further information please contact: NYSDAM (631) 288-1751.
- B. Tree Protection Requirements: The Contractor shall retain a Certified Arborist, as defined by New York City Department of Parks and Recreation (NYCDPR) regulations, to provide the services described below.
1. Surveys and Reports: The Certified Arborist shall, at the times indicated below, conduct a survey and prepare a plant material assessment report which includes: (1) identification, by species and pertinent measurements, of all plant material located on the project site, or in proximity to the project site, as described below, including all trees, significant shrubs and/or planting masses; (2) identification and plan for the containment of plant pests and pathogens, including the ALB, as described in paragraph A above; (3) evaluation of the general health and condition of any infected plant material.
  2. Frequency of Reports: The Certified Arborist shall conduct a survey and provide a plant material assessment report at two (2) points in time: (1) prior to the commencement of construction work; and (2) at the time of substantial completion. In addition, for projects exceeding 24 months in duration, the Certified Arborist shall conduct a survey and prepare a report at the midpoint of



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construction. Copies of each plant material assessment report shall be submitted to the Resident Engineer within two (2) weeks of the survey.

3. Proximity to Project Site: Off-site trees, significant shrubs and/or planting masses shall be considered to be located in proximity to the project site under the circumstances described below.
    - a. The tree trunk, significant shrub, or primary cluster of stems in a planting mass is within 50 (fifty) feet of the project's Contract Limit Lines (CLLs) or Property Lines (PLs).
    - b. Any part of the tree or shrub stands within 50 (fifty) feet of: (a) a path for site access for vehicles and/or construction equipment; or (b) scaffolding to be erected for construction activity, including façade remediation projects.
    - c. The Certified Arborist determines that the critical root zone (CRZ) of an off-site tree, significant shrub, or primary cluster of stems in a planting mass extends into the project site, whether or not that plant material is located within the 50-foot inclusionary perimeter as outlined above.
  4. Tree Protection Plan: The Certified Arborist shall prepare, and the Contractor shall implement, a Tree Protection Plan, for all trees that may be affected by any construction work, excavation or demolition activities, including without limitation, (1) on-site trees, (2) street trees, as defined below, (3) trees under NYCDPR jurisdiction as determined by the Department of Transportation, and (4) all trees that are located in proximity to the project site, as defined above. The Tree Protection Plan shall comply with the NYC DPR rules, regulations and specifications. The Contractor is referred to Chapter 5 of Title 56 of the Official Compilation of the Rules of the City of New York. Copies of the Tree Protection Plan shall be submitted to the Resident Engineer prior to the commencement of construction. Implementation of the Tree Protection Plan for street trees and trees under NYCDPR jurisdiction shall be in addition to any tree protection requirements specified or required for the project site. For the purpose of this article, a "street tree" means the following: (1) a tree that stands in a sidewalk, whether paved or unpaved, between the curb lines or lateral lines of a roadway and the adjacent property lines of the project site, or (2) a tree that stands in a sidewalk and is located within 50 feet of the intersection of the project's site's property line with the street frontage property line.
- C. No Separate Payment. No separate payment shall be made for compliance with Plant Pest Control Requirements or Tree Protection Requirements. The cost of compliance with Plant Pest Control Requirements and Tree Protection Requirements shall be deemed included in the Contractor's bid for the Project.

**3.16 PROJECT IDENTIFICATION SIGNAGE:**

- A. The Contractor shall provide, install and maintain Project identification and other signs where indicated to inform public and individuals seeking entrance to the Project.
- B. In order to properly convey notice to persons entering upon a City construction site, the Contractor shall furnish and install a sign at the entrance (gates) as follows:

---

**NO TRESPASSING**

**AUTHORIZED PERSONNEL ONLY**

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- C. If no construction fence exists at the site, this notice shall be conveyed by incorporating the above language into safety materials (barriers, tape, and signs).
- D. Provide temporary, directional signs for construction personnel and visitors.
- E. Maintain and touch up signs so that they are legible at all times.

### **3.17 PROJECT CONSTRUCTION SIGN AND RENDERING:**

#### **A. PROJECT SIGN:**

- 1 Responsibility: The Contractor shall produce and install one (1) project sign which shall be posted and maintained upon the site of the project at a place and in a position directed by the Commissioner. The Contractor shall protect the sign from damage during the continuance of work under the Contract and shall do all patching of lettering, painting and bracing thereof necessary to maintain the sign in first class condition and in proper position. Prior to fabrication, the Contractor shall submit an 8-1/2" x 11" color match print proof from the sign manufacturer of the completed sign for approval by the Commissioner.
- 2 Sign Quality: The Contractor shall provide all materials required for the production of the sign as specified herein. Workmanship shall be of the best quality, free from defects and shall be produced in a timely manner.
- 3 Schedule: Upon project mobilization, the Contractor shall commence production and installation of the sign.
- 4 Removal: At the completion of all work under the Contract, the Contractor shall remove and dispose of the project sign away from the site.
- 5 Sign construction:
  - a. Frame: The frame shall be from quality dressed 2"x2" pine, fire retardant, pressure treated lumber, that surrounds the inside back edge of the sign. The sign shall have one (1) intermediate vertical and two (2) diagonal supports, glued and screwed for rigidity. Frame shall be painted white with two (2) coats of exterior enamel paint, prior to mounting of sign panel.
  - b. Edging: U-shaped, 22 gauge aluminum edging, with a white enameled finish to match sign background, shall run around entire edging of sign panel and frame. Corners shall be mitered for a tight fit. Channel dimensions shall be 1" inch (overlap to sign panel face) x 1 3/4" (or as required across frame depth) x 1" (back overlap).
  - c. Sign Panel: 4' x 8' panel shall be constructed in one (1) piece of 14 gauge (.0785") 6061-T6 aluminum. This panel shall be pre-finished both sides with a glossy white baked-on enamel finish and be flush with edge of 2" x 2" wood frame. Samples must be submitted for approval.
  - d. Fastening: Fasten sign panel to wood frame using cadmium plated no. 8 sheet metal screws at 1/2" below edge of panel and 8" on center. The U-shaped aluminum channel shall be applied over the wood frame edge and fastened with cadmium plated no. 8 sheet metal screws at 12" on center around the entire perimeter.
- 6 Sign Graphics:
  - a. A digital file of the project sign will be provided to the Contractor by the Commissioner's representative for printing. The Commissioner's representative shall insert the project name and names and titles of personnel (3 or more) and any other required information associated with the project. All signs may include a second panel for a project rendering as described in Sub-Section 3.17.B herein.
  - b. The digital file shall be reproduced at the Sign Panel size of 4' x 8' on 3M High Performance Vinyl or approved equal. The 3M High Performance Vinyl or equivalent shall be guaranteed for nine (9) years. Guarantee must cover fading, peeling, chipping or cracking. The sign manufacturer is required to maintain all specified Pantone Matching System (PMS) type and other composition elements represented in the digital file of the project sign.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.17 B**

**B. PROJECT RENDERING:**

1. Responsibility: In addition to the Project Sign, the Contractor shall furnish and install one (1) sign showing a rendering of the project. A digital file of the project rendering will be provided to the Contractor by the Commissioner's representative. From an approved image file provided by DDC, the Project Rendering is to be sized, printed, and mounted in an identical manner as described in Sub-Section 3.17.A above for the Project Sign. A color match print proof from the sign manufacturer of the Rendering Sign printed from the supplied file is to be submitted to DDC for approval before fabrication. The Rendering Sign is to be posted at the same height as the Project Sign. Where possible, the Rendering Sign shall be mounted with a perfect match of the short sides of the rectangle so that the Rendering Sign and the Project Sign together will create one long rectangle.
2. Removal: At the completion of all work under the Contract, the Contractor shall remove and dispose of the project rendering away from the site.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.18**

**3.18 SECURITY GUARDS/FIRE GUARDS ON SITE:**

**A. SECURITY GUARDS (WATCHMEN):**

1. The Contractor shall provide competent Security Guard Service on the site, beginning on the date on which the Contractor commences actual construction work, or on such earlier date on which there is activity at the site related to the work, including without limitation, delivery of materials or construction set-up. The Contractor shall continue to provide such Security Guard Service until the date on which it completes all required work at the site, including all punch list work, as certified in writing by the Resident Engineer, or earlier if so directed in writing by the Commissioner. Throughout the specified time period, there shall be no less than one (1) Security Guard on duty every day, including Saturdays, Sunday and Holidays, 24 hours a day, except between the hours of 8:00 A.M. and 4:00 P.M. on any day which is a regular working day for a majority of the trade subcontractors. This exception during the working day shall not apply after the finishing painting of the plaster work is commenced; thereafter, not less than one (1) Security Guard shall be on duty continuously, 24 hours a day.
2. Every Security Guard shall be required to hold a "Certificate of Fitness" issued by the Fire Department. Every Security Guard shall, during his/her tour of duty, perform the duties of Fire Guard in addition to his/her security obligations.
3. Should the Commissioner find that any Security Guard is unsatisfactory; such guard shall be replaced by the Contractor upon the written demand of the Commissioner.
4. Each Security Guard furnished by the Contractor shall be instructed by the Contractor to include in his/her duties the entire construction site including the Field Office, temporary structures, and equipment, materials, etc.
5. Should the Contractor or any other subcontractor consider the security requirements outlined above inadequate, the Contractor shall provide such additional security as it thinks necessary, after obtaining the written consent of the Commissioner. The additional cost of such approved increased protection will be paid by the Contractor.
6. Nothing contained in this Sub-Section shall diminish in any way the responsibility of the Contractor and each subcontractor for its own work, materials, tools, equipment, nor for any of the other risks and obligations outlined hereinbefore in this Article.

- B. COSTS** - The Contractor shall employ Security Guards/Fire Guards throughout the specified time period, except as otherwise modified by the detailed Specifications and as approved by the Commissioner, for the purpose of safeguarding and protecting the site. All costs for Security Guards/Fire Guards shall be



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- borne by the Contractor.
- C. **RESPONSIBILITY** - The Contractor and its subcontractors will be responsible for safeguarding and protecting their own work, materials, tools and equipment.

**3.19 SAFETY:**

- A. The Contractor, in compliance with requirements of Section 01 35 26, **SAFETY REQUIREMENTS PROCEDURES**, shall provide and maintain all necessary temporary closures, guard rails, and barricades to adequately protect all workers and the public from possible injury. Any removal of these items, during the progress of the work, shall be replaced by the Contractor at no additional cost to the City.

**END OF SECTION 01 50 00**





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**SECTION 01 54 11  
TEMPORARY ELEVATORS AND HOISTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This section includes the following:
1. Temporary Use, Operation and Maintenance of Elevators during Construction
    - a. For New buildings up to 15 Stories
    - b. For New buildings over 15 Stories
    - c. For Existing Buildings
  2. Temporary Construction Hoists and Hoist ways (For Material and Personnel)

**1.3 RELATED SECTIONS:** include without limitation the following:

- A. Section 01 10 00 SUMMARY  
B. Section 01 42 00 REFERENCES  
C. Section 01 50 00 TEMPORARY FACILITIES AND CONTROLS  
D. Section 01 54 23 TEMPORARY SCAFFOLDS AND SWING STAGING  
E. Section 01 77 00 CLOSE OUT PROCEDURES

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION**

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.1**

**3.1 TEMPORARY USE, OPERATION AND MAINTENANCE OF ELEVATORS DURING CONSTRUCTION FOR NEW BUILDINGS UP TO AND INCLUDING 15 STORIES:**

- A. **INSTALLATION:** The Contractor shall install, complete, operate, and maintain in good working order, as indicated herein, one (1) selected main elevator for the transport of employees of the Contractor and/or its subcontractors, and representatives of the DDC and other Governmental Agencies having jurisdiction of work at the project. The Contractor shall furnish, install, and maintain such elevator in good working order, including all necessary hoisting ropes, governor cables, traveling conductor cables, operating devices, temporary hand reset target annunciators, temporary signal devices, and all other permanent or temporary parts. The installation, operation and maintenance of the temporary elevator and all equipment and/or parts utilized in connection therewith shall be in accordance with the rules and regulations of all agencies and/or entities having jurisdiction over elevators in temporary use.



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- B. **RESPONSIBILITY:** The Contractor shall be responsible for any injury to persons or damage to property arising out of the temporary elevator and all equipment and/or parts utilized in connection therewith.
- C. **COSTS:** The Contractor shall be responsible for all costs in connection with the temporary elevator, including without limitation: (1) installing and operating the temporary elevator, (2) maintaining the temporary elevator in clean, proper operating condition, including the cost of lubricants and/or parts for such maintenance, (3) performing all work in pits, shaft ways and machine rooms necessary for the operation of the temporary elevator, (4) replacing the temporary elevator or any equipment or parts utilized in connection therewith, if required, due to damage, destruction or excessive wear or corrosion, except for the replacement of hoisting ropes as set forth below, (5) performing all required electrical work in connection with the temporary elevator, (6) providing all electric power required to operate the temporary elevator, (7) providing all necessary conduit and wiring connections for the proper operation and signaling of the temporary elevator, and (8) providing all labor for the operation and maintenance of the temporary elevator, including on an overtime basis if necessary. The total Contract Price shall include all costs in connection with the temporary elevator, including without limitation, the costs specified herein.
- D. **COMMENCEMENT OF SERVICE:** The Contractor shall begin to provide temporary elevator service using the selected main passenger elevator no later than eight (8) weeks (40 working days) after the machine room roof slab, or that portion of it surrounding the elevator shaft, has been placed. No later than three (3) weeks (15 working days) after the machine room roof slab, or that portion of it surrounding the elevator shaft, has been placed the following work shall have been completed:
1. The shaft shall have been completely enclosed by either the permanent or a temporary enclosure meeting the requirements of the law.
  2. The machine room shall have been made completely watertight either by permanent or temporary construction. Beams or other devices, either permanent or temporary shall be provided which will enable the safe and practicable hoisting of the elevator machinery for installation.
  3. There shall have been installed on all floors at the shaft way entrances to the elevator, solid substantial frames and either sliding or swing doors with substantial hardware and door locks and any necessary approved wire mesh barricades for adjacent shaft ways.
  4. There shall have been furnished and installed solid substantial enclosures at front, back, sides and top of car platform enclosure, with emergency exit at top of car, excepting that the portion of the front at the elevator entrance shall have been provided with a substantial temporary door or gate.
- E. **ELECTRICAL INSTALLATION:** The Contractor, not later than 20 calendar days after the machine room roof slab or that portion of its surrounding the elevator has been placed, shall have furnished and installed temporary or permanent power and light feeders as required for the elevator used for temporary service and shall have connected such feeders to the terminals on the starter panels or controllers in the machine room to the low voltage transformers and car light outlets in the center of shaft way and for the car control and signal traveling cables. The Contractor shall make all these required connections as soon as the equipment is declared ready for such connections by the Resident Engineer.
- F. **REMOVAL:** When elevators for permanent use have been installed and are in condition for service, and when directed by the Commissioner, the Contractor shall remove the temporary enclosures and all temporary elevator equipment and promptly proceed with the installation of the permanent equipment as required under the Contract.
- G. **INSPECTION:** Before temporary elevator equipment is removed, a joint inspection of the equipment shall be made by the Contractor and the Commissioner to determine the condition of this equipment upon the discontinuation of its temporary use. If this inspection deems it necessary, the Contractor shall furnish and install new governor and compensating ropes, new traveling cables and new controller parts, etc. The car and counterweight safeties shall be thoroughly cleaned of all dirt and all foreign matter, then properly lubricated and placed in good operating condition to the satisfaction of the Commissioner. If it is



determined and ordered by the Commissioner that new hoist ropes are required, such ropes shall be installed and payment therefore will be made in accordance with Article 26 of the Contract.

- H. **REPLACEMENT:** The Contractor shall furnish and install new equipment or parts for any equipment or parts of the temporary elevator installation that have been damaged, destroyed, or that indicate excessive wear or corrosion, excepting the replacement of hoisting ropes. All shaft ways, pits, motor rooms and sheave spaces used for temporary operation of elevators shall be thoroughly cleaned. Where lubricated rails are used they shall be washed down. If roller guides are used, all rust, dirt, etc., must be moved from the rails. The full cost of parts replacement, cleaning, etc., shall be borne by the Contractor except for the replacement of hoisting ropes.
- I. **LIMITATIONS ON USE:** The temporary elevator shall not be used during its operation for the hoisting of materials or the removal of rubbish, but shall be limited only to the transportation of employees of the Contractor and/or its subcontractors, and representatives of DDC and other Governmental Agencies having jurisdiction of work at the project. However, the Resident Engineer may grant special permission at specified times to the Contractor and/or its subcontractors to hoist materials, which in the Resident Engineer's opinion will not overload or damage the elevator installation, but only after such times as all plastering has been completed from the second floor up. In the event of any damage to the temporary elevator, the Contractor shall notify the Resident Engineer within 24 hours after such damage has occurred. As indicated above, the Contractor shall be responsible for the replacement of any equipment or parts of the temporary elevator that have been damaged.
- J. **LIQUIDATED DAMAGES:** The Contractor will be charged at the rate of \$100 per day for each day it fails to provide the temporary elevator service described in this section beginning with the 41<sup>st</sup> working day after the machine room roof slab, or that portion of it surrounding the elevator shaft, has been placed and stripped. This charge will be deducted from any amount due and owing to the Contractor.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.2**

**3.2 TEMPORARY USE, OPERATION AND MAINTENANCE OF ELEVATORS DURING CONSTRUCTION FOR NEW BUILDING OVER 15 STORIES:**

- A. **INSTALLATION:** The Contractor shall install, complete, operate, and maintain in good working order, as indicated herein, two (2) selected main elevators for the transport of employees of the Contractor and/or its subcontractors, and representatives of the DDC and other Governmental Agencies having jurisdiction of work at the project. The Contractor shall furnish, install, and maintain such elevators in good working order, including all necessary hoisting ropes, governor cables, traveling conductor cables, operating devices, temporary hand reset target annunciators, temporary signal devices, and all other permanent or temporary parts. The installation, operation and maintenance of the temporary elevators and all equipment and/or parts utilized in connection therewith shall be in accordance with the rules and regulations of all agencies and/or entities having jurisdiction over elevators in temporary use. The two (2) elevators shall not be operated simultaneously.
- B. **RESPONSIBILITY:** The Contractor shall be responsible for any injury to persons or damage to property arising out of the temporary elevators and all equipment and/or parts utilized in connection therewith.
- C. **COSTS:** The Contractor shall be responsible for all costs in connection with the temporary elevators, including without limitation: (1) installing and operating the temporary elevators, (2) maintaining the temporary elevators in clean, proper operating condition, including the cost of lubricants and/or parts for such maintenance, (3) performing all work in pits, shaft ways and machine rooms necessary for the operation of the temporary elevators, (4) replacing the temporary elevators or any equipment or parts utilized in connection therewith, if required due to damage, destruction or excessive wear or corrosion, except for the replacement of hoisting ropes as set forth below, (5) performing all required electrical work in connection with the temporary elevators, (6) providing all electric power required to operate the temporary elevators, (7) providing all necessary conduit and wiring connections for the proper operation



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and signaling of the temporary elevators, and (8) providing all labor for the operation and maintenance of the temporary elevators, including on an overtime basis if necessary. The total Contract Price shall include all costs in connection with the temporary elevators, including without limitation, the costs specified herein.

- D. **LOW RISE ELEVATOR:** The Contractor shall begin to provide temporary elevator service using one (1) selected main passenger elevator no later than six (6) weeks (30 working days) after the 12th Floor slab, or that portion of it surrounding the elevator shaft, has been placed and stripped. No later than one (1) week, five (5) working days, after the 12th Floor slab, or that portion of it surrounding the elevator shaft, has been placed and stripped the following work shall have been completed:
1. The shaft shall have been completely enclosed up to the 12th Floor by either the permanent or a temporary enclosure meeting the requirements of the law.
  2. A temporary machine room enclosure shall have been provided at the 11th Floor and shall have been made completely watertight either by permanent or temporary construction. Beams or other devices, either permanent or temporary, shall be provided which will enable the safe and practicable hoisting of the elevator machinery for installation.
  3. There shall have been installed on all floors up to and including the 9th Floor at the shaft entrances to the elevator, solid substantial wood frames and either sliding or swing doors with substantial hardware and door locks, also any necessary approved wire mesh barricades for adjacent shaft ways.
  4. There shall have been furnished and installed solid substantial enclosures at front, back, sides and top of car platform enclosure, with an emergency exit at top of car, excepting that the portion of the front at the elevator entrance shall have been provided with a substantial temporary door or gate.
- E. **ELECTRICAL INSTALLATION:** The Contractor not later than 10 calendar days after the 12th Floor slab or that portion of it surrounding the elevator, has been poured and stripped, shall have furnished and installed temporary or permanent power and light feeders as required for the elevator used for temporary service and shall have connected such feeders to the terminals on the starter panels or controllers in the temporary machine room, to the low voltage transformers and car light outlets in the center of the shaftway and for the car control and signal traveling cables. The Contractor shall make all these required connections as soon as the Equipment is declared ready for such connections by the Resident Engineer.
- F. **HIGH RISE ELEVATOR:** The Contractor shall begin to provide temporary elevator service to all floors, using a selected main passenger elevator, no later than eight (8) weeks (40 working days) after the machine room roof slab, or that portion of it surrounding the elevator shaft, has been placed. No later than three (3) weeks (15 working days) after the machine room roof slab, or that portion of it surrounding the elevator shaft, has been placed, the following work shall have been completed:
1. The shaft shall have been completely enclosed by either the permanent or temporary enclosure, meeting the requirements of the law.
  2. The machine room shall have been made completely watertight either by permanent or temporary construction. Beams or other devices, either permanent or temporary shall be provided which will enable the safe and practicable hoisting of the elevator machinery for installation.
  3. There shall have been installed on all floors at the shaft way entrances to the elevator, solid substantial frames and either sliding or swing doors with substantial hardware and door locks, also any necessary approved wire mesh barricades for adjacent shaft ways.
  4. There shall have been furnished and installed, solid substantial enclosures at front, back, sides and top of car platform enclosure, with an emergency exit at top of car, excepting that the portion of the front at the elevator entrance shall have been provided with a substantial temporary door or gate.



- G. **ELECTRICAL INSTALLATION:** The Contractor, not later than 20 calendar days after the machine room slab or that portion of it surrounding the elevator shaft has been placed, shall have furnished and installed temporary or permanent power and light feeders as required for the high rise elevator to be used for temporary service and shall have connected such feeders to the terminals on the motor-generator starter panels or controllers in the machine room, to the signal circuits low voltage transformers for the annunciators and car light outlets in the center of shaft way. The Contractor shall make all these required connections as soon as the equipment is declared ready for such connections by the Resident Engineer.
- H. When the high rise elevator is completed and ready for temporary operation, the low rise temporary elevator shall be shut down.
- I. **REMOVAL:** When one (1) or more elevators for permanent use have been installed and are in condition for service, and when directed by the Commissioner, the Contractor shall remove the temporary enclosures and all temporary elevator equipment, and promptly proceed with the installation of the permanent equipment as required under the Contract.
- J. **INSPECTION:** Before temporary elevator equipment is removed, a joint inspection of the equipment shall be made by the Contractor and the Commissioner to determine the condition of this equipment upon the discontinuation of its temporary use. If this inspection determines it necessary, the Contractor shall furnish and install new governor and compensating ropes, new traveling cables, new controller parts, etc. The car and counterweight safeties shall be thoroughly cleaned of all dirt and all foreign matter, then properly lubricated and placed in good operating condition to the satisfaction of the Commissioner. If it is determined and ordered by the Commissioner that new hoist ropes are required, such ropes shall be installed and payment therefore will be made in accordance with Article 26 of the Contract.
- K. **REPLACEMENT:** The Contractor shall furnish and install new equipment or parts for any equipment or parts of the temporary elevator installations that have been damaged, destroyed, or that indicate excessive wear or corrosion, excepting the replacement of hoisting ropes. All shaft ways, pits, motor rooms and sheaves spaces used for temporary operation of elevators shall be thoroughly cleaned down. Where lubricated rails are used they shall be washed down, if roller guides are used, all rust, dirt, etc., must be removed from the rails. The full cost of parts replacement cleaning, etc., shall be borne by the Contractor except for the replacement of hoisting ropes.
- L. **LIMITATIONS ON USE:** The temporary elevators shall not be used during their operation for the hoisting of materials or the removal of rubbish, but shall be limited only to the transportation of employees of the Contractor and/or its subcontractors, and representatives of DDC and other Governmental Agencies having jurisdiction of work at the project. However, the Resident Engineer may grant special permission at specified times to the Contractor and/or its subcontractors to hoist materials, which in the Resident Engineer's opinion will not overload or damage the elevator installation, but only after such times as all plastering has been completed from the second floor up. In the event of any damage to the temporary elevator, the Contractor shall notify the Resident Engineer within 24 hours after such damage has occurred. As indicated above, the Contractor shall be responsible for the replacement of any equipment or parts of the temporary elevator that have been damaged.
- M. **LIQUIDATED DAMAGES:** The Contractor will be charged at the rate of \$100 per day for each day it fails to provide the temporary elevator service described in this Section beginning with the 31st working day after the 12th Floor slab, or that portion of the 12th Floor slab surrounding the elevator shaft, has been placed and stripped. This charge will be deducted from any amount due and owing to the Contractor.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.3**

**3.3 TEMPORARY USE, OPERATION AND MAINTENANCE OF ELEVATORS DURING CONSTRUCTION FOR EXISTING BUILDINGS:**

- A. The Contractor may use, at the Commissioner's discretion, one (1) selected elevator in the building for temporary operation by the Contractor for the transportation of employees of the Contractor and/or its subcontractors, and representatives of DDC and other Governmental Agencies having jurisdiction over



the work at the Project. The operation of the temporary elevator and all equipment and/or parts utilized in connection therewith shall be in accordance with the rules and regulations of all agencies and/or entities having jurisdiction over elevators in temporary use.

- B. **RESPONSIBILITY:** The Contractor shall be responsible for any injury to persons or damage to property arising out of the temporary elevator and all equipment and/or parts utilized in connection therewith.
- C. **REPLACEMENT:** The Contractor shall furnish and install new equipment or parts for any equipment or parts of the elevator for temporary operation that have been damaged, destroyed, or that indicate excessive wear or corrosion, excepting the replacement of hoisting ropes. All shaft ways, pits, motor rooms and sheave spaces used for temporary operation of elevators shall be thoroughly cleaned down. Where lubricated rails are used they shall be washed down, if roller guides are used, all rust, dirt, etc., must be moved from the rails. The full cost of parts replacement, cleaning, etc., shall be borne by the Contractor except for the replacement of hoisting ropes. If it is determined and ordered by the Commissioner that new hoist ropes are required, such ropes shall be installed and payment therefore will be made in accordance with Article 26 of the Contract.
- D. **LIMITATIONS ON USE:** The temporary elevator shall not be used during its operation for the hoisting of materials or the removal of rubbish, but shall be limited only to the transportation of employees of the Contractor and/or its subcontractors, and representatives of DDC and other Governmental Agencies having jurisdiction of work at the project. However, the Resident Engineer may grant special permission at specified times to the Contractor and/or its subcontractors to hoist materials, which in the Resident Engineer's opinion will not overload or damage the elevator installation. In the event of any damage to the temporary elevator, the Contractor shall notify the Resident Engineer within 24 hours after such damage has occurred. As indicated above, the Contractor shall be responsible for the replacement of any equipment or parts of the temporary elevator that have been damaged.
- E. **LIQUIDATED DAMAGES:** The Contractor will be charged at the rate of \$100 per day for each day it fails to provide elevator services described in this section beginning with 15 consecutive calendar days from Notice to Proceed. This charge will be deducted from any amount due and owing to the Contractor.

### **3.4 TEMPORARY HOISTS AND HOISTWAYS (FOR MATERIAL AND PERSONNEL):**

- A. **RESPONSIBILITY:** The Contractor shall provide adequate numbers of material hoists for the most expeditious performance of all parts of the work including the work of all its subcontractors.
- B. **LOCATIONS:** No hoists shall be constructed at such locations as will interfere with, or affect the construction of, floor arches, or the work of subcontractors. The hoists may be located at the exterior sides of the structure or in the courtyard and extend upward adjacent to the line of window openings. The hoists shall be located a sufficient distance from the exterior walls and be so protected as to prevent any of the permanent work from being damaged, stained or marred.
- C. **ELEVATOR SHAFT:** Wherever possible, one or more of the permanent elevator shafts may be used as temporary hoist ways, providing such use complies with the requirements of the Building Code of the City of New York and has been approved by the Commissioner, and providing further it entails no interference with the progress of the work.
- D. **PROTECTION FOR INTERIOR HOISTS:** All interior material hoist ways shall be enclosed on each floor and shall be adequately protected with appropriate safety guards. In no event shall the protection be less than that required by law.

**END OF SECTION 01 54 11**



**SECTION 01 54 23  
TEMPORARY SCAFFOLDING AND PLATFORMS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 01 35 26: Safety Requirements Procedures.
- C. The Contractor shall comply with the requirements of "*The City of New York Department of Design and Construction Safety Requirements*". This document is included in the Information for Bidders.

**1.2 SUMMARY:**

- A. This Section includes administrative and general procedural requirements for Temporary Scaffolding and Platforms, including:
  - 1. Conformance
  - 2. Responsibility
  - 3. Jobsite Documentation and Submittals
  - 4. Inspections
- B. This Section governs ALL scaffold used on DDC project sites including, but not limited to, Suspended Scaffold, Supported Scaffold and Sidewalk Sheds.

**1.3 CONFORMANCE:**

- A. Unless otherwise indicated, the Contractor is responsible for providing, erecting, installing and maintaining all temporary scaffolding and platforms which shall comply with requirements of Chapter 33 (Safeguards During Construction or Demolition) of the NYC Building Code, NYC Local Law 52 of 2005, OSHA Construction Standard 1926 Subpart L, and furnishing the items and personnel set forth in this section.

**1.4 RESPONSIBILITY:**

- A. Jobsite Safety Coordinator: The Contractor shall designate and employ a Jobsite Safety Coordinator, who shall be a competent person, who shall have a daily presence on the project site during scaffold use. This designee must possess and maintain a valid New York City Department of Buildings supported scaffold certificate of completion. An alternate shall also be designated, in the event that the Jobsite Safety Coordinator is absent. The Jobsite Safety Coordinator shall:
  - 1. Verify completeness of documentation and submittals (as described below).
  - 2. Verify that inspections are performed, including pull tests (see below), reports are filed and reported deficiencies are corrected.
  - 3. Monitor trades using scaffold.
  - 4. Limit access to scaffold areas that are tagged for non-use.
  - 5. Inform trades of scaffold load limitations.
  - 6. Monitor loading of decks.
  - 7. Verify that any ties that are temporarily removed are properly restored in the same shift.
  - 8. Verify that outriggers and planks that are moved are properly set up and secured.
  - 9. Verify that all scaffold decks in use have proper access/egress.





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10. Verify that all open sides of decks in excess of 14 inches have proper guardrails and toe-boards.
  11. Notify appropriate parties, including but not limited to the Resident Engineer, site safety coordinator / monitor, site safety consultant, scaffold users, contractor and the scaffold engineer, of misuses, non-conformances, hazards and accidents.
  12. Keep a log of significant actions and events connected with the scaffolding.
- B. The Contractor shall be responsible for erecting, maintaining and dismantling the scaffolding and/or sidewalk shed in conformance with requirements of the New York City Building Code, OSHA and the Contract documents, including the specifications. The Contractor shall also be guided by generally accepted standards of scaffold industry practice as promulgated by the Scaffold Industry Association.
- C. The Contractor shall require the subcontractor responsible for erecting the scaffolding to engage a Scaffold Engineer, licensed as a professional engineer by the State of New York. The Scaffold Engineer shall be responsible to ensure the following: (1) that the installation design is in compliance with requirements of the New York City Building Code and OSHA, (2) that the design comports with the capabilities of the components and the characteristics of the site, (3) that scaffold loads on the host building, including netting, have been properly considered, and (4) that the design documents provide accurate information for erectors and users.
- D. Scaffold users are trade contractors assigned to work on the scaffold. Training certificates from a New York City Department of Buildings approved training provider are mandatory. These users have the duty to become familiar with the New York City Building Code and OSHA requirements germane to users, to obey the instructions of the Jobsite Safety Coordinator and to inform the Jobsite Safety Coordinator of known hazards, non-conformances or violations.

### 1.5 JOBSITE DOCUMENTATION AND SUBMITTALS:

The Contractor shall prepare, obtain and submit the following to the Resident Engineer:

- A. NYC Department of Buildings permit(s) for scaffold and sidewalk sheds (as applicable) including filing applications signed and sealed by a Professional Engineer licensed in the State of New York;
- B. Site logistics plan / site safety plan;
- C. Installation drawing(s), design and product data to be provided for all scaffold(s) and shed(s) must include, at a minimum:
  1. Plan(s);
  2. Elevation(s);
  3. Duty load designation; "standard" (150 psf live load) or "heavy duty" (300 psf live load).
  4. Details including base support, anchors and ties;
  5. Notes and specifications including load limits, number of planked levels, tie spacing, netting, and sequence of installation and removal.
  6. Anchorage into sound material.
  7. Load limits based on pull tests;
  8. Specifications for pull test(s), method, proof load and the number of trials;
  9. Elevations, levels or heights, where anchorage is made into masonry;
  10. Specifications for frames, planks, screw jacks, anchors, and any other ancillary hardware;
  11. Samples for anchors, ties and netting;
  12. Sequence of operations for erection and demolition;
  13. Location plan, heights, widths, "jumps" over doorways and driveways;
  14. Specify size, maximum span and maximum spacing of headers and stringers;
  15. Specify legs, girts, braces, nailing and connections;
  16. All sidewalk sheds shall be designed, engineered, signed and sealed by a Professional Engineer licensed in the State of New York;



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- a. Generic (not job specific) engineering drawings are satisfactory for standard sheds and arrangements.
- b. Special engineering is required for custom sheds, site-specific problems or non-standard arrangements.

**1.6 INSPECTIONS:**

- A. Signed inspection reports shall be issued for each inspection and pull-test below, and shall be logged and maintained on site by the Jobsite Safety Coordinator for the duration of the project.
- B. Pull testing shall be required during design, and during or post erection, where anchorage is made into masonry. The Scaffold Engineer shall specify the test method, proof load and the number of trials.
- C. Sidewalk sheds shall be inspected after initial installation, major modification, or damage and thence every three months. Inspections shall be by a Scaffold Engineer for custom sheds and by a Competent Person employed by the Contractor for standard sheds.
- D. Scaffolds shall be inspected by the Scaffold Engineer during erection, post-erection and prior to use and thence every three months. The Scaffold Engineer shall repeat inspections after major alteration/modification, damage.
- E. A Qualified Person assigned by the Contractor shall inspect the progress of erection and dismantling, and the condition and integrity of the sidewalk sheds after high winds, major storms and at least once per month during usage.
- F. A Qualified Person assigned by the Contractor shall inspect the progress of erection and dismantling at least weekly, and the condition and integrity of the scaffold after high winds, major storms and at least once per month during usage.
- G. Scaffolds and Sidewalk Sheds shall be inspected daily by the Jobsite Safety Coordinator or alternate prior to use by scaffold users. The inspection results must be recorded in the maintenance log, and be available on-site at all times.
- H. At the completion of the project, submit all inspection documents as Miscellaneous Record Documents in accordance with Section 01 78 39, CONTRACT RECORD DOCUMENTS.

**1.7 LADDERS AND STAIRS:**

- A. The Contractor shall provide and maintain ladders or temporary stairs extending from the street to the first story, and to and from every floor and roof level of the project.

**1.8 ACCESS AND EXITS:**

- A. The ladders or temporary stairs shall be of acceptable size, number and location, so that proper and convenient access may be had by those required to proceed to and from all parts of the project.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 54 23**



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**SECTION 01 73 00  
EXECUTION**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes general procedural requirements governing execution of the Work including without limitation the following:
1. Delivery of Materials
  2. Contractor's Superintendent
  3. Surveys
  4. Borings
  5. Examination
  6. Environmental Assessment
  7. Preparation
  8. Deferred Construction
  9. Installation
  10. Permits
  11. Transportation
  12. Sleeves and Hangers
  13. Sleeve and Hanger Drawings
  14. Cutting and Patching
  15. Location of Partitions
  16. Furniture and Equipment
  17. Removal of Rubbish and Surplus Material
  18. Cleaning
  19. Security and Protection of Work Site
  20. Maintenance of Site and Adjoining Property
  21. Maintenance of Project Site
  22. Safety Precautions for Control Circuits
  23. Obstructions in Drainage Lines

**1.3 RELATED SECTIONS:** Include without limitation the following:

- |    |                  |  |
|----|------------------|--|
| A. | Section 01 10 00 | SUMMARY                                  |
| B. | Section 01 31 00 | PROJECT MANAGEMENT AND COORDINATION      |
| C. | Section 01 33 00 | SUBMITTAL PROCEDURES                     |
| D. | Section 01 74 19 | CONSTRUCTION WASTE MANAGEMENT & DISPOSAL |
| E. | Section 01 77 00 | CLOSEOUT PROCEDURES                      |
| F. | Section 01 78 39 | CONTRACT RECORD DOCUMENTS                |



#### **1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

#### **1.5 QUALITY ASSURANCE:**

- A. Land Surveyor Qualifications: A professional land surveyor who is licensed in the State of New York and who is experienced in providing land-surveying services of the kind indicated.

#### **PART 2 - PRODUCTS (Not Used)**

#### **PART 3 - EXECUTION**

##### **3.1 DELIVERY OF MATERIALS:**

- A. Material Orders: The Contractor shall furnish to the Commissioner a copy of each material order, indicating date of order and quantity of material, and shall also notify the Commissioner when materials have been delivered to the site and in what quantities.
- B. Ample Quantities: The Contractor shall deliver materials in ample quantities to insure the most prompt and uninterrupted progress of the work so as to complete the work within the Contract time.
- C. Containers: The manufacturer's containers shall be delivered with unbroken seals and shall bear proper labels.
- D. Deliveries: The Contractor shall coordinate deliveries in order to avoid delaying or impeding the progress of the work.
- E. Handling: The Contractor shall provide equipment and personnel to handle products by methods to prevent soiling or damage.
  - 1. Promptly inspect shipments to assure products comply with requirements, quantities are correct, and products are undamaged.
  - 2. Promptly return damaged shipments or incorrect orders to manufacturer.
  - 3. For materials or equipment to be reused or salvaged, use special care in removal, storage and reinstallation to insure proper function in completed work.
- F. Storage: Store products in accordance with provisions of Article 3.1, and periodically inspect to assure that stored products are undamaged and are maintained under required conditions.
- G. Stacking: All materials shall be properly stacked in convenient places adjacent to the site, or where directed, and protected in a satisfactory manner. Stacked materials shall be so arranged as to not interfere with visibility of traffic control devices.
- H. Overloading: If authority is given to store materials in any part of the project area, they shall be so stored as to cause no overloading.



- I. No Interference: If it becomes necessary to remove and restack materials to avoid impeding the progress of any part of the work or interfering with the work to be done by any trade subcontractor, the Contractor shall remove and restack such materials at no additional cost to the City.

### **3.2 CONTRACTOR'S CONSTRUCTION SUPERINTENDENT:**

- A. Contractor's Construction Superintendent: The Contractor shall devote its time and personal attention to the work and shall employ and retain at the project site, from the commencement until the entire completion of the work, a Contractor's Construction Superintendent. The Contractor's Construction Superintendent shall be registered with the New York City Department of Buildings in compliance with the Construction Superintendent Rule of the City of New York and shall be competent and capable of maintaining proper supervision and care of the work and shall be acceptable to the Commissioner. The Construction Superintendent shall, in the absence of the Contractor, and irrespective of any superintendent or foreman employed by any subcontractor, shall see that the instructions of the Commissioner are carried out.
- B. Replacement: The Contractor's Construction Superintendent on the job shall not be changed or removed without the consent of the Commissioner.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.3**

### **3.3 SURVEYS:**

- A. Line and Grade: The City will establish a baseline and bench mark near the site of the work for use of the Contractor in connection with the performance of the work.
- B. Responsibility: The Contractor shall establish all other lines and elevations required for its work and shall be solely responsible for the accuracy thereof.
- C. Safeguard All Points: The Contractor shall safeguard all points, stakes, grade marks and bench marks made or established by the Contractor on the work, shall re-establish same if disturbed and bear the entire expense of rectifying the work improperly installed due to not maintaining, not protecting or removing without authorization such established points, stakes, or marks.
- D. City Monuments and Markers: No work shall be performed near City monuments or marks so as to disturb them until the said monuments or marks have been referenced or reset or otherwise disposed of by the relevant Agency or party who installed them.
- E. Foundations: The Contractor shall furnish certification from a licensed Surveyor that all portions of the foundation work are located in accordance with the Contract Drawings and at the elevations required thereby. This certification shall show the actual locations and the actual elevations of all the work in relation to the locations and elevations shown on the Contract Drawings, including but not restricted to the following:
1. The locations and elevations of all piles, if any.
  2. Elevations of tops of all spread footings, tops of pile caps, and tops of all foundation walls, elevator pit walls and ramp walls.
  3. Location of all footing centers and pier centers including those for exterior wall columns.
  4. Location of all foundation walls including wall columns, elevator pit walls and ramp walls.
- F. Wall Lines: After the first courses of masonry or stone have been laid, the Contractor shall establish the permanent lines of exterior walls. The Contractor shall furnish promptly, certification from a licensed Surveyor, in the form of signed original drawings showing the exact location of such wall lines, of all portions of all structures. Except at its own risk, the Contractor shall not proceed further with the erection of walls until the Surveyor's certification has been submitted and verified for correct location of wall lines.



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- G. Surveyor: The Surveyor selected for any of the purposes mentioned in Paragraph E and Paragraph F above, and Paragraph I below, shall be a land Surveyor licensed in the State of New York and shall be subject to the approval of the Commissioner. The Surveyor shall not be a regular employee of the Contractor, nor shall the Surveyor have any interest in the Contract. The Surveyor shall not be employed by the Contractor in laying out any work, it being intended that the Surveyor's certification shall represent an independent and disinterested verification of such layout. The Surveyor shall report to the Department of Design and Construction's Resident Engineer each time upon arrival to and departure from the site and review with the Resident Engineer the data required for the project.
- H. Final Certification: Final certification shall be submitted upon completion of the work or upon completion of any subdivision of the work as directed by the Commissioner. Any exceptions or deviations from the drawings shall be noted on the final certificate and there shall be included any maps, plates, notes, pertinent documents and data necessary, in the opinion of the Commissioner, to constitute a full and complete report.
- I. Final Survey: The Contractor shall submit to DDC for submission to the Department of Buildings a final Survey by the licensed Surveyor showing the location of the new Structure, before completion of the Structure. This Survey shall show the location of the first tier of beams or of the first floor; the finish grades of the open spaces on the plot; the established curb level and the location of all other Structures on the plan, together with the location and boundaries of the lot or plot upon which the Structure is constructed, curb cuts, all yard dimensions, etc.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.4**

**3.4 BORINGS:**

- A. The work of this article shall be the responsibility of the Contractor unless otherwise indicated.
- B. Reference Drawings: The Boring Drawings as listed on the title sheet are for information to the bidder and are to be used under the conditions as follows:
  - 1. Boring Logs: shown on the Boring Drawings, record information obtained under engineering supervision in the course of exploration carried out by or under the direction of forces of the Department of Design and Construction at the site.
  - 2. Soils and Rock Samples: All inferences are drawn from the indications observed as made by engineering and scientific personnel. All such inferences and all records of the work including soil samples and rock cores, if any, are available to bidders for inspection.
  - 3. Certification of Samples: The City certifies that the work was carried out as stated, and that the soil samples and rock cores, if any were referred to, were actually taken from the site at the times, places and in the manner indicated. The samples are available for inspection in the Department of Design and Construction Subsurface Exploration Section.
  - 4. Bidder's Responsibility: The bidder, however, is responsible for any conclusions to be drawn from the work. If the bidder accepts those of the City, it must do so at its own risk. If the bidder prefers not to assume such risk, the bidder is under the obligation of employing its own experts to analyze the available information, and must be responsible for any consequences of acting on their conclusions.
  - 5. Continuity Not Guarantee: The City does not guarantee continuity of conditions shown at actual boring locations over the entire site. Where possible, borings are located to avoid all obstructions and previous construction which can be found by inspection of the surface and the bidder is required to estimate the influence of such features from its own inspection of the site.



### **3.5 EXAMINATION:**

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
  - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground utilities and other construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with the subcontractor responsible for installation or application present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### **3.6 ENVIRONMENTAL ASSESSMENTS:**

- A. City Responsibilities: An Environmental Assessment and survey is performed by the NYC DDC and its findings are included in the Contract Documents. In accordance with the NYC Administrative Code Title 15 Chapter 1 an asbestos survey is required to be performed by an Asbestos Investigator certified by the NYC Department of Environmental Protection (DEP) to identify the presence of asbestos containing material (ACM) prior to any alteration, renovation or demolition activity. The findings of such survey are required for the submission of approvals and permits issued by the NYC Department of Buildings (DOB). When the findings indicate that asbestos containing material is present and will be disturbed during the alteration, renovation or demolition activity then abatement design specifications will be incorporated into the contract documents. The Contractor shall comply with all federal, state and local asbestos regulations affecting the work for this Contract.
- B. Contractor Responsibility: The Contractor shall comply with all federal, state and local environmental regulations, including without limitation USEPA and OSHA regulations which require the Contractor to assess if lead based paint will be disturbed during the work in order to protect his/her workers and the building occupants from migration of lead dust into the air. The Contractor shall comply with all federal, state and local environmental waste disposal regulation which may be required during the work. The Contractor is required to hire licensed abatement and disposal companies for the requisite work.

### **3.7 PREPARATION:**

- A. Field Measurements: The Contractor shall verify all dimensions and conditions on the job so that all work will properly join the existing work.
- B. The Contractor, before commencing work, shall examine all adjoining work on which its work is in any way dependent on good workmanship in accordance to the intent of the Specifications and the Contract





Drawings. The Contractor shall report to the Commissioner any condition that will prevent it from performing work that conforms to the required standard.

- C. Existing Utility Information: Furnish information to the Commissioner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

### **3.8 DEFERRED CONSTRUCTION:**

- A. Where necessity for deferred construction is certified by the Commissioner, in order to permit the installation of any item or items of equipment required to be furnished and installed concurrent with the time allowed for doing and completing the work of the Contract, the Contractor shall defer construction work limited to adequate areas as approved by the Commissioner.
- B. The Contractor shall confer with the affected trade subcontractors and ascertain arrangements, time and facilities necessary to be made by the Contractor in order to execute the provisions specified herein.

### **3.9 INSTALLATION:**

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work and work of trade subcontractors to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by the Design Consultant.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.



- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### **3.10 PERMITS:**

- A. The Contractor shall comply with all local, state and federal laws, rules and regulations affecting the Work of this Project, including, without limitation, (1) obtaining all necessary permits for the performance of the Work prior to commencement thereof, and (2) complying with all requirements for the disposal of demolition and/or construction debris, waste, etc., including disposal in City landfills. The Contractor shall be responsible for all costs in connection with such regulatory compliance, unless otherwise specified in the Contract.

### **3.11 TRANSPORTATION:**

- A. Availability: It shall be the duty of the Contractor to determine the availability of transportation facilities and dockage for the use of its employees, equipment and material and the conditions under which such use will be permitted.
- B. Costs: If transportation facilities and dockage are available and are permitted to be used by the governmental agency having jurisdiction, the Contractor shall pay all necessary costs and expenses, and abide by all rules and regulations promulgated in connection therewith.
- C. Vehicles: With respect to the use of vehicles on highways and bridges, the Contractor's attention is directed to the limitations set forth in the Rules of the City of New York, Title 34, Chapter 4, Section 4-15.
- D. Continued Use: It is understood that the Commissioner makes no warranty as to the continued use by the Contractor of such facilities.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.12**

### **3.12 SLEEVES AND HANGERS:**

- A. Coordinate with Progress Schedule: The Contractor shall promptly furnish and install conduits, outlets, piping sleeves, boxes, inserts and all other materials and equipment that is to be built into the work in conformity with the requirements of the project.
- B. Cooperation of Subcontractors: All subcontractors shall fully cooperate with each other in connection with the performance of the above work as "cutting in" new work is neither contemplated nor will it be tolerated.
- C. Timeliness: In the event that timely delivery of sleeves and other materials cannot be made, and to avoid delay, the Contractor may arrange to have boxes or other forms set at the locations where the piping or other material is to pass through or into the slabs, walls or other work. Upon the subsequent installation of the sleeves or other material, the Contractor shall fill around them with materials as required by the Contract. The necessary expenditures incurred for the boxing out and filling in shall be borne by the Contractor.
- D. Inserts: The Contractor is to install strip inserts four (4) foot on center and perpendicular to beams in ceiling slabs of boiler, machine and mechanical equipment rooms. Inserts are to be installed for strippable concrete slabs only.



**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.13**

**3.13 SLEEVE AND PENETRATION DRAWINGS:**

- A. As soon as practicable after the commencement of work and when the order in which concrete for the first slabs, walls, etc. to be poured is determined, the Contractor shall submit to the DDC a sketch indicating the location and size of all penetrations for sleeves, ducts, etc. which will be required to accommodate the mechanical trades, in order to determine if such penetrations will materially weaken the project's structure. The sketch shall be stamped and returned if approved and/or comments will be transmitted. The Contractor shall continue to submit sketches as the pouring schedule and the concrete work progresses and, until approvals for the penetration sketches have been given. The Contractor shall not predicate its layout work on unapproved sketches.

**3.14 CUTTING AND PATCHING:**

- A. Responsibility: The Contractor shall do all cutting, patching and restoration required by its work, unless otherwise particularly specified in the Specifications.
- B. Restore Work: The Contractor shall restore any work damaged during the performance of the work.
- C. Competent Workers: All restoration work shall be done to the satisfaction of the Commissioner by competent workers skilled in the trade required by such restoration. If, in the judgment of the Commissioner, workers engaged in restoration work are incompetent, they shall be replaced immediately by competent workers.
- D. Structural Elements: Do not cut and patch structural elements without the prior approval, in writing, of the Resident Engineer.
- E. Operational Elements: Do not cut and patch operating elements and related components.
- F. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Commissioner's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- G. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
- H. Removals: The Contractor must remove from the premises all demolished materials of every nature or description resulting from cutting, patching and restoration work, in accordance with the requirements hereinafter stipulated under Sub-Section 3.17 herein and as further required in Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

**REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 3.15**

**3.15 LOCATION OF PARTITIONS:**

- A. Within three (3) weeks after the concrete slabs have been poured on each floor level, the Contractor shall immediately locate accurately all of the partitions, including the door openings, on the floor slabs in a manner approved by the Resident Engineer.



**3.16 FURNITURE AND EQUIPMENT:**

- A. Responsibility: The Contractor is responsible for moving all loose furniture and/or equipment in all areas where the location of such furniture and/or equipment interferes with the proper performance of its work.
- B. Protection: All such furniture and/or equipment must be adequately protected with dust cloths and returned to their original locations when directed to do so by the Resident Engineer.

**3.17 REMOVAL OF RUBBISH AND SURPLUS MATERIALS:**

- A. Of the waste that is generated during demolition, as many of the waste materials as economically feasible, and as stated here, shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized. Comply with requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.
- B. Rubbish: Rubbish shall not be thrown from the windows or other parts of the project. Mason's rubbish, dirt and other dust-producing material shall be wetted down periodically.
- C. Location: The Contractor shall clean Project site and work area daily and sweep up and deposit, at a location designated on each floor, all of its rubbish, debris and waste materials, as it accumulates and when directed by the Resident Engineer. Wood crating shall be broken up, neatly bundled, tied and stacked ready for removal and be deposited at a location designated on each floor.
  - 1. Comply with requirements in NYC Fire Department for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees F (27 degrees C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- D. Laborers: The Contractor shall be responsible for the removal of all rubbish, etc., from the site. The Contractor shall remove from the designated locations all piles of rubbish, debris, waste material and wood crating as they accumulate and when directed by the Resident Engineer, and shall remove them from the site. The Contractor shall employ and keep engaged for this purpose an adequate number of laborers.
- E. Surplus Materials: The Contractor shall remove from the site all surplus materials when there is no further use for same.
- F. Tools And Materials: At the conclusion of the work, all erection plant, tools, temporary structures and materials belonging to the Contractor shall be promptly removed.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

**3.18 CLEANING:**

- A. The Contractor shall thoroughly clean all equipment and materials furnished and installed and shall deliver such materials and equipment undamaged in a clean and new appearing condition up to date of Final Acceptance.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- D. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.



- E. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration up to date of Final Acceptance.
- F. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration up to date of Final Acceptance.

**3.19 SECURITY AND PROTECTION OF WORK SITE:**

- A. Provide protection of installed work, including appropriate protective coverings and maintain conditions that ensure installed Work is without damage or deterioration up to date of Final Acceptance.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.
- C. Secure and protect work and work site against damage, loss, injury, theft and/or vandalism.
- D. Maintain daily sign-in sheets of workers and visitors and make the sheets available to the Commissioner

**3.20 MAINTENANCE OF SITE AND ADJOINING PROPERTY:**

- A. The Contractor shall take over and maintain the Project site, after order to start work.
- B. The Contractor shall be responsible for the safety of the adjoining property, including sidewalks, paving, fences, sewers, water, gas, electric and other mains, pipes and conduits etc. until the date of Final Acceptance. The Contractor shall, at its own expense, except as otherwise specified, protect same and maintain them in at least as good a condition as that in which the Contractor finds them.
- C. All pavements, sidewalks, roads and approaches to fire hydrants shall be kept clear at all times, maintained and repaired to serviceable condition with materials to match existing.
- D. Provide and keep in good repair all bridging and decking necessary to maintain vehicular and pedestrian traffic.
- E. The Contractor shall also remove all snow and ice as it accumulates on the sidewalks within the Contract Limits Lines.

**3.21 MAINTENANCE OF PROJECT SITE:**

- A. The Contractor shall take over and maintain all project areas, after order to start work.
- B. Until the date of Final Acceptance, the Contractor shall be responsible for the safety of all project areas, including water, gas, electric and other mains and pipes and conduits and shall at the Contractor's own expense, except as otherwise specified, protect same and maintain them in at least as good condition as that in which the Contractor finds them.
- C. All pavements, sidewalks, roads and approaches to fire hydrants shall be kept clear at all times, maintained, and if damaged, repaired to serviceable conditions with materials to match existing.
- D. The Contractor shall keep the space for the Resident Engineer in a clean condition.

**3.22 SAFETY PRECAUTIONS FOR CONTROL CIRCUITS:**

- A. Control circuits, the failure of which will cause a hazard to life and property, shall comply with the New York City Dept. of Buildings, Bureau of Electrical Control requirements.

**3.23 OBSTRUCTIONS IN DRAINAGE LINES:**

- A. The Contractor shall be responsible for all obstructions occurring in all drainage lines, fittings and fixtures after the installations and cleaning of these drainage lines, fittings and fixtures as certified by the Resident Engineer. Roof drains shall be kept clear of any and all debris. Any stoppage shall be repaired immediately at the expense of the Contractor.

**END OF SECTION 01 73 00**



**SECTION 01 74 19**

**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This section includes administrative and procedural requirements for the management and disposal of construction waste and includes the following requirements:
1. Waste Management Goals
  2. Waste Management Plan
  3. Progress Reports
  4. Progress Meetings
  5. Management Plan Implementation
- B. This Section includes:
1. Definitions
  2. Waste Management Performance Requirements
  3. Reference Resources
  4. Submittals
  5. Quality Assurance
  6. Waste Plan Implementation
  7. Additional Demolition and Salvage Requirements
  8. Disposal

**1.3 RELATED SECTIONS:** Include without limitation the following:

- A. Section 01 10 00 SUMMARY
- B. Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION
- C. Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION
- D. Section 01 73 00 EXECUTION
- E. Section 01 77 00 CLOSEOUT PROCEDURES
- F. Section 01 78 39 CONSTRUCTION RECORD DOCUMENTS
- G. Refer to the Addendum to identify whether this project is designed to comply with a Certification Level according to the U.S. Green Building Council's LEED Rating System, as specified in Section 01 81 13.03 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS" or Section 01 81 13.04 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS".

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Alternative Daily Cover (ADC): Material other than earthen material placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter and scavenging.



- C. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- D. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk or the like.
- E. Construction and Demolition Waste: Solid wastes typically including building materials, trash debris and rubble resulting from remodeling, repair and demolition operations. Hazardous materials and land clearing waste are not included.
- F. Diversion from Landfill: To remove, or have removed, from the site for recycling, reuse or salvage, material that might otherwise be sent to a landfill.
- G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product.
- H. Recycle (recycling): To sort, separate, process, treat or reconstitute solid waste and other discarded materials for the purpose of redirecting such materials into the manufacture of useful products. Recycling does not include burning, incinerating or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors.
- J. Reuse: To reuse excess or discarded construction material in some manner on the Project site.
- K. Salvage: To remove a waste material from the Project site for resale or reuse.
- L. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable and reusable material.
- M. Waste Management Plan: A Project-related plan for the collection, transportation and disposal of waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material becoming landfill.
- N. Waste-to-Energy: The conversion of non-recyclable waste materials into usable heat, electricity or fuel through a variety of processes, including combustion, gasification, pyrolyzation, anaerobic digestion and landfill gas recovery.

#### **1.5 WASTE MANAGEMENT PERFORMANCE REQUIREMENTS:**

- A. The City of New York has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, inaccurate planning, breakage, mishandling, contamination, or other factors shall be employed.
- B. Of the waste that is generated during demolition, as many of the waste materials as economically feasible, and as stated here, shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized.

<b>REFER TO THE ADDENDUM FOR THE APPLICABILITY OF SUB-SECTION 1.5 C</b>
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- C. LEED CERTIFICATION: The City of New York will seek LEED (Leadership in Energy and Environmental Design) certification for this Project as indicated in the Addendum to the General Conditions from the U.S. Green Building Council. The documentation required here will be used for this purpose. LEED awards points for a variety of sustainable design measures on a project, one of which is the reuse and recycling of project waste.



- D. **DIVERSION REQUIREMENTS.** With the exception of LEED v4 projects with demolition ADC waste, a minimum of 75% of total Project demolition and construction waste (by weight) shall be diverted from landfill. LEED v4 projects with demolition ADC waste shall divert a minimum of 50% of total Project demolition and construction waste (by weight) from landfill. The following waste categories are likely candidates to be included in the diversion plan as applicable for this Project:
1. Concrete
  2. Bricks
  3. Concrete masonry units (CMU)
  4. Asphalt
  5. Metals (e.g. banding, stud trim, ceiling grid, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, brass, bronze)
  6. Clean dimensional wood
  7. Carpet and pad
  8. Drywall
  9. Ceiling tiles
  10. Cardboard, paper and packaging
  11. Reuse items indicated on the Drawings and/or elsewhere in the Specification
- E. All fluorescent lamps, HID lamps and mercury-containing thermostats removed from the site shall be recycled. Do not use bulb crusher on site.
- F. Recycling on the job, subject to the Commissioner's approval, is encouraged on the site itself, such as the crushing and reuse of removed sound concrete and stone. Include these categories in the Waste Management Plan.
- G. Land-clearing debris is not considered construction, demolition or renovation waste and is not to be included as contribution to waste diversion.
- H. A minimum of five material types, both structural and nonstructural, are to be identified in the Construction Waste Management Plan for diversion.
- I. For LEED v4 projects, material to be used as ADC does not qualify as material diverted from disposal.

#### **1.6 REFERENCES, RESOURCES:**

- A. DDC encourages its contractors to seek information from websites and experts in salvage or recycling in order to minimize disposal costs. There are numerous opportunities to sell, salvage, or to donate materials and accrue tax benefits (which would accrue to the contractor); there are also outlets that will pick up, and in some cases, buy recyclable materials. Examples of information resources are as follows:
1. DDC's Sustainable Design web site: <https://www1.nyc.gov/site/ddc/about/sustainable-design.page>. A standard Construction and Demolition Waste Management Log form is included at the end of this section.
  2. Web Resources  
(Information only; no warranty or endorsement is implied.)  
[www.wastematch.org](http://www.wastematch.org) Site of New York Waste Match, a materials exchange database and service  
[www.bignyc.org](http://www.bignyc.org) Site of Build It Green NYC, a non-profit outlet for salvaged and surplus building materials





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[www.usgbc.org](http://www.usgbc.org) Site of the United States Green Building Council, with a description of the LEED certification process and requirements for C&D waste recycling

<http://www.epa.gov/epawaste/index.htm> Site of the U.S. Environmental Protection Agency that discusses construction and demolition waste issues, and links to other resources.

3. For Waste-to-Energy Facilities that need to comply with European Standard (EN) for waste management and emissions into air, soil, surface water and groundwater:

[www.ec.europa.eu/environment/waste/framework/index.htm](http://www.ec.europa.eu/environment/waste/framework/index.htm) European Commission Waste Framework Directive 2008/98/EC

[http://www.europa.eu/legislation\\_summaries/environment/waste\\_management](http://www.europa.eu/legislation_summaries/environment/waste_management) European Commission Waste Incineration Directive 2000/76/EC

[www.cen.eu/cen/Products](http://www.cen.eu/cen/Products) EN standards 303-1, 303-2, 303-3, 303-4, 303-5, 303-6, 303-7

### 1.7 SUBMITTALS:

- A. The Contractor shall refer to Section 01 33 00 SUBMITTAL PROCEDURES for submittal requirements.
- B. The Contractor shall be responsible for the development and implementation of a Waste Management Plan for the Project. The Contractor's subcontractors shall assist in the development of that Plan, and collect and deposit their waste and recyclable materials in accordance with the approved Plan.
- C. **DRAFT WASTE MANAGEMENT PLAN.** Within fifteen (15) days after receipt of 'Notice to Proceed', or prior to any waste removal, whichever occurs sooner, the Contractor shall submit to the Commissioner a Draft Waste Management Plan. Include separate sections for demolition and construction waste. The Plan shall demonstrate how the performance goals will be met, and contain the following:
  1. List of materials targeted for reuse, salvage, or recycling, and names, addresses, and phone numbers of receiving facilities/companies that will be purchasing or accepting each material.
  2. Description of on-site and/or off-site sorting methods for all materials to be removed from site.
  3. If mixed construction and demolition waste is to be sorted off-site, provide a letter from the processor stating the average percentage of mixed construction and demolition waste they recycle.
  4. Landfill information: Names of landfills where non-recyclable/reusable/salvageable waste will be disposed, and list of applicable tipping fees.
  5. Materials handling procedures: Specify whether materials shall be separated or commingled and describe the planned diversion strategies. Describe expected amount of each material type, where materials shall be taken and how the recycling facility shall process the material. Provide a description of the means by which any recyclable, salvaged, or reused materials will be protected from contamination, and collected in a manner that will meet the requirements for acceptance by the designated recycling processors.
  6. Transportation: A description of the means of transportation and destination for recycled materials.
  7. Meetings: Description of regular meetings to be held to address waste management.
  8. Sample spreadsheet and description of how the implementation of the plan will be documented and submitted on a monthly basis.
- D. **FINAL WASTE MANAGEMENT PLAN.** Within fifteen (15) days of Commissioner's approval of the Draft Waste Management Plan, the Contractor shall submit a Final Waste Management Plan.
- E. **PROGRESS REPORTS.** The Contractor shall submit monthly a Waste Management Progress Report, containing the following information:



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1. Project title, name of company completing report, and dates of period covered by the report
  2. Report on the disposal of all jobsite waste. A DDC C&D Waste Management Log form is included at the end of this section. For each shipment of material removed from the site, provide the following:
    - a. Date and ticket number of removal
    - b. Identity of material hauler
    - c. Material category
    - d. Total quantity of waste, in tons/cubic yards, by type
    - e. Quantity of waste salvaged, recycled and/or reused, by type
    - f. Total quantity of waste diverted from landfill (recycled, salvaged, reused) as a percentage of total waste
    - g. Recipient of each material type
  3. Provide monthly and cumulative Project totals of waste, quantity diverted, and percentage diverted.
  4. Note that the unit of measure may be either tons or cubic yards, but must be consistent for all shipments and all materials throughout the Project. Reports with inconsistent or mixed units will not be reviewed and will be returned for re-submission.
  5. Include legible copies of on-site logs, weight tickets and receipts. Receipts shall be from charitable organizations, recycling and/or disposal site operators who can legally accept the materials for the purpose of reuse, recycling or disposal. Contractor shall save such original documents for the life of the Project plus seven (7) years.
- F. LEED Submittal: For LEED designated projects, submit final LEED construction waste report signed by the Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Waste report must include:
1. For diverted materials, include at least four material streams
  2. For commingled facilities, submit documentation of recycling rates
  3. For waste-to-energy strategy, submit documentation of facility adherence to relevant EN standards, and justification of strategy
- G. Refrigerant Recovery: Where refrigerant is recovered, submit statement of refrigerant recovery, which must include:
1. Name, address, qualification data and signature of the refrigerant recovery technician responsible for recovering refrigerant
  2. Statement that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations
  3. Date refrigerant was recovered

**1.8 QUALITY ASSURANCE:**

- A. The Contractor shall designate a Construction Waste Management Representative, to ensure compliance with this section. Coordinator shall be present at Project site full-time for the duration of the Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Waste management plans, documentation and implementation shall be discussed at the following meetings:
  1. Pre-demolition kick-off meeting



2. Pre-construction kick-off meeting
  3. Regular job-site meetings
  4. Contractor toolbox meetings
- E. For LEED v4 projects, Waste-to-Energy Facilities: Comply with EN standards for waste management and emissions into air, soil, surface water and groundwater.

## **PART II – PRODUCTS (Not Used)**

## **PART III – EXECUTION**

### **3.1 WASTE PLAN IMPLEMENTATION:**

- A. Prior to the demolition and construction start, the Contractor shall implement the Waste Management Plan, coordinate the Plan with all affected trades, and designate one individual as the Construction Waste Management Representative, who will be responsible for communicating the progress of the Plan with the Commissioner on a regular basis, and for assembling the required LEED documentation.
- B. The Contractor shall be responsible for the provision of containers and the removal of all waste, non-returned surplus materials and rubbish from the site in accordance with the approved Waste Management Plan. The Contractor shall oversee and document the results of the Plan. Monies received for salvaged materials shall remain with the Contractor, except the monies for those items specifically identified elsewhere in the specifications or indicated on the drawings as belonging to others.
- C. Responsibilities of Subcontractors: Each Subcontractor shall be responsible for collecting its waste, non-returned surplus materials and rubbish, in accordance with the Waste Management Plan.
- D. Distribution: The Contractor shall distribute copies of the Waste Management Plan to each Subcontractor, Resident Engineer, Construction Manager and Commissioner.
- E. Instruction: The Contractor shall provide on-site instruction of proper waste management procedures to be used by all parties in appropriate stages of the Project.
- F. Procedures: Conduct waste management operations to ensure minimum interference with site vegetation, roads, streets, walks and other adjacent occupied and used facilities.
  1. Collect commingled waste and/or separate all recyclable waste in accordance with the Plan. Specific areas on the Project site are to be designated, and appropriate containers and bins clearly marked with acceptable and unacceptable materials.
  2. Inspect containers and bins for contamination and remove contaminated materials if found.
  3. Comply with the General Conditions for controlling dust and dirt, environmental protection and noise control.

### **3.2 ADDITIONAL DEMOLITION AND SALVAGE REQUIREMENTS:**

- A. Demolition and salvage of additional items indicated in other sections of the Project Specifications require special attention as part of the overall 75% diversion from landfill. Specific requirements for special attention are designated in other sections of the Project Specifications.



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**3.3 DISPOSAL:**

- A. General: Except for items or material to be salvaged, recycled or otherwise reused, remove waste material from the Project site and legally dispose of them in a manner acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Project site and legally dispose of them.

**END OF SECTION 01 74 19**



# CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT LOG

Project Name:  
Project I.D.:

Contractor: \_\_\_\_\_  
Prepared by: \_\_\_\_\_  
For Month: \_\_\_\_\_

[illegible]

**Notes:**

1. Volume (cubic yards) may be used instead of weight if used for ALL amounts and ALL materials.
  2. Includes concrete; bricks; concrete masonry units (CMU); asphalt; metals; clean dimensional wood; carpet and pad; drywall; ceiling tiles; cardboard, paper, and packaging; and any other reuse items indicated on the Drawings and/or elsewhere in the Specification.
  3. Excluded material includes soil or land clearing debris and for LEED v4 projects, alternative daily cover (ADC) such as screen fines and 6" minus.
  4. Diverted material includes recycled and reused material diverted from landfill. Recycled material is reprocessed into new products. Reused material is reclaimed, salvaged or otherwise used in its original form, either on-site or off-site.
- \* These items must be listed in order to receive LEED credit.



**SECTION 01 77 00  
CLOSEOUT PROCEDURES**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes administrative and general procedural requirements for Closeout Procedures, including without limitation the following:
1. Definitions
  2. Substantial Completion
  3. Final Acceptance
  4. Warranties
  5. Final Cleaning
  6. Repair of the Work
- B. LEED: Refer to the Addendum to identify whether this Project is designed to comply with a Certification Level according to the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) Rating System, as specified in Section 01 81 13, "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS."
- C. COMMISSIONING: Refer to the Addendum to identify whether this Project will be commissioned by an independent third party under separate contract with the City of New York. Commissioning shall be in accordance with ASHRAE and USGBC LEED- NC procedures, as described in Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS. The Contractor shall cooperate with the commissioning agent and provide whatever assistance is required.

**1.3 RELATED SECTIONS:** include without limitation the following:

- |    |                  |  |
|----|------------------|--|
| A. | Section 01 10 00 | SUMMARY  |
| B. | Section 01 33 00 | SUBMITTAL PROCEDURES                                 |
| C. | Section 01 74 19 | CONSTRUCTION WASTE MANAGEMENT & DISPOSAL             |
| D. | Section 01 78 39 | CONTRACT RECORD DOCUMENTS                            |
| E. | Section 01 79 00 | DEMONSTRATION AND OWNER'S PRE-ACCEPTANCE ORIENTATION |

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or



combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

- C. Substantial Completion: shall mean the written determination by the Commissioner that the Work required under the Contract is substantially, but not entirely, complete.
- D. Final Acceptance: shall mean final written acceptance of all the Work by the Commissioner, a copy of which shall be sent to the Contractor.

#### **1.5 SUBSTANTIAL COMPLETION:**

- A. Preliminary Procedures: Before requesting inspection to determine the date of Substantial Completion, the Contractor shall complete and supply all items required by the contract specifications, General Conditions, Addendum to the General Conditions, change orders or other directives from the Commissioner's representatives. The required items will include all contract requirements for substantial completion, including but not limited to items related to releases, regulatory approvals, warranties and guarantees, record documents, testing, demonstration and orientation, final clean up and repairs, and all specific checklist of items by the Resident Engineer. (See Attachment "A" at the end of this section for sample requirements for Substantial Completion).
- B. Prepare and submit a list to the Resident Engineer of incomplete items, the value of incomplete construction, and reasons the work is not complete.
- C. Inspection: The Contractor shall submit to the Resident Engineer a written request for inspection for Substantial Completion. Within ten (10) days of receipt of the request, the Resident Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. The Resident Engineer may request the services, as required, of the Design Consultant, Client Agency Representative and/or other entities having involvement with the Work to assist in the inspection of the Work. If the Resident Engineer makes a determination that the work is substantially complete and approves the Final Punch List and the date for Final Acceptance, he/she will so advise the Commissioner and recommend issuance of the Certificate of Substantial Completion. If the Resident Engineer determines that the work is not substantially complete, he/she will notify the Contractor of those items that must be completed or corrected before the Certificate of Substantial Completion will be issued.
  - 1 Re-inspection: Contractor shall request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
  - 2 Results of completed inspection will form the basis of requirements for Final Acceptance.

#### **1.6 FINAL ACCEPTANCE:**

- A. Preliminary Procedures: Before requesting final inspection for Final Acceptance of the Work, the Contractor shall complete the following. (Note that the following are to be completed, submitted as appropriate, and approved by the Commissioner, as applicable, prior to the final inspection and are not to be submitted for approval or otherwise at the final inspection unless specifically indicated). List exceptions in the request.
  - 1. Verify that all required submittals have been provided to the Commissioner including but not limited to the following:
    - a. Manufacturer's cleaning instructions
    - b. Posted instructions
    - c. As-built Record Documents (Drawings, specifications, and product data) as described in Section 01 78 39, CONTRACT RECORD DOCUMENTS, incorporating any changes required by the Commissioner as a result of the review of the submission prior to the pre-final inspection.
    - d. Operation and Maintenance Manuals, including Preventive Maintenance, Special Tools, Repair Requirements, Parts List, Spare Parts List, and Operating Instructions.



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- e. Completion of required Demonstration and Orientation, as applicable, of designated personnel in operation and maintenance of systems, sub-systems and equipment.
  - f. Applicable LEED Building submittals as described in Section 01 81 13.03, SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS or Section 01 81 13.04 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS.
  - g. Construction progress photographs as described in Section 01 32 33, PHOTOGRAPHIC DOCUMENTATION.
- 2. Submit a certified copy of the final approved Punch List of items to be completed or corrected. The certified copy of the Punch List shall state that each item has been completed or otherwise resolved for acceptance, and shall be endorsed and dated by the Contractor.
  - 3. Submit pest-control final inspection report and survey as required in Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS.
  - 4. Submit record documents and similar final record information.
  - 5. Deliver tools, spare parts, extra stock and similar items.
  - 6. Complete final clean-up requirements including touch-up painting of marred surfaces.
  - 7. Submit final meter readings for utilities, as applicable, a measured record of stored fuel, and similar data as of the date when the City took possession of and assumed responsibility for corresponding elements of the work.
- B. Final Inspection: The Contractor shall submit to the Resident Engineer a written request for inspection for Final Acceptance of the Work. Within ten (10) days of receipt of the request, the Resident Engineer will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Resident Engineer may request the services, as required, of the Design Consultant, Client Agency Representative and/or other entities having involvement with the Work to assist in the inspection of the Work. If the Resident Engineer finds that all items on the Final Approved Punch List are complete and no further work remains to be done, he/she will so advise the Commissioner and recommend the issuance of the determination of Final Acceptance. If the Resident Engineer determines that the work is not complete, he/she will notify the Contractor of those items that must be completed or corrected before the determination of Final Acceptance will be issued.
  - C. Final Acceptance: The Work will be accepted as final and complete as of the date of the Resident Engineer's inspection if, upon such inspection, the Resident Engineer finds that all items on the Punch List are complete and no further Work remains to be done. The Commissioner will then issue a written determination of Final Acceptance.

**1.7 WARRANTIES:**

- A. The items of materials and/or equipment for which manufacturer warranties are required are listed in Schedule B of the Addendum. For each item of material and/or equipment listed in Schedule B, the Contractor shall obtain a written warranty from the manufacturer. Such warranty shall provide that the material or equipment is free from defects for the period set forth in Schedule B and will be replaced or repaired within such specified period. The contractor shall deliver all required warranties to the Commissioner.
- B. Unless indicated otherwise Warranties are to take effect on the date of Substantial Completion.
- C. Submittal Time: Submit written Warranties on request of the Commissioner for designated portions of the Work where commencement of Warranties other than date of Substantial Completion is indicated.
- D. Partial Occupancy: Submit properly executed Warranties to the Commissioner within 15 days of completion of designated portions of the Work that are completed and occupied or used by the City.
- E. Organize the Warranty documents into an orderly sequence based on the Project Specification Divisions and Section Numbers.





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1. Bind Warranties in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES;" name and location of Project; Capitol Budget Project Number (FMS ID); and Contractor's and applicable subcontractor's name and address.
  3. Provide heavy paper dividers with plastic-covered tabs for each separate Warranty. Mark tab to identify the product or installation.
  4. Provide a typed description of each product or installation being warranted, including the name of the product, and the name, address, and telephone number of the Installer.
- F. When warranted materials and/or equipment require operation and maintenance manuals, provide additional copies of each required Warranty in each required manual. Refer to Section 01 78 39, CONTRACT RECORD DOCUMENTS, for requirements of Operation and Maintenance Manuals.

## PART II – PRODUCTS

### 2.1 MATERIALS:

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART III – EXECUTION

### 3.1 FINAL CLEANING:

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations, as applicable, before requesting inspection for Final Acceptance of the Work for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.



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- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Replace parts subject to unusual operating conditions.
  - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - s. Leave Project clean and ready for occupancy.
  - t. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests, as required in Section 01 50 00, TEMPORARY FACILITIES, SERVICES AND CONTROLS. Prepare and submit a Pest Control report to the Commissioner.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on City's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

### 3.2 REPAIR OF THE WORK:

- A. Subject to the terms of the Contract the Contractor shall complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Contractor shall repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.



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3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

**END OF SECTION 01 77 00**



**SECTION 01 77 00**

**ATTACHMENT 'A'**

**The following list is a general sample of Substantial Completion requirements, including but not limited to:**

1. Prepare and submit a list to the Resident Engineer, of incomplete items, the value of incomplete construction, and reasons the work is not complete.
2. Obtain and submit any necessary releases enabling the City unrestricted use of the project and access to services and utilities.
3. Regulatory Approvals: Submit all required documentation from applicable Governing Authorities, including, but not limited to, Department of Buildings (DoB); Department of Transportation (DoT); Department of Environmental Protection (DEP); Fire Department (FDNY); etc. Documentation to include, but not limited to, the following:
  - a. Building Permits, Applications and Sign-offs.
  - b. Permits and Sign-off for construction fences; sidewalk bridges; scaffolds, cranes and derricks; utilities; etc.
  - c. Certificates of Inspections and Sign-offs.
  - d. Required Certificates and Use Permits.
  - e. Certificate of Occupancy (C.O.), Temporary Certificate of Occupancy (T.C.O.) or Letter of Completion as applicable.
4. Submit specific warranties required by the specifications, final certifications, and similar documents.
5. Prepare and submit Record Documents as described in Section 01 78 39, **CONTRACT RECORD DOCUMENTS**, including but not limited to; approved documentation from Governing Authorities; as-built record drawings and specifications; product data; operation and maintenance manuals; Final Completion construction photographs; damage or settlement surveys; final property surveys; and similar final record information. The Resident Engineer will review the submission and provide appropriate comments. If comments are significant the initial submission will be returned to the Contractor for correction and re-submission incorporating the comments prior to the Final Inspection.
6. Record Waste Management Progress Report: Submit C&D Waste Management logs, with legible copies of weight tickets and receipts required in accordance with Section 01 74 19, **CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**.
7. If applicable submit LEED Letter Template in accordance with the requirements of Section 01 81 13.03, **SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS** or Section 01 81 13.04 **SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS**.
8. Schedule applicable Demonstration and Orientation required in other Sections of the Project Specifications and as described in Section 01 79 00, **DEMONSTRATION AND OWNER'S PRE-ACCEPTANCE ORIENTATION**.
9. Deliver tools, spare parts, extra materials, and similar items to location designated by Resident Engineer. Label with manufacturer's name and model number where applicable.
10. Make final changeover of permanent locks and deliver keys to the Resident Engineer. Advise Commissioner of changeover in security provisions.
11. Complete startup testing of systems as applicable.
12. Submit approved test/adjust/balance records.
13. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements as directed by the Resident Engineer.
14. If applicable complete Commissioning requirements as defined in Section 01 91 13, **GENERAL COMMISSIONING REQUIREMENTS For MEP Systems and/ or Section 01 91 15, BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS**.
15. Complete final cleaning requirements, including touchup painting.
16. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.



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**SECTION 01 78 39  
CONTRACT RECORD DOCUMENTS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes administrative and general procedural requirements for Contract Record Documents, including:
1. As-built Contract Record Drawings.
  2. As-built marked-up copies of Record Specifications, addenda and Change Orders.
  3. As-built marked-up Product Data
  4. Record Samples
  5. Construction Record Photographs
  6. Operating and Maintenance Manuals
  7. Final Site Survey
  8. Guarantees and Warranties
  9. Waste Disposal Documentation
  10. LEED Materials and Matrix
  11. Miscellaneous Record Submittals
- B. The Department of Design and Construction, at the start of construction (kick-off meeting), will furnish to the Contractor at no cost a complete set of Contract Drawings Mylars (reproducible) pertaining to the work to be performed under the Contract. It is the responsibility of the Contractor to modify the Contract Drawings to indicate all changes and corrections, if any, occurring in the work as actually installed. The Contractor is required to furnish all other Mylar (reproducible) drawings, if necessary, such as Addenda Drawings and Supplementary Drawings as may be necessary to indicate all work in detail as actually completed. All professional seals must be blocked out. Title box complete with Project title and Design Consultants' names will remain.
- C. Maintenance of Documents and Samples: The Contractor shall maintain, during the progress of the work, an accurate record of the work as actually installed, on Contract Record Drawings, on Mylar (reproducible), in ink. Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and samples available at all times for the Resident Engineer's inspections.
1. The Contractor's attention is particularly directed to the necessity of keeping accurate records of all subsurface and concealed work, so that the Contract Record Drawings contain this information in exact detail and location. Contract Record Drawings shall also show all connections, valves, gates, switches, cut-outs and similar operating equipment.
  2. For projects designated to achieve a LEED rating the Contractor shall receive a copy of the Project's LEED scorecard for the purpose of monitoring compliance with the target objectives and to facilitate



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coordination with the LEED Consultant. The Contractor shall receive periodic updates of this scorecard and is required to submit the final version of the Scorecard at Substantial Completion with other Project Record Documents.

## 1.3 RELATED SECTIONS: include without limitation the following:

- |    |                  |                                     |
|----|------------------|-------------------------------------|
| A. | Section 01 10 00 | SUMMARY                             |
| B. | Section 01 32 00 | CONSTRUCTION PROGRESS DOCUMENTATION |
| C. | Section 01 32 33 | PHOTOGRAPHIC DOCUMENTATION          |
| D. | Section 01 33 00 | SUBMITTAL PROCEDURES                |
| E. | Section 01 77 00 | PROJECT CLOSEOUT PROCEDURES         |

## 1.4 DEFINITIONS:

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

## 1.5 SUBMITTALS:

- A. As-Built Contract Record Drawings: Comply with the following:
1. Progress Submission: As directed by the Resident Engineer, submit progress As-Built Contract Record Drawings at the 50% Construction Completion stage.
  2. Final Submission: Before substantial completion payment, the Contractor shall furnish to the Commissioner one (1) complete set of marked-up Mylar (reproducible) As-Built Contract Record Drawings, in ink indicating all of the work and locations as actually installed, plus one (1) set of paper prints which will be furnished to the sponsoring agency by DDC.
  3. As-Built Contract Record Drawings shall be of the same size as that of the Contract Drawings, with a one (1) inch margin on three (3) sides and a two (2) inch margin on the left side for binding.
  4. Each As-Built Contract Record Drawing shall bear the legend "AS-BUILT CONTRACT RECORD DRAWING" in heavy block lettering, one half (1/2) inch high, and contain the following data:

### AS-BUILT CONTRACT RECORD DRAWING

Contractor's Name

Contractor's Address

Subcontractor's Name (where applicable)

Subcontractor's Address

Made by:

Date

Checked by:

Date

Commissioner's Representatives

(Resident Engineer)

DDC

(Plumbing Inspector)

DDC

(Heating & Ventilating Inspector)

DDC

(Electrical Inspector)

DDC



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5. Record Drawing Title Sheet: The Contractor shall prepare a title sheet, the same size as the Contract Record Drawings, which shall contain the following:
  - a. Heading:  
The City of New York  
Department of Design and Construction  
Division of Public Buildings
  - b. Capital Budget Project Number (FMS ID)
  - c. Name and Location of Project
  - d. Contractor's Name and Address
  - e. Subcontractor's Name and Address (where applicable)
  - f. Record of changes (a caption description of work affected, and the date and number of Change Order or other authorization)
  - g. List of Record Drawings
- B. Record Specifications, Addenda and Change Order: Submit to the Commissioner two (2) copies each of marked-up Record Specifications, Addenda and Change Orders.
- C. Record Product Data: Submit to the Commissioner two (2) sets of Record Product Data.
- D. Record Construction Photographs: Submit to the Commissioner final as-built construction photographs and negatives of the completed work as described in Section 01 32 33, PHOTOGRAPHIC DOCUMENTATION.
- E. Operating and Maintenance Manuals:
  1. Submit three (3) copies each of preliminary manuals to the Resident Engineer for review and approval. The Contractor shall make such corrections, changes and/or additions to the manual until deemed satisfactory by the Resident Engineer. Deliver three (3) copies of the final approved manuals to the Resident Engineer for distribution.
  2. Commissioning: Comply with the requirements of Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS, as well as the requirements set forth in sections of the Project Specifications, for projects designated for Commissioning. Submit four (4) copies each of data designated to be included in the Commissioning Operation and Maintenance Manual to the Resident Engineer. The Resident Engineer will forward such data to the Commissioning Authority/Agent (CxA) for review and comment. The Contractor shall make such corrections, changes and/or additions to the data until deemed satisfactory and deliver four (4) copies of the final data to the Resident Engineer for use by the Commissioning Authority/Agent (CxA) to prepare the Commissioning Operation and Maintenance Manual.
    - a. Non-Commissioning Data: All remaining data not designated for Commissioning and required as part of Maintenance and Operation Manual shall be prepared and assembled in accordance with the requirements of this section for Operating and Maintenance Manuals.
- F. Final Site Survey: Submit Final Site Survey as described in Section 01 73 00, EXECUTION, in quantities requested by the Commissioner, signed and sealed by a Land Surveyor licensed in the State of New York.
- G. Guarantees and Warranties.
- H. Waste Disposal Documents and Miscellaneous Record Documents.





**PART II – PRODUCTS**

**2.1 CONTRACT RECORD DRAWINGS:**

- A. Record Prints: The Contractor shall maintain one set of blue- or black-line white prints as applicable of the Contract Drawings and Shop Drawings. If applicable, the Record Contract Drawings and Shop Drawings shall incorporate the arrangement of the work based on the accepted Master Coordination Drawing(s) as described in Section 01 33 00, SUBMITTAL PROCEDURES.
1. Preparation: The Contractor shall mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Change Orders: All changes from Contract Drawings shall be distinctly encircled and identified by Change Order number correlating to changes listed on the "Title Sheet." The Contractor shall show within the encircled areas the work as actually installed.
- B. Content: Types of items requiring marking include, but are not limited to, the following:
1. Dimensional changes to Drawings.
  2. Revisions to details shown on Drawings.
  3. Depths of foundations below first floor.
  4. Locations and depths of underground utilities.
  5. Revisions to routing of piping and conduits.
  6. Revisions to electrical circuitry.
  7. Actual equipment locations.
  8. Duct size and routing.
  9. Locations of concealed internal utilities.
  10. Changes made by Change Order
  11. Changes made following Commissioner's written orders.
  12. Details not on the original Contract Drawings.
  13. Field records for variable and concealed conditions.
  14. Record information on the Work that is shown only schematically.
- C. Progress Record Mylar's (reproducible): As directed by the Resident Engineer at 50% construction completion, review marked-up Record Prints with the Resident Engineer and the Design Consulting. When directed by the Resident Engineer transfer progress mark-ups to a full set of Mylar's (reproducible) and submit one blue line or black line record copy to the Resident Engineer. The marked-up Mylar's (reproducible) shall be retained by the Contractor for completion of mark-up and final submission.
- D. Final Contract Record Mylar's (reproducible): Immediately before final inspection for Certificate of Substantial Completion, review marked-up Record Prints with the Resident Engineer and the Design Consulting. When authorized, complete mark-up of a full set of corrected Mylar's (reproducible) of the Contract Drawings.
1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
  2. Refer instances of uncertainty to Resident Engineer for resolution.
  3. Print the As-Built Contract Drawings and Shop Drawings for use as Record Transparencies as described in Sub-Section 1.5.



## **2.2 RECORD SPECIFICATIONS, ADDENDA AND CHANGE ORDERS:**

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made
  4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  5. Note related Change Orders and Record Drawings where applicable.
  6. Upon completion of mark-up, submit two (2) complete copies of the marked-up Record Specifications to the Commissioner.

## **2.3 RECORD PRODUCT DATA:**

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. If possible, a Change Order proposal should include resubmitting updated Product Data. This eliminates the need to mark up the previous submittal.
  4. Note related Change Orders and Record Drawings where applicable.
  5. Upon completion of mark-up submit to the Commissioner two (2) sets of the marked-up Record Product Data.
  6. Where Record Product Data is required as part of Maintenance Manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.

## **2.4 RECORD SAMPLE SUBMITTAL:**

- A. Prior to the date of Substantial Completion, the Contractor shall meet with the Resident Engineer at the site to determine which of the Samples maintained during the construction period shall be transmitted to the Commissioner for record purposes.
- B. Comply with the Resident Engineer's instructions for packaging, identification marking and delivery to DDC. Dispose of other samples as specified for disposal of surplus and waste material.

## **2.5 OPERATING AND MAINTENANCE MANUALS:**

- A. The Contractor shall provide preliminary and final versions of Operating and Maintenance Manuals required for those systems, equipment and materials listed in other Sections of the Project Specifications.
- B. Format: Prepare and assemble Operation and Maintenance Manuals in heavy-duty, 3-ring, hardback loose leaf binders in the form of an instructional manual. All binders for each discipline shall be the same color. When multiple binders are used, correlate data into related consistent groupings. Binder front shall containing permanently attached labels displaying the following:



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1. Heading:  
The City of New York  
Department of Design and Construction  
Division of Public Buildings
  2. Capital Budget Project Number (FMS ID)
  3. Name and Location of Project
  4. Contractor's Name and Address
  5. Subcontractor's Name and Address (where applicable)
  6. Dates of the work covered by the contents of the Project Manual.
  7. Binder spine shall display Project Number (FMS ID) and date of completion.
- C. Organization: Include a section in the directory for each of the following:
1. List of documents
  2. List of systems
  3. List of equipment
  4. Table of contents
- D. Each manual shall contain the following materials, in the order listed:
1. Title page
  2. Table of contents
  3. Manual contents
- E. Arrange contents alphabetically by system, subsystem, and equipment and sequence of Table of Contents of the Project Manual. Cross-reference Specification Section numbers. Provide tabbed flyleaf for each separate product, equipment and/or system/subsystem with typed description of product and major component parts of equipment.
- F. Safety warnings or cautions shall be visibly highlighted within each maintenance procedure. Use of such highlights shall be limited to only critical items and shall not be used in an excessive manner which would reduce their effectiveness.
- G. For each product or system, list names, addresses and telephone numbers of Subcontractors and Suppliers, including local source of supplies and replacement parts. Vendors and Supplier listings are to include names, addresses and telephone numbers, including nearest field service telephone numbers.
- H. Where contents of the manual include any manufacturer's catalog pages, clearly indicate the precise items and options included in the installation and delete all manufacturers' data regarding products not included in the installation.
- I. All material within manuals shall be new. Copies used for prior submittals or used in construction shall not be used.
- J. Submit preliminary and final manual editions to the Commissioner according to the approved progress schedule.
- K. Manuals shall present all technical material to the greatest extent possible, with respect to text, tabular matter and illustrations. Illustrations shall preferably consist of line drawings. All applicable drawings shall be included. If available, color photograph prints may be included.
- L. Preliminary manual editions shall be as technically complete as the final manual edition. All illustrations shall be in final forms.
- M. Final manual editions shall be technically accurate and complete and shall represent all "as-built" systems, pieces of equipment, or materials, which have been accepted by the Commissioner. All



illustrations, text and tabular material shall be in final form. All shop drawings shall be included as specified in individual Specification Sections.

- N. Building products, applied materials, and finishes: Include product data, with catalog number, size, composition, and color texture designations. Where applicable, provide information for re-ordering custom manufactured products.
- O. Instructions for care and maintenance: Include manufacturers' recommendations for cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- P. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical compositions, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- Q. Additional Requirements: Specified in individual Specification Sections.

## **2.6 DEMONSTRATION AND ORIENTATION DVD:**

- A. The Contractor shall submit final version of applicable Demonstration and Training DVD recordings in compliance with Section 01 79 00, DEMONSTRATION AND OWNER'S PRE-ACCEPTANCE ORIENTATION.

## **2.7 GUARANTEES AND WARRANTIES:**

- A. SCHEDULE B – Requirements for guarantees and warranties for the Project are set forth in Schedule B, which is included as part of the Addendum.
- B. FORM – For all guarantee requirements set forth in Schedule B, the Contractor shall provide a written guaranty, in the form set forth herein.
- C. Submit fully executed and signed manufacturers' Warranties as listed in the Project Specifications and outlined in Schedule B of the Addendum. Refer to Section 01 77 00, CLOSEOUT PROCEDURES for submittal requirements.



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**GUARANTY**

DDC PROJECT # \_\_\_\_\_

PROJECT DESCRIPTION \_\_\_\_\_

CONTRACT # \_\_\_\_\_

SPECIFICATION SECTION # AND TITLE \_\_\_\_\_

GUARANTY TO BE IN EFFECT FROM \_\_\_\_\_

TO \_\_\_\_\_

The Contractor hereby guarantees that the work specified under the above section of the aforesaid Contract will be free from defects of material and/or workmanship, for the period indicated above.

The Contractor also guarantees that it will promptly repair, restore, rebuild or replace whichever may be deemed necessary by the City, any or all defective material or workmanship of the aforementioned section, that may appear within the guaranty period and any finished work to which damage may occur because of such defects, to the satisfaction of the City and without any cost or expense to the City.

The Contractor hereby agrees to pay to the City the cost of the repairs or replacements should the City make the same because of the failure of the Contractor to do so.

Contractor: \_\_\_\_\_

By: \_\_\_\_\_  
Signature of Partner or Corporate Officer

Print Name: \_\_\_\_\_

Subscribed and sworn to before me this  
day of \_\_\_\_\_, year \_\_\_\_\_

\_\_\_\_\_  
Notary Public



**2.8 WASTE DISPOSAL DOCUMENTATION:**

- A. Certify and deliver to the Commissioner all documentation including reports, receipts, certificates, records etc. for the collection, handling, storage, classification, testing, transportation, recycling and/or disposal of all Non-Hazardous Construction Waste as required by Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL, and Hazardous Waste as required by other Project Specification Sections. Certify compliance with all applicable governing laws, codes, rules and regulations.

**2.9 MISCELLANEOUS RECORD DOCUMENTS:**

- A. Refer to other Project Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Prior to Final Acceptance, complete miscellaneous records and place in good order, properly identified and bound or otherwise organized to allow for use and reference.
- B. Submit three (3) copies of each document to the Commissioner or as otherwise directed by the Commissioner.

**PART III – EXECUTION**

**3.1 RECORDING AND MAINTENANCE:**

- A. Recording: Maintain one copy of each submittal during the construction period for Contract Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Contract Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to the Contract Record Documents for the Resident Engineer's reference during normal working hours.

**END OF SECTION 01 78 39**



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**SECTION 01 79 00  
DEMONSTRATION AND OWNER'S PRE-ACCEPTANCE ORIENTATION**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 79 00**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes administrative and procedural requirements, when set forth in sections of the Project Specifications, for instructing facility's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Owner's Pre-Acceptance Orientation in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and Orientation video recordings.
- B. The Contractor shall provide the services of equipment manufacturers orientation specialists experienced in the type of equipment to be demonstrated.
- C. Separate Orientation sessions shall be conducted for mechanical operations and maintenance personnel and for electronic and electrical maintenance personnel.
- D. Commissioning: Refer to the Addendum to identify whether this project is to be Commissioned. For Commissioned projects the Contractor shall provide Demonstration and Orientation as described in this section and cooperate with the Commissioning Authority/Agent (CxA) to implement Commissioning requirements as described in Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS For MEP Systems, and/ or Section 01 91 15 BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS.

**1.3 RELATED SECTIONS: include without limitation the following:**

- A. Section 01 10 00 SUMMARY
- B. Section 01 33 00 SUBMITTAL PROCEDURES
- C. Section 01 77 00 CLOSEOUT PROCEDURES
- D. Section 01 78 39 CONTRACT RECORD DOCUMENTS
- E. Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS
- F. Section 01 91 15 BUILDING ENCLOSURE COMMISSIONING REQUIREMENTS
- G. Specific requirements for demonstration and orientation indicated in other sections of the Project Specifications





#### **1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.

#### **1.5 SUBMITTALS:**

- A. Instruction Program: Submit three (3) copies of outline of instructional program for demonstration and orientation, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each orientation module to the Commissioner for approval no less than thirty (30) days prior to the date the proposed orientation is to take place. Include learning objectives and outline for each orientation module.
  - 1. At completion of orientation, submit three (3) complete training manual(s) and three (3) applicable video recording(s) to the Commissioner for the facility's and City's use.
- B. Qualification Data: For facilitator, instructor and Videographer.
- C. Attendance Record: For each orientation module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each orientation module, submit results and documentation of performance-based test.
- E. Submit all final orientation material to the Resident Engineer a minimum of fourteen (14) days prior to the scheduled orientation.
- F. Demonstration and Orientation Recordings:
  - 1. All Projects:
    - a. The Contractor shall submit to the Commissioner three (3) copies of Demonstration and Orientation Video recordings within seven (7) days of end of each orientation module.
    - b. Identification: On each copy, provide an applied label with the following information:
      - 1) Project Contract I.D. Number
      - 2) Project Contract Name
      - 3) Name of Contractor
      - 4) Name of Subcontractor as applicable
      - 5) Name of Design Consultant
      - 6) Name of Construction Manager as applicable
      - 7) Date recorded.
      - 8) Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      - 9) Table of Contents including list of systems covered.
    - c. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding DVD recording. Include name of Project and date of recording on each page.



- d. Commissioned Projects: The Contractor shall submit one (1) additional copy of the Demonstration and Orientation video recording to the Commissioning Agent through the Resident Engineer who will include the approved recording in the Commissioning Report.

#### **1.6 QUALITY ASSURANCE:**

- A. Facilitator Qualifications: A firm or individual experienced in orientation or educating maintenance personnel in an orientation program similar in content and extent to that indicated for this Project.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00, QUALITY REQUIREMENTS, experienced in operation and maintenance procedures and orientation.
- C. Videographer Qualifications: A professional Videographer who has experience with orientation and construction projects.
- D. Pre-instruction Conference: Schedule with the Resident Engineer a conference at Project site in accordance with Section 01 31 00, PROJECT MANAGEMENT AND COORDINATION. Review methods and procedures related to demonstration and orientation including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

#### **1.7 COORDINATION:**

- A. Coordinate instruction schedule with the Resident Engineer and facility's operations. Adjust schedule as required to minimize disrupting facility's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of orientation modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the Commissioner.

### **PART II – PRODUCTS**

#### **2.1 INSTRUCTION PROGRAM:**

- A. Program Structure: Develop an instruction program that includes individual orientation modules for each system and equipment not part of a system, as specified and required by individual Specification Sections.
- B. Orientation Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.



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- c. Operating standards.
  - d. Regulatory requirements.
  - e. Equipment function including auxiliary equipment and systems.
  - f. Operating characteristics.
  - g. Limiting conditions.
  - h. Performance curves.
- 2. Documentation: Review the following items in detail:
  - a. Emergency manuals.
  - b. Operations manuals.
  - c. Maintenance manuals.
  - d. Project Record Documents.
  - e. Identification systems.
  - f. Warranties
- 3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.



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- d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
  - h. Housekeeping practices
8. Repairs: Include the following:
- a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### PART III – EXECUTION

#### 3.1 INSTRUCTION:

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and orientation modules, to coordinate instructors, and to coordinate between Contractor and the Resident Engineer for the number of participants, instruction times, and location.
- B. The Contractor shall engage qualified instructors to instruct facility's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Schedule instruction with the Resident Engineer at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule orientation with the Resident Engineer with at least fourteen (14) days' advance notice.
- D. Evaluation: At conclusion of each orientation module, assess and document each participant's mastery of module(s) by use of an oral a written or a demonstration performance-based test.
- E. Cleanup: Collect and remove used and leftover educational materials from project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial orientation use.

#### 3.2 DEMONSTRATION AND ORIENTATION VIDEO RECORDINGS:

- A. All projects:
  - 1. The Contractor shall engage a qualified commercial Videographer to video record demonstration and orientation sessions. Record each orientation module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 2. At beginning of each orientation module, record each chart containing learning objective and lesson outline.
  - 3. All recordings must be close captioned.
  - 4. Recording Format: Provide high-quality video recording on USB drive or other electronic media requested by the Commissioner.
  - 5. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and orientation. Display continuous running time.



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6. Narration: Describe scenes on the recording by audio narration by microphone while recording or by dubbing audio narration off-site after. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
7. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from opposite the corresponding narration segment.

**B. Commissioned Projects:**

Refer to the Addendum to determine if the project is to be Commissioned.

1. The Commissioning Authority/Agent (CxA) under separate contract with the City of New York will assess and comment on the adequacy of the Orientation Instruction sessions by reviewing the Orientation and Instruction program and agenda provided by the Contractor. The provider of the Orientation program will video record the sessions and provide a copy to the CxA for final review and comments. If necessary, Contractor shall edit the recording per CxA comments.

**END OF SECTION 01 79 00**



**SECTION 01 81 13.03**

**SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 81 13.03**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

**A. LEED BUILDING - GENERAL REQUIREMENTS:**

The City of New York is committed to implementing good environmental practices and procedures which include achieving a LEED™ Green Building rating. Specific project requirements related to this goal are listed in the applicable paragraphs of this section of the General Conditions. The Contractor shall ensure that these requirements as defined in the sections below and in related sections of the Contract Documents, are implemented to the fullest extent. Substitutions, or other changes to the work proposed by the Contractor or their Subcontractors, shall not be allowed if such changes compromise the stated LEED BUILDING criteria.

**B. This Section includes:**

1. Definitions
2. LEED Provisions
3. LEED Building Submittals
4. LEED Building Submittal Requirements
5. LEED Action Plan

**1.3 RELATED SECTIONS:** Include without limitation the following:

- |    |                     |   |
|----|---------------------|---|
| A. | Section 01 74 19    | CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL  |
| B. | Section 01 81 13.13 | VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS FOR LEED v3 BUILDINGS |
| C. | Section 01 81 19    | INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS  |
| D. | Section 01 91 13    | GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS  |
| E. | Section 01 91 15    | GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE   |

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.



- B. Agrifiber Products: Products derived from recovered agricultural waste fiber from sources such as cereal straw, sugarcane bagasse, sunflower husk, walnut shells, coconut husks, and agricultural prunings, processed and mixed with resins to produce panels with characteristics similar to composite wood.
- C. Composite Wood: Products composed of wood or plant particles or fibers bonded by a synthetic resin or binder to produce panels such as plywood, particleboard, and medium density fiberboard (MDF). Does not include hardboard, structural panels, glued laminated timber, prefabricated wood I-joists, or finger-jointed lumber.
- D. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- E. Forest Stewardship Council (FSC) Certified Wood: Wood-based materials and products certified in accordance with the Forest Stewardship Council's principles and criteria.
- F. LEED: The Leadership in Energy & Environmental Design rating system developed by the United States Green Building Council.
- G. Rapidly Renewable Materials: Materials made from agricultural products that are typically harvested within a ten-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.
- H. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from the Project location. Manufacturing refers to the final assembly of components into the building product that is installed at the Project site.
- I. Regionally Extracted, Harvested, or Recovered Materials: Materials which are extracted, harvested, or recovered and manufactured within a radius of 500 miles from the Project site.
- J. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
  - 1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
  - 2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.
  - 3. "Pre-consumer" may also be referred to as "post-industrial".
- K. Solar Reflectance Index (SRI): A measure of a material's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is equal to 0, and a standard white (reflectance 0.80, emittance of 0.90) is equal to 100.
- L. Volatile Organic Compound (VOC): Any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) which vaporizes (becomes a gas) and participates in atmospheric photochemical reactions, as specified in Part 51.00 of Chapter 40 of the U.S. Code of Federal Regulations, at normal room temperatures. For the purposes of this specification, formaldehyde and acetaldehyde are considered to be VOCs.



### 1.5 LEED PROVISIONS:

- A. Refer to the Addendum for the LEED rating to be achieved for this project. The provisions to achieve this LEED rating are integrated within the project construction documents and specifications. The Contractor is specifically directed to the "LEED BUILDING Performance Criteria" and "LEED BUILDING Submittals" sections within the contract specification. Additional LEED requirements are met through aspects of the project design, including material and equipment selections, which may not be specifically identified as LEED BUILDING requirements. Compliance with the requirements needed to obtain LEED prerequisites and credits will be used as one criterion to evaluate substitution requests.

### 1.6 LEED BUILDING SUBMITTALS:

- A. Scope: LEED BUILDING submittals are required for all installed materials included in General Construction work. LEED BUILDING Submittals are only required for field-applied adhesives, sealants, paints and coatings included in Plumbing, Mechanical and Electrical work. Submit all required LEED BUILDING submittals in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.
- B. Applicability: The extent of the LEED BUILDING Submittals varies depending on the specification section. Applicable LEED BUILDING Submittals are listed under the "LEED BUILDING Submittals" heading in each specification section. The detailed requirements for the LEED BUILDING Submittals are defined in Item C below.
- C. Detailed Requirements: Sub-Sections 1.6 C.1 through 1.6 C.3 below defines the information and documents to be provided for each type of LEED BUILDING Submittal as identified in the LEED Submittal Requirements of each specification section:
1. ENVIRONMENTAL BUILDING MATERIALS CERTIFICATION FORM (EBMCF)[GHI]: Information to be supplied for this form (blank sample copy attached at end of this Section to be modified as appropriate to the project) shall include some or all of the following items, as identified in the LEED Submittal Requirements of each specification section:
    - a. Cost breakdowns for the materials included in the contractor or sub-contractor's scope of work. Cost reporting shall include itemized material costs (excluding the contractor's labor, equipment, overhead and profit).
    - b. The percentages (by weight) of post-consumer and/or post-industrial recycled content in the supplied product(s).
      1. For each product with recycled content, also indicate the total recycled content value ( $\frac{1}{2} \times \text{pre-consumer percentage} \times \text{product value} + 1 \times \text{post-consumer percentage} \times \text{product value} = \text{total recycled content value}$ ).
      2. See additional requirements for concrete below.
    - c. Identification (Yes/No) of materials manufactured within 500 miles of the project site AND containing raw materials harvested or extracted within 500 miles of the project site.
      - 1) Indicate the percentage by weight, relative to the total weight of the product that meets these criteria.
      - 2) Indicate the point of harvest/extraction/recovery of regional raw materials, the point of final assembly of regional manufactured products, and the distance from each point to the project site.
    - d. Volatile Organic Compound (VOC) content of all field-applied adhesives, sealants, paints, and coatings, listed in grams/liter or lbs./gallon, less water.
      - 1) For detailed requirements refer to Section 01 81 13.13 VOC LIMITS FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS.
    - e. The amount of "Forest Stewardship Council (FSC) Certified" wood products if used in the Project.
      - 1) Record only new FSC-certified wood products. Do not record reclaimed, salvaged, or recycled FSC-certified wood products.





- 2) Reclaimed, salvaged, or recycled FSC-certified wood may be recorded as post-consumer recycled content.
  - f. The amount of Rapidly Renewable materials if used in the Project.
    - 1) Indicate the type of rapidly renewable material used, and the percentage by weight, relative to the total weight of the product, that consists of rapidly renewable material.
  - g. The percentage (by weight), relative to the total weight of cementitious materials, of supplementary cementitious materials or pozzolans such as fly ash used in each concrete mix used in the Project.
    - 1) For each concrete mix, provide a complete breakdown of all components, by weight and by cost.
  - h. Identification (Yes/No) of composite wood or agrifiber products used in the project that are free of added urea-added formaldehyde resins.
  - i. Identification (Yes/No) of flooring products used in the project that have Carpet and Rug Institute (CRI) Green Label or Green Label Plus certification, or Resilient Floor Covering Institute FloorScore certification.
    - 1) Untreated solid wood flooring, and mineral-based flooring products such as tile, masonry, terrazzo, and cut stone that have no organic-based coatings or sealants, are excluded from this requirement.
  - j. The EBMCF shall record the above information only for those materials or products permanently installed in the project. The EBMCF shall record VOC content, composite and agrifiber products, and CRI or FloorScore ratings only for those materials or products permanently installed within the weather barrier of the LEED building.
2. **EBMCF BACK-UP DOCUMENTATION:** These documents are used to validate the information provided on the EBMCF (except cost data). For each material listed on the EBMCF, provide documentation to certify the material's LEED BUILDING attributes, as applicable:
- a. **RECYCLED CONTENT:** Provide published product literature or letter of certification on the manufacturer's letterhead certifying the amounts of post-consumer and/or post-industrial content.
  - b. **REGIONAL MANUFACTURING AND REGIONAL RAW MATERIALS (WITHIN 500 MILES):** Provide published product literature or letter of certification on the manufacturer's letterhead indicating the city/state where the manufacturing plant is located, where each of the raw materials in the product were extracted, harvested or recovered and the distance in miles from the project site.
    - 1) If only some of the raw materials for a particular product or assembly originate within 500 miles of the project site, provide the percentage (by weight) that these materials comprise in the complete product.
  - c. **VOC CONTENT:** Provide Material Safety Data Sheets (MSDS) certifying the Volatile Organic Compound (VOC) content of the adhesive, sealant, paint, or coating products. VOC content is to be reported in grams/liter or lbs./gallon, less water. If the MSDS does not show the product's VOC content, this information must be provided through other published product literature from the manufacturer, or stated in a letter of certification from the product manufacturer on the manufacturer's letterhead.
  - d. **RAPIDLY RENEWABLE MATERIALS:** If used in the project, provide published literature or letter of certification on the manufacturer's letterhead certifying the percentage of each product that is rapidly renewable (by weight).
3. **PRODUCT CUT SHEETS:** Provide product cut sheets with the Contractor's or sub-contractor's stamp, confirming that the submitted products are the products installed in the Project.
4. **CRI GREEN LABEL PLUS CERTIFICATION:** For carpets and carpet cushions, provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products comply with the "Green Label Plus" IAQ testing program of the Carpet and Rug Institute of Dalton, GA.



5. **CERTIFICATION OF COMPOSITE WOOD OR AGRIFIBER RESINS:** For all composite wood, engineered wood and agrifiber products (including plywood, particleboard, and medium density fiberboard), provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products do not contain added urea-formaldehyde resins.
6. **CERTIFICATION OF COMPOSITE WOOD OR AGRIFIBER LAMINATING ADHESIVES:** For all laminating adhesives used with composite wood, engineered wood and agrifiber products (e.g., adhesives used to laminate wood veneers to an engineered wood substrate), provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the adhesive products do not contain urea-formaldehyde.
7. **FSC-CERTIFIED WOOD:**
  - a. If used in the project, provide chain of custody documents and copies of invoices regarding wood products, including whether or not such wood product is FSC-certified.
  - b. If used in the project, for assemblies, provide the percentage (by cost and by weight) of the assembly that is FSC-certified wood.
  - c. If used in the project, for assemblies, provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the percentage that is FSC-certified wood.
8. **GREEN SEAL COMPLIANCE:** Provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the following product types comply with the VOC limits and chemical component restrictions developed by the Green Seal organization of Washington, DC:
  - a. Interior Architectural Paints and Coatings: refer to Green Seal standard GS-11 (1<sup>st</sup> edition, May 1993)
  - b. Anti-corrosive and Anti-rust paints: refer to Green Seal standard GC-03 (2<sup>nd</sup> Edition, January 1997)
  - c. Aerosol Adhesives: refer to Green Seal standard GS-36 (1<sup>st</sup> edition, October 2000)
9. **HIGH ALBEDO PAVING AND WALKWAY MATERIALS:** For paving and walkway materials made from concrete or brick provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying a minimum Solar Reflectance Index (SRI) value of 29. SRI values shall be calculated according to ASTM E 1980. Reflectance shall be measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance shall be measured according to ASTM E 408 or ASTM C 1371.
10. **HIGH ALBEDO ROOFING MATERIALS:** For exposed roofing membranes, pavers, and ballast products, provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the following minimum Solar Reflectance Index (SRI) values:
  - a. 78 for low-sloped roofing applications (slope  $\leq$  2:12)
  - b. 29 for steep-sloped roofing applications (slope  $>$  2:12)

SRI values shall be calculated according to ASTM E 1980. Reflectance shall be measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance shall be measured according to ASTM E 408 or ASTM C 1371.

Vegetated roof surfaces are exempt from the SRI criteria.
11. **LOW MERCURY LAMPS:** For all fluorescent, compact fluorescent, and HID lamps installed in the project, provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying:
  - a. The mercury content or content range per lamp in milligrams or picograms;
  - b. The design light output per lamp (light at 40% of a lamp's useful life) in lumens; and
  - c. The rated average life of the lamp in hours.



In addition, provide the total number of each lamp type installed in the project.

12. **FLOORSCORE CERTIFICATION:** For all hard surface flooring, including vinyl, linoleum, laminate flooring, wood flooring, ceramic flooring, rubber flooring, and wall base, provide published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying that the products comply with the current FloorScore standard requirements.
13. **CONCRETE:** Provide concrete mix design for each mix, designated by a distinct identifying code or number and signed by a Professional Engineer licensed in the state in which the concrete manufacturer or supplier is located.
14. **INTERIOR LIGHTING FIXTURES:** For each lighting fixture type installed within the building's weather barrier, provide manufacturer's cut sheets indicating the following:
  - a. Fixture power in watts.
  - b. Initial lamp lumens.
  - c. Photometric distribution data.
  - d. Dimming capability, in range of percentages.
15. **EXTERIOR LIGHTING FIXTURES:** For each lighting fixture type installed on site, provide manufacturer's cut sheets indicating the following:
  - a. Fixture power in watts.
  - b. Initial lamp lumens.
  - c. Photometric distribution data.
  - d. Range of field adjustability, if any.
  - e. Warranty of suitability for exterior use.
16. **ALTERNATIVE TRANSPORTATION:** Provide manufacturer's cut sheets and/or shop drawings for the following items installed on site:
  - a. Bike racks, including total number of bicycle slots provided.
  - b. Signage indicating parking spaces reserved for electric or low-emitting vehicles and for carpools/vanpools, including total number of signs.
17. **WATER CONSERVING FIXTURES:** For all water consuming plumbing fixtures and fittings, provide manufacturer's cut sheets showing maximum flow rates and/or flush rates.
18. **ENERGY SAVING APPLIANCES:** Provide manufacturer's cut sheets and published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the product's rating under the U.S. EPA/DOE Energy Star program, for all of the following:
  - a. Appliances (i.e., refrigerators, dishwashers, microwave ovens, televisions, clothes washers, clothes dryers, chilled water dispensers).
  - b. Office equipment (i.e., copy machines, fax machines, plotters/printers, scanners, binding and publishing equipment).
  - c. Electronics (i.e., servers, desktop computers, computer monitor displays, laptop computers, network equipment).
  - d. Commercial food service equipment
19. **GLAZING:** For glazing in any windows, doors, storefront and window wall systems, curtainwall systems, skylights, and partitions, provide manufacturer's cut sheets indicating the following:
  - a. Glazed area.
  - b. Visible light transmittance.
  - c. Solar heat gain coefficient.
  - d. Fenestration assembly u-factor.



20. VENTILATION: Provide manufacturer's cut sheets for the following:
- Carbon dioxide monitoring systems, if any, installed to measure outside air delivery.
  - Air filters: for detailed requirements refer to Section 01 81 19 INDOOR AIR QUALITY REQUIREMENTS.
21. REFRIGERATION: For all refrigeration equipment, provide manufacturer's cut sheets indicating the following:
- Equipment type.
  - Equipment life. Default values specified by the 2007 ASHRAE Applications Handbook will be used unless otherwise demonstrated by the manufacturer's guarantee and an equivalent long-term service contract.
  - Refrigerant type.
  - Refrigerant charge in pounds of refrigerant per ton of gross cooling capacity.
  - Tested refrigerant leakage rate, in percent per year. A default rate of 2% will be used unless otherwise demonstrated by test data.
  - Tested end-of-life refrigerant loss, in percent. A default rate of 10% will be used unless otherwise demonstrated by test data.

#### **1.7 LEED BUILDING SUBMITTAL REQUIREMENTS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per contract specification section(s) (or per subcontractor), and submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES. Incomplete or inaccurate LEED BUILDING submittals may be used as the basis for the rejection of products or assemblies. Incomplete or inaccurate LEED BUILDING Submittals may be used as the basis for rejecting the submitted products or assemblies.

#### **1.8 LEED ACTION PLANS:**

- A. Construction Waste Management Plan- Refer to Section 01 74 19, Construction Waste Management and Disposal for detailed submittal requirements.
- B. Construction IAQ Management Plan- Refer to Section 01 81 19, Indoor Air Quality Requirements for LEED Buildings, for detailed submittal requirements.
- C. Erosion and Sedimentation Control Plan:
- The Plan shall be in accordance with the New York State Department of Environmental Conservation (NYSDEC) or the 2003 EPA Construction General Permit, whichever is more stringent.
  - The Plan shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEEDURES.
  - Detailed requirements: ESC Plan
    - Include the Stormwater Pollution Prevention Plan, if required.
    - Identify the party responsible for Plan monitoring and documentation. The party must be regularly on site.
    - Describe all site work that will be implemented on the project.
    - Provide site plan with location of ESC measures, including, but not limited to, stormwater quantity controls, stormwater quality controls, stabilized construction entrances, washdown areas, and inlet/catch basin protection.
    - Describe the inspection and maintenance of the ESC measures. Provide a construction schedule indicating weekly site review.
    - Describe reporting and documentation measures.
  - Detailed requirements: ESC Measures



5. Submittal requirements: ESC Tracking Log
  - a. Note date of major rain events, describe damage, describe any repairs or maintenance performed, and note responsible party.
  - b. Note date and findings of weekly site review, describe any repairs or maintenance performed, and note responsible party.
  - c. Submit monthly.
6. Implementation
  - a. The Contractor shall implement the ESC Plan, coordinate the Plan with all affected trades, and designate one individual as the Erosion and Sedimentation Control Representative, who will be responsible for communicating the progress of the Plan with the Commissioner on a regular basis, and for assembling the required LEED documentation.
  - b. The Contractor shall be responsible for the provision, maintenance, and repair of all ESC measures.
  - c. Demonstration. The Contractor shall provide on-site instruction of proper construction practices required to prevent erosion and sedimentation.
  - d. Meetings. Urgent or ongoing ESC issues shall be discussed at weekly on-site job meetings.

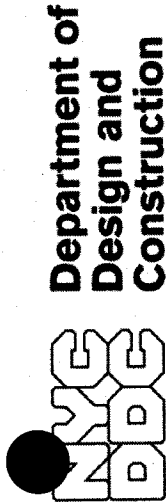
#### **1.9 QUALITY ASSURANCE:**

- A. The Contractor shall implement all LEED Action Plans, coordinate the Plans and LEED Building Submittals with all affected trades, and designate one individual as the Sustainable Construction Representative at no additional cost to the City of New York, who will be responsible for communicating the progress of LEED activities with the Commissioner on a regular basis, and for assembling the required LEED documentation.
- B. Responsibilities of Contractor's Subcontractors: The Contractor shall be responsible for his/her subcontractors complying with the LEED Action Plans and for providing required LEED documentation as required for the project.
- C. Distribution and Compilation: The Contractor shall be responsible for distributing the EBMCF and any other forms or templates required for the subcontractors to record LEED documentation. The Contractor shall also be responsible for collecting and compiling EBMCF information into packages as described in Section 01 33 00 SUBMITTAL PROCEDURES.
- D. Meetings: Sustainable design and construction issues shall be discussed at the following meetings:
  1. Demolition kick-off meeting
  2. Construction kick-off meeting
  3. Construction kick-off meeting for LEED (independent meeting)
  4. Weekly job-site progress and coordination meetings
  5. Closeout meeting

#### **PART II – PRODUCTS (Not Used)**

#### **PART III – EXECUTION (Not Used)**

**END OF SECTION 01 81 13.03**



ENVIRONMENTAL BUILDING MATERIALS CERTIFICATION FORM

Contractor Name: \_\_\_\_\_  
Contractor Contact: \_\_\_\_\_  
Telephone Number: \_\_\_\_\_

Project Name: \_\_\_\_\_  
Project I.D.: \_\_\_\_\_

Product/Manufacturer	Recycled Content		Regional <sup>4</sup>		Rapidly Renewable <sup>7</sup>		VOC content <sup>8</sup>		Flooring <sup>9</sup>		Wood	
	Material Cost <sup>1</sup>	Pre-Consumer (% by wt) <sup>2</sup>	Post-Consumer (% by wt) <sup>3</sup>	Total % Pre-Consumer (1/2 Pre + Post)	Location & Distance to Manufacture <sup>6</sup>	Extracted & Manuf. (% by wt)	Material	% by wt listed	*VOC content allowed	*Green Label or FloorScore	*Added urea formaldehyde (Yes/No) <sup>10</sup>	FSC Certified <sup>11</sup> (% by wt)

<sup>1</sup> **Material Cost:** As it appears on the manufacturer's invoice to the contractor or subcontractor. Does not include labor or equipment costs associated with installation.

<sup>2</sup> **Pre-Consumer Recycled Content:** Industrial/manufacturing waste material (e.g., fly-ash and synthetic gypsum, both waste products from coal burning electricity plants) diverted from landfill and incorporated into a finished product. Scrap raw materials that can be reused in the same manufacturing process from which they are recovered are not considered Pre-Consumer Recycled Content.

<sup>3</sup> **Post-Consumer Recycled Content:** Material or product that has served its intended consumer use (e.g., an empty plastic bottle) and has been diverted from landfill and incorporated into a finished product.

<sup>4</sup> **Regional:** Refers to a material/product that is BOTH extracted AND manufactured within 500 miles of the Project site. Record this information ONLY for materials/products meeting BOTH of these criteria.

<sup>5</sup> **Extraction:** Refers to the location from which the raw resources used in a building product are extracted, harvested, or recovered.

<sup>6</sup> **Manufacture:** Refers to the location of the final assembly of components into a building product that is furnished and installed by the Contractor.

<sup>7</sup> **Rapidly Renewable:** Refers to materials/products derived from agricultural products that are typically harvested within a ten-year or shorter cycle.

<sup>8</sup> **VOC Content:** The quantity of volatile organic compounds contained in adhesives, sealants, paints and architectural coatings. Reported in grams/liter or lbs/gallon, less water.

<sup>9</sup> **Flooring:** For carpet, indicate Carpet and Rug Institute (CRI) Green Label Plus certification. For carpet cushion, indicate CRI Green Label certification. For all flooring except unfinished/unreated wood and mineral-based flooring (tile, masonry, terrazzo, cut stone) without organic-based coatings or sealants, indicate Resilient Floor Covering Institute FloorScore rating. VOC limits for adhesives, sealants, etc. still apply.

<sup>10</sup> **Added Urea Formaldehyde:** Applies to composite wood and agrifiber products only (plywood, particleboard, MDF, OSB, wheatboard, strawboard). Resins or binders with added urea formaldehyde are prohibited.

<sup>11</sup> **FSC Certified:** Certification from the Forest Stewardship Council. This column is only applicable to wood products.

\* Applies only to materials/products installed within the weather barrier.

Contractor Certification: \_\_\_\_\_ a duly authorized representative of \_\_\_\_\_ (the Contractor) hereby certify that the material information contained herein is an accurate representation of the material qualifications to be provided by the Contractor as components of the final building construction. Furthermore, I understand that any change in such qualifications during the purchasing period will require prior written approval from the Commissioner.

Signature of Authorized Representative: \_\_\_\_\_ Date: \_\_\_\_\_



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**SECTION 01 81 13.04**

**SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 81 13.04**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

**A. LEED BUILDING - GENERAL REQUIREMENTS:**

The City of New York is committed to implementing good environmental practices and procedures which include achieving a LEED™ Green Building rating. Specific Project requirements related to this goal are listed in the applicable paragraphs of this section of the General Conditions. The Contractor shall ensure that these requirements as defined in the sections below and in related sections of the Contract Documents, are implemented to the fullest extent. Substitutions, or other changes to the work proposed by the Contractor or their Subcontractors, shall not be allowed if such changes compromise the stated LEED BUILDING criteria.

**B. This Section includes:**

1. Definitions
2. LEED Provisions
3. LEED Building Submittals
4. LEED Building Submittal Requirements
5. LEED Action Plan
6. VOC Requirements for Interior Adhesives and Sealants
7. VOC Requirements for Interior Paints and Coatings
8. Low-Emitting Materials, Flooring
9. Low-Emitting Materials, Composite Wood
10. Low-Emitting Materials, Ceilings, Walls, Thermals and Acoustic Insulation
11. Low-Emitting Materials, Furniture
12. Low-Emitting Materials, Exterior Applied Products
13. Low-Emitting Materials, Additional Low-Emitting Requirements

**C. This Section includes requirements for Volatile Organic Compound (VOC) emissions and content in specific materials used within the Project.**

**D. All sections in the Project Specifications with adhesives, sealant or sealant primer applications, paints, coatings, flooring, composite wood, ceilings, walls, thermal and acoustic insulation, furniture, and for healthcare and schools, exterior applied products, shall follow all requirements of this section. In the event of any conflict or inconsistency between this section and the Specifications regarding adhesives, sealant or sealant applications, paints, coatings, flooring, composite wood, ceilings, walls, thermal and acoustic insulation, furniture, and for healthcare and schools, exterior applied products, the requirements set forth in this Section shall prevail.**





**1.3 RELATED SECTIONS:** Include without limitation the following:

- |    |                  |   |
|----|------------------|---|
| A. | Section 01 74 19 | CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL                |
| B. | Section 01 81 19 | INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS        |
| C. | Section 01 91 13 | GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS        |
| D. | Section 01 91 15 | GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE |

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Adhesive: Any substance used to bond one surface to another by attachment. Includes adhesive primers and adhesive bonding primers.
- C. Aerosol Adhesive: Any adhesive packaged as an aerosol with a spray mechanism permanently housed in a non-refillable can designed for hand-held application without the need for ancillary equipment.
- D. Agrifiber Products: Products derived from recovered agricultural waste fiber from sources such as cereal straw, sugarcane bagasse, sunflower husk, walnut shells, coconut husks and agricultural prunings, processed and mixed with resins to produce panels with characteristics similar to composite wood.
- E. Bio-based materials: Composed in whole or in significant part of biological products, renewable agricultural materials or forestry materials, and must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. Exclude hide products, such as leather and other animal skin material.
- F. Building Exterior: A structure's primary and secondary weatherproofing system, including waterproofing membranes and air- and water-resistant barrier materials, and all building elements outside that system.
- G. Building Interior: Everything inside a structure's weatherproofing membrane.
- H. Carcinogen: A chemical listed as a known, probable, reasonably anticipated, or possible human carcinogen by the International Agency for Research on Cancer (IARC) (Groups 1, 2A, and 2B), the National Toxicology Program (NTP) (Groups 1 and 2), the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) (weight-of-evidence classifications A, B1, B2, and C, carcinogenic, likely to be carcinogenic, and suggestive evidence of carcinogenicity or carcinogen potential), or the Occupational Safety and Health Administration (OSHA).
- I. Certified Wood: See Forest Stewardship Council (FSC) Certified Wood.
- J. Clear Wood Finish: Clear/semi-transparent coating applied to wood substrates to provide a transparent or translucent solid film.
- K. Coating: Liquid, liquefiable or mastic composition that is converted to a solid adherent film after application to a substrate as a thin layer; and is used for decorating, protecting, identifying or to serve some functional purpose such as the filling or concealing of surface irregularities or the modification of light and heat radiation characteristics; and is intended for on-site application to interior or exterior surfaces of buildings. Does not include stains, clear finishes, recycled latex paint, specialty (industrial, marine or automotive) coatings or paint sold in aerosol cans.



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- L. Composite Wood: Products composed of wood or plant particles or fibers bonded by a synthetic resin or binder to produce panels such as plywood, particleboard, and medium density fiberboard (MDF). Does not include hardboard, structural panels, glued laminated timber, prefabricated wood I-joists or finger-jointed lumber.
- M. Cradle-to-Gate Assessment: Analysis of a product's partial life cycle, from resource extraction to the factory gate, before it is transported for distribution and sale.
- N. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- O. Enclosure: The exterior plus semi-exterior portions of the building. Exterior consists of the elements of a building that separate conditioned spaces from the outside (i.e., the wall assembly). Semi-exterior consists of the elements of a building that separate conditioned space from unconditioned space or that encloses semi-heated space through which thermal energy may be transferred to or from the exterior or conditioned or unconditioned spaces (e.g., attic, crawl space, basement).
- P. Environmental Product Declaration (EPD): A statement that the item meets the environmental requirements of, ISO 14025, 14040 and EN 15804, or ISO 21930 and have at least a cradle-to-gate scope.
- Q. Extended Producer Responsibility: A waste management strategy, also known as closed-loop program or product take-back, where the manufacturer's responsibility for a product is extended to the post-consumer stage of the product's life-cycle.
- R. Floor Coating: Opaque coating applied to flooring. Excludes industrial maintenance coatings.
- S. Forest Stewardship Council (FSC) Certified Wood: Wood-based materials and products certified in accordance with the Forest Stewardship Council's principles and criteria.
- T. Hazardous Air Pollutant: Any compound listed by the U.S. EPA in the Clean Air Act Section 112(b)(1) as a hazardous air pollutant.
- U. Inherently Non-Emitting Materials: Products that are inherently non-emitting sources of VOCs, including stone, ceramic, powder-coated metals, plated or anodized metals, lass, concrete, clay brick, unfinished solid wood, untreated solid wood. These materials are considered compliant without VOC testing if they do not include integral organic-based surface coatings, binders or sealants.
- V. Lacquer: Clear/semi-transparent coating formulated with cellulosic or synthetic resins to dry by evaporation without chemical reaction and provide a solid, protective film.
- W. LEED: The Leadership in Energy & Environmental Design rating system developed by the United States Green Building Council (USGBC).
- X. Life-Cycle Assessment: An evaluation of the environmental effects of a product from cradle to grave, as defined by ISO 14040-2006 and ISO 14044-2006.
- Y. Mutagen: A chemical that meets the criteria for category 1, chemicals known to induce heritable mutations or to be regarding as if they induce heritable mutations in the germ cells of humans, under the Harmonized



System for the Classification of Chemicals Which Cause Mutations in Germ Cells (United Nations Economic Commission for Europe, Globally Harmonized System of Classification and Labeling of Chemicals).

- Z. Ozone-Depleting Compounds: A compound with an ozone-depletion potential greater than 0.1 (CFC 11=1) according to the U.S. EPA list of Class I and Class II Ozone-Depleting Substances.
- AA. Paint: A pigmented coating. For the purposes of this specification, paint primers are considered to be paints.
  - a. Flat Coating or Paint: Has a gloss of less than 15 (using an 85-degree meter) or less than 5 (using a 60-degree meter).
  - b. Non-Flat Coating or Paint: Has a gloss of greater than or equal to 15 (using an 85-degree meter) or greater than or equal to 5 (using a 60-degree meter).
  - c. Non-Flat High-Gloss Coating or Paint: Has a gloss of greater than or equal to 70 (using a 60-degree meter).
  - d. Anti-Corrosive / Rust Preventative Paint: Coating formulated and recommended for use in preventing the corrosion of ferrous metal substrates.
- BB. Permanently Installed Building Product: See Product.
- CC. Primer: Coating that is formulated and recommended for one or more of the following purposes: to provide a firm bond between the substrate and a subsequent coating; to prevent a subsequent coating from being absorbed into the substrate; to prevent harm to a subsequent coating from materials in the substrate; or to provide a smooth surface for application of a subsequent coating.
- DD. Product: An item that arrives on the Project site either as a finished element ready for installation or as a component to another item assembled on-site. The product unit is defined by the functional requirement for use in the Project; this includes the physical components and services needed to serve the intended function of the permanently installed building product. Similar products within a specification shall each contribute as a separate product.
- EE. Product-Specific Declaration: Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle-to-gate scope.
- FF. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer) or after consumer use (post-consumer). Recycled content claims for products must conform to the definition in ISO 14021-1999, Environmental Labels and Declarations, Self-Declared Environmental Claims (Type II Environmental Labeling).
  - a. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
  - b. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.
  - c. "Pre-consumer" may also be referred to as "post-industrial".
- GG. Regionally Manufactured Materials: Materials that are manufactured, distributed and purchased within a radius of 100 miles from the Project location. Manufacturing refers to all points of manufacture for an assembly of components.
- HH. Regionally Extracted, Harvested, or Recovered Materials: Materials which are extracted, harvested or recovered, manufactured, distributed and purchased within a radius of 100 miles from the Project site.



- II. Reproductive Toxin: A chemical listed as a reproductive toxin (including developmental, female, and male toxins) by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (California Code of Regulations, Title 22, Division 2, Subdivision 1, Chapter 3, Sections 1200, et. Seq.).
- JJ. Sanding Sealer: Clear/semi-transparent coating formulated to seal bare wood. Can be abraded to create a smooth surface for subsequent coatings. Does not include sanding sealers that are lacquers (see Clear Wood Finish above).
- KK. Sealant: Any material with adhesive properties, formulated primarily to fill, seal, or waterproof gaps or joints between surfaces. Includes sealant primers and caulks.
- LL. Shellac: Clear or pigmented coating formulated solely with the resinous secretions of the lac beetle, thinned with alcohol and formulated to dry by evaporation without chemical reaction. Excludes floor applications.
- MM. Solar Reflectance Index (SRI): A measure of a material's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is equal to 0, and a standard white (reflectance 0.80, emittance of 0.90) is equal to 100.
- NN. Stain: Clear semi-transparent/opaque coating formulated to change the color but not conceal the grain pattern or texture of the substrate.
- OO. Varnish: Clear/semi-transparent coating, excluding lacquers and shellacs, formulated to dry by chemical reaction on exposure to air. May contain small amounts of pigment.
- PP. Volatile Aromatic Compound: Any hydrocarbon compound containing one or more 6-carbone benzene rings, and having an initial boiling point less than or equal to 280 degrees Celsius measured at standard conditions of temperature and pressure.
- QQ. Volatile Organic Compound (VOC): Any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate) which vaporizes (becomes a gas) and participates in atmospheric photochemical reactions, as specified in Part 51.00 of Chapter 40 of the U.S. Code of Federal Regulations, at normal room temperatures. For the purposes of this specification, formaldehyde and acetaldehyde are considered to be VOCs. Waterproofing Sealer: A coating that prevents the penetration of water into porous substrates.

## **1.5 LEED PROVISIONS:**

- A. Refer to the Addendum for the LEED rating to be achieved for this Project. The provisions to achieve this LEED rating are integrated within the Project construction documents and specifications. Additional LEED requirements are met through aspects of the Project design, including material and equipment selections, which may not be specifically identified as LEED Building requirements. Compliance with the requirements needed to obtain LEED prerequisites and credits will be used as one criterion to evaluate substitution requests.

## **1.6 LEED BUILDING SUBMITTALS:**

- A. Scope: LEED Building Submittals are required for all permanently installed materials included in General Construction work. For Plumbing, Mechanical and Electrical work, LEED Building Submittals are only required for field-applied adhesives, sealants, paints and coatings. Voluntary inclusion of system components such as piping, pipe insulation, ducts, conduits, plumbing fixtures, faucets and lamp housings shall be consistently applied to the Project's LEED credits. Submit all required LEED Building Submittals in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.



- B. Applicability: The extent of the LEED Building Submittals varies depending on the specification section. Applicable LEED Building Submittals are listed under the "LEED Building Submittals" heading in each specification section. The detailed requirements for the LEED Building Submittals are defined in Sub-Section 1.6 C below.
- C. Detailed Requirements: Sub-Sections 1.6 C.1 through 1.6 C.18 below define the information and documents to be submitted for each type of LEED Building Submittal as identified in the LEED Building Submittals heading in each specification section:
1. LEED v4 Material and Resources (MR) Credits Calculator for Building Product Disclosure and Optimization (Disclosure and Optimization Calculator): With each submittal of a product permanently installed in the Project, the Contractor shall be responsible for the completion of the Disclosure and Optimization Calculator, which can be found on USGBC's website. The Contractor shall maintain an updated Disclosure and Optimization Calculator for all applicable products throughout the Project duration and submit the updated calculator on a monthly basis.
    - a. The Disclosure and Optimization Calculator shall record the information outlined in Items b.-c. below for all permanently installed products, the information outlined in Item d. below for all permanently installed concrete mixes, and the information outlined in Items e.-i. below for all permanently installed products that have the content, disclosure or optimization characteristics described herein:
    - b. Cost breakdowns for the materials included in the contractor or sub-contractor's scope of work. Cost reporting shall include itemized material costs (excluding the contractor's labor, equipment, overhead and profit).
    - c. The percentages (by weight) of post-consumer and/or post-industrial recycled content in the supplied product(s).
      - 1) For each product with recycled content, also indicate the total recycled content value ( $\frac{1}{2} \times \text{pre-consumer percentage} \times \text{product value} + 1 \times \text{post-consumer percentage} \times \text{product value} = \text{total recycled content value}$ ).
      - 2) See additional requirements for concrete in section 1.6.C.1.d below.
    - d. The percentage (by weight), relative to the total weight of cementitious materials, of supplementary cementitious materials or pozzolans such as fly ash used in each concrete mix used in the Project.
      - 1) For each concrete mix, submit a complete breakdown of all components, by weight and by cost.
    - e. Identification (Yes/No) of materials manufactured, distributed and purchased within 100 miles of the Project site AND containing raw materials harvested or extracted within 100 miles of the Project site, if used in the Project, as well as the following information:
      - 1) Indicate the percentage by weight, relative to the total weight of the product that meets these criteria.
      - 2) Indicate the point of harvest/extraction/recovery of regional raw materials, the point of final assembly of regional manufactured products, and the distance from each point to the Project site.
    - f. The percentage (by cost) of "Forest Stewardship Council (FSC) Certified" wood products, if used in the Project.
      - 1) Record all new wood products, indicating which are FSC-certified. Do not record reclaimed, salvaged, or recycled FSC-certified wood products.
      - 2) Reclaimed, salvaged, or recycled FSC-certified wood may be recorded as post-consumer recycled content.
    - g. The number or percentage of products with Environmental Product Declarations (EPD), with fractional or multiplied values as indicated below. If a product used in the Project has an EPD Declaration, submit one of the following:
      - 1) EPD:



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- i. Product-Specific Declaration: Valued as one quarter (1/4) of a product
    - ii. Industry-Wide (Generic) EPD: Valued as one half (1/2) of a product
    - iii. Product-Specific Type III EPD: Valued as one whole product
  - 2) Documentation of third-party certification of impact reduction below industry average for at least three of the following categories, valued at 100%:
    - i. Global warming potential (greenhouse gases), in CO<sub>2</sub>e;
    - ii. Depletion of the stratospheric ozone layer, in kg CFC-11;
    - iii. Acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;
    - iv. Eutrophication, in kg nitrogen or kg phosphate;
    - v. Formation of tropospheric ozone, in kg NO<sub>x</sub> or kg ethene; and depletion of nonrenewable energy resources, in MJ.
  - 3) For 1) and 2) above, if a product is also sourced (extracted, manufactured, purchased) within 100 miles of the site, it is valued as two times the whole product.
  - 4) For 1) and 2) above, structure and enclosure materials may not constitute more than 30% of the value of compliant building products.
- h. The number or percentage of products for which Sourcing of Raw Materials has been documented, with fractional or multiplied values as indicated below. If a product used in the Project has documented Sourcing of Raw Materials, submit one of the following:
  - 1) Corporate sustainability report (CSR). Submit one of the following:
    - i. Manufacturer's self-declared report: valued as half of a product
    - ii. Third-party verified CSR which include environmental impacts of extraction operations and activities associated with the manufacturer's product and the product's supply chain: valued as one whole product:
      1. Global Reporting Initiative (GRI) Sustainability Report
      2. Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises
      3. U.N. Global Compact: Communication of Progress
      4. ISO 26000: 2010 Guidance on Social Responsibility
      5. Other USGBC approved programs meeting the CSR criteria
  - 2) Documentation of at least one of the responsible extraction criteria below:
    - i. Extended producer responsibility program, valued as half of a product
    - ii. Bio-based materials, valued as one whole product
    - iii. Certified Wood: Wood-based materials include all materials made from wood, including engineered wood products and wood-based panel products, valued as one whole product
    - iv. Material Reuse: Materials may be salvaged, refurbished, or reused, valued as one whole product.
    - v. Recycled content. The sum of post-consumer recycled content plus one-half the pre-consumer recycled content, based on cost, valued as one whole product.
    - vi. Other USGBC approved programs meeting leadership extraction criteria
  - 3) For 1) and 2) above, if a product is also sourced (extracted, manufactured, purchased) within 100 miles of the site: valued as two times the whole product.
  - 4) For 1) and 2) above, structure and enclosure materials may not constitute more than 30% of the value of compliant building products. Products meeting multiple criteria may only be counted once.



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- i. The number or percentage of products for which Material Ingredients have been disclosed, with fractional or multiplied values as indicated below. If a product used in the Project discloses its Material Ingredients, submit one of the following:
  - 1) Chemical inventory of the product to at least 0.1% (1000 ppm), documented by one of the following:
    - i. Manufacturer Inventory
    - ii. Health Product Declarations (HPDs)
    - iii. Cradle to Cradle (C2C) certifications
    - iv. Declare product labels
    - v. ANSI/BIFMA e3 Furniture Sustainability Standard (Furniture may be included, providing it is included consistently in all MR Credits.)
  - 2) Documentation of compliance with one of the following material ingredient optimization criteria programs:
    - i. GreenScreen benchmarks
    - ii. Cradle to Cradle certifications
    - iii. REACH optimizations
    - iv. Other USGBC approved programs meeting building product optimization criteria
  - 3) Documentation that the product is sourced from a manufacturer that meets all of the below supply chain optimization criteria:
    - i. Manufacturer engages in validated and robust safety, health, hazard and risk programs which at a minimum document at least 99% (by weight) of the ingredients used to make the building product or building material
    - ii. Manufacturer provides independent third party verification of the following conditions for their supply chain, at a minimum:
      1. Processes are in place to communicate and transparently prioritize chemical ingredients along the supply chain according to available hazard, exposure and use information to identify those that require more detailed evaluation
      2. Processes are in place to identify, document, and communicate information on health, safety and environmental characteristics of chemical ingredients
      3. Processes are in place to implement measures to manage the health, safety and environmental hazard and risk of chemical ingredients
      4. Processes are in place to optimize health, safety and environmental impacts when designing and improving chemical ingredients
      5. Processes are in place to communicate, receive and evaluate chemical ingredient safety and stewardship information along the supply chain
      6. Safety and stewardship information about the chemical ingredients is publicly available from all points along the supply chain
  - 4) For 2) and 3) above, if a product is also sourced (extracted, manufactured, purchased) within 100 miles of the site: valued as two times the whole product. Products compliant with both 2) and 3) may only be counted once.
  - 5) For 1), 2), and 3) above, structure and enclosure materials may not constitute more than 30% of the value of compliant building products.
2. LEED v4 Indoor Environmental Quality Credit Low-Emitting Materials Calculator (EQ Calculator). With each relevant product submittal, the Contractor shall be responsible for the completion of the EQ Calculator, which can be found on USGBC's website. The Contractor shall maintain an updated EQ Calculator throughout the Project duration for all applicable products and submit the updated calculator on a monthly basis.



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- a. The EQ Calculator shall record information for all relevant products as outlined below. Include the following documentation. Detailed requirements are listed in b. – j. below.
  - 1) VOC content of all field-applied interior adhesives, sealants, paints, and coatings, listed in grams/liter or lbs./gallon, less water.
  - 2) General Emissions Evaluation for more than 90 percent of all field-applied interior paints, coatings, adhesives, and sealants, by volume, and for 100 percent of all flooring, ceilings, walls, and thermal and acoustic insulation.
  - 3) Composite Wood Evaluation for all composite wood not covered by other categories.
  - 4) Furniture Evaluation for 90% of all furniture, by cost.
  - 5) For schools/healthcare only: Exterior-Applied Products Evaluation for 90% of all exterior applied materials, measured by volume. All batt insulation products shall contain no added formaldehyde.
- b. VOC REQUIREMENTS, GENERAL: The following materials must meet the listed compliance requirements for emissions and content standards, for all applicable categories. All products shall comply with each applicable threshold requirement. Refer to LEED BD+C Reference Guide, EQ Credit Low-Emitting Materials for additional guidance.
  - 1) General Emissions Requirements: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health (CDPH), Standard Method v1.1-2010, using the applicable exposure scenario, and stating the range of total VOCs (TVOC) after 14 days measured as specified in the CDPH Standard Method v1.1 as follows:
    - i. 0.5mg/m<sup>3</sup> or less;
    - ii. between 0.5 and 5.0 mg/m<sup>3</sup>; or,
    - iii. 0.50 mg/m<sup>3</sup> or more
  - 2) No product shall contain any ingredients that are carcinogens, mutagens, reproductive toxins, persistent bioaccumulative compounds, hazardous air pollutants, or ozone-depleting compounds. An exception shall be made for titanium dioxide and, for products that are pre-tinted by the manufacturer, carbon black, which shall be less than or equal to 1% by weight of the product.
  - 3) No product shall contain the following:
    - i. methylene chloride
    - ii. 1,1,1-trichloroethane
    - iii. benzene
    - iv. toluene
    - v. ethylbenzene
    - vi. vinyl chloride
    - vii. naphthalene
    - viii. 1,2-dichlorobenzene
    - ix. di (2-ethylhexyl) phthalate
    - x. butyl benzyl phthalate
    - xi. di-n-butyl phthalate
    - xii. di-n-octyl phthalate
    - xiii. diethyl phthalate
    - xiv. dimethyl phthalate
    - xv. isophorone
    - xvi. antimony
    - xvii. cadmium
    - xviii. hexavalent chromium
    - xix. lead
    - xx. mercury
    - xxi. formaldehyde





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- xxii. methyl ethyl ketone
- xxiii. methyl isobutyl ketone
- xxiv. acrolein
- xxv. acrylonitrile
- 4) No product shall contain more than 1.0% by weight of sum total of volatile aromatic compounds.
- c. VOC REQUIREMENTS FOR INTERIOR ADHESIVES AND SEALANTS:
  - 1) For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168 requirements in effect on July 1, 2005, and rule amendment date January 7, 2005:

	Allowable VOC Content (g/L):
<b>Architectural Applications:</b>	
Indoor carpet adhesives	50
Carpet pad adhesives	50
Outdoor carpet adhesives	150
Wood flooring adhesives	100
Rubber floor adhesives	60
Subfloor adhesives	50
Ceramic tile adhesives	65
VCT and asphalt tile adhesives	50
Dry wall and panel adhesives	50
Cove base adhesives	50
Multipurpose construction adhesives	70
Structural glazing adhesives	100
Single ply roof membrane adhesives	250
<b>Specialty Applications:</b>	
PVC welding	510
CPVC welding	490
ABS welding	325
Plastic cement welding	250
Adhesive primer for plastic	550
Computer diskette manufacturing	350
Contact adhesive	80
Special purpose contact adhesive	250
Tire retread	100
Adhesive primer for traffic marking tape	150
Structural wood member adhesive	140
Sheet applied rubber lining operations specialty	850
Top and Trim adhesive	250
<b>Substrate Specific Applications:</b>	
Metal to metal substrate specific adhesives	30
Plastic foam substrate specific adhesives	50
Porous material (except wood) substrate specific adhesives	50
Wood substrate specific adhesives	30
Fiberglass substrate specific adhesives	80
<b>Sealants:</b>	
Architectural sealant	250



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Marine deck sealant	760
Nonmember roof sealant	300
Roadway sealant	250
Single-ply roof membrane sealant	450
Other sealant	420
<b>Sealant Primers:</b>	
Architectural non-porous sealant primer	250
Architectural porous sealant primer	775
Modified bituminous sealant primer	500
Marine deck sealant primer	760
Other sealant primer	750
Other	
Other adhesives, adhesive bonding primers, adhesive primers or any other primers	250

- 2) For field applications that are inside the weatherproofing system, a minimum of 90 percent of adhesives and sealants, by volume, shall comply with the requirements of the CDPH "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

**d. VOC REQUIREMENTS FOR INTERIOR PAINTS AND COATINGS:**

- 1) For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the SCAQMD Rule #1113, effective June 3, 2011.

Product Type:	Allowable VOC Content (g/L):
Bond Breaker	350
Clear wood finishes - Varnish	275
Clear wood finishes – Sanding Sealer	275
Clear wood finishes - Lacquer	275
Colorant – Architectural Coatings, excluding IM coatings	50
Colorant – Solvent Based IM	600
Colorant - Waterborne IM	50
Concrete – Curing compounds	100
Concrete – Curing compounds for roadways & bridges	350
Concrete surface retarder	50
Driveway Sealer	50
Dry-fog coatings	50
Faux finishing coatings - Clear topcoat	100
Faux finishing coatings – Decorative Coatings	350
Faux finishing coatings - Glazes	350
Faux finishing coatings - Japan	350
Faux finishing coatings – Trowel applied coatings	50
Fire-proof coatings	150
Flats	50
Floor coatings	50



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Form release compounds	100
Graphic arts (sign) coatings	150
Industrial maintenance coatings	100
Industrial maintenance coatings – High temperature IM coatings	420
Industrial maintenance coatings – Non-sacrificial anti-graffiti coatings	100
Industrial maintenance coatings – Zinc rich IM primers	100
Magnesite cement coatings	450
Mastic coatings	100
Metallic pigmented coatings	150
Multi-color coatings	250
Non-flat coatings	50
Pre-treatment wash primers	420
Primers, sealers and undercoaters	100
Reactive penetrating sealers	350
Recycled coatings	250
Roof coatings	50
Roof coatings, aluminum	100
Roof primers, bituminous	350
Rust preventative coatings	100
Stone consolidant	450
Sacrificial anti-graffiti coatings	50
Shellac- Clear	730
Shellac – Pigmented	550
Specialty primers	100
Stains	100
Stains, interior	250
Swimming pool coatings – repair	340
Swimming pool coatings – other	340
Traffic Coatings	100
Waterproofing sealers	100
Waterproofing concrete/masonry sealers	100
Wood preservatives	350
Low solids coatings	120

- 2) For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the CDPH's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- e. **LOW-EMITTING MATERIALS, FLOORING:** Flooring shall comply with the requirements of the CDPH's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- f. **LOW-EMITTING MATERIALS, COMPOSITE WOOD:** Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the CARB's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
- g. **LOW-EMITTING MATERIALS, CEILINGS, WALLS, THERMAL, AND ACOUSTIC INSULATION:** Ceilings, walls, and thermal and acoustic insulation shall comply with the



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- requirements of the CDPH's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- h. **LOW-EMITTING MATERIALS, FURNITURE:** At least 90 percent of furniture, measured by cost, shall be tested in accordance with ANSI/BIFMA Standard Method M7.1-2011; comply with ANSI/BIFMA e3-2011 Furniture Sustainability Standard, Sections 7.6.1 and 7.6.2, using either the concentration modeling approach or the emissions factor approach; and model the test results using the open plan, private office, or seating scenario in ANSI/BIFMA M7.1, as appropriate.
  - i. **LOW-EMITTING MATERIALS, EXTERIOR APPLIED MATERIALS (HEALTHCARE/ SCHOOLS ONLY):** At least 90 percent of exterior applied materials, measured by volume, shall comply with the requirements of the CDPH's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    - 1) The following materials are prohibited and do not count toward total percentage compliance:
      - a) Hot-mopped asphalt for roofing.
      - b) Coal tar sealants for parking lots and other paved surfaces.
  - j. **LOW-EMITTING MATERIALS, ADDITIONAL LOW-EMITTING REQUIREMENTS:** If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
    - 1) If a product cannot reasonably be tested as specified above, testing of VOC content must comply with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
    - 2) Methylene chloride and perchloroethylene may not be intentionally added in adhesives, sealants, paints or coatings.
3. **BACK-UP DOCUMENTATION:** For each material listed in the Disclosure and Optimization Calculator or the EQ Calculator, provide and submit in accordance with Section 01 33 00 **SUBMITTAL PROCEDURES**, including but not limited to the documentation to certify the material's LEED Building attributes, as applicable:
- a. **RECYCLED CONTENT:** Submit published product literature or letter of certification on the manufacturer's letterhead certifying the amounts of post-consumer and/or post-industrial content.
  - b. **REGIONAL SOURCING (WITHIN 100 MILES):** Submit published product literature or letter of certification on the manufacturer's letterhead indicating the city/state where the manufacturing plant is located, where each of the raw materials in the product were extracted, harvested or recovered, manufactured, distributed and the distance in miles from the Project site.
    - 1) If only some of the raw materials for a particular product or assembly originate within 100 miles of the Project site, provide the percentage (by weight) that these materials comprise in the complete product.
  - c. **BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION:** Submit published third-party or manufacturer's product literature or letter of certification, on the third-party or manufacturer's letterhead, certifying the documented disclosure and optimization information.
  - d. **VOC EMISSIONS AND CONTENT:** Submit Material Safety Data Sheets (MSDS), for all applicable products. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings, flooring, composite wood, ceilings, walls, thermal and acoustic insulation, furniture, and for healthcare and schools, exterior applied products. MSDS shall indicate the VOC emissions and content of products submitted. (If an MSDS does not include a product's VOC emissions and content, then product data sheets, manufacturer literature, or



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a letter of certification from the manufacturer shall be submitted in addition to the MSDS to indicate the VOC emissions and content). Submit product third-party certificates and test reports, stating the testing methodology and the model, to include units that are consistent with those required. For wet-applied products, the manufacturer's documentation must state each product's classification and application according to the referenced standard's definition.

4. **PRODUCT CUT SHEETS:** Submit product cut sheets with the Contractor's or sub-contractor's stamp, confirming that the submitted products are the products installed in the Project.
5. **FSC-CERTIFIED WOOD:** If FSC-Certified Wood is used in the Project, submit:
  - a. Copies of vendor's invoices itemizing all new wood purchases, showing the cost for each line item.
  - b. For FSC-certified products, the vendor invoice shall list product's FSC content percent and its Chain-of-Custody (CoC) certification number.
  - c. For FSC-certified products, submit the product and producer's CoC certificates.
  - d. For FSC-certified products modified on-site, submit on-site installer's CoC certification.
  - e. For assemblies, submit the percentage (by cost and by weight) of the assembly that is FSC-certified wood and published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the percentage that is FSC-certified wood.
6. **HIGH ALBEDO PAVING AND WALKWAY MATERIALS:** For paving and walkway materials made from concrete or brick, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying a minimum 3-year aged Solar Reflectance (SR) value of 0.28. If 3-year aged value information is not available, submit published product literature or letter verifying an initial SR value of at least 0.33 at installation.
7. **HIGH ALBEDO ROOFING MATERIALS:** For exposed roofing membranes, pavers, and ballast products, submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the following minimum Solar Reflectance Index (SRI) values, calculated according to ASTM E 1980. Reflectance shall be measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance shall be measured according to ASTM E 408 or ASTM C 1371. Vegetated roof surfaces are exempt from the SRI criteria.
  - a. 82 for initial SRI, or 64 for 3-year aged SRI for low-sloped roofing applications (slope  $\leq$  2:12)
  - b. 39 for initial SRI or 32 for 3-year aged SRI for steep-sloped roofing applications (slope  $>$  2:12)
8. **LOW MERCURY LAMPS:** For all fluorescent, compact fluorescent and HID lamps installed in the Project, submit the total number of each lamp type and submit published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the following information. Preheat, T-9, T-10 and T-12 fluorescents or mercury vapor high-intensity discharge (HID) lamps shall not be installed in the Project. For healthcare projects only, probe-start metal halide HID lamps shall not be installed in any interior spaces.
  - a. The mercury content or content range per lamp in milligrams or picograms, meeting the following criteria;

Lamp	Maximum Mercury Content (milligram)
T-8 fluorescent, eight-foot	10 mg
T-8 fluorescent, four-foot	3.5 mg
T-8 fluorescent, U-bent	6 mg
T-5 fluorescent, linear	2.5 mg
T-5 fluorescent, circular	9 mg
Compact fluorescent, nonintegral ballast	3.5 mg
Compact fluorescent, integral ballast	3.5 mg, ENERGY STAR qualified
High-pressure sodium, up to 400 watts	10 mg
High-pressure sodium, above 400 watts	32 mg



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- b. The design light output per lamp (light at 40% of a lamp's useful life) in lumens; and
  - c. The rated average life of the lamp in hours.
- 9. **EXIT SIGNS:** Illuminated exit signs shall not contain mercury, and shall use less than 5 watts of electricity.
- 10. **CONCRETE:** Submit concrete mix design for each mix, designated by a distinct identifying code or number and signed by a Professional Engineer licensed in the state of New York.
- 11. **INTERIOR LIGHTING FIXTURES:** For each lighting fixture type installed within the building's weather barrier, submit manufacturer's cut sheets indicating the following:
  - a. Fixture power in watts.
  - b. Initial lamp lumens.
  - c. Photometric distribution data.
  - d. Dimming capability, in range of percentages.
- 12. **EXTERIOR LIGHTING FIXTURES:** For each lighting fixture type installed on site, submit manufacturer's cut sheets indicating the following:
  - a. Fixture power in watts.
  - b. Initial lamp lumens.
  - c. Photometric distribution data.
  - d. Range of field adjustability, if any.
  - e. Warranty of suitability for exterior use.
- 13. **ALTERNATIVE TRANSPORTATION:** Submit manufacturer's cut sheets and/or shop drawings for the following items installed on site:
  - a. Bike racks, including total number of bicycle slots provided.
  - b. Signage indicating parking spaces reserved for electric or low-emitting vehicles and for carpools/vanpools, including total number of signs.
- 14. **WATER CONSERVING FIXTURES:** For all water consuming plumbing fixtures and fittings, submit manufacturer's cut sheets showing maximum flow rates and/or flush rates.
- 15. **ENERGY SAVING APPLIANCES:** Submit manufacturer's cut sheets and published product literature or letter from the manufacturer (on the manufacturer's letterhead) verifying the product's rating under the U.S. EPA/DOE Energy Star program, for all of the following:
  - a. Appliances (i.e., refrigerators, dishwashers, microwave ovens, televisions, clothes washers, clothes dryers, chilled water dispensers).
  - b. Office equipment (i.e., copy machines, fax machines, plotters/printers, scanners, binding and publishing equipment).
  - c. Electronics (i.e., servers, desktop computers, computer monitor displays, laptop computers, network equipment).
  - d. Commercial food service equipment.
- 16. **GLAZING:** For glazing in any windows, doors, storefront and window wall systems, curtainwall systems, skylights, and partitions, submit manufacturer's cut sheets indicating the following:
  - a. Glazed area.
  - b. Visible light transmittance.
  - c. Solar heat gain coefficient.
  - d. Fenestration assembly u-factor.
- 17. **VENTILATION:** Submit manufacturer's cut sheets for the following:
  - a. Carbon dioxide monitoring systems, if any, installed to measure outside air delivery.



- b. Air filters: for detailed requirements refer to Section 01 81 19 INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS.
- 18. REFRIGERATION: For all refrigeration equipment, submit manufacturer's cut sheets indicating the following:
  - a. Equipment type.
  - b. Equipment life. Default values specified by the 2007 ASHRAE Applications Handbook will be used unless otherwise demonstrated by the manufacturer's guarantee and an equivalent long-term service contract.
  - c. Refrigerant type.
  - d. Refrigerant charge in pounds of refrigerant per ton of gross cooling capacity.
  - e. Tested refrigerant leakage rate, in percent per year. A default rate of 2% will be used unless otherwise demonstrated by test data.
  - f. Tested end-of-life refrigerant loss, in percent. A default rate of 10% will be used unless otherwise demonstrated by test data.

#### **1.7 LEED BUILDING SUBMITTAL REQUIREMENTS:**

- A. The LEED Building Submittal information shall be assembled into one package per contract specification section(s) (or per subcontractor), and submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES. Incomplete or inaccurate LEED Building Submittals may be used as the basis for the rejection of products or assemblies.
- B. All final LEED Building Submittal information with back-up documentation shall be submitted within two (2) months of the Project's substantial completion. If in the Project's LEED review, the USGBC or their third party reviewer requires additional documentation as it relates to the LEED Building Submittals, the Contractor shall provide the requested documentation within two (2) weeks.

#### **1.8 LEED ACTION PLANS:**

- A. Construction Waste Management Plan- Refer to Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL for detailed requirements.
- B. Construction IAQ Management Plan- Refer to Section 01 81 19 INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS for detailed requirements.
- C. Erosion and Sedimentation Control (ESC) Plan:
  - 1. The Plan shall be in accordance with the New York State Department of Environmental Conservation (NYSDEC)'s New York State Standards and Specifications for Erosion and Sediment Control (Blue Book) or the 2012 EPA Construction General Permit, whichever is more stringent.
  - 2. The Plan shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.
  - 3. Detailed requirements: ESC Plan
    - a. Include the Stormwater Pollution Prevention Plan, if required.
    - b. Identify the party responsible for Plan monitoring and documentation. The party must be regularly on site.
    - c. Describe all site work that will be implemented on the Project and include timing of implementation.
    - d. Submit site plan with location of ESC measures, including, but not limited to, stormwater quantity controls, stormwater quality controls, stabilized construction entrances, washdown areas, inlet/catch basin protection and perimeter controls.



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- e. Establish and clearly delineate construction buffer zones to avoid soil compaction and other construction damage to greenfields.
  - f. Describe the inspection and maintenance protocols of the ESC measures. Submit a construction schedule indicating weekly site review.
  - g. Describe reporting and documentation measures.
4. Detailed requirements: ESC Tracking Log
  - a. Note date of major rain events, describe damage, describe any repairs or maintenance of specific control measures performed, and note responsible party.
  - b. Note date and findings of weekly site review, describe any repairs or maintenance performed, and note responsible party. Submit date-stamped photographs, inspection reports or other recording processes.
  - c. Submit monthly.
5. Implementation
  - a. Before Demolition and/or Construction begins, the Contractor shall implement the ESC Plan, coordinate the Plan with all affected trades, and designate one individual as the Erosion and Sedimentation Control Representative, who will be responsible for communicating the progress of the Plan with the Commissioner monthly, and for assembling the required LEED documentation.
  - b. The Contractor shall be responsible for the provision, maintenance, and repair of all ESC measures. Any problems identified in site inspections shall be resolved in a timely manner.
  - c. Demonstration. The Contractor shall provide on-site instruction of proper construction practices required to prevent erosion and sedimentation.
  - d. All sub-contractors shall promptly notify the ESC Representative if damage to an ESC measure is observed.
  - e. Meetings. Urgent or ongoing ESC issues shall be discussed at weekly on-site job meetings.
6. All projects, including zero lot line buildings and projects that cause minimal or even no exterior site disturbance, must have ESC Plan that meets requirements.
7. Contractor shall save such original documents for the life of the Project plus seven (7) years.

### 1.9 QUALITY ASSURANCE:

- A. The Contractor shall implement all LEED Action Plans, coordinate the Plans and LEED Building Submittals with all affected trades, and designate one individual as the Sustainable Construction Representative at no additional cost to the City of New York, who will be responsible for communicating the progress of LEED activities with the Commissioner monthly, and for assembling the required LEED documentation. The Contractor shall facilitate measurements taken by authorized parties on site for LEED compliance verification purposes.
- B. Responsibilities of Contractor's Subcontractors: The Contractor shall be responsible for his/her subcontractors complying with the LEED Action Plans and for providing required LEED documentation as required for the Project.
- C. Distribution and Compilation: The Contractor shall be responsible for distributing the LEED v4 MR Credits Calculator for Building Product Disclosure and Optimization, the LEED v4 EQ Credit Low-Emitting Materials Calculator, and any other forms or templates required for the subcontractors to record LEED documentation. The Contractor shall also be responsible for collecting and compiling Building Product Disclosure and Optimization and Low-Emitting Materials information into packages as described in Section 01 33 00 SUBMITTAL PROCEDURES.
- D. Meetings: Sustainable design and construction issues shall be discussed at the following meetings in accordance with Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION:
  1. Demolition kick-off meeting
  2. Construction kick-off meeting
  3. Construction kick-off meeting for LEED (independent meeting)
  4. Weekly job-site progress and coordination meetings





5. Closeout meeting

**1.10 REFERENCES:**

- A. New York State Standards and Specifications for Erosion and Sediment Control, amended November 2016: [http://www.dec.ny.gov/docs/water\\_pdf/2016nysstanec.pdf](http://www.dec.ny.gov/docs/water_pdf/2016nysstanec.pdf)
- B. 2012 EPA Construction General Permit: <https://www.epa.gov/npdes/epas-2012-construction-general-permit-cgp-and-related-documents>
- C. South Coast Air Quality Management District (SCAQMD), Rule 1168: [www.aqmd.gov](http://www.aqmd.gov)
- D. South Coast Air Quality Management District (SCAQMD), Rule 1113: [www.aqmd.gov](http://www.aqmd.gov)
- E. CDPH Standard Method v1.1-2010: [www.cal-iaq.org](http://www.cal-iaq.org)
- F. ISO 17025: [www.iso.org](http://www.iso.org)
- G. ISO Guide 65: [www.iso.org](http://www.iso.org)
- H. CARB 93120 ATCM: [arb.ca.gov/toxics/compwood/compwood.htm](http://arb.ca.gov/toxics/compwood/compwood.htm)
- I. ANSI/BIFMA M7.1 Standard Test Method for Determining VOC Emissions from Office Furniture Systems, Components and Seating: [bifma.org](http://bifma.org)
- J. ANSI/BIFMA e3-2011 Furniture Sustainability Standard: [bifma.org](http://bifma.org)
- K. ISO 14021–1999, Environmental labels and declarations—Self Declared Claims (Type II Environmental Labeling): [iso.org](http://iso.org)
- L. ISO 14025–2006, Environmental labels and declarations (Type III Environmental
- M. Declarations—Principles and Procedures): [iso.org](http://iso.org)
- N. ISO 14040–2006, Environmental management, Life cycle assessment principles, and frameworks: [iso.org](http://iso.org)
- O. ISO 14044–2006, Environmental management, Life cycle assessment requirements, and guidelines: [iso.org](http://iso.org)
- P. International Standard ISO 21930–2007 Sustainability in building construction—Environmental declaration of building products: [iso.org](http://iso.org)
- Q. Federal Trade Commission, Guides for the Use of Environmental Marketing Claims, 16 CFR 260.7 (e): [ftc.gov/bcp/grnrule/guides980427.htm](http://ftc.gov/bcp/grnrule/guides980427.htm)
- R. Global Reporting Initiative (GRI) Sustainability Report: [globalreporting.org/](http://globalreporting.org/)
- S. Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational
- T. Enterprises: [oecd.org/daf/internationalinvestment/guidelinesformultinationalenterprises/](http://oecd.org/daf/internationalinvestment/guidelinesformultinationalenterprises/)
- U. U.N. Global Compact, Communication of Progress: [unglobalcompact.org/cop/](http://unglobalcompact.org/cop/)
- V. ISO 26000—2010 Guidance on Social Responsibility: [iso.org/iso/home/standards/iso26000.htm](http://iso.org/iso/home/standards/iso26000.htm)
- W. Forest Stewardship Council: [ic.fsc.org](http://ic.fsc.org)
- X. Sustainable Agriculture Network: [sanstandards.org](http://sanstandards.org)
- Y. The Rainforest Alliance: [rainforest-alliance.org/](http://rainforest-alliance.org/)
- Z. ASTM Test Method D6866: [astm.org/Standards/D6866.htm](http://astm.org/Standards/D6866.htm)
- AA. Chemical Abstracts Service: [cas.org/](http://cas.org/)
- BB. Health Product Declaration: [hpdcollaborative.org/](http://hpdcollaborative.org/)



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- CC. Cradle-to-Cradle CertifiedCM Product Standard: [c2ccertified.org/product\\_certification](http://c2ccertified.org/product_certification)
- DD. Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH):  
[echa.europa.eu/support/guidance-on-reach-and-clp-implementation](http://echa.europa.eu/support/guidance-on-reach-and-clp-implementation)
- EE. GreenScreen: <https://www.greenscreenchemicals.org/method/greenscreen-list-translator>

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 81 13.04**



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**SECTION 01 81 13.13**

**VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS FOR  
LEED v3 BUILDINGS**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 81 13.13**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY:**

- A. This Section includes requirements for volatile organic compound (VOC) content in adhesives, sealants, paints and coatings used for the project.
- B. All sections in the Project Specifications with adhesives, sealant or sealant primer applications, paints and coatings shall follow all requirements of this section. In the event of any conflict or inconsistency between this section and the Specifications regarding adhesives, sealant or sealant applications, paints and coatings, the requirements set forth in this Section shall prevail.
- C. This Section includes:
1. General Requirements
  2. References
  3. VOC Requirements for Interior Adhesives
  4. VOC Requirements for Interior Sealants
  5. VOC requirements for Interior Paints
  6. VOC requirements for Interior Coatings
  7. Submittals

**1.3 RELATED SECTIONS:** Include without limitation the following:

- |    |                  |   |
|----|------------------|---|
| A. | Section 01 10 00 | SUMMARY   |
| B. | Section 01 31 00 | PROJECT MANAGEMENT AND COORDINATION                   |
| C. | Section 01 32 00 | CONSTRUCTION PROGRESS DOCUMENTATION                   |
| D. | Section 01 33 00 | SUBMITTAL PROCEDURES                                  |
| E. | Section 01 73 00 | EXECUTION   |
| F. | Section 01 77 00 | CLOSEOUT PROCEDURES                                   |
| G. | Section 01 78 39 | CONTRACT RECORD DOCUMENTS                             |
| H. | Section 01 81 13 | SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS |
| I. | Section 01 81 19 | INDOOR AIR QUALITY FOR LEED BUILDINGS                 |

**1.4 DEFINITIONS:**

- A. **ADHESIVE:** Any substance used to bond one surface to another by attachment. Includes adhesive primers and adhesive bonding primers.
1. **Aerosol Adhesive:** Any adhesive packaged as an aerosol with a spray mechanism permanently housed in a non-refillable can designed for hand-held application without the need for ancillary equipment.
- B. **CARCINOGEN:** A chemical listed as a known, probable, reasonably anticipated, or possible human

**VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES,  
SEALANTS, PAINTS AND COATINGS FOR LEED v3 BUILDINGS**



carcinogen by the International Agency for Research on Cancer (IARC) (Groups 1, 2A, and 2B), the National Toxicology Program (NTP) (Groups 1 and 2), the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) (weight-of-evidence classifications A, B1, B2, and C, carcinogenic, likely to be carcinogenic, and suggestive evidence of carcinogenicity or carcinogen potential), or the Occupational Safety and Health Administration (OSHA).

- C. **CLEAR WOOD FINISH:** Clear/semi-transparent coating applied to wood substrates to provide a transparent or translucent solid film.
  - 1. **Lacquer:** Clear/semi-transparent coating formulated with cellulosic or synthetic resins to dry by evaporation without chemical reaction and provide a solid, protective film.
  - 2. **Sanding Sealer:** A sanding sealer that also meets the definition of a lacquer.
  - 3. **Varnish:** Clear/semi-transparent coating, excluding lacquers and shellacs, formulated to dry by chemical reaction on exposure to air. May contain small amounts of pigment.
- D. **COATING:** Liquid, liquefiable, or mastic composition that is converted to a solid adherent film after application to a substrate as a thin layer; and is used for decorating, protecting, identifying or to serve some functional purpose such as the filling or concealing of surface irregularities or the modification of light and heat radiation characteristics; and is intended for on-site application to interior or exterior surfaces of buildings. Does not include stains, clear finishes, recycled latex paint, specialty (industrial, marine or automotive) coatings or paint sold in aerosol cans.
- E. **FLOOR COATING:** Opaque coating applied to flooring. Excludes industrial maintenance coatings.
- F. **HAZARDOUS AIR POLLUTANT:** Any compound listed by the U.S. EPA in the Clean Air Act Section 112(b)(1) as a hazardous air pollutant.
- G. **MUTAGEN:** A chemical that meets the criteria for category 1, chemicals known to induce heritable mutations or to be regarded as if they induce heritable mutations in the germ cells of humans, under the Harmonized System for the Classification of Chemicals Which Cause Mutations in Germ Cells (United Nations Economic Commission for Europe, Globally Harmonized System of Classification and Labeling of Chemicals).
- H. **OZONE-DEPLETING COMPOUNDS:** A compound with an ozone-depletion potential greater than 0.1 (CFC 11=1) according to the U.S. EPA list of Class I and Class II Ozone-Depleting Substances.
- I. **PAINT:** A pigmented coating. For the purposes of this specification, paint primers are considered to be paints.
  - 1. **Flat Coating or Paint:** Has a gloss of less than 15 (using an 85-degree meter) or less than 5 (using a 60-degree meter).
  - 2. **Non-Flat Coating or Paint:** Has a gloss of greater than or equal to 15 (using an 85-degree meter) or greater than or equal to 5 (using a 60-degree meter).
  - 3. **Non-Flat High-Gloss Coating or Paint:** Has a gloss of greater than or equal to 70 (using a 60-degree meter).
  - 4. **Anti-Corrosive / Rust Preventative Paint:** Coating formulated and recommended for use in preventing the corrosion of ferrous metal substrates.
- J. **PRIMER:** Coating that is formulated and recommended for one or more of the following purposes: to provide a firm bond between the substrate and a subsequent coating; to prevent a subsequent coating from being absorbed into the substrate; to prevent harm to a subsequent coating from materials in the substrate; or to provide a smooth surface for application of a subsequent coating.
- K. **REPRODUCTIVE TOXIN:** A chemical listed as a reproductive toxin (including developmental, female, and male toxins) by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (California Code of Regulations, Title 22, Division 2, Subdivision 1, Chapter 3, Sections 1200, et. Seq.).
- L. **SANDING SEALER:** Clear/semi-transparent coating formulated to seal bare wood. Can be abraded to create a smooth surface for subsequent coatings. Does not include sanding sealers that are lacquers (see Clear Wood Finish above).
- M. **SEALANT:** Any material with adhesive properties, formulated primarily to fill, seal, or waterproof gaps or joints.



between surfaces. Includes sealant primers and caulks.

- N. SHELLAC: Clear or pigmented coating formulated solely with the resinous secretions of the lac beetle, thinned with alcohol and formulated to dry by evaporation without chemical reaction. Excludes floor applications.
- O. STAIN: Clear semi-transparent/opaque coating formulated to change the color but not conceal the grain pattern or texture of the substrate.
- P. VOLATILE AROMATIC COMPOUND: Any hydrocarbon compound containing one or more 6-carbone benzene rings, and having an initial boiling point less than or equal to 280 degrees Celsius measured at standard conditions of temperature and pressure.
- Q. VOLATILE ORGANIC COMPOUND: Any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) which vaporizes (becomes a gas) and participates in atmospheric photochemical reactions, as specified in Part 51.00 of Chapter 40 of the U.S. Code of Federal Regulations, at normal room temperatures. For the purposes of this specification, formaldehyde and acetaldehyde are considered to be VOCs.
- R. WATERPROOFING SEALER: A coating that prevents the penetration of water into porous substrates.

#### 1.5 GENERAL REQUIREMENTS:

- A. The City of New York is committed to implementing good environmental practices and procedures which include achieving a LEED Green building rating. Specific project requirements related to this goal which may impact this area of work are listed in the applicable paragraphs of this specification section. The Contractor shall ensure that the requirements as defined in the sections below and in related sections of the Contract Documents, are implemented to the fullest extent. Substitutions, or other changes to the work proposed by the Contractor or their Subcontractors, shall not be allowed if such changes compromise the stated environmental goals.

#### 1.6 REFERENCES:

- A. Rule 1168 – “Adhesive and Sealant Applications”, amended 7 January 2005): South Coast Air Quality Management District (SCAQMD), State of California, [www.aqmd.gov](http://www.aqmd.gov)
- B. Rule 1113 - “Architectural Coatings”, amended 9 July 2004: South Coast Air Quality Management District (SCAQMD), State of California, [www.aqmd.gov](http://www.aqmd.gov)
- C. Green Seal Standard GS-11- “Paints”, of Green Seal, Inc., Washington, DC, [www.greenseal.org](http://www.greenseal.org)
- D. Green Seal Standard GC-03- “Anti-Corrosive Paints”, of Green Seal, Inc., Washington, DC, [www.greenseal.org](http://www.greenseal.org)

#### 1.7 VOC REQUIREMENTS FOR INTERIOR ADHESIVES, SEALANTS, PAINTS AND COATINGS:

- A. GENERAL: Unless otherwise specified herein, the VOC content of all interior adhesives, sealants, paints and coatings (herein referred to as “products”) shall not be in excess of **250 grams per liter**.
- B. No product shall contain any ingredients that are carcinogens, mutagens, reproductive toxins, persistent bioaccumulative compounds, hazardous air pollutants, or ozone-depleting compounds. An exception shall be made for titanium dioxide and, for products that are pre-tinted by the manufacturer, carbon black, which shall be less than or equal to 1% by weight of the product.
- C. No product shall contain the following:
  - 1. methylene chloride
  - 2. 1,1,1-trichloroethane
  - 3. benzene

VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES,  
SEALANTS, PAINTS AND COATINGS FOR LEED v3 BUILDINGS



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4. toluene
5. ethylbenzene
6. vinyl chloride
7. naphthalene
8. 1,2-dichlorobenzene
9. di (2-ethylhexyl) phthalate
10. butyl benzyl phthalate
11. di-n-butyl phthalate
12. di-n-octyl phthalate
13. diethyl phthalate
14. dimethyl phthalate
15. isophorone
16. antimony
17. cadmium
18. hexavalent chromium
19. lead
20. mercury
21. formaldehyde
22. methyl ethyl ketone
23. methyl isobutyl ketone
24. acrolein
25. acrylonitrile

- D. No product shall contain more than 1.0% by weight of sum total of volatile aromatic compounds.

**1.8 VOC REQUIREMENTS FOR INTERIOR ADHESIVES:**

- A. The volatile organic compound (VOC) content of adhesives, adhesive bonding primers, or adhesive primers used in this project shall not exceed the limits defined in Rule 1168 – “Adhesive and Sealant Applications” of the South Coast Air Quality Management District (SCAQMD), of the State of California.
- B. The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.
- C. For specified building construction related applications, the allowable VOC content is as follows:

1. Architectural Applications:
  - a. Indoor carpet adhesive 50
  - b. Carpet pad adhesive 50
  - c. Wood flooring adhesive 100
  - d. Rubber floor adhesive 60
  - e. Subfloor adhesive 50
  - f. Ceramic tile adhesive 65
  - g. VCT and asphalt tile adhesive 50
  - h. Drywall and panel adhesive 50
  - i. Cove base adhesive 50
  - j. Multipurpose construction adhesive 70
  - k. Structural glazing adhesive 100
2. Specialty Applications:
  - a. PVC welding 510
  - b. CPVC welding 490
  - c. ABS welding 325
  - d. Plastic cement welding 250

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- |    |  |     |
|----|--|-----|
| e. | Adhesive primer for plastic            | 550 |
| f. | Contact Adhesive                       | 80  |
| g. | Special Purpose Contact Adhesive       | 250 |
| h. | Structural Wood Member Adhesive        | 140 |
| i. | Sheet Applied Rubber Lining Operations | 850 |
| j. | Top and Trim Adhesive                  | 250 |
3. Substrate Specific Applications:
- |    |                               |    |
|----|-------------------------------|----|
| a. | Metal to metal                | 30 |
| b. | Plastic foams                 | 50 |
| c. | Porous material (except wood) | 50 |
| d. | Wood                          | 30 |
| e. | Fiberglass                    | 80 |
4. Aerosol Adhesives:
- |    |   |                     |
|----|---|---------------------|
| a. | General purpose mist spray                    | 65% VOC's by weight |
| b. | General purpose web spray                     | 55% VOC's by weight |
| c. | Special purpose aerosol adhesives (all types) | 70% VOC's by weight |

#### 1.9 VOC REQUIREMENTS FOR INTERIOR SEALANTS:

- A. The volatile organic compound (VOC) content of sealants, or sealant primers used in this project shall not exceed the limits defined in Rule 1168 – "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California.
- B. The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.
1. Sealants:
- |    |                          |     |
|----|--------------------------|-----|
| a. | Architectural            | 250 |
| b. | Non-membrane roof        | 300 |
| c. | Roadway                  | 250 |
| d. | Single-ply roof membrane | 450 |
| e. | Other                    | 420 |
2. Sealant Primer:
- |    |                           |     |
|----|---------------------------|-----|
| a. | Architectural – Nonporous | 250 |
| b. | Architectural – Porous    | 775 |
| c. | Other                     | 750 |

#### 1.10 VOC REQUIREMENTS FOR INTERIOR PAINTS:

- A. Paints and Primers: Paints and primers used in non-specialized interior applications (i.e., for wallboard, plaster, wood, metal doors and frames, etc.) shall meet the VOC limitations of the Green Seal Paint Standard GS-11, of Green Seal, Inc., Washington, DC. Product-specific environmental requirements are as follows:
1. Volatile Organic Compounds:
- a. The VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by U. S. Environmental Protection Agency (EPA) Reference Test Method 24.
- Interior Paints and Primers:  
Non-flat: 150 g/l  
Flat: 50 g/l  
The calculation of VOC shall exclude water and tinting color added at the point of sale.





- B. Anti-Corrosive and Anti-Rust Paints: Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates shall meet the VOC limitations of the Green Seal Paint Standard GC-03, of Green Seal, Inc., Washington, DC. Product-specific environmental requirements are as follows:

1. Volatile Organic Compounds:

- a. The VOC concentrations (in grams per liter) of the product shall not exceed those listed below as determined by U. S. Environmental Protection Agency (EPA) Reference Test Method 24.

Anti-Corrosive and Anti-Rust Paints: 250 g/l

The calculation of VOC shall exclude water and tinting color added at the point of sale.

**1.11 VOC REQUIREMENTS FOR INTERIOR COATINGS:**

- A. Clear wood finishes, floor coatings, stains, sealers, and shellacs applied to the interior shall meet the VOC limitations defined in Rule 1113, "Architectural Coatings" of SCAQMD, of the State of California. The VOC limits defined by SCAQMD, based on 7/9/04 amendments, are as follows. VOC limits are defined in grams per liter, less water and less exempt compounds.

1. Clear Wood Finishes:	
a. Varnish	350
b. Sanding Sealers	350
c. Lacquer	550
2. Shellac:	
a. Clear	730
b. Pigmented	550
3. Stains	250
4. Floor Coatings	100
5. Waterproofing Sealers	250
6. Sanding Sealers	275
7. Other Sealers	200

The calculation of VOC shall exclude water and tinting color added at the point of sale.

**1.12 SUBMITTALS:**

- A. Submit Material Safety Data Sheets, for all applicable products in accordance with Section 01 33 00, SUBMITTAL PROCEDURES. Applicable products include, but are not limited to adhesives, sealants, carpets, paints and coatings. Material Safety Data Sheets shall indicate the Volatile Organic Compound (VOC) limits of products submitted. (If an MSDS does not include a product's VOC limits, then product data sheets, manufacturer literature, or a letter of certification from the manufacturer can be submitted in addition to the MSDS to indicate the VOC limits).
- B. Submit Environmental Building Materials Certification Form (EBMCF) as referenced in Section 01 81 13.03 SUSTAINABLE REQUIREMENTS FOR LEED v3 BUILDINGS: For each field-applied adhesive, sealant, paint, and coating product, provide the VOC requirement, as provided in this Specification, for the relevant material category indicated on the documentation noted above.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 81 13.13**



**SECTION 01 81 19  
INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 81 19**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].

**1.2 CONSTRUCTION IAQ MANAGEMENT GOALS FOR THE PROJECT:**

- A. The City of New York has determined that this Project shall minimize the detrimental impacts on Indoor Air Quality (IAQ) resulting from construction activities. Factors that contaminate indoor air, such as dust entering HVAC systems and ductwork, improper storage of materials on-site, poor housekeeping, shall be minimized.

**1.3 RELATED SECTIONS:**

- A. All sections of the Specifications related to interior construction, MEP systems and items affecting indoor air quality.
- B. Division 9 (of the Specifications): Finishes.
- C. Refer to the Addendum to identify whether this project is designed to comply with a Certification Level according to the U.S. Green Building Council's LEED Rating System, as specified in Section 01 81 13.03 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS" or Section 01 81 13.04 "SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS".
- D. Refer to the Addendum to identify whether this project is designed to comply with Section 01 81 13.13 VOLATILE ORGANIC COMPOUND (VOC) LIMITS FOR ADHESIVES, SEALANTS, PAINTS AND COATINGS FOR LEED v3 BUILDINGS
- E. Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- C. Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products, including solvents in paints, coatings, adhesives and sealants, wood preservatives, composite



wood binder, and foam insulations. Not all VOC's are harmful, but many of those contained within building products contribute to the formation of smog and may irritate building occupants by their smell and/or health impact.

- D. Materials that act as "sinks" for VOC contamination: Absorptive materials, typically dry and soft materials (such as textiles, carpeting, acoustical ceiling tiles and gypsum board) that readily absorb VOC's emitted by "source" materials and release them over a prolonged period of time.
- E. Materials that act as "sources" for VOC contamination: Products with high VOC contents that emit VOC's either rapidly during application and curing (typically "wet" products, such as paints, sealants, adhesives, caulks and sealers) or over a prolonged period (typically "dry" products such as flooring coverings with plasticizers and engineered wood with formaldehyde).

#### **1.5 REFERENCES, RESOURCES:**

- A. "IAQ Guidelines for Occupied Buildings Under Construction", Second Edition, 2007, The Sheet Metal and Air Conditioner Contractors National Association (SMACNA). (703) 803-2980, [www.smacna.org](http://www.smacna.org).
- B. ANSI/ASHRAE 52.2-2007, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size", [www.ashrae.org](http://www.ashrae.org)

#### **1.6 LEED BUILDING GENERAL REQUIREMENTS:**

- A. Implement practices and procedures as necessary to meet the Project's environmental performance goals as set forth in the specific requirements of this section. Specific Project goals that may impact this area of work include: use of recycled-content materials; use of low-emitting materials; construction waste recycling; and the implementation of a construction indoor air quality management plan. Ensure that the requirements related to these goals, as defined in this Section, are implemented to the fullest extent. Substitutions or other changes to the work shall not be allowed if such changes compromise the stated LEED BUILDING Performance Criteria.

#### **1.7 CONSTRUCTION IAQ MANAGEMENT PLAN:**

- A. The Contractor shall prepare a Construction IAQ Management Plan in coordination with each subcontractor and submit the Construction IAQ Management Plan to the Commissioner for approval in accordance with Section 01 33 00 SUBMITTAL PROCEDURES. The Construction IAQ Management Plan shall meet the following criteria:
  - 1. Construction activities shall be planned to meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) "IAQ Guidelines for Occupied Buildings under Construction", Second Edition, 2007.
  - 2. Absorptive materials shall be protected from moisture damage when stored on-site and after installation.
  - 3. The planned operation of air handlers during construction shall be described. If air handlers are to be used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grille and return or transfer duct inlet opening, such that there is no bypass around the filtration media, as determined by ASHRAE 52.2-2007.
  - 4. Filtration media shall be replaced immediately prior to occupancy. Filtration media shall have a MERV of 13 as determined by ASHRAE 52.2-2007.
  - 5. A "Sequence of Finish Installation Plan" shall be developed, highlighting measures to reduce the absorption of VOCs by materials that act as "sinks".
  - 6. The use of tobacco products shall be prohibited inside the building and within 25 feet of the building entrance during construction.



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7. A flush-out or air testing shall be performed.
8. Upon approval of the Plan by the Commissioner, it shall be implemented by the Contractor through the duration of the construction process, and documented in accordance with the Submittal Requirements of Sub-Section 1.8 herein.

B. Detailed requirements of the Construction IAQ Management Plan are as follows:

1. SMACNA Guidelines: Chapter 3 of the referenced "IAQ Guidelines for Occupied Buildings Under Construction", outline IAQ measures in five categories as listed below. The Construction IAQ Management Plan shall be organized in accordance with the SMACNA format, and shall address measures to be implemented in each of the five categories (including subsections). All subsections shall be listed in the Plan; items that are not applicable for this Project should be listed as such.
  - a. HVAC Protection
    - 1) Protect air handling and distribution equipment and air supply and return ducting during construction.
    - 2) All ductwork arriving on site will be sealed with plastic sheeting and stored on pallets or dunnage until installed.
    - 3) Cover and protect all exposed air inlets and outlets, openings, grilles, ducts, plenums, etc. to prevent water, moisture, dust and other contaminant intrusion.
    - 4) Apply protection immediately after ducting.
    - 5) Protect ducting runs at the end of day's work.
    - 6) Inspect temporary filtration weekly and replace as required to maintain the proper ventilation rates in the building.
    - 7) To reduce debris and contamination to mechanical systems, do not store materials in mechanical rooms.
  - b. Source Control
    - 1) Protect stored on-site or installed absorptive or porous materials. Store materials in dry conditions indoors, under cover, and off the ground or floor.
    - 2) Do not use wet or damaged porous materials in the building. Materials which become contaminated through direct exposure to moisture from precipitation, plumbing leaks, or condensation shall be replaced by the Contractor, at no additional cost to the City of New York.
    - 3) Use low-toxicity and low-VOC materials to the greatest extent possible.
    - 4) Recover, isolate, and ventilate containers housing toxic materials and materials with VOC levels above the limits for interior adhesives, sealants, paints, and coatings described in these Specifications.
    - 5) Prevent exhaust fumes from idling vehicles, equipment, and fossil-fueled tools from entering the building.
    - 6) Containers housing toxic materials and materials with VOC levels above the limits for interior adhesives, sealants, paints, and coatings described in these Specifications, shall be closed when not in use.
    - 7) Enforce the no-smoking job site policy.
  - c. Pathway Interruption
    - 1) Depressurize work areas to contain dust and odors.
    - 2) Pressurize occupied spaces to prevent intrusion of dust and odors.
    - 3) Erect barriers to contain construction areas.
    - 4) Relocate pollutant sources.
    - 5) Temporarily seal the building and provide 100% outside air for ventilation.
    - 6) Provide walk-off mats at entryways to reduce introduced dirt and pollutants.
    - 7) Use dust guards and collectors on saws and other tools.
  - d. Housekeeping
    - 1) Store materials on elevated platforms under cover, in a designated dry, clean location, prior to unpacking for installation.



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- 2) If materials are not stored in an enclosed location, cover tops and sides of material with waterproof sheeting, securely tied.
      - 3) Institute cleaning activities to remove contaminants from the building prior to occupancy. Clean all coils, air filters, and ductwork prior to performing testing, adjusting, and balancing of HVAC systems.
      - 4) Sweep the work area on a daily basis. Use an efficient and effective dust collecting method such as damp cloth, wet mop, or vacuum with high-efficiency particulate filters. Activities which produce high levels of dust shall be cleaned up immediately upon completion.
      - 5) Spills or excess applications of products containing solvents, or with VOC levels above the limits for interior adhesives, sealants, paints, and coatings described in these Specifications, must be removed immediately.
      - 6) Dust all walls prior to application of finishes.
      - 7) Vacuum all stud tracks prior to application of insulation.
      - 8) Keep materials organized to improve job safety as well as indoor air quality.
    - e. Scheduling
      - 1) Phase construction such that absorptive materials are installed only in areas that are weathertight.
      - 2) Schedule activities that utilize "sources" of VOC contamination to take place prior to installing high absorbent materials that will act as "sinks" for contaminants.
      - 3) Review of the appropriate components of the Construction IAQ Management Plan shall be a regular action topic at weekly site coordination meetings. Implementation of the Plan shall be documented in the meeting minutes.
2. Protection of Materials from Moisture Damage: As part of the "Source Control" section of the Construction IAQ Management Plan, measures to prevent installed materials or material stored on-site from moisture damage shall be described. This section shall also describe corrective measures to be taken if moisture damage does occur to absorptive materials during the course of construction (see Section 1.7 B.1.b).
3. Replacement of Filtration Media: Under the "HVAC Protection" section of the Construction IAQ Management Plan, a description of the filtration media in all ventilation equipment shall be provided. The description shall include replacement criteria for filtration media during construction, and confirmation of filtration media replacement for all equipment immediately prior to occupancy.
4. Sequence of Finish Installation for Materials: Where feasible, absorptive materials shall be installed after the installation of materials or finishes which have high short-term emissions of VOC's, formaldehyde, particulates, or other air-borne compounds. Absorptive materials include, but are not limited to: carpets; acoustical ceiling panels; fabric wall coverings; insulations (exposed to the airstream); upholstered furnishings; and other woven, fibrous or porous materials. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paints, wood preservatives and finishes; control and/or expansion joint fillers; hard finishes requiring adhesive installation; gypsum board (with associated finish processes and products); and composite or engineered wood products with formaldehyde binders.
5. Pre-Occupancy Phase: Perform either a flush-out or air sample testing (Options 1 or 2), as follows:
  - a. OPTION 1 — Flush-Out
    - 1) Perform flush-out using either Path 1 or Path 2.
      - i. Path 1: After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while



maintaining an internal temperature of at least 60 degrees F and no higher than 80 degrees F and relative humidity no higher than 60%.

- ii. Path 2: If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cu.ft. of outdoor air per sq.ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm/sq.ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite: Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space.
- 2) Commissioning can occur during flush-out, at the discretion of the Commissioning Agent, provided none of the commissioning procedures introduce contaminants into the space and none of the flush-out procedures circumvent the commissioning process. Complete testing and balancing of the HVAC system after the flush-out is complete. Refer to Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS.
- 3) If even partial construction work occurs during the flush-out, the flush-out must be started again from the beginning for that space. If multiple, discrete HVAC systems operate independently, flush-out may be completed in portions of the building as work is completed in each area served by a given system.

OR

b. **OPTION 2 — Air Testing**

- 1) Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with current versions of the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air or ISO methods, as additionally detailed in the LEED BD+C Reference Guide.
- 2) Demonstrate that the contaminant maximum concentrations listed below are not exceeded.

CONTAMINANT	MAXIMUM CONCENTRATION
Formaldehyde	27 parts per billion
Particulates (PM10 for all buildings; PM25 for buildings in EPA nonattainment areas, or local equivalent)	PM10: 50 micrograms per cubic meter PM25: 15 micrograms per cubic meter
Ozone (for buildings in EPA nonattainment areas)	0.075 parts per million
Total Volatile Organic Compounds (TVOC)	500 micrograms per cubic meter
Target chemicals listed in CDPH Standard Method c1.1, Table 4-1, except formaldehyde	CDPH Standard Method v1.1-2010, Allowable Concentrations, Table 4-1
Carbon Monoxide (CO)	9 part per million and no greater than 2 parts per million above outdoor levels

- 3) The air sample testing shall be conducted as follows:



- i. All measurements shall be conducted prior to occupancy, but during normal occupied hours and with the building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
  - ii. The building shall have all interior finishes installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Non-fixed furnishings such as workstations and partitions are required to be in place for the testing.
  - iii. Prior to air sample testing, all punch-list items that would generate VOCs or other contaminants, the testing and balancing of the HVAC system and finalization of all cleaning shall be complete. Use low-emitting cleaning products and vacuum cleaners with HEPA filtration.
  - iv. The number of sampling locations will vary depending upon the size of the building and number of ventilation systems. For each portion of the building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq.ft., or for each contiguous floor area, whichever is larger, and include areas with the least ventilation and greatest presumed source strength.
  - v. Air samples shall be collected between 3 feet and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum 4-hour period.
  - vi. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test.
6. Implementation and Coordination: Before Demolition and/or Construction begins, the Contractor shall implement the Construction IAQ Management Plan, coordinate the Plan with all affected trades, and designate one individual as the Construction IAQ Representative at no additional cost to the City of New York, who will be responsible for communicating the progress of the Construction IAQ Management Plan with the Commissioner monthly and for assembling the required LEED documentation. Include provisions in the Construction IAQ Management Plan for addressing conditions in the field that do not adhere to the Plan, including provisions to implement a stop work order, or to rectify non-compliant conditions.
  - a. Distribution: The Contractor shall distribute copies of the Construction IAQ Management Plan in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.
  - b. Instruction: The Contractor shall provide on-site instruction of appropriate site management to all Contractor's Subcontractors.
  - c. Monitoring: The Construction IAQ Representative shall monitor the implementation of the Construction IAQ Management Plan.

#### **1.8 SUBMITTALS:**

Submit the following LEED-required records and documents in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and, as applicable, Section 01 81 13.03 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v3 BUILDINGS or Section 01 81 13.04 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED v4 BUILDINGS.

- A. A copy of the Construction IAQ Management Plan as defined in Sub-Section 1.7 herein.
- B. IAQ Tracking Log
  1. Note date of observed major Construction IAQ issues, describe any damage, describe any repairs or maintenance of specific control measures performed and note responsible party.
  2. Note date and findings of weekly site review, describe any repairs or maintenance performed, and note responsible party. Provide date-stamped photographs, inspection reports or other recording processes.



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3. Submit monthly.
- B. Product cut-sheets for all filtration media used during construction and installed immediately prior to occupancy, with MERV values highlighted. Cut sheets shall be submitted with the Contactor's or Subcontractor's 'approved' stamp as confirmation that the products are the products installed on the Project.
- C. PHOTOGRAPHS: Submit to the Commissioner a minimum of 18 photographs as required under the provision for Special Photographs, in accordance with Section 01 32 33 PHOTOGRAPHIC DOCUMENTATION, comprised of at least six photographs taken on three different occasions during construction of each IAQ measure. The photographs shall document the implementation of the Construction IAQ Management Plan throughout the course of the Project construction. Examples include photographs of ductwork sealing and protection, temporary ventilation measures, and conditions of on-site materials storage (to prevent moisture damage). Photographs shall include integral date stamping, and shall be submitted with brief descriptions of the Construction IAQ Management Plan measure documented, or be referenced to Project meeting minutes or similar Project documents which reference to the Construction IAQ Management Plan measure documented.
- D. A copy of the Project's Testing, Adjusting and Balancing (TAB) report, if applicable.

**1.9 QUALITY ASSURANCE:**

- A. The Contractor shall be responsible for preparing and implementing the Construction IAQ Management Plan and shall coordinate and incorporate the work of its subcontractors in the IAQ Management Plan. Include the Construction IAQ Management Plan requirements in contract agreements with subcontractors. Familiarize subcontractors with the plan and how it will affect their daily activities. Hold a subcontractors' orientation meeting to review the plan requirements.
- B. Responsibility of Subcontractors: Subcontractors for this Project shall be responsible to cooperate with the Contractor in the preparation and implementation of the Construction IAQ Management Plan.
- C. Include construction IAQ progress check-ins as a regular item in weekly subcontractor meetings and safety meetings. Provide a copy of the plan on site, posted in an accessible area.

**PART II – PRODUCTS (Not Used)**

**PART III – EXECUTION (Not Used)**

**END OF SECTION 01 81 19**





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**SECTION 01 91 13**

**GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 91 13**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].
- B. The Owner's Project Requirements (OPR) and Basis of Design (BOD) documents are included by reference for information only.
- C. The Commissioning Plan, prepared by the Commissioning Agent (CxA) under separate contract with the City of New York, contains requirements that apply to this section.

**1.2 SUMMARY:**

This Section includes general requirements that apply to implementation of Commissioning without regard to systems, subsystems, and equipment being commissioned. General Requirements for Building Enclosure Commissioning are addressed in a separate specification.

- A. This Section includes:
  - 1. Definitions
  - 2. Commissioning Team
  - 3. City's Responsibilities
  - 4. Contractor's Responsibilities
  - 5. CxA Responsibilities
  - 6. Commissioning Documentation
  - 7. Submittals
  - 8. Coordination
  - 9. Execution

**1.3 RELATED SECTIONS: Include without limitation the following:**

- A. System-Specific Commissioning requirements indicated in other sections of the Project Specifications for specific requirements for commissioning systems.
- B. This Project will be commissioned by an independent third party under separate contract with the City of New York. Commissioning shall be in accordance with ASHRAE and USGBC LEED procedures, and specific commissioning requirements of the Project Specifications, whichever is more stringent. The Contractor shall cooperate with the CxA and provide whatever assistance is required.
- C. Related Sections include without limitation the following:
  - 1. Section 01 10 00 SUMMARY
  - 2. Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION
  - 3. Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION
  - 4. Section 01 78 39 CONTRACT RECORD DOCUMENTS
  - 5. Section 01 79 00 DEMONSTRATION AND OWNERS PRE-ACCEPTANCE ORIENTATION
  - 6. Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS



7. Section 01 91 15 GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE

**1.4 DEFINITIONS:**

- A. Refer to Article 2 of the Contract for definition of terms, words and expressions used in the General Conditions not otherwise defined herein.
- B. Basis of Design (BOD): A document, prepared by the Design Consultant, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- C. Checklists: Forms that outline the step by step process that must be executed to fulfill the test requirements and to verify that materials, equipment, assemblies, and systems are installed in accordance with the Contract Documents. The CxA shall develop the checklists; the Contractor shall complete them.
- D. Commissioning: Commissioning is a systematic process of ensuring and documenting that the building systems, including the mechanical and electrical systems, have been installed in the prescribed manner, are functionally checked and capable of being operated and maintained to perform with the design intent and have documentation to support proper installation and operation. The process does not eliminate or reduce the responsibility of the installing contractors to provide a finished product.
- E. Commissioning Agent (Aka Commissioning Authority) (CxA): Consultant under separate contract with the City of New York to provide Commissioning Services for this project. The CxA shall not be an employee of the Contractor, nor shall the CxA have any interest in the Contract.
- F. Commissioning Plan: A document developed by the CxA that outlines the organization, schedule, roles and responsibilities, allocation of resources, and documentation requirements of the commissioning process.
- G. Deferred Performance Tests: Performance tests that are performed, at the discretion of the CxA, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.
- H. Design Consultant: "Design Consultant" shall mean the entity responsible for providing design services for the Project, including without limitation, preparing the construction documents (drawings and Specifications) and providing services in connection with such documents during construction. The entity serving as the "Design Consultant" may be a corporation, firm, partnership, joint venture, individual or combination thereof. Such entity may be either an employee(s) of the City or an entity engaged by the City to provide such services.
- I. Factory Testing: Testing of equipment on-site or at the factory, by factory personnel, with or without an owner's representative.
- J. Functional Performance Test (FPT): Functional performance testing includes the dynamic functions and operations of equipment and systems using manual or monitoring methods under various levels of operation. Systems are tested under various modes, such as during low cooling loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarms, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to respond as the sequences state. Such tests shall be performed as per the protocol written by the CxA, defining the methods, personnel, and expectations.



- K. **Issue (or Deficiency):** A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract Documents.
- L. **Issues Log:** A formal and ongoing record of problems, deficiencies or concerns that have been raised by members of the Commissioning Team during the course of commissioning. The issues log is the primary tracking tool to address all commissioning issues by concerned parties. All issues must be addressed and resolved by the concerned parties before the closeout of the Project. This log tracks the resolution performed and date of closure of each issue.
- M. **Master Equipment List (MEL):** A complete listing of all commissioned building equipment, including details such as make, model, location, ID Tag number, etc. that is taken from submittals and is the basis from which checklists will be generated. The MEL is a spreadsheet which is also used as a tracking tool for all milestones of the commissioning process, such as the creation and performance of checklists, startup of equipment, TAB work, etc.
- N. **Monitoring:** The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- O. **Owner (City of New York) Contracted Tests:** Tests paid for by the City of New York outside of the Contractor's Contract and for which the CxA does not provide oversight. These tests will not be repeated during functional testing if properly documented.
- P. **Owner's (City of New York) Project Requirements (OPR):** A document, prepared by the Design Consultant that details the functional requirements of a Project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- Q. **Pre-functional (Installation) Checklists:** A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Contractor. Installation checklists are primarily static inspections and procedures to prepare equipment or systems for initial operation. Pre-functional (Installation) checklists augment, and are combined with, the manufacturer's startup checklist. The Checklists are filled out by the Contractor and reviewed by the CxA.
- R. **Sampling:** Functional testing for a percentage of the total number of identical or near-identical pieces of equipment.
- S. **Seasonal Performance Tests:** Functional tests that are deferred until, or performed again when, the system(s) will experience climate conditions close to their design conditions.
- T. **Startup:** The initial starting or activating of equipment, including executing construction checklists.
- U. **Systems, Subsystems, Equipment, and Components:** Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- V. **Systems Manual:** A system-focused composite document that includes the Operation and Maintenance Manual, and additional information of use to the owner during the occupancy and operations phase.
- W. **Testing, Adjusting, and Balancing (TAB):** Testing, adjusting, and balancing of the Heating Hot Water (HHW), Chilled Water (CHW) and Heating, Cooling, and Ventilation Airflow distribution system flows and pressures as specified in Contract Documents by a subcontractor certified to perform such work.



- X. Test requirements: Requirements specifying what modes and functions, etc. shall be tested on any given piece of equipment or any given system (integrated or standalone). The test requirements are not the detailed test procedures. The test requirements for each system are specified in the respective Contract Documents.
- Y. Trending: Monitoring using the building controls system, and analysis of the data gathered over a period of time.

#### **1.5 COMMISSIONING TEAM:**

- A. Members Appointed by the Contractor and its Subcontractors: Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The Commissioning Team shall consist of, but not be limited to, representatives of the Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by the City:
  - 1. Commissioning Authority/Agent (CxA): The designated person, company, or entity under separate Contract with the City that plans, schedules, and coordinates the Commissioning Team to implement the commissioning process.
  - 2. Representatives of the facility user and operation and maintenance personnel.
  - 3. Design Consultant and other concerned entities.

#### **1.6 CITY'S RESPONSIBILITIES:**

- A. Provide the OPR and BOD documentation to the CxA for use in developing the Commissioning Plan; systems manual; operation and maintenance orientation plan; and testing plans and checklists.
- B. Assign operation and maintenance personnel to participate in Commissioning Team activities.
- C. Provide full details and results of any Owner Contracted tests relevant to the current Project.

#### **1.7 CONTRACTOR'S RESPONSIBILITIES:**

- A. The Contractor shall provide utility services required for the commissioning process.
- B. As a member of the Commissioning Team, the Contractor and subcontractor(s) shall assign representatives with expertise and authority to act on behalf of the Contractor and its subcontractor(s) and schedule them to participate in and perform Commissioning Team activities including, but not limited to, the following:
  - 1. Participate in scheduled construction-phase coordination and Commissioning Team meetings.
  - 2. Integrate and coordinate commissioning process activities with the construction schedule.
  - 3. Provide any and all factory acceptance test reports to the CxA through the Commissioner.
  - 4. Respond to any additional specific information requests from the CxA. CxA may request additional documentation necessary for the commissioning process. Requests by CxA may precede, be concurrent with, or follow normal submittals.
  - 5. Ensure the cooperation and participation of all subcontractors and manufacturers of equipment to be commissioned.
  - 6. Verify and confirm that components, equipment, and system are functioning as per design prior to CxA witnessing testing.
  - 7. Perform testing required in the Commissioning Schedule as per the Commissioning Process test procedures provided by the CxA, providing no less than 48 hours' notice to the CxA through the Commissioner.



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8. Complete installation checklists as Work is completed and return to CxA through the Commissioner.
9. Provide written responses to the CxA through the Commissioner for resolution of issues recorded in the Issues Log within five (5) business days.
10. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
11. Submit As-Built documents, operation and maintenance manuals for systems and subsystems, and equipment in accordance with Section 01 78 39 CONTRACT RECORD DOCUMENTS. Such documents shall be submitted prior to functional testing.
12. Provide orientation sessions for operation and maintenance personnel (sessions will be witnessed by the CxA) in accordance with Section 01 79 00 DEMONSTRATION AND OWNER'S PRE-ACCEPTANCE ORIENTATION. Provide no less than 48 hours' notice to the CxA, through the Commissioner. Video record and edit orientation sessions and provide DVD to the CxA and Commissioner no later than two weeks after the orientation session occurs. Edit as requested by the Commissioner.

### 1.8 COMMISSIONING AGENT'S (CxA) RESPONSIBILITIES:

- A. Organize and lead the Commissioning Team.
- B. Prepare a construction-phase Commissioning Plan. Collaborate through the Commissioner with each Contractor and with subcontractors to develop test and inspection procedures. Include design changes and coordinate commissioning activities with the overall Project schedule. Identify Commissioning Team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task. Update the Commissioning Plan during construction as required.
- C. Review and comment in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, on submittals from the Contractor for compliance with the OPR, BOD, Contract Documents, and construction-phase Commissioning Plan. Review and comment on performance expectations of systems and equipment and interface between systems relating to the OPR and BOD.
- D. Coordinate with the Commissioner, in accordance with Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION, to convene Commissioning Team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes.
- E. At the beginning of the construction phase, coordinate with the Commissioner's kick-off meeting schedule to conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals, operation and maintenance orientation sessions, TAB Work, testing, and Project completion.
- F. Perform site visits to observe and inspect construction as described in the Commissioning Plan. Report progress and deficiencies to the Commissioner. In addition to compliance with the OPR, BOD, and Contract Documents, inspect systems and equipment installation for adequate accessibility required for component maintenance replacement and repair.
- G. Prepare and distribute project-specific test and inspection procedures and checklists and maintain a Master Equipment List.
- H. Verify air and water systems balancing by sampling, by reviewing completed reports, and by selected site observation. Coordinate submittal reviews with the Commissioner so that the comments are combined into a single review and submitted to the Contractor.
- I. Coordinate with the Commissioner to witness and document tests, inspections, and systems startup, as per the Commissioning Plan.



- J. Maintain an issues log and a record of functional testing. Report all issues as they occur to the Commissioner.
- K. Compile test data, inspection reports, and certificates and include them in the systems manual and Commissioning Report.
- L. Certify date of acceptance and startup for each item of equipment for start of warranty periods.
- M. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the OPR, BOD, and Contract Documents. Operation and maintenance documentation requirements are specified in other sections of the Project Specifications and described in Section 01 78 39 CONTRACT RECORD DOCUMENTS.
- N. Review agenda for orientation; witness and confirm orientation session conforms with agenda and Contract Documents; review recording of demonstration and orientation sessions provided by the Contractor on USB drive or other electronic media as requested by the Commissioner and provide appropriate comments for editing.
- O. Return to the site 10 months into the 12-month guaranty period, to review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Interview facility staff and identify problems or concerns they have with operating the building as originally intended.
- P. Prepare Commissioning Reports.
- Q. Assemble the final commissioning documentation, including the Commissioning Report and Systems Manual.
- R. Perform all CxA tasks as defined by LEED; prepare LEED submittal documents.

#### **1.9 COMMISSIONING DOCUMENTATION:**

The Contractor shall assist the CxA in the development and compiling of the following Commissioning Documentation:

- A. Index of Commissioning Documents: The CxA will prepare an index including the storage location of each document.
- B. Commissioning Plan: A document prepared by the CxA that outlines the schedule, allocation of resources, roles and responsibilities, and documentation requirements of the commissioning process.
- C. Test Checklists: The CxA will develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. The CxA will prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Space will be provided for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in other sections of the Project Specifications, but shall include without limitation:
  - 1. Identification of tested item
  - 2. Date of test
  - 3. Indication of whether the record is for a first test or retest following correction of a problem or issue
  - 4. Dated signatures of the person performing the test and of the witness if applicable
  - 5. Deficiencies and issues, if any, generated as a result of the test



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- D. Inspection Checklists will be signed by the Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing.
- E. Test and Inspection Reports: The CxA will record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application will be included with data. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and Commissioning Report.
- F. Corrective Action Documents: The CxA will document corrective action taken for systems and equipment that fail tests and include required modifications to systems and equipment and revisions to test procedures, if any. The Contractor shall retest systems and equipment requiring corrective action. The CxA will document retest results.
- G. Issues Log: The CxA will prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the OPR, BOD, and Contract Documents. The log will identify and track issues as they are encountered, documenting the status of unresolved and resolved issues. The Issues Log will identify, at a minimum:
  - 1. The party responsible for correcting the issue,
  - 2. The person documenting the issue resolution,
  - 3. The exact location of the issue (floor and room),
  - 4. The applicable system component,
  - 5. A detailed description of the issue,
  - 6. The issue status, and
  - 7. The date the issue was discovered and the date the issue was resolved.
- H. Commissioning Report: The CxA will document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BOD, and Contract Documents. The Commissioning Report shall include:
  - 1. An Executive Summary, including participants and their roles, a brief building description, an overview of the commissioning and testing scope, and a general description of testing and verification methods,
  - 2. Installation/ Pre-Functional Checklists,
  - 3. Start-up Reports,
  - 4. Functional Test documentation,
  - 5. Trend Log Analysis,
  - 6. The final Issues Log, with all issues identified through the commissioning process, identifying which, if any, issues remain unresolved,
  - 7. The Commissioning Plan,
  - 8. Commissioning progress and field reports,
  - 9. Commissioning review documents, and
  - 10. Record of Owner's Orientation.





- I. Systems Manual: The CxA will gather required information and compile systems manual as specified in other sections of the Project Specifications and described in Section 01 78 39 CONTRACT RECORD DOCUMENTS.

#### **1.10 SUBMITTALS:**

- A. Submittal of shop drawings, product data, samples, etc., relevant to commissioning shall be provided to the CxA as requested. Such submittals shall be in compliance with Section 01 33 00 SUBMITTAL PROCEDURES.
- B. As-Built Contract Record Drawings and Operating and Maintenance Manuals relevant to commissioning shall be provided to the CxA as requested. Such submittals shall be in compliance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.
- C. All demonstration and orientation submittals relevant to commissioning shall be provided to the CxA as requested. Such submittals shall be in compliance with Section 01 79 00 DEMONSTRATION AND OWNER'S PREACCEPTANCE ORIENTATION.
- D. Completed Prefunctional (Installation) Checksheets shall be provided to the CxA.

#### **1.11 COORDINATION:**

- A. Coordination of Commissioning is the responsibility of all Commissioning Team members.
- B. Coordinating Meetings: The CxA will coordinate with the Commissioner's regularly scheduled construction progress meetings to conduct coordination meetings of the Commissioning Team to review progress on the Commissioning Plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities. Commissioner and Contractor shall ensure that all required Commissioning Team members attend.
- C. Construction Documents: The Contractor, through the Commissioner, will furnish copies of all construction documents, addenda, change orders and appropriate submittals and shop drawings to the CxA.
- D. Pre-testing Meetings: The CxA will coordinate with the Commissioner to conduct pretest meetings of the Commissioning Team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested. Commissioner and Contractor shall ensure that all required Commissioning Team members attend.
- E. Testing Coordination: Contractor shall coordinate schedule times with the Commissioning Team, through the Commissioner, for tests, inspections, obtaining samples, and similar activities. The CxA will advise the Commissioning Team as to the sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
- F. Manufacturers' Field Services: The Contractor shall coordinate manufacturers' field services, as per the Commissioning Plan.
- G. The CxA will regularly apprise the Commissioner of progress, pending problems and/or disputes, as well as provide regular status reports on progress with each system.



## **PART II – PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All industry standard test equipment required for performing the specific tests shall be provided by the Contractor responsible for testing. Any proprietary Vendor-specific test equipment shall be provided by that Vendor or Manufacturer.
- B. Special equipment, tools, instruments, software, and equipment communication network access hardware and software (only available from Vendor, specific to the piece of equipment) required for testing equipment according to the Contract Documents shall be included at no extra cost to the City and shall be turned over to the City at Project close-out, except for stand-alone data logging equipment that may be used by the CxA.
- C. Any portable or handheld setup and/or calibration devices required to initialize the control system shall be made available by the control vendor for use by the CxA at no additional cost to the City.
- D. The instrumentation used in the commissioning process shall comply with the following:
  - 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required
  - 2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument
  - 3. Be maintained in good repair and operating condition throughout use duration on this Project
  - 4. Be immediately recalibrated or repaired if dropped and/or damaged in any way during this Project.

## **PART III – EXECUTION**

### **3.1 COMMISSIONING PROCESS**

- A. The following provides an overview of the Commissioning tasks during Project construction and the general order in which they occur.
  - 1. Construction-phase Commissioning begins with a Commissioning Kickoff Meeting, conducted by the CxA through the Commissioner in accordance with section 01 31 00 PROJECT MANAGEMENT AND COORDINATION, where the Commissioning process is reviewed with all the Commissioning Team Members.
  - 2. Additional meetings may be required throughout construction, scheduled by the CxA through the Commissioner in accordance with 01 31 00 PROJECT MANAGEMENT AND COORDINATION with necessary parties attending, to plan, scope, coordinate and schedule future activities and resolve open issues.
  - 3. The CxA will review the Contractor submittals concurrent with the Commissioner and provide comments to the Commissioner for inclusion in their review. The reviewed submittals will include all commissioned equipment information, including detailed startup procedures, and coordination drawings that include commissioned equipment and systems, control drawings and sequences, and interfaces and interlocks between systems.
  - 4. The CxA works with the Commissioner and Contractor in developing Pre-functional and Functional Test documentation formats.
  - 5. Periodically throughout the construction process, the CxA will perform site visits to observe component and system installations.
  - 6. The checkout and performance verification generally proceeds from component level to equipment to systems and intersystem levels. Pre-functional (Installation) Checklists are to be completed before Functional Performance Checklists.



7. The Contractor shall, with guidance from the CxA, execute and document the Pre-Functional (Installation) Checklists and perform startup and initial checkout of equipment and systems. The CxA documents that the checklists and startup are completed according to the approved plans. This will include the CxA witnessing selected assembly markups, portions of the startup of selected equipment, and spot checking the Pre-Functional (Installation) Checklists.
8. The CxA develops specific equipment and system Functional Checklists. The Contractor receives a copy of the procedure through the Commissioner. The CxA may request additional design narrative from the Commissioner and Controls Contractor, depending on the completeness of the Basis of Design and sequences provided within the design documents.
9. The Functional Checklists are executed by the Contractor and witnessed and documented by the CxA.
10. Items of non-compliance in material, installation startup, and operation are corrected and the equipment or system is rechecked. The CxA will maintain an Issues Log to track issues and issue resolution.
11. The CxA will review the Operation & Maintenance documentation for completeness.
12. Commissioning, excluding the Warranty Walkthrough, shall be completed prior to Substantial Completion.
13. The CxA reviews the orientation documentation. The orientation schedules and agenda are provided by the subcontractors. The CxA verifies that orientation is completed, attended by the appropriate City of New York personnel, is thorough and provides all necessary information required to operate and service the equipment or system.
14. Deferred testing/ checkouts are conducted, as specified or required in the Contract Documents.

### **3.2 COMMISSIONING PLAN AND SCHEDULE**

- A. Commissioning Plan: The Commissioning Plan provides guidance in the execution of the commissioning process. After the initial construction phase Commissioning kickoff meeting, the CxA will update the plan. This plan is a living document that shall evolve and expand as the Project progresses. The Commissioning Plan shall include:
  1. Description of the facility and Project.
  2. Description of the commissioning process and associated deliverable documents.
  3. Description of equipment and systems to be commissioned.
  4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
  5. Sample rates for equipment to be tested.
  6. Identification of task items that must be completed before the next operation can proceed.
  7. Description of responsibilities of Commissioning Team members.
  8. Description of observations to be made and reported on during testing and witnessing of testing by all parties involved in the Project.
- B. Commissioning Schedule: Contractor shall provide construction schedules to the CxA, in accordance with Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION. The CxA will develop and submit a schedule identifying the commissioning process and provide commissioning scheduling information to the Commissioner and Contractor for review and planning activities. The Contractor shall incorporate the CxA's activities into the Project schedule.



### **3.3 TESTING PROCEDURES**

- A. The CxA will determine and document the acceptance procedures for each system within disciplines. The acceptance procedures shall incorporate the commissioning standards and successful testing results as referred to throughout the Specifications.
- B. The CxA will provide performance checklists and performance checkout data sheets for each system based on actual system configuration. Special emphasis shall be placed on checkout procedures that shall conclusively determine actual system performance and compliance with the OPR and BoD.
- C. The Contractor and appropriate Vendor(s) shall be informed of what tests are to be performed and the expected results. The Commissioning Plan shall address the test requirements and be distributed to all parties involved with that system.
- D. Prior to Functional Testing, the Contractor shall provide the following:
  - 1. Contractor shall certify in writing that commissioned systems, subsystems, and equipment have been installed, calibrated and started, and are operating according to the Contract Documents.
  - 2. Contractor shall certify in writing that all relevant instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.
  - 3. Contractor shall certify in writing that TAB procedures have been completed, and that the TAB report has been submitted, discrepancies corrected, and corrective work approved.
  - 4. Contractor shall perform tests for system and intersystem performance only after CxA and Commissioner have approved the completed testing checklists for systems, subsystems, and equipment.
- E. The Functional Performance tests shall be performed by the Contractor and Vendor(s) with oversight by the CxA. The CxA shall witness, verify, and document these tests.
  - 1. Functional Performance Tests shall include operating the systems and components through each of the written sequences of operation, other significant modes of miscellaneous alarms, power failure, and security alarm when impacted by and interlocked with commissioned equipment, as detailed in the Commissioning Plan.
  - 2. Checklists shall be completed comprehensively and to the extent necessary to enable the CxA to assure the Commissioner that the systems perform as per the OPR, BOD, and Contract Documents.
  - 3. If a test is failed for any reason and retesting is required, the Contractor shall provide retesting at no additional cost to the City.
  - 4. After testing, Contractor shall return settings to normal operating conditions.

### **3.4 OPERATION & MAINTENANCE MANUALS**

- A. General
  - 1. The CxA shall review the Operation & Maintenance manuals provided by the Contractor for completeness of the document. The review process shall verify that Operation & Maintenance instructions meet Specifications and are included for all commissioned equipment furnished by the Contractor.
  - 2. Published literature shall be specifically oriented to the provided equipment, indicating required operation and maintenance procedures, parts lists, assembly / disassembly diagrams and related information.
  - 3. The Contractor shall incorporate the standard technical literature into system specific formats for this facility as designed and as actually installed. The resulting Operation & Maintenance information shall be system specific, concise, to the point and tailored specifically to this facility. The CxA shall review these documents as necessary for final corrections by the Contractor.
  - 4. Contractor shall submit Operations & Maintenance Manuals for each piece of equipment for review no later than 45 days after submittal approval.



- B. The Operation & Maintenance Manual review and coordination efforts shall be completed prior to Owner orientation sessions, as these documents are to be utilized in the orientation sessions.
- C. System Operations Manual
  - 1. The CxA shall prepare and deliver these documents with inputs from the Contractor. The Contractor shall provide all required documents to the CxA, through the Commissioner. The required documents shall be described in the Commissioning Plan and Contract Documents. Typically, the manual includes the following:
    - a. System, subsystem, and equipment descriptions
    - b. Commissioned systems single line diagrams (to be provided by Mechanical, Electrical, Plumbing, and Building Management System (BMS) subcontractors).
    - c. As built sequences of operations, control drawings and original set points (to be provided by Design Consultant and BMS subcontractor).
    - d. Operating instructions for integrated building systems (to be provided by Mechanical and BMS subcontractors).
    - e. Recommended schedule of maintenance requirements and frequency (to be provided by subcontractors).
    - f. Recommended schedule for calibrating sensors and actuators (to be provided by BMS subcontractor).

### **3.5 DEMONSTRATION AND INSTRUCTION**

- A. The Contractor shall schedule and coordinate instruction sessions for the facility's staff for each commissioned system. Demonstrations shall be held per Contract Documents, along with the appropriate schematics, handouts and visual / audio orientation aids onsite with equipment.
- B. The equipment vendors shall provide instruction on the specifics of each major equipment item including philosophy, troubleshooting and repair techniques.
- C. The Contractor shall record and edit demonstration and orientation sessions, and provide these records to the CxA, through the Commissioner.
- D. For additional direction pertinent to instruction, refer to other specific divisions for demonstration and instruction requirements.

### **3.6 WARRANTY REVIEW / SEASONAL TESTING**

- A. The CxA will return upon the start of the new season (cooling or heating) after Project completion to conduct performance tests that could not be performed due to ambient conditions. The seasonal testing will only be performed if unsuitable loads / conditions were unavailable during the performance testing stages (in other words; the requirement for testing is warranted).
- B. The CxA will return to the site approximately 10 months into the 12-month warranty period and interview the occupants and maintenance staff, review the operation of the building, provide recommendations for installation and operational problems and document warranty and operational issues in the issues database.

### **3.7 RECORD DRAWINGS**

- A. The CxA shall review the as built Contract Documents to verify incorporation of both design changes and as built construction details. Discrepancies noted shall be corrected by the appropriate party.

**END OF SECTION 01 91 13**



**SECTION 01 91 15  
GENERAL COMMISSIONING REQUIREMENTS FOR BUILDING ENCLOSURE**

**REFER TO THE ADDENDUM FOR APPLICABILITY OF THIS SECTION 01 91 15**

**PART I – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum, and (5) the Contract [City of New York Standard Construction Contract].
- B. The Owner's Project Requirements (OPR) and Basis of Design (BOD) documents are included by reference for information only.
- C. The Commissioning Plan, prepared by the Commissioning Agent (CxA) under separate contract with the City of New York, contains requirements that apply to this section.

**1.2 SECTION INCLUDES**

- A. This section includes the commissioning requirements for the Building Enclosure systems. Refer to "Building Enclosure Functional Performance Test Protocol" in other sections of the Project specifications for specific requirements regarding Building Enclosure Commissioning.
  - 1. The commissioning requirements for the Building Enclosure systems given in this section are entirely separate from, and in addition to, the Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS for this Project. The Contractor, and his/her Suppliers, Subcontractors, Vendors, etc., are required to participate in both commissioning processes as required.

**1.3 DESCRIPTION**

- A. Building Enclosure Commissioning (BECx) is a systematic process of ensuring all building enclosure systems responsible for environmental separation perform **OPR BOD**. The BECx process is intended to verify and document proper installation and performance of building enclosure materials and systems in accordance with the Contract Documents.
- B. Commissioning does not take away from, or reduce the Contractor's responsibility to provide a finished and fully functioning product and installation.
- C. This section shall in no way diminish the responsibility of the Contractor in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this section are in addition to requirements outlined in the Contract Drawings and Specifications.

**1.4 RELATED WORK**

- A. Specific BECx requirements are given in this Section. The following Project Specification sections are related to the commissioning work specified in this section:
  - 1. Basic Concrete Requirements: Refer to Division 03
  - 2. Basic Metal Requirements: Refer to Division 05
  - 3. Basic Waterproofing, Roofing, Air Barrier and Insulation Requirements: Refer to Division 07



- 4. Basic Fenestrations Requirements: Refer to Division 08
- 5. Basic Finishing Requirements: Refer to Division 09

## **1.5 DEFINITIONS AND ABBREVIATIONS**

- A. Refer to Article 2 of the Contract and Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS for terms, words, and expressions not otherwise defined herein.
- B. Approval: Acceptance that a material or system has been properly installed and is functioning in tested modes according to the Contract Documents.
- C. Building Enclosure Commissioning Agent (BECA): Consultant under separate contract with the City of New York to provide BECx Services for this Project. BECA directs and coordinates day-to-day BECx commissioning activities.
- D. Building Enclosure Testing Agency (BETA): Building Enclosure Testing Agency whom is an independent agency retained by the Contractor and approved by the Commissioner, fully accredited by the appropriate governing body for each of the materials, components or systems to be tested or evaluated for compliance with requirements of the Contract Documents and as directed by the BECA. Documentation of such certification must be submitted to and approved by the Commissioner prior to the start of any work by the BETA.
- E. Commissioning: Commissioning is a systematic process of ensuring and documenting that the building systems, including the Building Enclosure, have been installed in the prescribed manner, are functionally checked and capable of being operated and maintained to perform with the design intent and have documentation to support proper installation and operation. The process does not eliminate or reduce the responsibility of the installing Contractors to provide a finished product.
- F. Commissioning Agent (CxA): Refer to Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS for Definition.
- G. Commissioning Plan: Refer to Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS for Definition.
- H. Deficiency: Condition of a building enclosure material or system that is not in compliance with Contract Documents (that is, does not perform properly or is not complying with design intent).
- I. Design Consultant: Refer to Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS FOR MEP SYSTEMS for Definition.
- J. Functional Performance Test (FPT): Test of performance of building enclosure materials and systems. Systems are tested under various simulated environmental conditions, such as air leakage under pressure differential and water leakage under pressure differential with water spray.
- K. Simulated Condition: Condition created for testing component or system (e.g., applying pressure differential across the building enclosure concurrent with water spray to simulate a wind driven rain).
- L. Mock-up: The activities where systems or materials are initially constructed and tested.



## **1.6 COORDINATION**

- A. Building Enclosure Commissioning Team: Members of the Building Enclosure Commissioning Team shall consist of:
1. CxA
  2. BECA
  3. BETA
  4. Commissioner
  5. Contractor, and all Building Enclosure Subcontractors
  6. Design Consultant
- B. Management: City of New York shall contract services of the BECA through a separate contract. The BECA shall direct and coordinate commissioning activities and report to the Commissioner. All members of the Building Enclosure Commissioning Team shall cooperate to fulfill contracted responsibilities and objectives of the Contract Documents.
- C. Scheduling: BECA shall work with Building Enclosure Commissioning Team to establish required commissioning activities to incorporate in preliminary commissioning schedule. The Contractor shall integrate commissioning activities into master construction schedule, in accordance with Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION. Necessary notifications are to be made in a timely manner in order to expedite commissioning.

## **1.7 SUBMITTALS**

- A. Contractor shall provide documentation required for commissioning work in accordance with Section 01 33 00 SUBMITTAL PROCEDURES. At minimum, documentation shall include but not be limited to:
1. Submittal of shop drawings, product data, samples, etc., relevant to BECx and as requested by the BECA. Such submittals shall be in compliance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.
  2. As-Built Record Drawings and Operation and Maintenance Information relevant to BECx and as required by the BECA. Such submittals shall be in compliance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.
  3. All demonstration and orientation submittals relevant to BECx and as requested by the BECA. Such submittals shall be in compliance with Section 01 79 00 DEMONSTRATION AND OWNER'S PREACCEPTANCE ORIENTATION.
  4. Performance data, any performance test procedures, and installation and checkout materials.
- B. The Contractor shall provide all submittals to the Design Consultant, as per Section 01 33 00 SUBMITTAL PROCEDURES. The Design Consultant will transmit all building enclosure related submittals to the BECA for concurrent review.

**PART II – PRODUCTS** – Part not used.

**PART III – EXECUTION**

### **3.1 SYSTEMS TO BE COMMISSIONED**

- A. Building Enclosure systems to be commissioned may include, but are not limited to, Below Grade Waterproofing Systems, Opaque Wall/Cladding Systems, and Fenestration systems. Refer to the Contract Documents for clarity.





### **3.2 RESPONSIBILITIES OF COMMISSIONING TEAM MEMBERS DURING CONSTRUCTION PHASE**

- A. Responsibilities of the Design Consultant include without limitation the following:
1. Review BECA comments on construction document and shop drawings.
  2. Assist in dispute resolution regarding building enclosure items.
  3. Review BECA reports.
  4. Incorporate BECA Submittal Review Comments into response on Submittals.
- B. Responsibilities of the BECA include the following without limitation, as needed per the Contract Documents:
1. Review and comment on mock-up construction and testing plan as provided by Contractor.
  2. Development of BECx Plan.
  3. Review of building enclosure shop drawings and submittals, including "approved equal" requests, through the Commissioner in accordance with Section 01 33 00 Submittal Procedures.
  4. Attend combined Pre-construction and BECx kick-off meeting.
  5. Develop construction checklists for the building enclosure for the Contractor's use.
  6. Observe the construction of a building enclosure mock-up.
  7. Witness the testing of a building enclosure mock-up.
  8. Project meetings / conference calls / Coordination.
  9. Field monitor installation of exterior enclosure components.
  10. Update field report log.
  11. Update BECx Plan.
  12. Advise on Requests For Information.
  13. Assist with the preparation of LEED paperwork.
  14. Prepare Systems Manual, with required inputs and documentation from the Contractor in accordance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.
  15. Complete Maintenance Plan, with required inputs and documentation from the Contractor in accordance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.
  16. Prepare Training Manual, with required inputs and documentation from the Contractor in accordance with Section 01 78 39 CONTRACT RECORD DOCUMENTS.
  17. Prepare final BECx record and enclosure commissioning close-out documents.
  18. Develop on-going BECx Plan.
- C. Responsibilities of the Contractor and Building Enclosure Subcontractors include without limitation the following:
1. Review BECx Plan and FPT specification.
  2. Attend commissioning kick-off meeting and other Building Enclosure Commissioning Team meetings.
  3. Incorporate commissioning activities into the construction schedule.
  4. Periodically update commissioning activities in the construction schedule.
  5. Notify Commissioner and BECA of work completion.
  6. Verify building enclosure materials and assemblies are ready for functional testing.
  7. Retain the services of an approved independent BETA; submit qualifications of independent BETA to Commissioner for approval; coordinate all activities and deliverables of this BETA; ensure all BETA deliverables are provided to the Building Enclosure Commissioning Team.
  8. Attend all required material and systems testing.
  9. Execute all periodic maintenance or repairs required on started systems from initial mock-up of equipment to final acceptance by Commissioner to prevent material warranties from being voided.



10. Submit maintenance logs of all interim maintenance or repair tasks performed by Contractor.
11. Ensure installation work is complete, is in compliance with Contract Documents, and is ready for Functional Performance Testing. FPT test results shall be documented by BECA.
12. Ensure resolution of non-compliance and deficiencies in construction or test results. Obtain written documentation of completion from the appropriate Contractors.
13. Provide letters of compatibility for adjacent building enclosure materials and assemblies.
14. Facilitate all repairs and retesting of failed condition at no additional cost to the City of New York.
15. Provide all warrantee information to BECA.

D. Responsibilities of the BETA include without limitation the following:

1. Attend commissioning kick-off meeting and other Building Enclosure Commissioning Team meetings.
2. Provide on-site technician and equipment to complete mock-up and field Functional Performance Testing.
3. Prepare and submit reports to the Commissioner at the conclusion of all testing.
4. Perform retesting and prepare corresponding reports.

### **3.3 BUILDING ENCLOSURE COMMISSIONING TEAM (BECx) MEETINGS**

- A. BECx meetings shall be held periodically as determined by the Commissioner and recommended by BECA.
- B. Discussions held in BECx meetings shall include, but not be limited to, system/materials, mock-up/field, progress, scheduling, testing, documentation, deficiencies, and problem resolution.
- C. The Contractor shall attend BECx meetings, and shall ensure the attendance of required subcontractors, as requested.

### **3.4 REPORTING**

- A. BECA shall provide status reports to the Commissioner. The Commissioner will provide such status reports to the Contractor, CxA, Design Consultant, and other entities as needed.
- B. BECA shall submit non-compliance and deficiency reports to Commissioner. The Commissioner shall provide such reports to the Contractor, CxA, Design Consultant, and other entities as needed.
- C. BECA shall provide a final summary report to Commissioner and CxA.

### **3.5 MOCK-UP AND FINAL CONSTRUCTION**

- A. Contractor shall verify completion of all assemblies compliant with Contract Documents and deficiency log items prior to Functional Performance Testing or concealment of functional performance layers within the building enclosure.

### **3.6 FUNCTIONAL PERFORMANCE TESTING**

A. Objectives and Scope

1. The objective of Functional Performance Testing is to demonstrate that the building enclosure is performing according to documented design intent and Contract Documents. Functional Performance Testing facilitates bringing the building enclosure systems from a state of substantial completion to fully operational. Additionally, during Functional Performance Testing, areas of deficient performance are identified and corrected, improving building enclosure system performance.



**B. Development of Test Procedures**

1. The purpose of a specific test is to verify and document compliance of the installed enclosure systems with the OPR. Building Enclosure Functional Performance Test Protocols are provided in other sections of the Project Specifications for specific requirements regarding BECx.

**C. Coordination and Scheduling**

1. Contractor shall provide sufficient notice to BECA, through the Commissioner, regarding completion schedule for materials and systems. Testing to be performed in conjunction with site visits. Contractor shall schedule Functional Performance Tests with Commissioning Team. BECA shall witness and document functional testing of equipment and systems. BECA, as retained by the Contractor, shall execute tests under direction of BECA.
2. Successful completion of mock-up functional performance testing shall occur prior to full production installation of building enclosure materials and systems.

**3.7 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS**

**A. Documentation**

1. BECA shall witness and document results of FPT.

**B. Non-Conformance**

1. BECA shall record results of functional testing. Deficiency or non-conformance issues shall be noted and reported to the Commissioner. The Commissioner shall provide such non-conformance reports to the CxA, Design Consultant, Contractor, and other entities, as needed.
2. Corrections of minor deficiencies identified may be made during tests at discretion of the Commissioner and recommended by the BECA. In such cases, deficiency and resolution shall be documented.
3. Every effort shall be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests.
4. Deficiencies are handled in the following manner:
  - a) BECA documents deficiencies and notes Contractors response and intentions. Finding a deficiency shall not end the testing process.
  - b) BECA submits deficiency report to the Commissioner. The Commissioner shall provide such deficiency report to the CxA, Contractor, Design Consultant, and other entities as required.
  - c) Contractor corrects deficiency and certifies that material or assembly is ready to be retested.
  - d) Contractor informs Commissioner of retesting schedule for coordination with the BECA.
  - e) Contractor reschedules test with the Commissioner and BECA at no additional cost to the City of New York.

**C. Testing**

1. Costs for all testing and retesting required for the Project shall be the responsibility of the Contractor. The Contractor is to provide access to the test specimens to the Commissioning Team, through the Commissioner.



### **3.8 COMMISSIONING DOCUMENTATION**

#### **A. Final Report Details**

1. Final BECx Report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope, and general description of testing and verification methods. Report shall contain evaluation regarding:
  - a) Conformance to specifications and design intent
  - b) Material/system installation
  - c) Functional performance
2. All outstanding non-compliance items shall be specifically listed.
3. Recommendations for improvement to system or operations, future actions, etc. shall also be listed.

**END OF SECTION 01 91 15**



**Department of  
Design and  
Construction**

Division 01 – DDC STANDARD GENERAL CONDITIONS  
SINGLE CONTRACT PROJECTS  
Issue Date: July 1, 2019

(No Text on This Page)

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**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

30-30 THOMSON AVENUE  
TELEPHONE (718) 391-1000

LONG ISLAND CITY, NEW YORK 11101-3045  
WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

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**Department of  
Design and  
Construction**

**Contract for Furnishing all Labor and Material Necessary**

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Contractor

Dated \_\_\_\_\_, 20\_\_\_\_

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Approved as to Form  
Certified as to Legal Authority

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Acting Corporation Counsel

Dated \_\_\_\_\_, 20\_\_\_\_

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Entered in the Comptroller's Office

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First Assistant Bookkeeper

Dated \_\_\_\_\_, 20\_\_\_\_



FMS ID: PO002-116



Department of  
Design and  
Construction

**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

30-30 THOMSON AVENUE LONG ISLAND CITY, NEW YORK 11101-3045  
TELEPHONE (718) 391-1000 WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

**Contract for Furnishing all Labor and Material Necessary and Required for:**

**CONTRACT NO. 1 GENERAL CONSTRUCTION WORK**

**New 116th Precinct Station House**

**LOCATION:** 244-04 North Conduit Avenue  
**BOROUGH:** Queens, NY 11422  
**CITY OF NEW YORK**

Citralta Construction Corp  
Contractor

Dated March 6, 20 20

Approved as to Form  
Certified as to Legal Authority

[Signature]  
Acting Corporation Counsel

Dated June 14, 20 19

Entered in the Comptroller's Office

First Assistant Bookkeeper

Dated \_\_\_\_\_, 20 \_\_\_\_\_

K.T. 6/14/19





**Department of  
Design and  
Construction**

**PROJECT ID:**

**PO002-116**

**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

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**VOLUME 3 OF 3**

**ADDENDUM TO THE GENERAL  
CONDITIONS**

**SPECIFICATIONS**

FOR FURNISHING ALL LABOR AND MATERIALS  
NECESSARY AND REQUIRED FOR:

**New 116th Precinct Station House  
Rebid**

**LOCATION:**  
**BOROUGH:**  
**CITY OF NEW YORK**

**244-04 North Conduit Avenue  
Queens, NY 11422**

**CONTRACT NO. 1**

**GENERAL CONSTRUCTION WORK**

**New York City Police Department**

**Dattner Architects**

**Date:**

**August 29, 2019**



**20-008**





THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS

ADDENDUM TO THE GENERAL CONDITIONS  
FOR SINGLE CONTRACT PROJECTS

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The General Conditions are hereby amended in accordance  
with the terms and conditions set forth in this Addendum.

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I. PROJECT DESCRIPTION

FMS #: **PO002-116**

PROJECT NAME: **116<sup>th</sup> Precinct Station House Rebid**

PROJECT DESCRIPTION: ***This Project consists of the 116<sup>th</sup> Precinct Station House. The new building will be sited adjacent to the existing 105th Precinct Annex, located on North Conduit Avenue between Francis Lewis Boulevard and 138th Avenue, in the Rosedale neighborhood of Queens.***

***The new building is 2 stories and includes a cellar level. Parking for the new facility will be provided in a surface lot behind the new building, as well as in a new surface lot in front of the existing 105th Precinct Annex. Fueling for the 116<sup>th</sup> precinct vehicles will be located at the rear parking lot of the new precinct.***

***An open space on axis with the LIRR entrance creates a new public open space. The main entrance to the new 2-story precinct station house opens off the new public open space. A secondary entrance, directly to the Community Room, is provided on North Conduit Avenue. The building is designed to be certified LEED Silver and will conform with Local Law 86.***

PROJECT LOCATION: **244-04 NORTH CONDUIT AVENUE**  
BOROUGH: **QUEENS**  
CITY OF NEW YORK  
ZIP CODE: **11422**  
COMMUNITY BOARD #: **QUEENS COMMUNITY DISTRICT 13**

LANDMARK STATUS:

DESIGNATED LANDMARK STRUCTURE OR SITE: **NO**

*If this is a Designated Landmark Structure or Site, Section 01 3591, Historic Treatment Procedures applies to this project.*

LANDMARK QUALITY STRUCTURE: **NO**

*If this is a Landmark Quality Structure, Section 01 3591, Historic Treatment Procedures applies to this project.*

## II. LEED GREEN BUILDING REQUIREMENTS

This project must achieve a **Certified, Silver** LEED Green Building Rating. A certain number of credits are required for this rating and are detailed in the Project Specifications. Sections 01 7419 Sub-Section 1.5(C) Waste Management Performance Requirements / LEED Certification, 01 8113.04 Sustainable Design Requirements for LEED v4 Buildings and 01 8119 Indoor Air Quality Requirements for LEED Buildings of the DDC Standard General Conditions shall apply to this project.

## III. COMMISSIONING REQUIREMENTS

This project includes Commissioning Requirements. The General Commissioning Requirements for MEP Systems are found in Section 01 91 13 of the DDC Standard General Conditions. The General Commissioning Requirements for Building Enclosure are found in Section 01 91 15 of the DDC Standard General Conditions. Other specific Commissioning Requirements can be found in the Project Specification Sections.

## IV. PROJECT MANAGEMENT

Contractor must use Procore, a construction management software application, for all Project submittals and deliverables, including, without limitation, RFIs, schedules, drawings, including shop drawings, and any other transmittals and tasks as directed by the Commissioner. DDC will provide access to Procore to the Contractor, and the Contractor must use DDC's version of Procore and not its own.

- ☐ DDC shall publicly bid and enter into all contracts for the Project. DDC shall manage the Project using its own personnel.
- ☒ DDC shall publicly bid and enter into all contracts for the Project. A Construction Management firm (the "CM") hired by DDC shall manage the Project. The Contractor is advised that the CM shall serve as the representative of the Commissioner at the site and shall, subject to review by the Commissioner, be responsible for the inspection, management, coordination and administration of the required construction work, as delineated in the article of the Standard Construction Contract entitled "The Resident Engineer".

## V. CONTRACTS FOR THE PROJECT

The Project consists of a single contract, the Contract for General Construction Work. The Contractor for General Construction Work is responsible for the performance of all required work for the Project as set forth in the Contract Documents (General Conditions, Drawings and Specifications), including all responsibilities and obligations assigned to separate Contractors for the following subdivisions of the work: Plumbing Work, HVAC Work, and Electrical Work. All responsibilities and obligations in the Contract Documents assigned to separate Contractors for such subdivisions of the work are the responsibility of the Contractor for General Construction Work.

## VI. SCHEDULES

The Contractor is advised that Schedules A through F are attached to, and incorporated as part of, this Addendum to the General Conditions. These schedules contain important information that is specific to this Project. The Contractor is advised to carefully review these schedules.

## VII. APPLICABILITY OF SECTIONS/SUB-SECTIONS AND AMENDED SUB-SECTIONS

The Contractor is advised that various Sections/Sub-Sections in the General Conditions may not apply to this Project or may apply as amended. Such Sections/Sub-Sections advise the Contractor to "Refer to the Addendum for the applicability of this Section/Sub-Section." Such Sections/Sub-Sections are set forth below. A check mark indicates whether the Section/Sub-Section (1) applies to the Project, (2) does not apply to the Project, or (3) applies to the Project as amended. If no box is checked, the Section/Sub-Section, as set forth in the General Conditions, applies to the Project. Amended Sections/Sub-Sections, if any, are set forth following this list of Sections.

<u>Section</u>	<u>Sub-Section</u>	<u>Sub-Section</u>	<u>Applies</u>	<u>Does not Apply</u>	<u>Applies as Amended</u>
<b>01 1000</b>	1.4 (B)	Scope and Intent / LEED	X		
	1.4(C)	Scope and Intent / Commissioning	X		
<b>01 3233</b>		Photographic Documentation	X		
<b>01 3300</b>	1.7 (A-D)	LEED Submittals	X		
<b>01 3503</b>		General Mechanical Requirements	X		
<b>01 3506</b>	3.2 (A-B)	Electrical Conduit System Including Boxes (Pull, Junction and Outlet)	X		
	3.3 (A-E)	Electrical Wiring Devices	X		
	3.4 (A-I)	Electrical Conductors and Terminations	X		
	3.5 (A-B)	Circuit Protective Devices	X		
	3.6 (A-J)	Distribution Centers	X		
	3.7 (A-I)	Motors	X		
	3.8 (A-I)	Motor Control Equipment	X		
<b>01 3591</b>		Historic Treatment Procedures		X	
<b>01 5000</b>	3.2 (A)	Temporary Water Facilities / Temporary Water	X		
	3.2 (B)	Temporary Water Facilities / Temporary Water – Work in Existing Facilities		X	
	3.3 (B)	Temporary Sanitary Facilities / Self-Contained Toilet Units	X		
	3.3 (C)	Temporary Sanitary Facilities / Existing Toilets		X	
	3.4 (B) 1	Temporary Power, Lighting, and Site Lighting / Connection to Utility Lines	X		
<b>01 5000</b>	3.4 (B) 2	Temporary Power, Lighting, and Site Lighting / Connection to Existing Electrical Power Service	X		
	3.4 (B) 3	Temporary Power, Lighting, and Site Lighting / Electrical Generator Power Service	X		
	3.4 (D)	Temporary Power, Lighting, and Site Lighting / Temporary Lighting	X		
	3.4 (E)	Temporary Power, Lighting, and Site Lighting / Site Security Lighting (for New Construction Only)	X		
	3.5 (A-J)	Temporary Heat	X		
	3.8 (A)	DDC Field Office / Office Space in Existing Building		X	
	3.8 (B)	DDC Field Office / DDC Field Office Trailer			X
	3.8 (B-3a)	DDC Field Office / DDC Managed Field Office Trailer		X	
	3.8 (B-3b)	DDC Field Office / CM Managed Field Office Trailer			X
	3.8 (D)	DDC Field Office / Additional Equipment for the DDC Field Office			X

<u>Section</u>	<u>Sub-Section</u>	<u>Sub-Section</u>	<u>Applies</u>	<u>Does not Apply</u>	<u>Applies as Amended</u>
<b>01 5000</b>	3.13(A-D)	Work Fence Enclosure	X		
	3.17(B)	Project Rendering	X		
	3.18 (A-C)	Security Guards / Fire Guards on Site	X		
<b>01 5411</b>	3.1 (A-J)	Temporary Use, Operation and Maintenance of Elevators During Construction for New Buildings Up To and Including 15 Stories	X		
	3.2 (A-M)	Temporary Use, Operation and Maintenance of Elevators During Construction for New Buildings Over 15 Stories		X	
	3.3 (A-E)	Temporary Use, Operation and Maintenance of Elevators During Construction for Existing Buildings		X	
<b>01 7300</b>	3.3 (A-I)	Surveys	X		
	3.4 (A-B)	Borings	X		
	3.12 (A-D)	Sleeves and Hangers	X		
	3.13 (A)	Sleeve and Penetration Drawings	X		
	3.15 (A)	Location of Partitions	X		
<b>01 7419</b>	1.5 (C)	Waste Management Performance Requirements / LEED Certification	X		
<b>01 7900</b>		Demonstration and Owner's Pre-Acceptance Orientation	X		
<b>01 8113.03</b>		Sustainable Design Requirements for LEED v3 Buildings		X	
<b>01 8113.04</b>		Sustainable Design Requirements for LEED v4 Buildings	X		
<b>01 8113.13</b>		VOC Limits for Adhesives, Sealants, Paints and Coatings for LEED v3 Buildings		X	
<b>01 8119</b>		Indoor Air Quality Requirements for LEED Buildings	X		
<b>01 9113</b>		General Commissioning Requirements for MEP Systems			X
<b>01 9115</b>		General Commissioning Requirements for Building Enclosure	X		

## AMENDED SECTIONS/SUB-SECTIONS

The Contractor is advised that the amended Sub-Sections set forth below are included in the General Conditions and apply to the Project.

## ADDITIONAL SECTIONS/SUB-SECTIONS

The Contractor is advised that the additional Sub-Sections set forth below are included in the General Conditions and apply to the Project.

### 01 50 00 Temporary Facilities, Services, and Controls

#### 3.8 (B-3b) CM Managed Trailer

b. CM Managed Project Trailer: DDC Field Office Trailer Size, Layout, and Computer Workstation:

- 1) Overall length: Minimum 60 Feet  
Overall width: Minimum 24 Feet
- 2) Interior Layout:  
Provide one (1) large general office/conference room in the center of the trailer and four private offices, two (2) at either end of the trailer. Provide equipment and amenities as specified in Sub-Section 3.8.B herein.
- 3) Computer Workstation:  
Provide six (6) complete computer workstations and two (2) Personal Computer(s) for NYPD as specified in Sub-Section 3.8.D herein. Provide two (2) complete workstations in each private office. Each computer workstation is to have two (2) computer monitors. One private office's computer workstations will be equipped with the two (2) additional Personal Computer(s) for NYPD.

#### 3.8 (B-12) CM Managed Project Trailer

12. The following movable equipment shall be furnished:

- a. Two (2) single pedestal desks, 42" x 32"; two (2) swivel chairs with arms and two (2) side chairs without arms to match desk in each private office. Two (2) full ball bearing suspension four (4) drawer vertical legal filing cabinets with locks and two (2) full ball bearing two (2) drawer vertical legal filing cabinets in each private office located below built in desk.
- b. Two (2) single pedestal desks, 42" x 32"; two (2) swivel chairs with arms in general office/conference room. Two (2) full ball bearing suspension four (4) drawer vertical legal filing cabinets with locks and two (2) full ball bearing two (2) drawer vertical legal filing cabinets in general office/conference room located below built in desk
- c. One (1) folding conference table, 96" x 30" and ten (10) folding chairs.
- d. Five (5) metal wastebaskets.
- e. One (1) fire extinguisher one (1) quart vaporizing liquid type, brass, wall mounted by Pyrene No. C21 or approved equal.
- f. One (1) Crystal Springs water cooler with bottled water, Model No. LP14058 or approved equal to be furnished for the duration of the Contract as required.

#### 3.8 (D) Additional Equipment for DDC Field Office

(2) Personal Computer(s) NYPD – Each Laptop Configuration

- a) Make and Model: Dell Inspiron 15 7000 2-in-1), or an approved equal.  
(Note: an approved equal requires written approval of the DDC Assistant Commissioner of ITS.)
- b) Processor: 8th Generation Intel® Core™ i7-8565U Processor (8MB Cache, up to 4.6 GHz)
- c) System RAM: 16GB, 16GBx1, DDR4 2666MHz

- d) Hard Disk Drive(s): 512GB M.2 PCIe NVMe Solid State Drive
- e) I/O Ports: 1x Combo Jack (Headphone / Microphone), 1x HDMI Out, 2x USB 3.1 Gen 1, 1x USB 3.1 Gen 1 Type-C
- f) Video Display Card: Intel UHD Graphics 620 with shared graphics memory
- g) LCD Panel: 15.6-inch FHD (1920 x 1080) Truelife Touch Narrow Border IPS Display with Active Pen support
- h) WI\_FI 802.11ac 2x2 WiFi and Bluetooth
- i) Carrying Case Nylon Carrying Case specifically designed for model being provided.
- j) Accidental Damage 3 Year Complete Care Accidental Damage Protection
- k) Other Peripherals: Dell Wireless Mouse – WM326, Dell USB Slim DVD+RW Drive, Dell Portable SSD, USB-C 250GB
- l) Operating System Windows 10 Professional
- m) Software Requirement: Microsoft Office 2019 Professional; Microsoft Project 2016 Professional, Adobe Acrobat Professional DC, Anti-Virus software package w/ 3 year updates subscription, AutoCAD 2019
- n) Warranty 3 Year Basic Limited Warranty and 3 Year NBD On-Site Service

**01 91 13 General Commissioning Requirements: 3.5 Functional Building Systems Demonstration Test (72 Hours)**

**3.5 FUNCTIONAL BUILDING SYSTEMS DEMONSTRATION TEST (72 HOURS)**

- A. Upon completion of all major commissioning for equipment and systems, and prior to occupancy, a 72-hour functional building system demonstration test shall be performed. A second 72-hour test shall be performed in the off-season equipment mode to demonstrate either heating or cooling operation.
- B. Prior to the test the following needs to be completed / reviewed and approved:
  - 1. Startup of all equipment
  - 2. Commissioning of all equipment and systems.
  - 3. Full air and waterside balancing
  - 4. Sequence of Operation
  - 5. Controls point-to-point verification
  - 6. Controls software check
  - 7. Graphics and Front-End Interface
  - 8. Sensor calibration verification
  - 9. Completion of all punchlist items that may affect testing
  - 10. Full equipment maintenance including changing filters
- C. The 72-hour test shall monitor and verify overall building system performance and how it automatically responds to load changes within the building. In order to accomplish this the CxA shall perform the following:
  - 1. Install sufficient calibrated temperature and humidity sensors and data loggers to trend the temperature and humidity within the building spaces to ensure it does not exceed design criteria. Readings should be taken at appropriate intervals (not to exceed 5 minutes, critical areas 1 minute) to assure compliance with design criteria.

2. Trend the equipment and system operation through the BMS to track operation of valves and dampers to assure correct operation of the systems.
  3. Set BMS to automatic mode and ensure all equipment is in automatic.
  4. Run the system for 72 hours
- D. Upon completion of the test, collect and analyze the data. Provide initial report findings within 48 hours upon the completion of the test. Final report shall follow successful 72-hour test.
1. Any equipment or controls requiring modification during the test shall constitute a failure of the test. The test shall be repeated until no equipment or controls failures occur.
  2. Review temperature and humidity levels within all spaces being tested. Document all deviations from acceptable levels or ranges. Fluctuations of significant time or magnitude shall be considered a failure.
  3. Review BMS system operation logs for static pressure, water temperatures, differential pressures and other control points being monitored. Document all deviations from acceptable levels or ranges.
  4. Below is a list of key performance indicators that must be maintained throughout the duration of the 72-hour test to demonstrate successful operation. This list includes specific performance metrics that must be maintained within the prescribed tolerances as well as critical faults/alarms that must not be tripped/activated throughout the duration of the 72-hour demonstration test:
    - a. Ventilation & Exhaust Systems (Heating & Cooling)
      - i. No exhaust fan faults/alarms
      - ii. No duct high pressure faults/alarms
      - iii. No AHU freeze-stat faults/alarms
      - iv. No AHU fan faults/alarms
      - v. No AHU enthalpy wheel faults/alarms
    - b. Heating Season System Test
      - i. Maintain Hot Water Setpoint (Leaving Boiler): **140.0°F (+/- 5%)**
      - ii. Maintain Hot Water Flow Rate (Leaving Boiler): **150.0 GPM (+/- 5%)**
      - iii. No heating pump faults/alarms
      - iv. No boiler high water cut off faults/alarms
      - v. No boiler low water cut off faults/alarms
    - c. Cooling Season System Test
      - i. Maintain Chilled Water Setpoint (Leaving Chiller): **45.0°F (+/- 2.0°F)**
      - ii. Maintain Chilled Water Flow Rate (Leaving Chiller): **305.0 GPM (+/- 5%)**
      - iii. Maintain Condenser Water Setpoint (Leaving Tower): **85.0°F (+/- 2.0°F)**
      - iv. Maintain Condenser Water Flow Rate (Leaving Tower): **360.0 GPM (+/- 5%)**
      - v. No cooling pump faults/alarms
      - vi. No chiller low suction faults/alarms
      - vii. No chiller high pressure faults/alarms
      - viii. No chiller low flow faults/alarms
      - ix. No cooling tower fan faults/alarms
      - x. No cooling tower vibration switch faults/alarms
      - xi. No cooling tower basin heater faults/alarms
      - xii. No cooling tower basin high level faults/alarms
      - xiii. No cooling tower basin low level faults/alarms
- E. In the event of a test failure, work with Engineer and Controls Vendor to develop corrective actions in order to mitigate issues. Ensure corrective actions are implemented prior to performing a retest. In no circumstance, can a test be continued, a new 72-hour test must be performed.
- F. A second 72-hour test shall be performed in the off season (heating or cooling mode). This test shall have the same parameters as the first 72-hour test listed above.

G. Upon the successful completion of the second 72-hour test, a final test report shall be generated. This report shall contain the following:

1. Executive Summary detailing the test(s) performed and results
2. Data from previous unsuccessful tests (if applicable)
3. Corrective actions taken
4. Data from the acceptable test
5. Graphs and Charts as required show trends in the data
6. Written confirmation that the systems operate per design in both heating and cooling modes.

### **LONG ISLAND RAILROAD (LIRR)**

There are LIRR facilities in the area of construction. The Contractor shall notify LIRR at least thirty days (30) prior to the start of construction by contacting Mr. Timothy Raichel, P.E. at (718) 588-3218. The Contractor shall

comply with the requirements as specified in **Section 10.25, paragraph (A)** and **Section 10.25 paragraph (B)** of this section.

Construction activities will impact the safety of pedestrians, the 105<sup>th</sup> Precinct Annex, and the LIRR North Access. The Site Logistics Plan provided in the Appendix must be complied with to fulfill the agreement with the LIRR, NYCDOT, and the Rosedale community to limit the closure time of the LIRR North Access. The LIRR South and West Access will remain open at all times.

At all times during construction, the LIRR North Access is to remain open except for the amount of time necessary to complete the plaza work directly in front of the LIRR North Access. There is storm drainage and cleanouts near the pedestrian path that may affect the path shown in the logistics plan and on sheet G-015. The contractor must sequence the work in a way that allows for the LIRR North Access to remain open during this work. The contractor is to limit the closure as much as possible. As shown in the Site Logistics Plan and sheet G-015, the Contractor is to provide a pedestrian path with temporary lighting/signage and a 10' wide walkway using Construction fencing on both the exterior of the path and the 105<sup>th</sup> Precinct Annex side of the path during Construction to provide access to the LIRR North Access and egress for the 105<sup>th</sup> Precinct Annex. Construction fencing will be used around the entire Construction site and must follow NYC Noise Control Code and the 2014 NYC Construction Code. The signage should divert pedestrians around the construction site to the LIRR North Access and to the other LIRR entrances during time of closure. Construction trailers are to be located on the West side of the Construction site.

**(3) Refer to Subsection 10.25 – Contractor To Carry Out Agreement Between City and Railroad Company Or Property Owner(s), Page I-14:**

**Add** the following to **Subsection 10.25:**

#### **(A) LIRR GENERAL NOTES**

(a) General Requirements For Projects Adjacent To LIRR Property With Potential To Impact LIRR Safety and Operations:

- (1) Attached are "General Requirements For Outside Contractors Working On LIRR Property". These requirements apply to this project. Cost of LIRR personnel (i.e. flag protection, project engineers, inspectors, etc.) required by the project will be paid for directly to the LIRR by the City.
- (2) Shop drawings and calculations detailing sheeting must be submitted prior to excavation, which may impact the stability of adjacent embankment or structures supporting our tracks. Shop drawings and calculations shall include the original seal and signature of a New York State Licensed Professional Engineer. Shoring shall be designed for Cooper E-80 Axle Loading as per the American Railway Engineering Association.
- (3) Drawings submitted to the LIRR for review shall be transmitted electronically on a CD or DVD with each drawing clearly defined. The format for the drawing can be either pdf or AutoCAD plotted to full size.



- (4) LIRR flagging will be required at all times when performing work at or near the LIRR structure.
- (5) Fouling of LIRR track includes work within 15-feet of or above LIRR tracks. This also includes operation of equipment or any part of equipment, (i.e. crane booms) which could fall onto or within six (6) feet of LIRR tracks.
- (6) All parties are notified that fouling LIRR track without LIRR flag protection being present is a violation of federal law.
- (7) Cranes:
  - (a) Cranes operations must maintain at least 15-feet vertical and horizontal separation from overhead LIRR's High Tension lines. If overhead power lines, from outside agencies, are supported from LIRR High Tension poles, a letter from that agency must be submitted to the LIRR stating their vertical and horizontal separation requirements.
  - (b) The following conditions apply for operating cranes with booms of sufficient length to fall onto or within six (6) feet of LIRR's tracks:
    - (1) Cranes information must be submitted to the LIRR for review, including proposed location of crane, proposed boom angle and loading diagram indicating that the crane is capable of supporting 150% of the load to be lifted. Loading diagram shall include original seal and
    - (2) signature of New York State Licensed Professional Engineer.
    - (3) LIRR flag protection must be on site. Crane operations will generally be restricted from 10:00 a.m. to 3:00 p.m. daily.
    - (4) Crane operators or one (1) construction supervisor who will be on the site full time, must be trained and certified in Roadway Worker Protection.
    - (5) Crane operators must follow the direction of LIRR's flagmen and face boom parallel to LIRR's track, when ordered to do so.
- (b) General Requirements For Survey By Outside Contractor On LIRR Property:
  - (1) All survey party members employed by an outside contractor shall herein be referred to as the "contractor"
  - (2) Permanent and temporary marking of LIRR track structure is not permitted. LIRR track structure consists of running rail (track), rail fasteners, concrete ties, wood ties.
  - (3) Reflective paint shall not be used on or adjacent to LIRR property.
  - (4) Nonreflective red, orange or yellow paint shall not be used on LIRR property.
  - (5) Electric third rail must be considered energized at all times. The contractor must not come into contact with or attempt to mark the electric third rail, third rail cover board or third rail cover board brackets.
- (c) Specific Requirements:
  - (1) This project is adjacent to LIRR's Rosedale Station; therefore, station entrances must be open and accessible at all time. Protection of LIRR property and facilities is the responsibility of the Contractor and at no additional cost to the City. All damage to LIRR property caused by the Contractor's operation shall be repaired by the Contractor or repaired by the LIRR and charged to the Contractor.
  - (2) The Contractor shall contact LIRR for the following:
    - (a) Obtaining Permits – Mr. Edward Maines at (718) 558-3536.
    - (b) Insurance Submittal – Ms. Carol Berlingieri at (646) 252-1429.
    - (c) Civil Design And Inspection – Joseph El-Kallassy at (718) 558-3218.
    - (d) Compliance With Safety Training Requirements – Training Department (718) 558-3128.
    - (e) Obtaining Flag Protection – Flag Desk (631) 893-2799.

## **(B) LIRR Insurance Requirements**

The following shall become a part of and apply to the contract:

- (a) LONG ISLAND RAIL ROAD INSURANCE: The Contractor shall procure, at its sole cost and expense, and shall maintain in force at all times during the term of this Agreement, policies of insurance as herein below set forth, written by companies with an A.M. Best Company rating of A- or better and approved by the LIRR/MTA. The Contractor shall deliver to the LIRR/MTA evidence of such policies. These policies must: (i) be written in accordance with the requirements of the paragraphs below, as applicable; (ii) be endorsed in form acceptable to the LIRR/MTA to include a provision that the policy will not be canceled, materially changed, or not renewed without at least thirty (30) days prior written notice to the LIRR, Attention: Carol Berlingieri, MTA Risk and

Insurance Management, Long Island Rail Road, 2 Broadway, New York, New York 10004, Telephone No. (646) 252-1429, by certified mail/return receipt requested; and (iii) state or be endorsed to provide that the coverage afforded under the policies shall apply on a primary and not on an excess or contributing basis with any policies which may be available to the LIRR/MTA. Except as otherwise provided herein, policies written on a "claims-made" basis are not acceptable. At least two (2) weeks prior to the expiration of the policies, evidence of renewal or replacement policies of insurance, with terms and limits no less favorable than the expiring policies, shall be delivered to the LIRR/MTA. Deductibles or self-insured retentions above those shown on Schedule "A" will require approval from the LIRR/MTA. The Contractor shall be responsible for all claim expense and loss payments within the deductible or self-insured retention.

- (1) Commercial General Liability Insurance (I.S.O. Form CG 00 01 01 96 or equivalent approved by the Railroad) in the Contractor's name with limits of liability in the amount of shown on Schedule "A" on a combined single limit basis for injuries to persons (including death) and for damage to property. If the policy is subject to an aggregate limit, replacement insurance will be required if it is likely such aggregate will be exceeded.

Such policies shall include:

- (a) Contractual coverage for liability assumed by the Contractor;
  - (b) "XCU" coverage (Explosion, Collapse, and Underground Hazards) where necessary;
  - (c) Products-Completed Operations Coverage;
  - (d) Independent Contractors Coverage;
  - (e) Coverage for claims for bodily injury asserted by an employee of an additional insured and any Employer Liability Exclusion which may otherwise operate to exclude such coverage shall be voided in this respect; and,
  - (f) Additional Insured Endorsement (latest I.S.O. Form CG 20 10 or equivalent approved by the Railroad) naming Long Island Rail Road and Metropolitan Transit Authority (LIRR/MTA) including its subsidiaries and affiliates, City of New York and New York City Department of Design and Construction.
- (2) Worker's Compensation Insurance (including Employer's Liability Insurance) meeting the statutory limits of New York State.
  - (3) An Automobile Liability Insurance Policy (I.S.O. Form CA 00 01 07 97 or equivalent approved by the Railroad) in Contractor's name with the Long Island Rail Road (LIRR), Metropolitan Transit Authority (MTA), its subsidiaries and affiliated companies, the City of New York and all other indemnified parties included in the contract as Additional Insured with limits of liability in the amount of shown on Schedule "A". for claims for bodily injuries (including death) to persons and for damage to property arising out of the ownership, maintenance or use of any owned, hired or non-owned motor vehicle. The policy shall be extended to include employees of any insured acting in the scope of their employment. If the policy is subject to an aggregate limit, replacement insurance will be required if it is likely such aggregate will be exceeded.
  - (4) Railroad Protective Liability Insurance (ISO-RIMA or equivalent form approved by the Railroad), covering the work to be performed at the designated job site and affording protection for damages arising out of bodily injuries or death, injury to or destruction of property, including damage to the insureds own property and confirming to the following:
    - (a) The Long Island Rail Road Company and Metropolitan Transportation Authority are the "Named Insured".
    - (b) The limit of liability shall be as shown on Schedule "A". If policy is subject to an aggregate limit, replacement insurance will be required if it is likely such aggregate will be exceeded.
    - (c) Evidence of Railroad Protective Liability Insurance, must be provided in the form of the original Policy or a detailed Binder pending issuance of the original Policy.
    - (d) Definition of "Physical Damage to Property" must be amended to mean direct and accidental loss of or damage to "all property of any Named Insured and all property in any Named Insured's care, custody of control".

- (b) The Contractor shall furnish evidence of all policies, before any work is started, to:  
Carol Berlingieri

MTA Risk and Insurance Management  
Long Island Rail Road  
2 Broadway  
New York, New York 10004  
Telephone No. (646) 252-1429

- (c) Certificates of Insurance may be supplied as evidence of policies in paragraph numbers (1), (2), and (3) above, however, if requested by Agency, the Contractor shall deliver to the Agency, within forty-five (45) days of the request, a copy of such policies, certified by the insurance carrier as being true and complete.

If a Certificate of Insurance is submitted it must:

- (A) Be provided on the Long Island Rail Road Certificate of Insurance Form (see Schedule "A");
- (B) Be signed by an authorized representative of the insurance carrier or producer and notarized;
- (C) Disclose any deductible, self-insured retention, aggregate limit or any exclusions to the policy that materially change the coverage;
- (D) Indicate the Additional Insureds and Named Insureds as required herein;
- (E) Reference the Contract by number on the face of the certificate; and,
- (F) Expressly reference the inclusion of all required endorsements.

- (d) Evidence of policy in paragraph number (4) above, Railroad Protective Liability Insurance, requires submittal of the original Policy. The original Binder will be accepted pending issuance of the original policy. Railroad Protective Liability Insurance cannot be submitted on insurance certificate forms. It must be provided as follows:

- (A) A detailed Binder, pending issuance of the actual policy, or the actual policy itself;
- (B) Named Insureds: Long Island Rail Road/Metropolitan Transportation Authority;
- (C) "Physical Damage to Property" definition must be amended as stated above in requirements.

- (e) If, at any time during the period of this Agreement, insurance as required is not in effect, or proof thereof is not provided to the LIRR/MTA, the LIRR/MTA shall have the option to: (i) direct the Contractor to suspend work with no additional cost or extension of time due on account thereof, or (ii) treat such failure as an Event of Default.

#### **ADDITIONAL SAFETY REQUIREMENTS**

The contractor must provide a dedicated Full Time Certified Site Safety Manager. The Project Site Super can't qualify for this. See Volume 2 of the bid package, Safety Requirements for Construction Contracts for Safety Requirements.

#### **VIII. SPECIAL EXPERIENCE REQUIREMENTS FOR THE PROJECT**

Refer to page 3 of the Bid Booklet in Volume 1 for Special Experience Requirements.

## IX. REVISIONS: SPECIFICATIONS AND CONTRACT DRAWINGS

The Specifications and the Contract Drawings for the Project are revised in accordance with the provisions set forth below.

- (1) Owner: Wherever the term “Owner” is used in the Specifications and/or the Contract Drawings, such term shall mean the City of New York.
- (2) Other Entities: In the event any entity other than the City of New York is referred to or named as the “Owner” in the Specifications and/or the Contract Drawings, the name of such other entity is deemed deleted and replaced with the “City of New York”.
- (3) Architect / Engineer: Wherever the words “Architect”, “Engineer”, “Architect / Engineer” or “Architect and/or Engineer” are used in the Specifications and/or the Contract Drawings, such words are deemed deleted and replaced with the word “Commissioner”.
- (4) Products / Manufacturers: Wherever the Specifications and/or the Contract Drawings require the contractor to provide a particular product (i.e., material and/or equipment) from a designated manufacturer and/or vendor, the term “or approved equal” is deemed inserted, even if only one product and/or manufacturer is specified, except as otherwise provided below.
  - (a) Proprietary Items: If the Bid Booklet contains a Notice which identifies a particular product from a designated manufacturer as a “Proprietary Item”, the Contractor shall be required to provide such specified product. In such case, no substitution or “approved equal” will be permitted.
- (5) Special Experience Requirements: Special Experience Requirements for the Project, if any, are set forth in the Bid Booklet. Special Experience Requirements may apply to contractors, subcontractors, installers, manufacturers and/or suppliers. If the Specifications and/or the Contract Drawings contain any Special Experience Requirement that is not set forth in the Bid Booklet, such Special Experience Requirement is deemed deleted, except as otherwise provided below.
  - (a) Any Special Experience Requirement that provides that the entity performing the work or supplying the material must have more than three (3) years of experience, is revised to provide that the entity performing the work or supplying the material must have three (3) years of experience, except as described in paragraph (b) below.
  - (b) Any Special Experience Requirement that pertains to the abatement of hazardous materials shall not be subject to the deletion and/or revision set forth above. Such Special Experience Requirement shall remain in full force and effect.
  - (c) Any Special Experience Requirement that provides that the entity performing the work must be licensed, authorized, certified, approved by or acceptable to the manufacturer, is deemed deleted and replaced with the requirement that such entity must be properly trained for the specified work.
  - (d) Any Special Experience Requirement that provides that the individual workers performing the work must be licensed, authorized, certified, approved by or acceptable to the manufacturer, is deemed deleted and replaced with the requirement that such individual workers must be properly trained for the specified work.
- (6) Alternate Bids: If the agency is requesting the submission of Alternate Bids, a Notice regarding such Alternate Bids is set forth in the Bid Booklet. In the event of any conflict or inconsistency between (1) the Notice regarding Alternate Bids set forth in the Bid Booklet and (2) a provision in the Specifications and/or the Contract Drawings regarding Alternate Bids, the Notice set forth in the Bid Booklet shall prevail. If the agency is not requesting the submission of Alternate Bids, as indicated by the absence of a Notice in the Bid Booklet, and the Specifications and/or the Contract Drawings contain any provision regarding Alternate Bids, such provision is deemed deleted.
- (7) Contractor Retained Engineer: If the Specifications and/or the Contract Drawings require the Contractor to retain an Engineer to provide engineering services for the Project, the following sentence is deemed inserted:

“Such Engineer must be a Professional Engineer, licensed in the State of New York.”

- (8) LEED Related Provisions: If the Specifications and/or the Contract Drawings require the Contractor to purchase FSC certified wood, rapidly renewable materials, materials within 500 miles, metal materials, products, anchors, framing and accessories with recycled content, or incorporate fly ash in concrete, such provisions are deemed deleted and replaced with the requirement that if the contractor has purchased FSC certified wood, rapidly renewable materials, materials within 500 miles, metal materials, products, anchors, framing and accessories with recycled content, or incorporated fly ash in concrete, the contractor shall submit such forms or documentation as may be required by the City in order for the USGBC to certify that the Project qualifies for the related LEED credit(s).
- (9) Guarantees: Requirements for Guarantees and Maintenance are set forth in Schedule B, which is included in the Addendum to the General Conditions. In the event of any conflict or inconsistency between (1) a guarantee and/or maintenance requirement set forth in the Specifications and/or the Contract Drawings and (2) a guarantee and/or maintenance requirement set forth in Schedule B, the guarantee and/or maintenance requirement set forth in Schedule B shall prevail.
- (10) Warranties: Requirements for Warranties are set forth in Schedule B, which is included in the Addendum to the General Conditions.
- (a) In the event of any conflict or inconsistency between (1) a warranty requirement set forth in the Specifications and/or the Contract Drawings and (2) a warranty requirement set forth in Schedule B, the warranty requirement set forth in Schedule B shall prevail.
  - (b) In the event a warranty requirement set forth in the Specifications and/or the Contract Drawings is omitted from Schedule B, such omission from Schedule B shall have no effect and the Contractor's obligation to provide the manufacturer's warranty, as set forth in the Specifications and/or the Contract Drawings, shall remain in full force and effect.
  - (c) In the event a warranty requirement for a particular item of material or equipment is omitted from Schedule B, as well as from the Specifications or the Contract Drawings, and the manufacturer of such item actually provides a warranty, the Contractor shall be obligated to obtain and deliver to the Commissioner the highest level of warranty actually provided by that manufacturer.
- (11) Exculpatory Provisions: In the event the Specifications and/or the Contract Drawings contain any provision whereby the consultant and/or any of its officers, employees or agents, including subconsultants, is absolved of responsibility for any act or omission, such provision is deemed deleted.
- (12) Insurance: Provisions regarding insurance coverage the Contractor is required to provide are set forth in Article 22 of the City of New York Standard Construction Contract and Schedule A, which is included in the Addendum to the General Conditions. In the event the Specifications and/or the Contract Drawings contain any provision regarding insurance requirements, such provision is deemed deleted.
- (13) Indemnification: Provisions regarding indemnification are set forth in Articles 7, 12, 22 and 57 of the City of New York Standard Construction Contract. In the event the Specifications and/or the Contract Drawings contain any provision regarding indemnification, such provision is deemed deleted.
- (14) Dispute Resolution: Provisions regarding dispute resolution are set forth in Article 27 of the City of New York Standard Construction Contract. In the event the Specifications and/or the Contract Drawings contain any provision regarding dispute resolution, such provision is deemed deleted.
- (15) Payment to Other Entities: In the event the Specifications and/or the Contract Drawings contain any provision which requires the Contractor to make payments to an entity other than a subcontractor and/or supplier providing services and/or material for the project, such provision is deemed deleted.
- (16) General Conditions: In the event of any conflict or inconsistency between (1) the Specifications and/or the Contract Drawings and (2) the General Conditions, the General Conditions shall prevail.
- (17) Standard Construction Contract: In the event of any conflict or inconsistency between (1) the Specifications and/or the Contract Drawings and (2) the City of New York Standard Construction Contract, the City of New York Standard Construction Contract shall prevail.

**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**  
**PART I - Contract Requirements**

Various Articles of the Contract refer to requirements which are set forth in Schedule A of the General Conditions. The Schedule set forth below specifies the following: (1) the referenced Articles of the Contract, and (2) the specific requirements applicable to the contract.

REFERENCE	ITEM	REQUIREMENTS	CONTRACT #1
Information For Bidders	Bid Security		See Attachment 1 – Bid Information in the Bid Booklet
Information For Bidders	Performance and Payment Bonds		See Attachment 1- Bid Information in the Bid Booklet
Article 14 Contract and Specification Section 01 20 00	Substantial Completion (Milestone 1)	Consecutive Calendar Days	<u>Incentive Milestone Schedule (Accelerated Substantial Completion):</u> <b>605 ccds</b> from the date set forth in the Notice to Proceed ("NTP")  <u>Contract Milestone Schedule (Scheduled Substantial Completion):</u> <b>920 ccds</b> from the date set forth in the NTP
Article 14 Contract and Specification Section 01 20 00	Time to Complete Milestone 2	Consecutive Calendar Days	<u>Contract Milestone Schedule:</u> <b>1,100 ccds</b> from the date set forth in the NTP
Article 15 Contract and Specification Section 01 20 00	Liquidated Damages	For failure to meet Milestone 1 (Substantial Completion)	<b>\$5,000</b> per consecutive calendar day after day <b>920</b> , the Scheduled Substantial Completion, until Milestone 1 has been met.
Article 15 Contract and Specification Section 01 20 00	Liquidated Damages	For failure to meet Milestone 2	<b>\$5,000</b> per consecutive calendar day after the day <b>1,100</b> , until Milestone 2 has been met
Article 17 Contract	Sub-Contracts	Not to exceed Percent of Contract Price	<b>60%</b>
Article 21 Contract	Retainage	Percent of Voucher	If 100% bonds are required <b>5%</b>  If 100% bonds are not required, and Contract Price is \$1,000,000 or less <b>5%</b>  If 100% bonds are not required, and Contract Price is more than \$1,000,000 <b>10%</b>
Article 24 Contract	Deposit Guarantee	Percent of Contract Price	<b>1%</b>
Article 24 Contract	Period of Guarantee		See Schedule B of the Addendum to the General Conditions
Article 74 Contract	Statement of Work		Addenda, numbered: _____
Article 75 Contract	Compensation to be Paid to Contractor		Amount for which the Contract was Awarded: _____ Dollars (\$ _____)
Article 79 Contract	MWBE Program		See M/WBE Utilization Plan in the Bid Booklet

**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART II. Types of Insurance, Minimum Limits and Special Conditions**

**Note:** All certificate(s) of insurance submitted pursuant to Contract Article 22.3. 3 must be accompanied by a Certification by Broker consistent with Part III below and include the following information:

- For each insurance policy, the name and NAIC number of issuing company, number of policy, and effective dates;
- Policy limits consistent with the requirements listed below;
- Additional insureds or loss payees consistent with the requirements listed below; and
- The number assigned to the Contract by the City (in the “Description of Operations” field).

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)	Minimum Limits and Special Conditions
<div> <div>■</div> <div>Commercial General Liability</div> <div>Art. 22.1.1</div> </div>	<p>This Contract requires Commercial General Liability Insurance (CGL) that is at least as broad as ISO Form CG 00 01 (see Section 22.1.1 of the New York City Standard Construction Contract). CGL policies that include endorsements that add exclusions to ISO Form CG 00 01 do not comply with the Contract. The Department may, in its sole discretion, accept endorsements that add exclusions, but the Department will generally reject endorsements that add exclusions that exempt all or part of the Work of the Project. For example, if the Project includes Work on a roof of a four-story building, the Department will reject a CGL policy that includes a “Three Story Height Limitation Endorsement.”</p> <p>The minimum limits shall be \$3,000,000.00 per occurrence and \$6,000,000.00 per project aggregate applicable to this <b>Contract</b>.</p> <p>Additional Insureds:</p> <ol style="list-style-type: none"> <li>1. City of New York, including its officials and employees, with coverage at least as broad as ISO Forms CG 20 10 and CG 20 37, and</li> <li>2. All person(s) or organization(s), if any, that Article 22.1.1(b) of the <b>Contract</b> requires to be named as Additional Insured(s), with coverage at least as broad as ISO Form CG 20 26. The Additional Insured endorsement shall either specify the entity's name, if known, or the entity's title (e.g., Project Manager).</li> <li>3. The Long Island Railroad (LIRR), Metropolitan Transportation Authority (MTA), its subsidiaries and affiliated companies. The Contractor shall furnish two (2) certificates of insurance (see pages SA-11 and SA-12) to the LIRR, Attention: MTA Risk and Insurance Management, Long Island Rail Road, 2 Broadway, New York, New York 10004.</li> </ol>

**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART II. Types of Insurance, Minimum Limits and Special Conditions**

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)	Minimum Limits and Special Conditions
<div> <div>■ Workers' Compensation</div> <div>Art. 22.1.2</div> </div> <div> <div>■ Disability Benefits Insurance</div> <div>Art. 22.1.2</div> </div> <div> <div>■ Employers' Liability</div> <div>Art. 22.1.2</div> </div> <div> <div><input type="checkbox"/> Jones Act</div> <div>Art. 22.1.3</div> </div> <div> <div><input type="checkbox"/> U.S. Longshoremen's and Harbor Workers Compensation Act</div> <div>Art. 22.1.3</div> </div>	<p>Workers' Compensation, Employers' Liability, and Disability Benefits Insurance: Statutory per New York State law without regard to jurisdiction.</p> <p><b>Note:</b> The following forms are acceptable: (1) New York State Workers' Compensation Board Form No. C-105.2, (2) State Insurance Fund Form No. U-26.3, (3) New York State Workers' Compensation Board Form No. DB-120.1 and (3) Request for WC/DB Exemption Form No. CE-200. The City will not accept an ACORD form as proof of Workers' Compensation or Disability Insurance.</p> <p>Jones Act and U.S. Longshoremen's and Harbor Workers' Compensation Act: Statutory per U.S. law.</p> <p>Additional Requirements:</p> <p>(1) LIRR "OUTSIDE CONTRACT" INSURANCE REQUIREMENTS: Workers' Compensation Insurance (including Employer's Liability Insurance) with limits of not less than \$2,000,000.00 which limit may be met by a combination of primary and excess insurance meeting the statutory limits of New York State.</p> <p>(2) Two (2) certificates of such insurance (see pages SA-11 and SA-12) shall be furnished to the LIRR, Attention: MTA Risk and Insurance Management, Long Island Rail Road, 2 Broadway, New York, New York 10004.</p>
<div> <div>■ Builders' Risk</div> <div>Art. 22.1.4</div> </div>	<p>100 % of total value of <b>Work</b></p> <p><b>Contractor</b> the Named Insured; the <b>City</b> both an Additional Insured and one of the loss payees as its interests may appear.</p> <p>If the <b>Work</b> does not involve construction of a new building or gut renovation work, the <b>Contractor</b> may provide an installation floater in lieu of Builders Risk insurance.</p> <p>Note: Builders Risk Insurance may terminate upon <b>Substantial Completion</b> of the <b>Work</b> in its entirety.</p>



<p>■ Commercial Auto Liability</p>	<p>Art. 22.1.5</p>	<p>\$2,000,000.00 per accident combined single limit</p> <p>If vehicles are used for transporting hazardous materials, the <b>Contractor</b> shall provide pollution liability broadened coverage for covered vehicles (endorsement CA 99 48) as well as proof of MCS 90</p> <p>Additional Insureds:</p> <ul style="list-style-type: none"><li>(1) City of New York, including its officials and employees.</li><li>(2) The Long Island Railroad (LIRR), Metropolitan Transportation Authority (MTA), its subsidiaries and affiliated companies.</li></ul>
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**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART II. Types of Insurance, Minimum Limits and Special Conditions**

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)	Minimum Limits and Special Conditions
<input type="checkbox"/> Contractor's Pollution Liability                      Art. 22.1.6	\$_____ per occurrence  \$_____ aggregate  Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
<input type="checkbox"/> Marine Protection and Indemnity                      Art. 22.1.7(a)	\$_____ per occurrence  \$_____ aggregate  Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
<input type="checkbox"/> Hull and Machinery Insurance                      Art. 22.1.7(b)	\$_____ per occurrence  \$_____ aggregate  Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
<input type="checkbox"/> Marine Pollution Liability                      Art. 22.1.7(c)	\$_____ each occurrence  Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
[OTHER]    Art. 22.1.8  <input type="checkbox"/> Ship Repairers Legal Liability	\$_____ each occurrence

**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART II. Types of Insurance, Minimum Limits and Special Conditions (Continued)**

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)	Minimum Limits and Special Conditions
<p>[OTHER] Art. 22.1.8</p> <p><input type="checkbox"/> Collision Liability/Towers Liability</p>	<p>\$_____ per occurrence</p> <p>\$_____ aggregate</p> <p>Additional Insureds:                      1. City of New York, including its officials and employees, and                      2. _____                      3. _____</p>
<p>[OTHER] Art. 22.1.8</p> <p>■ Railroad Protective Liability</p> <p>(ISO-RIMA or equivalent form) approved by Permitior covering the work to be performed at the designated site and affording protection for damages arising out of bodily injury or death, physical damage to or destruction of property, including damage to the Insured's own property and conforming to the following:</p> <ul style="list-style-type: none"> <li>• Policy Endorsement CD 28 31 – Pollution Exclusion Amendment is required to be endorsed onto the policy when environmental-related work and/or exposures exist.</li> <li>• Indicate the Name and address of the Contractor to perform the work, the Contract # and the name of the railroad property where the work is being performed and the Agency Permit.</li> <li>• Evidence of Railroad Protective Liability Insurance, must be provided in the form of the <u>Original Policy</u>. <u>A detailed insurance Binder (ACORD or Manuscript Form) will be accepted pending issuance of the Original Policy, which must be provided within 30 days of the Binder Approval.</u></li> </ul>	<p><u>\$2,000,000.00</u> per occurrence</p> <p><u>\$6,000,000.00</u> annual aggregate</p> <p>Named Insureds:                      1. The City of New York (as Owner) and all other indemnified parties.                      2. The Long Island Railroad (LIRR) Metropolitan Transportation Authority (MTA), its subsidiaries and affiliated companies, the City of New York and all other indemnified parties.</p>

<p>[OTHER] Art. 22.1.8</p> <p><input type="checkbox"/> Asbestos Liability _____</p>	<p>Only required of the Contractor or Subcontractor performing any required asbestos removal.</p> <p>\$1,000,000 each occurrence, \$2,000,000 aggregate (Combined Single Limit); only required of the Contractor or Subcontractor performing any required asbestos removal.</p> <p>Additional Insureds: 1. City of New York, including its officials and employees, and</p> <p>2. _____</p> <p>3. _____</p>
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**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART II. Types of Insurance, Minimum Limits and Special Conditions (Continued)**

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

<p>[OTHER] Art. 22.1.8</p> <p>■ Boiler Insurance _____</p>	<p>\$200,000</p>
<p>[OTHER] Art. 22.1.8</p> <p>■ Professional Liability</p> <p>In the event any section of the Specifications requires the Contractor to engage a Professional Engineer to provide design and/or engineering services, the Engineer engaged by the Contractor, as well as any sub consultant(s) performing professional services, shall provide Professional Liability Insurance.</p>	<p>\$1,000,000 per occurrence</p> <p>The Contractor's Professional Engineer shall maintain and submit evidence of Professional Liability Insurance in the minimum amount of \$1,000,000 per claim. The policy or policies shall include an endorsement to cover the liability assumed by the Contractor under this Agreement arising out of the negligent performance of professional services or caused by an error, omission or negligent act of the Contractor's Professional Engineer or anyone employed by the Contractor's Professional Engineer.</p> <p>Claims-made policies will be accepted for Professional Liability Insurance. All such policies shall have an extended reporting period option or automatic coverage of not less than two (2) years. If available as an option, the Contractor's Professional Engineer shall purchase extended reporting period coverage effective on cancellation or termination of such insurance unless a new policy is secured with a retroactive date, including at least the last policy year.</p>

**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART III. Certificates of Insurance**

All certificates of insurance (except certificates of insurance solely evidencing Workers' Compensation Insurance, Employer's Liability Insurance, and/or Disability Benefits Insurance) must be accompanied by one of the following:

- (1) the Certification by Insurance Broker or Agent on the following page setting forth the required information and signatures;

-- OR --

- (2) copies of all policies as certified by an authorized representative of the issuing insurance carrier that are referenced in such certificate of insurance. If any policy is not available at the time of submission, certified binders may be submitted until such time as the policy is available, at which time a certified copy of the policy shall be submitted.



**SCHEDULE A (FOR PUBLICLY BID PROJECTS)**

**Relating to Article 22 - Insurance**

**PART IV. Address of Commissioner**

Wherever reference is made in Article 7 or Article 22 to documents to be sent to the **Commissioner** (e.g., notices, filings, or submissions), such documents shall be sent to the address set forth below or, in the absence of such address, to the **Commissioner's** address as provided elsewhere in this **Contract**.

ACCO's Office, Insurance Unit

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30-30 Thomson Avenue, 4<sup>th</sup> Floor

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Long Island City, New York 11101

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**SCHEDULE B**

**Guarantees and Warranties**

**(Reference: Section 01 7839, Article 2.7 of the DDC Standard General Conditions)**

**GUARANTY FROM CONTRACTOR**

**(1) Contractor's Guaranty Obligation:** The Contractor shall promptly repair, replace, restore or rebuild, as the Commissioner may determine, any finished Work in which defects of materials or workmanship may appear or to which damage may occur because of such defects, during the one (1) year period subsequent to the date of Substantial Completion (or use and occupancy in accordance with the Contract), except for the areas of Work set forth below:

- Roofing, Waterproofing, and Joint Sealant Work. For these types of work, the guarantee period shall be (2) two years.
- Trees and/or Plant Material. For trees and/or plant material furnished and installed, the guarantee period shall be (2) two years. During the guarantee period, the Contractor shall provide all maintenance services set forth in the Specifications.

**[reference specifications sections 32 91 13 Planting Soils, 32 91 19 Landscape Grading, 32 93 00 Landscape Planting, 32 94 50 Cellular Tree Planting System.]**

**(2) Guaranty Period:** The obligation of the Contractor, and its Surety under the Performance Bond, is limited to the period(s) of time specified above.

**(3) Other Provisions Deemed Deleted:** In the event the Specifications and/or the Contract Drawings contain any provisions regarding guaranty requirements, such provisions are deemed deleted and replaced with the guaranty requirements set forth in this Schedule B.

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**WARRANTY FROM MANUFACTURER**

**(1) Contractor's Obligation to Provide Warranties:** The items of material and/or equipment for which manufacturer warranties are required are listed below. For each item of material and/or equipment listed below, the Contractor shall obtain a written warranty from the manufacturer. Such warranty shall provide that the material or equipment is free from defects for the period set forth below and will be replaced or repaired within such specified period. The Contractor shall deliver all required warranties to the Commissioner.

**(2) Required Warranties:**

Specification Number		Material or Equipment	Warranty Period	
03 30 00	2.10.D.8.b	Cast-in-place Concrete	Expanded Polystyrene used as Fill - Geofoam	ten (10) year manufacturer warranty
05 73 20	1.12.A.1	Decorative Metal Screens	repair finishes or replace aluminum showing evidence of deterioration	twenty (20) years from date of Substantial Completion
07 10 00	1.10.A	Foundation Waterproofing	foundation waterproofing	two (2) years from the date of Substantial Completion
07 42 13	1.14.A.1	Insulated Metal Wall Panels	components of metal panel systems	two (2) years from the date of Substantial Completion
07 42 13	1.14.B.1	Insulated Metal Wall Panels	finishes of metal panels	twenty (20) years from date of Substantial Completion
07 52 16	1.10.A.1	SBS Modified Bituminous Membrane Roofing	roofing system	twenty (20) years from date of Substantial Completion
07 62 00	1.13.B	Sheet Metal Flashing and Trim	finishes of sheet metal flashing and trim	twenty (20) years from date of Substantial Completion
07 72 00	1.10.A.1	Roof Accessories	finishes of roof accessories	ten (10) years from the date of Substantial Completion
07 92 00	1.10.A.1	Joint Sealants	joint sealants	five (5) years from the date of Substantial Completion

08 33 23	1.10.A.1	Overhead Coiling Doors	components of doors	two (2) years from the date of Substantial Completion
08 41 15	1.9.A.1	Interior Aluminum-Framed Storefronts	components of aluminum-framed systems	five (5) years from the date of Substantial Completion
08 41 15	1.9.B.1	Interior Aluminum-Framed Storefronts	finishes of components of aluminum-framed systems	ten (10) years from the date of Substantial Completion
08 41 23	1.12.A.1	Fire-Rated Storefronts and Curtain Walls	components of Fire-rated storefronts and curtain walls	five (5) years from the date of Substantial Completion
08 43 33	1.10.B	Security Storefronts	finishes of aluminum	twenty (20) years from date of Substantial Completion
08 44 13	1.12.A.1	Glazed Aluminum Curtain Walls	components of glazed aluminum curtain wall	ten (10) years from the date of Substantial Completion
08 44 13	1.12.B	Glazed Aluminum Curtain Walls	baked enamel, powder coat, or organic finishes of aluminum	twenty (20) years from date of Substantial Completion
08 70 00	1.11.A	Finish Hardware	manufacturer overhead closers	five (5) years from the date of Substantial Completion
08 70 00	1.11.B	Finish Hardware	manufacturer concealed floor closers	twenty-five (25) years from the date of Substantial Completion
08 70 00	1.11.C	Finish Hardware	hardware supplier warranty	one (1) year from the date of Substantial Completion
08 80 00	1.14.A.1	Glazing	coated-glass units	ten (10) years from the date of Substantial Completion
08 80 00	1.14.B.1	Glazing	laminated-glass units	ten (10) years from the date of Substantial Completion
08 80 00	1.14.C.1	Glazing	insulating-glass units	ten (10) years from the date of Substantial Completion
08 88 53	1.13.A.1	Security Glazing	glass-clad polycarbonate	ten (10) years from the date of Substantial Completion
09 77 23	1.13.A.2	Fabric-Wrapped Panels	acoustical, fabric-wrapped wall panels	two (2) years from the date of Substantial Completion
08 91 19	1.10.A.1	Fixed Louvers	finishes of components of louvers	twenty (20) years from date of Substantial Completion
10 11 00	1.12.A.2	Visual Display Units	porcelain-enamel face sheets	fifty (50) years from the date of Substantial Completion
10 14 00	2.13.H	Signage	paints, inks, and coatings	ten (10) years from the date of Substantial Completion
10 26 00	1.10.A.1	Wall and Door Protection	components of wall and door protection units	five (5) years from the date of Substantial Completion
10 28 00	1.11.A.2	Toilet and Bath Accessories	mirrors	fifteen (15) years from the date of Substantial Completion
10 28 13	1.5.A.2	Detention Toilet Accessories	detention toilet accessories	two (2) years from the date of Substantial Completion
10 51 13	1.14.A.3	Metal Lockers	components of metal lockers	Lifetime Replacement Warranty
11 82 26	1.9.B	Facility Waste Compactor	facility waste compactor and odor neutralizer	twelve (12) months from the date of Substantial Completion
14 21 23	1.13.A.2.a	Traction Elevators	Traction Elevators and associated equipment	one (1) year from the date of Substantial Completion
21 34 00	2.2	Pressure-Maintenance Pumps	complete pump system	one (1) year from the date of Substantial Completion
22 05 33	1.9.A.1	Heat Tracing for Plumbing Piping	electric heating cables	five (5) years from the date of Substantial Completion
22 11 24	1.12.A	Domestic Water Packaged Booster Pumps	pump valves	three (3) years from date of Substantial Completion
22 13 29	1.7.E	Sanitary Sewage and Sump Pumps	complete pumping system	one (1) year from date of Substantial Completion
22 35 00	1.8.A	Domestic Water Heaters	storage tank, heating surfaces, and combustion chamber	fifteen (15) years from date of Substantial Completion
22 35 00	1.8.B	Domestic Water Heaters	burners and all heater parts	one (1) year from date of Substantial Completion
23 05 14	1.14.A.1	Variable Frequency Motor Drives	variable frequency motor drives	five (5) years from the date of Substantial Completion
23 05 23	2.12.O	Valves for HVAC Piping	all valves	five (5) years from the date of Substantial Completion
23 05 33	1.8.A.1	Heat Tracing for HVAC Piping	electric heating cables	ten (10) years from the date of Substantial Completion
23 09 00	1.11.A	HVAC Instrumentation and Controls	expenses for parts, labor, associated travel, and expenses for both hardware and software	one (1) year from the date of Substantial Completion
23 09 00	2.13.A.3	HVAC Instrumentation and Controls	actuators and valves	two (2) year unconditional and three (3) year product defect from the date of installation
23 11 13	1.15.A.1.b	Facility Fuel-Oil Piping	components of fuel-oil storage tanks	thirty (30) years from the date of Substantial Completion
23 11 13	1.15.A.2.b	Facility Fuel-Oil Piping	components of flexible, double-containment piping and related equipment	ten (10) years from the date of Substantial Completion
23 13 13	1.11.A	Underground Fuel Storage Tanks and	Fiberglass tanks	thirty (30) years from the date of Substantial

		Fuel Systems		Completion
23 34 16	1.13.A.1	HVAC Fans	parts or units of HVAC fans	five (5) years from the date of Substantial Completion
23 34 16	1.13.A.2	HVAC Fans	fan motor warranty	ten (10) years from the date of Substantial Completion
23 34 16	2.6.A	HVAC Fans	units or parts of HVAC fans	one (1) year from the purchase date
23 34 16	2.6.B	HVAC Fans	fan motor warranty	one (1) year from the purchase date Contradicts above
23 34 33	1.10.1	Air Curtains	components of water heating units	five (5) years from the date of Substantial Completion
23 51 00	1.8.A.1	Breechings, Chimneys, and Stacks	components of venting system	twenty (20) years from date of Substantial Completion
23 51 01	1.10.A.2	Boiler Draft Control System	components of draft inducer fans	ten (10) years from the date of Substantial Completion
23 52 16	1.8.A.1.a	Condensing Boilers	heat exchanger damaged by thermal shock for pulse-combustion boilers	fifteen (15) years from the date of Substantial Completion
23 52 16	1.8.A.1.b	Condensing Boilers	heat exchanger damaged by corrosion for pulse-combustion boilers	fifteen (15) years from the date of Substantial Completion
23 52 16	1.8.A.2.a	Condensing Boilers	leakage and materials for fire-tube condensing boilers	ten (10) years from the date of Substantial Completion
23 52 16	1.8.A.2.b	Condensing Boilers	heat exchanger damaged by thermal stress and corrosion	fifteen (15) years from the date of Substantial Completion
23 52 16	1.8.A.3	Condensing Boilers	water-tube condensing boilers	twenty (20) years from date of Substantial Completion
23 52 16	1.8.A.4.a	Condensing Boilers	leakage and materials for water-jacketed condensing boilers	twenty (20) years from date of Substantial Completion
23 52 16	1.8.A.4.b	Condensing Boilers	heat exchanger damaged by thermal stress and corrosion	fifteen (15) years from the date of Substantial Completion
23 55 33	1.10.A	Gas-Fired Unit Heaters	heat exchanger of gas-fired unit heater	three (3) years from date of Substantial Completion
23 64 18	1.17.A	Heat Recovery Chiller Heater Packaged Modular Water Chiller	full parts and labor coverage for entire chiller	two (2) years from the date of Substantial Completion
23 64 18	1.17.B	Heat Recovery Chiller Heater Packaged Modular Water Chiller	full parts only extended warranty coverage for entire chiller	additional three (3) years from end of two (2) year manufacturer warranty from the date of Substantial Completion
23 64 18	1.17.C	Heat Recovery Chiller Heater Packaged Modular Water Chiller	full parts and labor coverage for chiller's compressors	five (5) years from the date of Substantial Completion
23 64 18	3.08.A	Heat Recovery Chiller Heater Packaged Modular Water Chiller	full parts only coverage for entire chiller	one (1) year from the equipment startup or six (6) months after shipment, whichever is earlier
23 65 00	1.14.A.1	Cooling Towers	entire cooling tower and associated equipment/components/accessories	ten (10) years from the date of Substantial Completion
23 65 00	2.2.1.1	Cooling Towers	welded seams of cold-water basin	ten (10) years from the date of Substantial Completion
23 73 13	2.9.N.3	Semi-Custom Air Handling Units	electronic damper actuators	five (5) years, two (2) year unconditional + three (3) year product defect from the date of installation
23 73 15	1.16.B	Factory Fabricated Custom Air Handling Units	parts and labor on all components of factory fabricated custom air handling units	three (3) years from the date of Substantial Completion
23 73 15	1.16.C	Factory Fabricated Custom Air Handling Units	corrosion of casing, walls, floor, and roof panels of factory fabricated custom air handling units	five (5) years from the date of Substantial Completion
23 77 33	1.14.A	Factory Fabricated Double Wall Above Ground Fuel Oil Storage Tank	all components of factory fabricated double wall above ground fuel oil storage tank	ten (10) years from the date of Substantial Completion
23 77 33	1.14.B	Factory Fabricated Double Wall Above Ground Fuel Oil Storage Tank	corrosion of walls (external or internal), fittings, and support saddles	twenty (20) years from date of Substantial Completion
23 81 23	1.12.A.1	Computer Room Air-Conditioning Units (CRAC Units)	components of computer-room air conditioners	manufacturer's standard, but not less than three (3) years from the date of Substantial Completion
23 82 50	1.9.A	Miscellaneous Mechanical Systems	buffer tanks	5 (5) years from date of Substantial Completion
23 82 50	1.9.B	Miscellaneous Mechanical Systems	expansion tanks	7 (7) years from date of Substantial Completion
23 82 23	1.9.A	Unit Heaters	unit heaters	three (3) years from date of Substantial Completion
26 09 43	1.9.B	Lighting Control System	manufacturer lighting control components	five (5) years from the date of Substantial Completion
26 09 43	1.9.B.1	Lighting Control System	expenses of replacement parts due to transient voltage surges	eight (8) years from the date of Substantial Completion
26 09 43	1.9.B.2	Lighting Control System	expenses to repair or replace electrically / mechanically held relays	ten (10) years from the date of Substantial Completion

26 09 43	1.9.C	Lighting Control System	parts, expenses to repair or replace malfunctioning parts	five (5) years from the date of Substantial Completion
26 09 43	1.9.D	Lighting Control System	expenses of replacement parts due to transient voltage surges	eight (8) years from the date of Substantial Completion
26 09 43	1.9.E	Lighting Control System	expenses to repair or replace electrically / mechanically held relays	ten (10) years from the date of Substantial Completion
26 26 53	1.12.A	Electric Vehicle Charging Equipment	EV charging units	one (1) year from date of Substantial Completion
26 31 00	1.7.A	Photovoltaic Collectors	all components of photovoltaic collectors	five (5) years from the date of Substantial Completion
26 32 13	1.9.G	Engine Generators	manufacturers for generator sets	five (5) years from the date of Substantial Completion
26 51 00	1.12.A.1	Interior Lighting	manufacturer LED Entire Luminaires (fixture components can be field replaceable)	one (1) year from the date of Substantial Completion
26 51 00	1.12.A.2	Interior Lighting	manufacturer LED Entire Luminaires (fixture components can NOT be field replaceable)	ten (10) years from the date of Substantial Completion
26 51 00	1.12.A.3	Interior Lighting	manufacturer LED Modules and Drivers	five (5) years from the date of Substantial Completion
26 51 00	2.4.G	Interior Lighting	metal finishes	five (5) years from the date of Substantial Completion
26 51 00	2.5.F	Interior Lighting	manufacturer parabolic cones	ten (10) years from the date of Substantial Completion
26 56 00	1.12.A.1	Exterior Lighting	manufacturer LED Entire Luminaires (fixture components can be field replaceable)	one (1) year from the date of Substantial Completion
26 56 00	1.12.A.2	Exterior Lighting	manufacturer LED Entire Luminaires (fixture components can NOT be field replaceable)	five (5) years from the date of Substantial Completion
26 56 00	1.12.A.3	Exterior Lighting	manufacturer LED Modules and Drivers	five (5) years from the date of Substantial Completion
26 56 00	1.12.A.4	Exterior Lighting	manufacturer lighting poles and standards	manufacturer standard warranty period, but not less than three (3) years from the date of Substantial Completion
26 56 00	2.2.A.8.f	Exterior Lighting	manufacturer LED Entire Fixture	five (5) years from the date of Substantial Completion
26 56 00	2.2.A.10	Exterior Lighting	drivers	five (5) years from the date of Substantial Completion
26 56 00	2.4.G	Exterior Lighting	metal finishes	five (5) years from the date of Substantial Completion
27 00 00	1.14.A	Telecommunications Cabling System	manufacturer Static, Dynamic, and Applications warranty	twenty-five (25) years from the date of Substantial Completion
27 00 00	1.14.C.1	Telecommunications Cabling System	for work not otherwise specified	one (1) year from the date of Substantial Completion
27 41 00	1.4.A	Audio-Video Communications	hardware, software, and workmanship in spaces and subsystems	one (1) year from the date of Substantial Completion
27 41 00	1.9.B.1	Audio-Video Communications	for work not otherwise specified	one (1) year from the date of Substantial Completion
27 41 00	1.9.G	Audio-Video Communications	Manufacturer equipment warranties	from the date of Substantial Completion
28 00 00	1.8.A	Security Systems	entire installed security system	one (1) year from the date of Substantial Completion
28 00 00	2.1.F.1.a.6	Security Systems	Network equipment manufacturer's limited lifetime warranty	Limited Lifetime Warranty
28 00 00	2.1.G.7.k	Security Systems	Surge Protector and/or Power injector	ten (10) years
28 00 00	2.3.A.2	Security Systems	Electromagnetic Lock, lifetime replacement warranty	Lifetime Replacement Warranty
28 00 00	2.6.E.1.a	Security Systems	CCTV Camera Manufacturer	three (3) years from the date of Substantial Completion
28 00 00	2.6.E.1.b	Security Systems	CCTV Camera Manufacturer extended warranty	optional two (2) year extension blocks, for total warranty period of maximum five (5) years
28 00 00	2.6.F.3.b.11	Security Systems	CCTV PC for Exterior Cameras, Hardware Services with Onsite Service After Remote Diagnosis	three (3) years from the date of Substantial Completion
28 31 11	1.14.A.1	Fire Alarm Integrated Audio/Visual Evacuation System	fire alarm equipment	one (1) year from the date of Substantial Completion
31 25 00	1.10.B	Soil Erosion and Sediment Control	temporary erosion control materials	eighteen (18) month warranty from the date of Substantial Completion

31 25 00	1.10.C	Soil Erosion and Sediment Control	permanent erosion control materials	three (3) years from the date of Substantial Completion
32 93 00	3.10.B	Landscape Planting	warranty maintenance establishment period	two (2) years from the date of Substantial Completion

**(3) Application:** The obligations under the warranty for the periods specified above shall apply only to the manufacturer of the material or equipment, and not to the Contractor or its Surety; provided, however, the Contractor retains responsibility for obtaining all required warranties from the manufacturers and delivering the same to the Commissioner.

**(4) Other Provisions:** The warranty requirements set forth in this Schedule B are also included in the Specifications.

- (a) In the event of any conflict between a warranty requirement set forth in the Specifications and a warranty requirement set forth in Schedule B, the warranty requirement set forth in Schedule B shall take precedence.
- (b) In the event a warranty requirement set forth in the Specifications is omitted from Schedule B, such omission from Schedule B shall have no effect and the Contractor's obligation to provide the manufacturer's warranty, as set forth in the Specifications, shall remain in full force and effect
- (c) In the event a warranty requirement for a particular item of material or equipment is omitted from both Schedule B and the Specifications, and the manufacturer of such item actually provides a warranty, the Contractor shall be obligated to obtain and deliver to the Commissioner the highest level of warranty actually provided by that manufacturer.
- (d) In the event a warranty requirement is provided for a particular item of material or equipment, and such requirement specifies a warranty period that is longer than that which is actually provided by any of the specified manufacturers, the Contractor shall be obligated to obtain and deliver to the Commissioner the highest level of warranty actually provided by any of the specified manufacturers, unless otherwise directed in writing by the Commissioner.
- (e) Unless indicated otherwise Warranties are to take effect on the date of Substantial Completion.

**END OF SCHEDULE B**

**SCHEDULE C**

**Contract Drawings**

**(Reference: Section 01 1000, Article 1.5 (A) of the DDC Standard General Conditions)**

The Schedule set forth below lists all Contract Drawings for the Project.

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G-003	Building Code Analysis
G-004	Occupancy Load Schedules
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G-012	Life Safety Plan - First Floor
G-013	Life Safety Plan - Second Floor
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G-015	Life Safety Plan - Temporary Walkway to Existing Building
G-021	FEMA Flood Insurance Rate Map - Effective
G-022	FEMA Flood Insurance Rate Map - Preliminary
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Z-002	Zoning Resolution Diagrams
Z-003	FAA Part 77 Compliance Diagram
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EN-2	COMcheck Energy Analysis Envelope Compliance
EN-3	Energy Code Compliance - Envelope Areas (Vertical)
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EN-6	COMcheck Energy Analysis - Inspection Checklist
EN-100	Mechanical Energy Compliance Report I
EN-101	Mechanical Energy Compliance Report II
EN-102	Mechanical Energy Compliance Report III
EN-103	Mechanical Energy Compliance Report IV
EN-104	Mechanical Energy Compliance Report V
EN-200	Electrical Energy Compliance Report I
EN-201	Electrical Energy Compliance Report II
EN-202	Electrical Energy Compliance Report III

01 Civil

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C-101	Site Removals Plan 2
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C-400	Utility Plan 1
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C-411	Utility Details
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SOE-101	Support of Excavation Plan
SOE-301	Support of Excavation Section
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BPP-102	Builders Pavement Plan - North Conduit Avenue Plan & Profile (2)
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BPP-104	Builders Pavement Plan - Details
BPP-105	Builders Pavement Plan - Photo Location Plan

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E-505	Electrical Chiller, Boiler, and Mechanical Room Part Plans
E-506	Electrical IT Rooms Part Plans
E-507	Electrical Details Sheet #1 - Lightning Protection
E-508	Electrical Details Sheet #2 - PV System
E-509	Electrical Details Sheet #3 - Grounding
E-510	Electrical Details Sheet #4 - Grounding
E-511	Electrical Details Sheet #5 - Conduit Mounting
E-512	Electrical Details Sheet #6 - Motor and Panelboards
E-513	Electrical Details Sheet #7 - Seismic
E-514	Electrical Details Sheet #8 - General
E-515	Electrical Details Sheet #9 - General
E-516	Electrical Lighting Device and Wiring Schematic - Cellar
E-517	Electrical Lighting Device and Wiring Schematic - First Floor
E-518	Electrical Lighting Device and Wiring Schematic - Second Floor
FA-001	Fire Alarm General Notes, Legend and Drawing List
FA-101	Fire Alarm - Cellar Partial Plan West
FA-102	Fire Alarm - Cellar Partial Plan East
FA-103	Fire Alarm - First Floor Partial Plan West
FA-104	Fire Alarm - First Floor Partial Plan East
FA-105	Fire Alarm - Second Floor Partial Plan West
FA-106	Fire Alarm - Second Floor Partial Plan East
FA-301	Fire Alarm Riser Diagram
FA-401	Fire Alarm Details Sheet #1



FA-402 Fire Alarm Details Sheet #2

08 Electrical Lighting

EL-000	Lighting Fixture Schedule 1 of 7
EL-001	Lighting Fixture Schedule 2 of 7
EL-002	Lighting Fixture Schedule 3 of 7
EL-003	Lighting Fixture Schedule 4 of 7
EL-004	Lighting Fixture Schedule 5 of 7
EL-005	Lighting Fixture Schedule 6 of 7
EL-006	Lighting Fixture Schedule 7 of 7
EL-007	Lighting Fixture Details 1 of 12
EL-008	Lighting Fixture Details 2 of 12
EL-009	Lighting Fixture Details 3 of 12
EL-010	Lighting Fixture Details 4 of 12
EL-011	Lighting Fixture Details 5 of 12
EL-012	Lighting Fixture Details 6 of 12
EL-013	Lighting Fixture Details 7 of 12
EL-014	Lighting Fixture Details 8 of 12
EL-015	Lighting Fixture Details 9 of 12
EL-016	Lighting Fixture Details 10 of 12
EL-017	Lighting Fixture Details 11 of 12
EL-018	Lighting Fixture Details 12 of 12
EL-019	Lighting Control Riser Diagram 1 of 2
EL-020	Lighting Control Riser Diagram 2 of 2

09 Fire Protection

SP-001	Sprinkler Symbols List, Schedules, Notes, and Abbreviations
SP-110	Sprinkler Cellar Plan West
SP-111	Sprinkler Cellar Plan East
SP-112	Sprinkler First Floor Plan West
SP-113	Sprinkler First Floor Plan East
SP-114	Sprinkler Second Floor Plan West
SP-115	Sprinkler Second Floor Plan East
SP-116	Sprinkler Roof Plan East
SP-500	Sprinkler Details
SP-501	Sprinkler Details and Riser Diagram
SP-502	Sprinkler Details
SP-503	Sprinkler Details

10 Telecommunications

TAC-001	Security General Notes and Symbols
TAC-002	Security Conduit Riser and Line Diagram
TAC-100	Security Cellar Floor Partial Plan East - CCTV
TAC-101	Security Cellar Floor Partial Plan West - CCTV

TAC-102	Security First Floor Partial Plan East - CCTV
TAC-103	Security First Floor Partial Plan West - CCTV
TAC-104	Security Second Floor Partial Plan East - CCTV
TAC-105	Security Second Floor Partial Plan West - CCTV
TAC-106	Security Roof Partial Plan East - CCTV
TAC-107	Security Roof Partial Plan West - CCTV
TAC-108	Security Cellar Floor Partial Plan East - AC
TAC-109	Security Cellar Floor Partial Plan West - AC
TAC-110	Security First Floor Partial Plan East - AC
TAC-111	Security First Floor Partial Plan West - AC
TAC-112	Security Second Floor Partial Plan East - AC
TAC-113	Security Second Floor Partial Plan West - AC
TAC-300	Security IT Server Room 112 - Layout
TAC-301	Security - Driveway Entrance - Details and Elevations
TAC-400	Security Detail Drawings - Page 1
TAC-401	Security Detail Drawings - Page 2
TAC-402	Security Detail Drawings - Page 3
TAC-403	Security Detail Drawings - Page 4
TAC-404	Security Detail Drawings - Page 5
TAC-405	Security Camera Schedule
TAC-406	Security Access Control Equipment Schedule
TAV-001	Audio Visual - General Notes and Symbols
TAV-100	Audio Visual - Cellar Floor Partial Plan West
TAV-101	Audio Visual - First Floor Partial Plan East
TAV-102	Audio Visual - First Floor Partial Plan West
TAV-103	Audio Visual - Second Floor Partial Plan East
TAV-104	Audio Visual - Second Floor Partial Plan West
TAV-300	Muster/Community Rm 115 - HDTV - Plan View
TAV-301	Muster/Community Rm 115 - HDTV - Elevation
TAV-302	Community Room - RM 103 - HDTV - Plan View
TAV-303	Community Room - RM 103 - HDTV - Elevation
TAV-304	Conference Room - Rm 212A - HDTV - Plan View
TAV-305	Conference Room - Rm 212A - HDTV - Elevations
TAV-306	Office (Typical) - HDTV Elevation
TAV-307	7 FT AFF (Typical) - HDTV Elevation
TAV-308	Main Desk - Rm 100-D - HDTV Layout and Elevation
TAV-309	Lobby Area - Reception - Rm 100L - HDTV - Plan View
TAV-400	Audio Visual - Outlet Details - Page 1
TAV-401	Audio Visual - Outlet Details - Page 2
TAV-402	Audio Visual - Conference Room Detail
TC-001	Telecommunications General Notes and Symbols
TC-002	Telecommunications Conduit Riser and Line Diagram
TC-100	Telecom Outlet Designation - Cellar Floor Partial Plan East
TC-101	Telecom Outlet Designation - Cellar Floor Partial Plan West

TC-102	Telecom Outlet Designation - First Floor Partial Plan East
TC-103	Telecom Outlet Designation - First Floor Partial Plan West
TC-104	Telecom Outlet Designation - Second Floor Partial Plan East
TC-105	Telecom Outlet Designation - Second Floor Partial Plan West
TC-106	Telecom Paging - Cellar Floor Ceiling Partial Plan East
TC-107	Telecom Paging - Cellar Floor Ceiling Partial Plan West
TC-108	Telecom Paging - First Floor Ceiling Partial Plan East
TC-109	Telecom Paging - First Floor Ceiling Partial Plan West
TC-110	Telecom Paging - Second Floor Ceiling Partial Plan East
TC-111	Telecom Paging - Second Floor Ceiling Partial Plan West
TC-300	Telecommunications IT Server Room 112 - Layouts
TC-301	Telecommunications IT Server Room 112 - Elevations
TC-302	Telecommunications IT Closet Room 213 - Layouts
TC-303	Telecommunications IT Closet Room 213 - Elevations
TC-304	Telecommunications IT Closet - Room 013 & Room 014 - Layouts
TC-305	Telecommunications IT Closet - Room 013 & Room 014 - Elevations
TC-306	Telecommunications Radio Base Station
TC-307	Telecommunications IT Rooms – Details and Notes
TC-400	Telecommunications Outlet Details Page 1
TC-401	Telecommunications Outlet Details Page 2
TC-402	Telecommunications Details
TC-403	Telecommunications Cable Tray Details Page 1
TC-404	Telecommunications Cable Tray Details Page 2
TC-500	Telecommunications Pathways & Spaces Cellar Level
TC-501	Telecommunications Pathways & Spaces First Floor
TC-502	Telecommunications Pathways & Spaces Second Floor

#### 11 Fuel Systems

FS-100	Pump and Tank Site Plan
FS-101	General & NYC Fire Department Notes
FS-102	Equipment List
FS-103	Concrete Pad Plan and Details I
FS-104	Concrete Pad Plan and Details II
FS-105	Tank Section I
FS-106	Tank Section II
FS-107	Tank Details I
FS-108	Tank Details II
FS-109	Tank Details III
FS-110	Electrical Schedule Conduit Plan
FS-111	Canopy Lighting Plan
FS-112	Diesel Filtration System Details
FS-113	Canopy Fire Suppression Plan

#### END OF SCHEDULE C

## **SCHEDULE D**

### **Electrical Motor Control Equipment**

**(Reference: 01 3506, Article 3.8 of the DDC Standard General Conditions)**

Requirements for electrical motor equipment may be included in one or more sections of the Specifications for the Contract for the Project. Schedule D set forth below delineates specific information for electrical motor control equipment. In the event of any conflict between the Specifications and this Schedule D, Schedule D shall take precedence; provided, however, in the event of an omission from Schedule D (i.e., Schedule D omits either a reference to or information concerning electrical motor equipment which is set forth in the Specifications), such omission from Schedule D shall have no effect and the Contractor's obligation with respect to the electrical motor control equipment, as set forth in the Specifications, shall remain in full force and effect.

<b>DB</b> Disconnect Circuit Breaker (Switch) <b>TS</b> Thermal Switch <b>MS</b> Magnetic Starter <b>CMS</b> Comb. Mag. Starter <b>VFD</b> Variable Frequency Drive	<b>P</b> Pilot Light <b>F</b> Firestat <b>T</b> Thermostat <b>AL</b> Alternator	<b>BG</b> Break Glass Station <b>HOA</b> Hand-Off Auto. <b>PB</b> Push Button Station <b>RO</b> Remote "off"
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Equip. Ident.	Location	# of Units	HP or KW	Volts and Phase	Control Type: See legend above	Remarks:
CH-1	Roof	(1)	106 KW	208/3	DB	
CH-1	Roof	(1)	104 KW	208/3	DB	
CT-1	Roof	(1)	10 HP	208/3	VFD	
CT-2	Roof	(1)	10 HP	208/3	VFD	
CTSF-1	2nd FI Chiller Rm	(1)	1 HP	208/3	CMS	
CWP-	2nd FI Chiller Rm	(1)	15 HP	208/3	VFD	
CWP-2	2nd FI Chiller Rm	(1)	15 HP	208/3	VFD	Stand-by
CHWP-1	2nd FI Chiller Rm	(1)	10 HP	208/3	VFD	
CHWP-2	2nd FI Chiller Rm	(1)	10 HP	208/3	VFD	Stand-by
HWP-1	2nd FI Boiler Rm	(1)	3 HP	208/3	VFD	
HWP-2	2nd FI Boiler Rm	(1)	3 HP	208/3	VFD	Stand-by
HWP-3	2nd FI Boiler Rm	(1)	1 HP	208/3	VFD	
HWP-4	2nd FI Boiler Rm	(1)	1 HP	208/3	VFD	Stand-by
BHWP-1	2nd FI Boiler Rm	(1)	1 HP	208/3	VFD	
BHWP-2	2nd FI Boiler Rm	(1)	1 HP	208/3	VFD	Stand-by
FZP-C-1	2nd FI Mech Rm	(1)	0.4 HP	120/1	TS	

FZP-1-1	2nd FI Mech Rm	(1)	0.4 HP	120/1	TS	
FZP-1-2	2nd FI Mech Rm	(1)	0.4 HP	120/1	TS	
FZP-2-1	2nd FI Mech Rm	(1)	0.4 HP	120/1	TS	
HRP-1	2nd FI Boiler Rm	(1)	3 HP	208/3	VFD	
HRP-2	2nd FI Boiler Rm	(1)	3 HP	208/3	VFD	Stand-by
FOP-B-1 & B2	Cellar FI fuel Oil Pump Rm	(1)	1/2 HP	208/3	DB	
FOP-B-3 & B4	Cellar FI fuel Oil Pump Rm	(1)	1/4 HP	120/1	TS	
AHU-C-1	2nd FI Mech Rm	(1)	27.5 KW	208/3	VFD	(2) 7.5HP & (2) 3HP
AHU-1-1	2nd FI Mech Rm	(1)	38.5 KW	208/3	VFD	(2) 10HP & (2) 5HP
AHU-2-1	2nd FI Mech Rm	(1)	38.5 KW	208/3	VFD	(2) 10HP & (2) 5HP
AHU-1-2	2nd FI Mech Rm	(1)	11.3 KW	208/3	VFD	(2) 5HP & (2) 3HP
GX-R-1	Roof	(1)	1/2 HP	208/3	TS	
GX-R-2	Roof	(1)	2 HP	208/3	CMS	2-Speed
GX-R-3	Roof	(1)	1 HP	208/3	VFD	
TX-R-1	Roof	(1)	1 HP	208/3	VFD	
TX-R-2	Roof	(1)	1 HP	208/3	VFD	
GX-R-4	Roof	(1)	2 HP	208/3	CMS	
GX-R-5	Roof	(1)	2 HP	208/3	CMS	
CRAC-C-1	Cellar IDF	(1)	1/4 HP	208/3	DB	
CRAC-1-1	1st FI IDF	(1)	1/4 HP	208/3	DB	
CRAC-2-1	2nd FI IDF	(1)	1/4 HP	208/3	DB	
CRAC-C-2	Cellar -EMR	(1)	1/2 HP	208/3	DB	
AD-1	1st FI Vestibule	(1)	1/2 HP	208/1	DB	
HV-2-1	2nd FI Mech Rm	(1)	1.3 HP	208/3	VFD	
DWP-1	Cellar-Water Service Rm	(1)	5 HP	208/3	DB	
ESP-1	Cellar Elev. Pit	(1)	2 HP	208/3	DB	
SE-1	Cellar water service room	(1)	3 HP	208/3	DB	
NGB-1	Cellar Gas Meter Rm	(1)	1/2 HP	208/3	DB	

**END OF SCHEDULE D**

**SCHEDULE E**

**Separation of Trades**

***NOT USED FOR SINGLE CONTRACTS***

## SCHEDULE F

### Submittals Schedule

**(Reference: Section 01 3300 Article 1.5 (C) of the General Conditions)**

The Schedule set forth below lists all submittal requirements for the Contract. In the event of any conflict between the Specifications and this Schedule F, Schedule F shall take precedence; provided, however, in the event of an omission from Schedule F (i.e., Schedule F omits either a reference to or information concerning a submittal requirement which is set forth in the Specifications), such omission from Schedule F shall have no effect and the Contractor's submittal obligation, as set forth in the Specifications, shall remain in full force and effect.

CONSULTANT:  
TELEPHONE NUMBER:  
DDC PROJECT MANAGER:  
TELEPHONE NUMBER:

DATE: \_\_\_\_\_

APPROVED: \_\_\_\_\_  
(DDC RESIDENT ENGINEER/CPM)

REPORT DATE		FMS ID #/PROJECT ID #: PO002-116 CONTRACT REGISTRATION #: PROJECT NAME: 116 <sup>th</sup> Precinct Station House							CONTRACT #: TRADE: SHOP DRAWING LOG SHEET #								
SPEC. SECT. #	DESCRIPTION	COORD. WITH CONTR.	SUBMITTAL			SUB. DATE	REQ'D DEL.	FABRIC. TIME	SUBMISSIONS								
			SHOP DWG.	SAMPLE	CAT. CUTS				REC'D	RET'D	ACTION	REC'D	RET'D	ACTION	REC'D	RET'D	ACTION
01 35 26	Safety and Health Program	X															
01 35 26	Contractor's Safety Plan	X															
01 50 00	Site Plan	X	X														
01 50 00	Reports	X															
01 54 23	NYC DOB Scaffold & Sidewalk Shed Permits	X	X														
01 54 23	Site Logistics/Site Safety Plan	X															

01 54 23	Scaffold & Shed Installation Drawings	X	X														
01 74 19	Waste Management Plan	X															
01 79 00	Instruction Program for Demonstration & Orientation	X															
01 79 00	Qualification Data	X															
01 81 13.13	MSDS	X			X												
01 81 19	IAQ Management Plan	X															
01 81 19	Product Cut Sheets	X			X												
01 81 19	IAQ Management Plan Photographs	X															
01 91 13	Commissioning Plan Pre-final submittal	X															
01 91 13	Commissioning plan final submittal	X															
01 91 13	Test and inspection reports	X															
01 91 13	Corrective action documents	X															
01 32 34	BIM Submittal	X															
01 91 17	BECx Requirements	X															
01 91 17	BECx Functional Performance Test	X															



02 80 13	Incidental Asbestos Abatement	X															
03 10 00	Submittal Schedule	X															
03 10 00	Shop Drawings	X	X														
03 10 00	Shoring/Reshoring Calculations	X															
03 10 00	Product Data	X			X												
03 10 00	Samples	X		X													
03 10 00	Compatibility Certification	X			X												
03 10 00	Hazardous Materials Notification	X															
03 10 00	Submittal Process	X															
03 10 00	SER Submittal Review	X															
03 10 00	Substitution Request	X															
03 10 00	RFI	X															
03 20 00	Submittal Schedule	X															
03 20 00	Shop Drawings	X	X														
03 20 00	Product Data	X			X												
03 20 00	Mill Reports	X			X												
03 20 00	Reinforcement Strain Test	X															
03 20 00	Hazardous Materials Notification	X															
03 20 00	Submittal Process	X															
03 20 00	SER Submittal Review	X															

03 20 00	Substitution Request	X															
03 20 00	RFI	X															
03 30 00	Submittal Schedule	X															
03 30 00	Mix Designs	X															
03 30 00	Concrete Travel Times to the Project Site	X															
03 30 00	Hot and Cold Weather Procedures	X															
03 30 00	Product Data	X			X												
03 30 00	Concrete Joint Locations	X	X														
03 30 00	Preconstruction Survey	X															
03 30 00	Survey of Flat Plate or Flat Slab Concrete Floors during Construction																
03 30 00	FF/DL Testing																
03 30 00	Structural Repairs	X															
03 30 00	Patching Defective Concrete Finishes	X															
03 30 00	Conduit and Pipes Embedded in Concrete	X															
03 30 00	Hazardous Materials Notification	X															
03 30 00	Submittal Process	X															
03 30 00	SER Submittal Review	X															

03 30 00	Substitution Request	X															
03 30 00	RFI	X															
03 33 00	Product Data	X			X												
03 33 00	Design Data	X															
03 33 00	Hot and Cold Weather Concrete Work	X															
03 33 00	Air Entrained Concrete Work	X															
03 33 00	Identify Mix Ingredients and Proportions, Including Admixtures	X															
03 33 00	Laboratory Test Reports	X															
03 33 00	Materials Certificates	X															
03 33 00	Concrete Testing Service	X															
03 33 00	Materials Tests	X															
03 33 00	Shop Drawings	X	X														
03 33 00	Quality Control plan	X															
03 45 00	Product Data	X			X												
03 45 00	Sustainable Design Submittals	X															
03 45 00	Design Mixtures	X															
03 45 00	Shop Drawings	X	X														
03 45 00	Samples	X		X													

03 45 00	Delegated-Design Submittal	X															
03 45 00	Welding Certificates	X															
03 45 00	Material Certificates	X															
03 45 00	Material Test Reports	X															
03 45 00	Field Quality-Control and Special Inspection Reports	X															
03 45 10	Product Data	X			X												
03 45 10	Sustainable Design Submittals	X															
03 45 10	Design Mixtures	X															
03 45 10	Shop Drawings	X	X														
03 45 10	Samples	X		X													
03 45 10	Delegated-Design Submittal	X															
03 45 10	Welding Certificates	X															
03 45 10	Material Certificates	X															
03 45 10	Material Test Reports	X															
03 45 10	Field Quality-Control and Special Inspection Reports	X															
03 48 00	Product Data	X															
03 48 00	Design Mixtures	X															
03 48 00	Shop Drawings	X	X														

03 48 00	Samples	X		X													
03 48 00	Templates	X															
03 48 00	Material Certificates	X															
03 48 00	Material Test Reports	X															
03 48 00	Field Quality-Control Test reports	X															
03 49 00	Product Data	X			X												
03 49 00	Shop Drawings	X	X														
03 49 00	Samples	X		X													
03 49 00	Delegated-Design Submittal	X															
03 49 00	Qualification Data	X															
03 49 00	Welding Certificates	X															
03 49 00	Source Quality-Control Program	X															
03 49 00	Source Quality-Control Test Reports	X															
04 20 00	Product Data	X			X												
04 20 00	Sustainable Design Submittals	X															
04 20 00	Shop Drawings	X	X														
04 20 00	Samples	X		X													
04 20 00	Material Certificates	X															
04 20 00	Mix Designs	X															
05 12 00	Submittal Schedule	X															

05 12 00	Calculations, Shop Drawings and Erection Drawings	X	X														
05 12 00	Submittal Letters	X															
05 12 00	Pre-construction Survey	X															
05 12 00	Quality control Program	X															
05 12 00	Product Data	X			X												
05 12 00	Samples	X		X													
05 12 00	Welding Procedures Specifications (WPS)	X															
05 12 00	Welder Certificates	X															
05 12 00	Mill Reports	X															
05 12 00	As-built Surveys	X															
05 12 00	LEED Submittals	X															
05 12 00	SER Submittal Review	X															
05 12 00	Substitution Request	X															
05 12 00	RFI	X															
05 30 00	Submittal Schedule	X															
05 30 00	Shop Drawings and Erection Drawings	X	X														
05 30 00	Manufacturer's Certification	X															
05 30 00	Manufacturer's Installation Instructions	X															
05 30 00	Welder Certification	X															

05 30 00	Research Reports or Evaluation Reports	X															
05 30 00	Submittal Process	X															
05 30 00	SER Submittal Review	X															
05 30 00	Substitution Request	X															
05 30 00	RFI	X															
05 40 00	Product Data	X			X												
05 40 00	Sustainable Design Submittals	X															
05 40 00	Shop Drawings	X	X														
05 40 00	Welding Certificates	X															
05 50 00	Product Data	X			X												
05 50 00	Sustainable Design Submittals	X															
05 50 00	Shop Drawings	X	X														
05 50 00	Samples	X		X													
05 50 00	Welding qualifications	X															
05 51 13	Product Data	X			X												
05 51 13	Sustainable Design Submittals	X															
05 51 13	Shop Drawings	X	X														
05 51 13	Delegated-Design Submittals	X															
05 51 13	Qualification Data	X															

05 51 13	Welding Certificates	X															
05 52 13	Product Data	X			X												
05 52 13	Sustainable Design Submittals	X															
05 52 13	Shop Drawings	X	X														
05 52 13	Samples	X		X													
05 52 13	Delegated- Design Submittals	X															
05 53 13	Product Data	X			X												
05 53 13	Sustainable Design Submittals	X															
05 53 13	Shop Drawings	X	X														
05 53 13	Samples	X		X													
05 53 13	Delegated- Design Submittals	X															
05 53 13	Mill Certificates	X															
05 53 13	Welding Certificates	X															
05 58 13	Product Data	X			X												
05 58 13	Shop Drawings	X	X														
05 58 13	Samples	X		X													
05 58 13	Qualification Data	X															
05 59 63	Product Data	X			X												
05 59 63	Sustainable Design Submittals	X															
05 59 63	Shop Drawings	X	X														



05 59 63	Samples	X		X													
05 59 63	Samples for Verification	X		X													
05 59 63	Welding Certificates	X															
05 59 63	Material Certificates	X															
05 59 63	Anchor-Inspection Reports	X															
05 59 63	Security Fasteners	X															
05 59 63	Tools																
05 73 20	Product Data	X			X												
05 73 20	Sustainable Design Submittals	X															
05 73 20	Shop Drawings	X	X														
05 73 20	Samples	X		X													
05 73 20	Samples for Verification	X		X													
05 73 20	Delegated-Design Submittals	X															
05 73 20	Qualification Data	X															
05 73 20	Mill Certificates	X															
05 73 20	Welding Certificates	X															
05 73 20	Evaluation Reports	X															
06 10 00	Product Data	X			X												
06 10 00	Sustainable Design Submittals	X															
06 16 00	Product Data	X			X												

06 16 00	Sustainable Design Submittals	X															
06 16 00	Product Certificates	X															
06 40 23	Product Data	X			X												
06 40 23	Sustainable Design Submittals	X															
06 40 23	Shop Drawings	X	X														
06 40 23	Samples for Initial Selection	X		X													
06 40 23	Samples for Verification	X		X													
06 40 23	Product Certificates	X															
06 40 23	Evaluation Reports	X															
07 10 00	Product Data	X			X												
07 10 00	Laboratory Test results	X															
07 10 00	Written Certification	X															
07 10 00	Shop Drawings	X	X														
07 10 00	Contractor's Review	X															
07 10 00	Substrate Acceptability	X															
07 10 00	Statement of Supervision	X															
07 10 00	Warranty	X															
07 21 00	Product Data	X			X												
07 21 00	Sustainable Design Submittals	X			X												
07 21 00	Product Test Reports	X															
07 21 00	Evaluation Reports	X															

07 21 19	Product Data	X			X												
07 21 19	Sustainable Design Submittals	X															
07 21 19	Product Test Reports	X															
07 27 26	Product Data	X			X												
07 27 26	Sustainable Design Submittals	X															
07 27 26	Shop drawings	X	X														
07 27 26	Product Certificates	X															
07 27 26	Product Test Reports	X															
07 27 26	Field Quality-Control Reports	X															
07 42 13	Product Data	X			X												
07 42 13	Sustainable Design Submittals	X															
07 42 13	Shop drawings	X	X														
07 42 13	Samples	X		X													
07 42 13	Qualification Data	X															
07 42 13	Product Test Reports	X															
07 42 13	Field Quality-Control Reports	X															
07 42 13	Sample Warranties	X		X													
07 42 13	Maintenance Data	X															
07 52 16	Product Data	X			X												

07 52 16	Sustainable Design Submittals	X															
07 52 16	Shop drawings	X	X														
07 52 16	Wind Uplift Resistance Submittal	X															
07 52 16	Manufacturer Certificates	X															
07 52 16	Performance Requirement Certificate	X															
07 52 16	Special Warranty Certificate	X															
07 52 16	Maintenance Data	X															
07 52 16	Certified Statement from Existing roof membrane manufacturer	X															
07 62 00	Product Data	X			X												
07 62 00	Sustainable Design Submittals	X															
07 62 00	Shop drawings	X	X														
07 62 00	Samples	X		X													
07 62 00	Qualification Data	X															
07 62 00	Product Test Reports	X															
07 62 00	Sample Warranties	X		X													
07 62 00	Maintenance Data	X															
07 72 00	Product Data	X			X												
07 72 00	Shop drawings	X	X														

07 72 00	Samples	X		X													
07 81 00	Product Data	X			X												
07 81 00	Sustainable Design Submittals	X															
07 81 00	Qualification Data	X															
07 81 00	Product Certificates	X															
07 81 00	Evaluation Reports	X															
07 81 00	Field quality-control reports	X															
07 84 10	Product Data	X			X												
07 84 10	Sustainable Design Submittals	X															
07 84 10	Product Schedule	X															
07 84 10	Engineering Judgments	X															
07 84 10	Qualification Data	X															
07 84 10	Product Test Reports	X															
07 84 10	Installer Certificates	X															
07 84 10	Installer Qualifications	X															
07 92 00	Product Data	X			X												
07 92 00	Sustainable Design Submittals	X															
07 92 00	Samples	X		X													
07 92 00	Joint-Sealant Schedule	X															
07 92 00	Qualification Data	X															

07 92 00	Product Test Reports	X															
07 92 00	Field-Adhesion-Test Reports	X															
07 92 00	Sample Warranties	X		X													
08 11 13	Product Data	X			X												
08 11 13	Sustainable Design Submittals	X															
08 11 13	Shop Drawings	X	X														
08 11 13	Product Schedule	X															
08 11 13	Product Test Reports	X															
08 31 13	Product Data	X			X												
08 31 13	Samples	X		X													
08 31 13	Sustainable Design Submittals	X															
08 31 13	Product Schedule	X															
08 33 23	Product Data	X			X												
08 33 23	Sustainable Design Submittals	X															
08 33 23	Shop Drawings	X	X														
08 33 23	samples	X		X													
08 33 23	Qualification data	X															
08 33 23	Oversize Construction Certification	X															
08 33 23	Sample Warranty	X															
08 33 23	Maintenance Data	X															

08 34 63	Product Data	X			X												
08 34 63	Sustainable Design Submittals	X															
08 34 63	Shop Drawings	X	X														
08 34 63	Samples	X		X													
08 34 63	Qualification data	X															
08 34 63	Welding certificates	X															
08 34 63	Product Test Reports	X															
08 34 63	Examination Reports	X															
08 34 63	Anchor Inspection Reports	X															
08 34 63	Field Quality Control Reports	X															
08 34 63	Furnish extra materials that match products installed	X															
08 41 15	Product Data	X			X												
08 41 15	Samples for Initial Selection	X		X													
08 41 15	Shop Drawings	X	X														
08 41 15	Samples for Verification	X		X													
08 41 15	Fabrication Sample	X		X													
08 41 15	Certificates	X															
08 41 15	Test Reports	X															
08 41 23	Product Data	X			X												

08 41 23	Samples for Initial Selection	X		X													
08 41 23	Shop Drawings	X	X														
08 41 23	Samples for Verification	X		X													
08 41 23	Fabrication Sample	X		X													
08 41 23	Certificates	X															
08 41 23	Test Reports	X															
08 43 33	Product Data	X															
08 43 33	Sustainable Design Submittals	X															
08 43 33	Shop Drawings	X	X														
08 43 33	Qualification data	X															
08 44 13	Product Data	X			X												
08 44 13	Sustainable Design Submittals	X															
08 44 13	Shop Drawings	X	X														
08 44 13	Samples	X		X													
08 44 13	Engineering Services Submittal	X															
08 44 13	Energy Performance Certificates	X															
08 44 13	Product Test Reports	X															
08 44 13	Source Quality-Control Reports	X															
08 44 13	Field Quality Control Reports	X															



08 44 13	Sample Warranties	X		X													
08 44 13	Maintenance data	X															
08 70 00	Catalog cuts	X			X												
08 70 00	Schedule of Finish Hardware	X															
08 70 00	Hardware Supplier Product Information	X															
08 70 00	Samples	X		X													
08 80 00	Product Data	X			X												
08 80 00	Sustainable Design Submittals	X															
08 80 00	Glass Samples	X		X													
08 80 00	Glazing Schedule	X															
08 80 00	Engineering Services Submittal	X															
08 80 00	Product Certificates	X															
08 80 00	Product Test Reports	X															
08 80 00	Preconstruction adhesion and compatibility test report	X															
08 80 00	Sample warranties	X		X													
08 88 53	Product Data	X			X												
08 88 53	Sustainable Design Submittals	X															

08 88 53	Security Glazing Samples	X		X													
08 88 53	Security Glazing Schedule	X															
08 88 53	Qualification Data	X															
08 88 53	Product Certificates	X															
08 88 53	Product Test Reports	X															
08 88 53	Preconstruction adhesion and compatibility test report	X															
08 88 53	Sample warranties	X															
08 91 19	Product Data	X			X												
08 91 19	Sustainable Design Submittals	X															
08 91 19	Shop Drawings	X	X														
08 91 19	Samples	X		X													
08 91 19	Engineering Services Submittal	X															
08 91 19	Product Test Reports	X															
09 22 16	Product Data	X			X												
09 22 16	Sustainable Design Submittals	X															
09 22 16	Product Certificates	X															
09 22 16	Evaluation Reports	X															
09 23 13	Product Data	X			X												

09 23 13	Sustainable Design Submittals	X															
09 23 13	Shop Drawings	X	X														
09 23 13	Samples	X		X													
09 29 00	Product Data	X			X												
09 29 00	Sustainable Design Submittals	X															
09 29 00	Samples	X		X													
09 30 13	Product Data	X															
09 30 13	Sustainable Design Submittals	X															
09 30 13	Samples	X		X													
09 51 13	Product Data	X			X												
09 51 13	Sustainable Design Submittals	X															
09 51 13	Samples	X		X													
09 51 13	Evaluation Reports	X															
09 51 13	Maintenance data	X															
09 65 13	Product Data	X			X												
09 65 13	Sustainable Design Submittals	X															
09 65 13	Samples	X		X													
09 66 21	Product Data	X															
09 66 21	Sustainable Design Submittals	X															

09 66 21	Shop Drawings	X	X														
09 66 21	Samples	X		X													
09 66 21	Maintenance Data	X															
09 66 21	Qualification data	X															
09 66 21	Material Certificates	X															
09 66 21	Installer Certificates	X															
09 66 21	Pre-Installation moisture-testing reports	X															
09 66 21	Maintenance Data	X															
09 67 23	Sustainable Design Submittals	X															
09 67 23	Shop Drawings	X	X														
09 67 23	Samples	X		X													
09 67 23	Installer Certificates	X															
09 67 23	Material Certificates	X															
09 67 23	Material test reports	X															
09 67 23	Maintenance Data	X															
09 69 00	Product Data	X			X												
09 69 00	Sustainable Design Submittals	X															
09 69 00	Shop Drawings	X	X														
09 69 00	Samples	X		X													
09 69 00	Delegated-Design Submittal	X															

09 69 00	Qualification data	X															
09 69 00	Product Certificates	X															
09 69 00	Product Test reports	X															
09 69 00	Seismic Design Calculations	X															
09 69 00	Furnish extra materials that match products installed	X															
09 77 23	Product Data	X			X												
09 77 23	Sustainable Design Submittals	X															
09 77 23	Samples	X		X													
09 77 23	Shop Drawings	X	X														
09 91 00	Product Data	X			X												
09 91 00	Sustainable Design Submittals	X															
09 91 00	Samples	X		X													
10 11 00	Product Data	X			X												
10 11 00	Sustainable Design Submittals	X															
10 11 00	Shop Drawings	X	X														
10 11 00	Samples	X		X													
10 11 00	Product Schedule	X															
10 11 00	Qualification data	X															
10 11 00	Sample Warranties	X		X													

10 11 00	Maintenance Data	X															
10 14 00	Product Data	X			X												
10 14 00	Shop Drawings	X	X														
10 14 00	Material and Finish Samples	X		X													
10 14 00	Manufacturer's Installation Instructions	X															
10 14 00	Schedule	X															
10 14 00	Submit maintenance and cleaning recommendations	X															
10 21 13	Product Data	X			X												
10 21 13	Sustainable Design Submittals	X															
10 21 13	Shop Drawings	X	X														
10 21 13	Samples	X		X													
10 21 13	Product Certificates	X															
10 21 13	Maintenance Data	X			X												
10 22 13	Product Data	X			X												
10 22 13	Sustainable Design Submittals	X															
10 22 13	Shop Drawings	X	X														
10 22 13	Samples	X		X													
10 22 13	Delegated-Design Submittal	X															

10 22 13	Qualification data	X															
10 22 13	Welding Certificates	X															
10 22 13	Maintenance Data	X															
10 22 13	Furnish extra materials that match products installed	X															
10 26 00	Product Data	X			X												
10 26 00	Sustainable Design Submittals	X															
10 26 00	Shop Drawings	X	X														
10 26 00	Samples	X		X													
10 26 00	Product Certificates	X															
10 26 00	Material Certificates	X															
10 26 00	Sample Warranty	X															
10 26 00	Maintenance data	X															
10 28 00	Product Data	X			X												
10 28 00	Samples	X		X													
10 28 00	Sample Warranty	X			X												
10 28 00	Maintenance data	X			X												
10 28 13	Product Data	X			X												
10 28 13	Shop Drawings	X	X														
10 28 13	Samples	X		X													
10 28 13	Examination Reports	X															

10 28 13	Anchor Inspection Reports	X															
10 28 13	Field Quality-Control Certification	X															
10 44 13	Product Data	X			X												
10 44 13	Shop Drawings	X	X														
10 44 13	Samples	X		X													
10 44 13	Maintenance data	X															
10 51 13	Product Data	X			X												
10 51 13	Sustainable Design Submittals	X															
10 51 13	Shop Drawings	X	X														
10 51 13	Samples	X		X													
10 51 13	Qualification data	X															
10 51 13	Sample Warranty	X															
10 51 13	Maintenance data	X															
10 75 00	Product Data	X			X												
10 75 00	Shop Drawings	X	X														
10 75 00	Samples	X		X													
11 30 13	Product Data	X			X												
11 30 13	Sustainable Design Submittals	X															
11 30 13	Samples	X		X													
11 30 13	Product Schedule	X															



11 30 13	Product Certificates	X															
11 30 13	Field Quality-Control reports	X															
11 30 13	Sample Warranties	X															
11 30 13	Operation and Maintenance data	X															
11 82 26	Product Data	X			X												
11 82 26	Shop Drawings	X	X														
11 82 26	Written Manufacturer Statement	X															
11 82 26	Certificate to DSNY	X															
11 82 26	Maintenance Manuals	X															
12 24 13	Product Data	X			X												
12 24 13	Shop Drawings	X	X														
12 24 13	Samples	X		X													
12 24 13	Product Certificates	X															
12 24 13	Product test reports	X															
12 24 13	Operation and Maintenance data	X															
12 48 16	Product Data	X			X												
12 48 16	Shop Drawings	X	X														
12 48 16	Samples	X		X													
12 48 16	Maintenance data	X															
12 93 00	Product Data	X			X												
12 93 00	Shop Drawings	X	X														

12 93 00	Samples	X		X													
12 93 00	Maintenance data	X															
13 10 00	Vehicle Operable Barriers	X	X	X	X												
14 21 23	Traction Elevator	X	X	X	X												
21 00 00	Shop Drawings	X	X														
21 00 00	Samples	X		X													
21 00 00	Electronic Copies of JFK & M Drawings	X															
21 00 00	Operating Instructions	X															
21 00 00	Maintenance Instructions	X															
21 00 00	Manufacturer's data	X															
21 05 13	Product Data	X			X												
21 05 17	Product Data	X			X												
21 05 18	Product Data	X			X												
21 05 48	Product Data	X			X												
21 05 53	Product Data	X			X												
21 05 53	Samples	X		X													
21 05 53	Equipment-Label Schedule	X															
21 05 53	Valve Schedules	X															
21 05 53	Maintenance data	X															
21 08 00	Cx Fire Suppression	X	X	X	X												
21 12 00	Product Data	X			X												

21 12 00	Shop Drawings	X	X														
21 12 00	Delegated- Design Submittal	X															
21 12 00	Coordination Drawings	X															
21 12 00	Qualification data	X															
21 12 00	Approved Standpipe Drawings	X															
21 12 00	Welding Certificates	X															
21 12 00	Fire-hydrant flow test report	X															
21 12 00	Field test reports and certificates	X															
21 12 00	Field quality- control reports	X															
21 12 00	Operation and Maintenance data	X															
21 13 13	Product Data	X			X												
21 13 13	Shop Drawings	X	X														
21 13 13	Delegated- Design Submittal	X															
21 13 13	Coordination Drawings	X															
21 13 13	Qualification data	X															
21 13 13	Welding Certificates	X															
21 13 13	Fire-hydrant flow test report	X															
21 13 13	Field test reports and certificates	X															
21 13 13	Field quality- control reports	X															

21 13 13	Operation and Maintenance data	X															
21 13 16	Product Data	X			X												
21 13 16	Shop Drawings	X	X														
21 13 16	Delegated-Design Submittal	X															
21 13 16	Coordination Drawings	X															
21 13 16	Qualification data	X															
21 13 16	Approved Sprinkler Piping Drawings	X															
21 13 16	Fire-hydrant flow test report	X															
21 13 16	Field test reports and certificates	X															
21 13 16	Field quality-control reports	X															
21 13 16	Operation and Maintenance data	X															
21 24 00	Product Data	X			X												
21 24 00	Shop Drawings	X	X														
21 24 00	Product Certificates	X															
21 24 00	Field test reports	X															
21 24 00	Operation and Maintenance data	X															
21 31 13	Product Data	X			X												
21 31 13	Shop Drawings	X	X														
21 31 13	Product Certificates	X															

21 31 13	Field test reports	X															
21 31 13	Operation and Maintenance data	X															
21 34 00	Product Data	X			X												
21 34 00	Shop Drawings	X	X														
21 34 00	Field quality-control reports	X															
21 34 00	Operation and Maintenance data	X															
21 39 00	Product Data	X			X												
21 39 00	Shop Drawings	X	X														
21 39 00	Qualification Data	X															
21 39 00	Seismic Qualification certificates	X															
21 39 00	Product Certificates	X															
21 39 00	Manufacturer's factory test reports	X															
21 39 00	Source quality-control reports	X															
21 39 00	Field quality-control reports	X															
21 39 00	Operation and Maintenance data	X															
22 00 00	Shop Drawings	X	X														
22 00 00	Samples	X		X													
22 05 13	Product Data	X			X												
22 05 16	Product Data	X			X												

22 05 16	Delegated-Design Submittal	X															
22 05 16	Maintenance Data	X															
22 05 16	Welding Certificates	X															
22 05 16	Product Certificates	X															
22 05 16	Maintenance Data	X															
22 05 17	Product Data	X			X												
22 05 18	Product Data	X			X												
22 05 19	Product Data	X			X												
22 05 19	Product Certificates	X															
22 05 23	Operation and Maintenance data	X															
22 05 23	Product Data	X			X												
22 05 29	Product Data	X			X												
22 05 29	Shop Drawings	X	X														
22 05 29	Delegated-Design Submittal	X															
22 05 29	Welding Certificates	X															
22 05 33	Product Data	X			X												
22 05 33	Shop Drawings	X	X														
22 05 33	Field quality-control reports	X															
22 05 33	Sample Warranty	X															
22 05 33	Operation and Maintenance data	X															

22 05 48	Load Restraint for Plumbing Components	X	X	X	X												
22 05 53	Identification																
22 07 19	Product Data	X			X												
22 07 19	LEED Product Data	X															
22 07 19	Laboratory Test Reports	X															
22 07 19	Shop Drawings	X	X														
22 07 19	Sample	X		X													
22 07 19	Qualification Data	X															
22 07 19	Material Test Reports	X															
22 07 19	Field quality-control reports	X															
22 08 00	Cx Plumbing	X	X	X	X												
22 11 13	Product Data	X			X												
22 11 13	Shop Drawings	X	X														
22 11 13	Operation and Maintenance data	X															
22 11 14	Product Data	X			X												
22 11 14	Shop Drawings	X	X														
22 11 14	Delegated-Design Submittal	X															
22 11 14	Coordination Drawings	X															
22 11 14	Site Survey	X															
22 11 14	Qualification Data	X															
22 11 14	Welding Certificates	X															

22 11 14	Field Quality-Control reports	X															
22 11 14	Operation and Maintenance data	X															
22 11 16	Product Data	X			X												
22 11 16	LEED Product Data	X															
22 11 16	Laboratory Test Reports	X															
22 11 16	System purging and disinfecting activities report	X															
22 11 16	Field Quality-Control Reports	X															
22 11 19	Product Data	X			X												
22 11 19	Shop Drawings	X	X														
22 11 19	Field Quality-Control reports	X															
22 11 19	Operation and Maintenance data	X															
22 11 23	Product Data	X			X												
22 11 23	LEED Product Data	X															
22 11 23	Operation and Maintenance data	X															
22 11 24	Product Data	X			X												
22 11 24	Seismic Qualification Certificates	X															
22 11 24	Operation and Maintenance Data	X															
22 12 23	Product Data	X			X												



22 12 23	Seismic Qualification Certificates	X															
22 13 16	Product Data	X			X												
22 13 16	LEED Product Data	X															
22 13 16	LEED Laboratory Test Reports	X															
22 13 16	Seismic Qualification Certificates	X															
22 13 16	Field Quality-Control reports	X															
22 13 19	Shop Drawings	X	X														
22 13 19	Manufacturer Seismic Qualification Certificates	X															
22 13 19	Field Quality-Control reports	X															
22 13 19	Operation and Maintenance data	X															
22 13 24	Product Data	X			X												
22 13 24	Shop Drawings	X	X														
22 13 24	Operation and Maintenance data	X															
22 13 29	Product Data	X			X												
22 13 29	Operation and Maintenance data	X															
22 14 13	Product Data	X			X												
22 14 13	LEED Product Data	X															
22 14 13	LEED Laboratory Test Reports	X															

22 14 13	Shop Drawings	X	X														
22 14 13	Seismic Qualification Certificates	X															
22 14 13	Field Quality-Control reports	X															
22 14 23	Product Data	X			X												
22 35 00	Product Data	X			X												
22 35 00	Shop Drawings	X	X														
22 43 00	Product Data	X			X												
22 43 00	LEED Product Data	X															
22 43 00	Shop Drawings	X	X														
22 43 00	Operation and Maintenance data	X															
22 45 00	Product Data	X			X												
22 46 00	Product Data	X			X												
22 47 00	Product Data	X			X												
23 05 00	AIA Document 21	X															
23 05 00	Coordination Drawings	X															
23 05 00	Certification	X															
23 05 13	Product Data	X			X												
23 05 13	Shop Drawings	X	X														
23 05 13	Manufacturer Seismic Qualification Certificates	X															
23 05 14	Product Data	X			X												

23 05 14	Shop Drawings	X	X														
23 05 14	Qualification Data	X															
23 05 14	Seismic Qualification Certificates	X															
23 05 14	Product Certificates	X															
23 05 14	Source quality-control reports	X															
23 05 14	Field quality-control reports	X															
23 05 14	Operation and Maintenance data	X															
23 05 15	Product Data	X															
23 05 15	Shop Drawings	X	X														
23 05 15	Qualification Data	X															
23 05 15	Seismic Qualification Certificates	X															
23 05 15	Field quality-control reports	X															
23 05 15	Operation and Maintenance data	X															
23 05 15	Load-Current and Overload-Relay Heater List	X															
23 05 15	Load-Current and List of Settings of Adjustable Overload Relays	X															
23 05 16	Product Data	X			X												
23 05 16	Delegated-Design Submittal	X															

23 05 16	Wiring Diagrams	X															
23 05 16	Product Certificates	X			X												
23 05 16	Operation and Maintenance data	X															
23 05 19	Product Data	X			X												
23 05 19	Material List	X															
23 05 19	Product Data	X			X												
23 05 19	Shop Drawings	X	X														
23 05 23	Product Data	X			X												
23 05 23	Material List	X															
23 05 33	Product Data	X			X												
23 05 33	Shop Drawings	X	X														
23 05 33	Field quality-control reports	X															
23 05 33	Operation and Maintenance data	X															
23 05 33	Warranty	X															
23 05 33	Samples	X		X													
23 05 33	Equipment Label Schedule	X															
23 05 33	Valve Numbering Scheme	X															
23 05 33	Valve Schedules	X															
23 05 48	Load Restraints for HVAC Components	X			X												

23 05 53	Identification HVAC	X			X												
23 05 93	LEED Submittal	X															
23 05 93	Qualification data	X															
23 05 93	Contract Documents Examination Report	X															
23 05 93	Strategies and Procedures Plan	X															
23 05 93	Certified TAB Reports	X															
23 05 93	Instrument Calibration report	X															
23 07 00	Shop Drawings	X	X														
23 07 00	Work schedule	X															
23 08 00	Certificates of readiness	X															
23 08 00	Certificates of completion of installation	X															
23 08 00	O&M manuals	X															
23 08 00	Test Reports	X															
23 09 00	Control Riser Diagram	X															
23 09 00	System flow diagrams	X															
23 09 00	Points List	X															
23 09 00	Operations Sequences	X															
23 09 00	Material List	X															
23 09 00	Control Damper Schedules	X															

23 09 00	Control Valve Schedules	X															
23 09 00	Catalog Cut Sheet	X			X												
23 09 00	Product Data	X															
23 09 00	Range and Scale Information	X															
23 09 00	Hardware data	X															
23 09 00	Software manuals	X															
23 09 00	Operation and Maintenance Instructions	X															
23 11 13	Product Data	X			X												
23 11 13	Shop Drawings	X	X														
23 11 13	Delegated-Design Submittal	X															
23 11 13	Coordination Drawings	X															
23 11 13	Qualification Data	X															
23 11 13	Seismic Qualification Certificates	X															
23 11 13	Brazing Certificates	X															
23 11 13	Welding Certificates	X															
23 11 13	Field quality-control reports	X															
23 11 13	Sample warranty	X															
23 11 13	Operation and Maintenance Data	X															
23 11 13	Furnish Extra Materials	X															
23 13 13	Product Data	X			X												

23 13 13	Catalog Sheets	X															
23 13 13	Quality Control Submittals	X															
23 13 13	Factory Test Certificate	X															
23 13 13	Final test procedure documentation	X															
23 21 13	LEED Submittal	X															
23 21 13	Shop Drawings	X	X														
23 21 13	Welding Certificates	X															
23 21 13	Qualification Data	X															
23 21 13	Field quality-control reports	X															
23 21 13	Operation and Maintenance Data	X															
23 21 23	Product Data	X			X												
23 21 23	Shop Drawings	X	X														
23 21 23	Product Certificates	X															
23 21 23	Operation and Maintenance Data	X															
23 25 00	Product Data	X			X												
23 25 00	Shop Drawings	X	X														
23 25 00	Field quality-control reports	X															
23 25 00	Manufacturer Seismic Qualification Certification	X															
23 25 00	Operation and Maintenance Data	X															

23 25 00	Water Treatment Program Sequence of operation	X															
23 25 00	Water analysis	X															
23 25 00	Passivation Confirmation Report	X															
23 25 10	Product Data	X			X												
23 25 10	Shop Drawings	X	X														
23 25 10	Field quality-control reports	X															
23 25 10	Manufacturer Seismic Qualification Certification	X															
23 25 10	Operation and Maintenance Data	X															
23 31 13	Product Data	X			X												
23 31 13	Ductwork Shop Standards	X															
23 31 13	Fabrication, assembly, and installation including drawings, take-offs and attachments to other work	X															
23 31 13	Duct layout	X															
23 31 13	Shop Drawing	X	X														
23 31 13	Material classification	X															
23 31 13	Welding certificates	X															
23 31 13	Maintenance data	X															



23 31 13	Field quality-control reports	X															
23 31 13	Design Calculations	X															
23 31 20	Test reports	X															
23 33 10	Product data	X			X												
23 33 10	Operation and Maintenance Data	X															
23 33 13	Product data	X			X												
23 33 13	Product Description	X															
23 33 13	Manufacturer's installation instructions	X															
23 34 16	Product data	X			X												
23 34 16	Coordination drawings	X															
23 34 16	Shop Drawing	X	X														
23 34 16	Field quality-control reports	X															
23 34 16	Operation and Maintenance Data	X															
23 34 33	Product data	X			X												
23 34 16	Shop Drawing	X	X														
23 34 16	Coordination drawings	X															
23 34 16	Samples for initial selection	X		X													
23 34 16	Operation and Maintenance Data	X															
23 34 16	Warranties	X															
23 36 00	Product data	X															

23 36 00	Shop Drawings	X	X														
23 36 00	Delegated- Design Submittal	X															
23 36 00	Coordination drawings	X															
23 36 00	Field quality- control reports	X															
23 36 00	Maintenance data	X															
23 37 13	Product data	X			X												
23 37 13	Manufacturing engineering data	X															
23 37 13	Samples for initial selection	X		X													
23 37 13	Samples for verification	X		X													
23 37 13	Coordination drawings	X															
23 37 13	Source quality control reports	X															
23 41 00	Product data	X			X												
23 41 00	Shop Drawings	X	X														
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23 51 00	Product data	X			X												
23 51 00	Welding certificates	X															
23 51 00	Shop drawings	X	X														
23 51 00	Manufacturer's Seismic Qualification Certification	X															
23 51 00	Warranty	X															
23 51 01	Product data	X			X												

23 51 01	Shop Drawings	X	X														
23 51 01	Warranty	X															
23 51 01	Operation and Maintenance Data	X															
23 52 16	Product data	X															
23 52 16	Shop Drawings	X	X														
23 52 16	Manufacturer's Seismic Qualification Certification	X															
23 52 16	Source quality-control reports	X															
23 52 16	Field quality-control reports	X															
23 52 16	Warranty	X															
23 52 16	ASME Stamp Certification and Report	X															
23 52 16	Design Calculations	X															
23 52 16	Coordination Drawings	X	X														
23 52 16	Qualification Data	X															
23 52 16	Welding Certificates	X															
23 52 16	Field quality-control reports	X															
23 52 16	Operation and Maintenance Data	X															
23 55 33	Product Data	X			X												
23 55 33	Shop Drawings	X	X														
23 55 33	Coordination Drawings	X	X														

23 55 33	Seismic Qualification Certificates	X															
23 55 33	Field Quality-Control Reports	X															
23 55 33	Sample Warranty	X															
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23 57 00	Product data	X			X												
23 57 00	Shop Drawings	X	X														
23 57 00	Coordination drawings	X	X														
23 57 00	Manufacturer's Seismic Qualification Certification	X															
23 57 00	Operation and Maintenance Data	X															
23 64 18	Shop Drawings	X	X														
23 64 18	Product data	X			X												
23 64 18	Coordination Drawings	X	X														
23 64 18	Seismic Qualification data	X															
23 64 18	Installation instructions	X															
23 64 18	Source quality-control reports	X															
23 64 18	Startup service reports	X															
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23 64 18	Spare parts list	X															
23 64 18	Touchup paint description	X															
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23 64 27	Refrigerant Monitoring and Alarm	X															
23 65 00	Product data	X			X												
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23 65 00	Source quality-control reports	X															
23 65 00	Field quality-control reports	X															
23 65 00	Startup service reports	X															
23 65 00	Operation and Maintenance Data	X															
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23 71 00	Contract conditions	X															
23 71 00	Schedules	X															
23 71 00	Field quality-control reports	X															
23 71 00	Operation and Maintenance Data	X															
23 71 00	Layout Coordination	X															
23 71 03	Contract conditions	X															

23 71 03	Shop Drawings	X	X														
23 71 03	Field quality-control reports	X															
23 71 03	Operation and Maintenance Data	X															
23 73 13	Product data	X			X												
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23 73 13	Coordination Drawings	X															
23 73 13	Seismic Qualification certificates	X															
23 73 13	Source quality-control reports	X															
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23 73 15	Wiring diagrams	X															
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23 73 15	Operation and Maintenance Manuals	X															
23 73 15	Trouble shooting maintenance guide	X															

23 73 39	Product data	X															
23 73 39	LEED Submittal product data	X															
23 73 39	Shop Drawings	X	X														
23 73 39	Coordination Drawings	X															
23 73 39	Startup service reports	X															
23 73 39	Operation and Maintenance Data	X															
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23 77 33	Coordination Drawings	X															
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23 77 33	Weld radiographs	X															
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23 77 33	Product data	X			X												
23 81 23	Product data	X			X												
23 81 23	Shop Drawings	X	X														
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23 81 23	Coordination Drawings	X															
23 81 23	Seismic Qualification certificates	X															
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23 82 33	Coordination Drawings	X	X														
23 82 33	Color Samples for Initial Selection	X		X													
23 82 33	Color Samples for Verification	X		X													
23 82 33	Field Quality-Control Test Reports	X															
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23 82 39	Samples for Initial Selection	X		X													
23 82 39	Samples for Verification	X		X													
23 82 39	Manufacturer Seismic Qualification Certification	X															
23 82 39	Field Quality-Control Test Reports	X															
23 82 39	Operation and Maintenance Data	X															
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23 82 50	Warranty	X															



23 82 50	Operation and maintenance data	X															
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23 84 13	Coordination Drawings	X															
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26 05 00	Manufacturer's list	X															
26 05 00	Contract conditions	X															
26 05 00	Coordination Drawings	X															
26 05 00	Shop drawings	X	X														
26 05 19	Qualification data	X															
26 05 19	Field quality-control reports	X															
26 05 26	Product data	X			X												
26 05 26	As-built data	X															
26 05 26	Qualification data	X															
26 05 26	Field quality-control reports	X															
26 05 26	Operation and Maintenance Data	X															
26 05 29	Product data	X			X												
26 05 29	Shop drawings	X	X														
26 05 29	Welding certificates	X															
26 05 33	Product data	X			X												

26 05 33	Shop Drawings	X	X														
26 05 33	Samples	X		X													
26 05 33	Coordination Drawings	X															
26 05 33	Qualification data	X															
26 05 43	Product data	X			X												
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26 05 43	Source quality-control reports	X															
26 05 44	Product data	X			X												
26 05 44	Laboratory test reports	X															
26 05 48	Product data	X			X												
26 05 48	Design Calculations	X															
26 05 48	Coordination Drawings	X															
26 05 48	Qualification data	X															
26 05 48	Welding certificates	X															
26 05 48	Field quality-control reports	X															
26 05 53	Product data	X															
26 05 53	Samples	X		X													
26 05 53	Identification Schedule	X															
26 05 72	Product data	X			X												

26 05 72	Short circuit input data	X															
26 05 72	Short circuit study and equipment evaluation report	X															
26 05 72	Field investigation diagram	X															
26 05 72	Qualification data	X															
26 05 72	Product certificates	X															
26 05 73	Product data	X			X												
26 05 73	Coordination-study input data	X															
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26 05 73	Overcurrent protective device coordination study report	X															
26 05 73	Qualification data	X															
26 05 73	Product certificates	X															
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26 05 74	Qualification data	X															
26 05 74	Product certificates	X															
26 05 74	Maintenance procedures	X															

26 05 74	Operation and maintenance procedures	X															
26 08 00	Certificates of readiness	X															
26 08 00	Certificates of completion of installation	X															
26 08 00	O&M manuals	X															
26 08 00	Test reports	X															
26 09 43	Product data	X			X												
26 09 43	Shop Drawings	X	X														
26 09 43	Coordination Drawings	X															
26 09 43	Load schedule	X															
26 09 43	Operating and maintenance manuals	X															
26 09 43	Catalogue submittals	X															
26 09 43	Control intent diagram	X															
26 09 43	Material Safety Data sheets	X															
26 09 43	LEED Materials Certification form	X															
26 09 43	Product cut sheets	X			X												
26 24 13	Product data	X			X												
26 24 13	Shop Drawings	X	X														
26 24 13	Samples	X		X													
26 24 13	Qualification data	X															

26 24 13	Seismic Qualification certificates	X															
26 24 13	Field quality-control reports	X															
26 24 13	Operating and maintenance data	X															
26 24 13	Qualification data	X															
26 24 13	Seismic Qualification certificates	X															
26 24 13	Field quality-control reports	X															
26 24 16	Product data	X			X												
26 24 16	Shop Drawings	X	X														
26 24 16	Qualification data	X															
26 24 16	Seismic Qualification certificates	X															
26 24 16	Field quality-control reports	X															
26 24 16	Panelboard schedules	X															
26 24 16	Operating and maintenance data	X															
26 24 19	Product data	X			X												
26 24 19	Shop Drawings	X	X														
26 24 19	Harmonic Analysis Study and report	X															
26 24 19	Standard Drawings	X															
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26 24 19	Coordination Drawings	X															
26 24 19	Qualification data	X															
26 24 19	Product certificates	X															
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26 24 19	Field quality-control reports	X															
26 24 19	Load-Current and Overload-Relay Heater List	X															
26 24 19	Load-Current and List of settings of adjustable Overload relays	X															
26 24 19	Warranty	X															
26 24 19	Operating and maintenance data	X															
26 26 53	Product Data	X			X												
26 26 53	Shop Drawings	X	X														
26 26 53	Product Schedule	X															
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26 26 53	Sample Warranty	X															
26 26 53	Operation and Maintenance Data	X															

26 26 53	Software and Firmware Operational Documentation	X															
26 27 13	Product data	X			X												
26 27 13	Shop Drawings	X	X														
26 27 13	Field quality-control reports	X															
26 27 13	Operating and maintenance data	X															
26 27 26	Product data	X			X												
26 27 26	Shop Drawings	X	X														
26 27 26	Field quality-control reports	X															
26 27 26	Operating and maintenance data	X															
26 28 13	Product data	X			X												
26 28 13	Operating and maintenance data	X															
26 28 16	Product data	X			X												
26 28 16	Shop Drawings	X	X														
26 28 16	Qualification data	X															
26 28 16	Seismic Qualification certificates	X															
26 28 16	Field quality-control reports	X															
26 28 16	Manufacturer's field service report	X															
26 28 16	Operating and maintenance data	X															

26 29 13	Product data	X			X												
26 29 13	Shop Drawings	X	X														
26 29 13	Qualification data	X															
26 29 13	Seismic Qualification certificates	X															
26 29 13	Field quality-control reports	X															
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26 29 13	Load-Current and List of settings of adjustable Overload relays	X															
26 29 13	Operating and maintenance data	X															
26 29 23	Product data	X			X												
26 29 23	Shop Drawings	X	X														
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26 29 23	warranty	X															
26 29 23	Operating and maintenance data	X															
26 31 00	Product data	X			X												
26 31 00	Shop Drawings	X	X														
26 31 00	Field quality-control reports	X															
26 31 00	Warranty	X															
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26 32 13	Product data	X			X												
26 32 13	Shop Drawings	X	X														
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26 32 13	Source quality-control reports	X															
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26 32 13	Warranty	X															
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26 36 00	Product data	X			X												
26 36 00	Shop Drawings	X	X														
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26 36 00	Manufacturer Qualifications	X															

26 36 00	Testing Agency Qualifications	X															
26 36 00	Source limitations	X															
26 51 00	Product data	X			X												
26 51 00	Shop Drawings	X	X														
26 51 00	Field quality-control reports	X															
26 51 00	Coordination drawings	X															
26 51 00	samples	X		X													
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27 00 00	Shop drawing	X	X														
27 00 00	Explanation of shop drawing stamp	X															
27 41 00	Shop drawing	X	X														
28 00 00	Shop drawing	X	X														
28 00 00	samples	X		X													

28 08 00	Cx Electronic Safety and Security	X	X	X	X												
28 31 11	Product data	X			X												
28 31 11	Power calculations	X															
28 31 11	Shop drawing	X	X														
28 31 11	Coordination drawings	X															
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31 00 00	Test reports	X															
31 00 00	Method statement	X															
31 00 00	Catalog cuts	X			X												
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32 05 16	Test reports	X															
32 05 16	Gradation and mechanical analysis	X															
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32 13 15	Product data	X			X												
32 13 15	Samples	X		X													
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32 17 33	Manufacturer's installation instructions	X															
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32 31 19	Shop drawings	X	X														
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32 31 19	Manufacturer's installation instructions	X															
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33 10 00	Product data	X			X												
33 10 00	Manufacturer's certificate	X															
33 31 00	Product data	X			X												
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22 12 23	Facility Indoor Water Storage Tanks
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22 13 24	Inline Macerators
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23 05 23	Valves for HVAC Piping
23 05 33	Heat Tracing for HVAC Piping
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23 09 05	Sequences of Operations for HVAC Controls
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23 21 23	HVAC Pumps
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**SECTION 01 20 00****Milestones, Liquidated Damages, and Incentive Payments****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 SUMMARY**

- A. This section includes Project milestones, assessments of liquidated damages for failure to meet the milestones, and incentive payment for accelerated completion of Milestone Number 1.

**1.3 GENERAL**

- A. Because this Project is critical to the City and TIME IS OF THE ESSENCE, the City is making available to the Contractor certain incentive payment. The Contractor's time for completion, in consecutive calendar days ("ccds"), for each of the milestones, is indicated in the Addendum to the General Conditions – Schedule A, and as specified in Section 1.6 below. To encourage timely completion, the City is imposing liquidated damages for failure to timely achieve each Project milestone, and providing incentive payment for early achievement of Milestone Number 1, as described in Section 1.6 below. Incentive payment will be made and liquidated damages will be assessed as provided in Section 1.4 and 1.5 below.
- B. The Contractor is a sophisticated business entity involved in the construction industry with access to legal representation and understands that by entering into this Contract with the City that the Contractor hereby waives any and all claims it may have against the City or any of its officials, employees or agencies for the Contractor failing to meet the Project milestones within the Incentive Milestone Schedule (as defined in Section 1.6 below), and, thus not receiving any incentive payment available for this Project. As a sophisticated business entity involved in the construction industry, the Contractor understands that it is possible that it may not receive any incentive under this Contract and that it cannot bring any claim or lawsuit in any jurisdiction against the City if it does not meet the Project milestones within the Incentive Milestone Schedule for any reason and does not earn the incentive payment.
- C. Any dispute, negotiation and/or any other cause resulting in a delay, whether caused by the City, the utilities, or any other party, which results in the Contractor's failure to meet the Project milestones within the Incentive Milestone Schedule, plus authorized time extensions, will result in no payment of the incentive and the Contractor agrees that it shall not bring a claim against the City for the incentive payment.
- D. Contractor will not have a claim against the City for a compensable delay under Article 11 of the Standard Construction Contract, or any other claim against the City, if the City does not pay any



incentive for this Project because the Contractor did not meet the Accelerated Substantial Completion date (as defined in Section 1.6 below), and the Contractor's failure to meet such Project milestone within the Incentive Milestone Schedule is due to a delay by the City or any City agency, any utilities or any other cause whatsoever.

- E. The early completion incentive is separate and distinct from Article 11 of the Standard Construction Contract and the Contractor agrees and understands that the incentive payment cannot be claimed under Article 11 of the Standard Construction Contract.
- F. Moreover, the Contractor hereby waives any and all rights (and hereby understands what it is waiving as described herein) the Contractor may have or thinks it has in law (contract law or torts law) or in this Contract to bring any kind of claim against the City, if the City, based on this Contract, does not pay the incentive amount for this Project for any reason.
- G. In the event the Contract is extended by the Commissioner in accordance with Article 13 "Extension of Time for Performance" of the Standard Construction Contract, the Incentive Milestone Schedule and/or Contract Milestone Schedule may be extended accordingly if the work and/or delay associated with the time extension directly affects the completion of any of the milestones.

#### **1.4 INCENTIVE PAYMENT**

- A. The Commissioner may authorize an incentive for Milestone Number 1 if the Commissioner determines, in his/her sole and absolute discretion, that the Project work, including, but not limited to, all change order work, has been substantially completed within the Incentive Milestone Schedule as described in Schedule A and Section 1.6, below, plus any authorized time extension.
- B. If the Project work, including, but not limited to, all change order work for, receives determination of Substantial Completion from the Commissioner, by the time specified in the Incentive Milestone Schedule, plus authorized time extensions, then the Commissioner will authorize incentive payment in the amount specified in Section 1.6, below, less any and all deductions authorized by this Contract or by law. The determination of the Commissioner with respect to the award of an incentive payment shall be accepted as final, binding, and conclusive.
- C. No incentive will be authorized for the early completion of the Contract in the event that Substantial Completion of the Project work occurs after the Accelerated Substantial Completion date as specified in Section 1.6, below, regardless of delays, including delays attributable to the City. Examples of delays that may cause the Contractor to miss the Accelerated Substantial Completion date and not earn the incentive payment include, without limitation, delays resulting from subsurface conditions at the site materially differing from any shown on the Contract Drawings or indicated in the Specifications, delays resulting from such subsurface conditions as could not reasonably have been anticipated by the Contractor and were not anticipated by the City, and delays due to private utilities, which conditions will materially affect the cost of the work to be done under the contract. Notwithstanding the above, the Commissioner may grant an extension of time in accordance with Article 13 of the Standard Construction Contract for any or all of such delays.
- D. The maximum incentive amount payable to the Contractor under this Section shall be capped at One Million Dollars (\$1,000,000).
- E. Incentive payment will be paid out of Allowance for Incentive Payments shown on the Bid Schedule, which must be included by the Contractor in its total bid for the Contract.



## **1.5 LIQUIDATED DAMAGES**

- A. Liquidated damages will be assessed against the Contractor should the actual time for completion of Project Milestones fail to occur within the Contract Milestone Schedule for these milestones, plus any authorized time extensions, or if the Contractor, in the sole determination of the Commissioner, should abandon the work. The amount of liquidated damages will be determined as follows: the liquidated damages amount stated in Section 1.6, below, multiplied by the number of calendar days required to achieve completion of the milestone after the time for completion set forth in Section 1.6, below, plus any authorized time extensions; which said sum, in view of the difficulty of accurately ascertaining the loss which the City will suffer by reason of delay in the completion of the work hereunder, is hereby fixed and agreed as the liquidated damages that the City will suffer by reason of such delay, and not as a penalty.
- B. For purposes of calculating the number of consecutive calendar days for liquidated damages assessment, such calculation shall include the day on which the Contractor has successfully completed the work under the appropriate milestone, but shall not include the day of the Contract Milestone Schedule completion date.
- C. The determination of the Commissioner with respect to the assessment of liquidated damages shall be accepted as final, binding, and conclusive.
- D. This Section shall also apply to the Contractor if it is defaulted pursuant to Chapter X of this Standard Construction Contract. Neither the failure to assess liquidated damages nor the granting of any time extension shall operate as a waiver or release of any claim the City may have against the Contractor for either actual or liquidated damages.
- E. There is no limit to the amount of liquidated damages which may be assessed for the failure to achieve the Project Milestones.
- F. In the event liquidated damages are assessed, the City will deduct and retain out of the monies which may become due under this Contract, the amount of the liquidated damages. If such amount due under the Contract shall be less than the liquidated damages assessment, the Contractor shall be liable to pay the difference upon demand by the Commissioner. Liquidated damages for failure to complete a milestone within the Contract Milestone Schedule for that milestone shall be assessed in accordance with Article 15 of the Standard Construction Contract.

## **1.6 INCENTIVE PAYMENT/LIQUIDATED DAMAGES AMOUNTS**

- A. Liquidated damage amounts and incentive payment amounts for Project milestones are shown in the table below. The times for completion are to be calculated based on consecutive calendar days from the Commence Work Date set forth in the Notice to Proceed.



Project Milestone	Incentive Milestone Schedule (ccds)	Contract Milestone Schedule (ccds)	Incentive Amount (lump sum)	Liquidated Damages (\$/day)
<b>1</b> <b>(Substantial Completion)</b>	<b>605</b>  (Accelerated Substantial Completion)	<b>920</b>  (Scheduled Substantial Completion)	\$1,000,000	\$5,000 until Milestone 1 is completed
<b>2</b> <b>(Issuance of Temporary Certificate of Occupancy)</b>	N/A	<b>1,100</b>	N/A	\$5,000 until Milestone 2 is completed

- B. There is no incentive payment associated with Milestone Number 2.
- C. Determination of the amount of liquidated damages and/or incentive payment will be made when the Contractor has successfully completed the work under the appropriate milestone as described in Section 1.7, below. Any such amount shall be paid to the Contractor or credited to the City at that time.

#### 1.7 MILESTONE WORK

- A. **Milestone Number 1** is Substantial Completion of all of Project work, including all change order work, to allow the New York City Police Department to occupy the building and operate without restrictions.
- B. **Milestone Number 2** is the issuance of the temporary certificate of occupancy ("TCO") following the determination of Substantial Completion for the Project.

**END OF SECTION 01 20 00**



**SECTION 01 21 00****Allowance for Project Work Acceleration****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 GENERAL**

- A. Under this Section, the Contractor will be paid for Project work deemed necessary by the Commissioner to accelerate the Project during critical periods. Payment for such accelerated Project work includes reimbursement of:
1. 100% of the premium portions of overtime pay for working during non-scheduled work hours, which are defined as those hours of work outside of the NYC Department of Buildings ("DOB") permissible hours of work between 7am to 6pm on weekdays; or,
  2. The premium portion of overtime pay for overtime actually worked beyond the 40-hour work week but within the DOB permissible hours of work or,
  3. All other incidental expenditures resulting from performance of accelerated Project work as ordered by the Commissioner that result in additional costs to perform such work.
- B. The use of this allowance will expire upon the scheduled Substantial Completion date.
- C. Such accelerated Project work will be paid in accordance with the requirements of Articles 25 and 26 of the Standard Construction Contract. Payment under this allowance will cover the cost of all labor, materials, plant, equipment, insurance, and incidentals necessary to accelerate the Project work as ordered by the Commissioner.
- D. No accelerated Project work will be performed, unless expressly authorized in advance in a written directive from the Commissioner.
- E. No guarantee is given that this allowance will in fact be required for this Project. The allowance amount shown in the Bid Form is included in the total bid solely to ensure a method of payment for any accelerated Project work performed by the Contractor, as directed by the Commissioner.

**END OF SECTION 01 21 00**



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**SECTION 01 22 00****Expanded Work Allowance****PART 1 - GENERAL****1.1 GENERAL**

- A. An Allowance has been established for the items set forth in sub-section 1.3 below (“Expanded Work Allowance” or “EWA”). Payment for the items set forth in sub-section 1.3 (“Expanded Work Items”) may be made through the EWA, as directed by the Engineer. “Extra Work”, “overrun”, and “Allowance” are defined by the Standard Construction Contract (see Articles 2.1.16, 26.1, and 2.1.4, respectively) and nothing in this Section alters, or will be deemed to alter the interpretation or application of, the Standard Construction Contract, including but not limited to Articles 25, 26, 28, and 78 of the Standard Construction Contract.

**1.2 PROCESS**

- A. If the Engineer determines that use of the EWA is appropriate, in their sole discretion, the Engineer will prepare a written scope document for the Expanded Work Items for the Contractor’s execution (“EWA Scope Memo”). The EWA Scope Memo will set forth the maximum amount payable from the EWA prior to the execution of a final cost memorandum (“Maximum Amount”), in accordance with this Section. The Maximum Amount may be increased from time to time by the Engineer, in their sole discretion, except that the Maximum Amount may not exceed 80% of the Engineer’s estimated total cost for such Work (the “Estimated Cost”) unless and until a final cost is determined and a final cost memorandum (“Final Cost Memo”) executed in accordance with this Section.
- B. Neither the Maximum Amount nor the Estimated Cost will be deemed to be the final cost of the Expanded Work Items. The final cost for the Expanded Work Items will be determined in accordance with Article 26 of the Standard Construction Contract. The Contractor must submit its detailed price proposal for the Expanded Work Items, calculated in accordance with the Contract, within the time period set forth in the EWA Scope Memo or within 90 Days after the executed EWA Scope Memo is issued to the Contractor, whichever is sooner.
- C. Once the EWA Scope Memo is executed and the Contractor is directed to proceed with the Work, DDC will make progress payments, as provided in the Contract, up to the Maximum Amount or until the submission period has expired, whichever occurs sooner.
- D. DDC will not make any progress payments for the performance of the Expanded Work Items beyond the submission period set forth in sub-Section C, above, unless and until a final cost has been determined and a Final Cost Memo executed in accordance with this Section. No amounts above the Maximum Amount set by the Engineer will be payable from the EWA, unless and until a final cost has been determined and a Final Cost Memo executed in accordance with this Section. In all events, the Contractor shall promptly and diligently comply with the Engineer’s direction and perform all Work required by the Contract and the EWA Scope Memo.
- E. Upon receipt of the Contractor’s cost detailed proposal, DDC will evaluate the proposal and initiate negotiations, as necessary, to determine the final cost of the Expanded Work Items in accordance with Article 26 of the Standard Construction Contract. The Contractor is responsible to furnish time and material records

in accordance with Article 28 of the Standard Construction Contract until a Final Cost Memo is executed. If the parties cannot agree on a unit price or fixed price, the Contractor will be paid on the basis of time and material records in accordance with Article 26 the Standard Construction Contract.

- F. A Final Cost Memo will be prepared by the Engineer to be executed by the parties. The total net sum of the amounts added and/or credited under the EWA Scope Memo and payment of the finalized Final Cost Memo constitutes full accord and satisfaction for the costs resulting from the Expanded Work Items. In the event the EWA is insufficient to pay the full amount of the Final Cost Memo, the parties agree to execute change order documents for the remaining funds, subject to registration in accordance with the New York City Charter.

### **1.3 PRICE TO COVER**

- A. Expanded Work Items are those items set forth below. The EWA may be used, in the Engineer's discretion, for the following Expanded Work Items:
1. Non-material changes in the Work necessary to complete Contract Work due to site conditions that differ from those included in the Contract Documents and that could not have been anticipated by the Contractor.
  2. Non-material changes in the Work directed by the Commissioner that result in a net change in the cost to the Contractor for the Work to be performed under this Contract, including but not limited to the following:
    - a. Overruns of unit price items and quantity increases in portions of work within a lump sum item.
    - b. NYCDOT traffic stipulations or permit requirements that significantly differ from those included in the Contract Documents and that could not have been anticipated by the Contractor.
    - c. Changes to the sizes of materials or changes to specifications of materials.
    - d. Materials/structures not included in the Contract Documents that are necessary to complete Contract Work and that could not have been anticipated by the Contractor.

### **1.4 BASIS OF PAYMENT**

- A. The fixed sum must be considered the price bid for this item. The fixed sum is not to be altered in any manner by the bidder. Should the amount shown be altered, the new figures will be disregarded, and the original price will be used to determine the total amount bid for the contract.
- B. The payment(s) made under this item will be equal to the Final Cost Memo prepared by the Engineer and executed by the parties in accordance with 1.2(F) above as proof of work performed for this item as approved by the Engineer.
- C. The total estimated cost of this item is the "fixed sum" amount shown for this item in the Bid Form and shall not be varied in the bid. The "fixed sum" amount is included in the bid solely to ensure that sufficient monies will be available to pay the Contractor for this work, which may be more or less than the fixed sum amount.
- D. The price will cover the cost of all labor, materials, equipment, insurance and incidentals necessary to complete the work under this section in accordance with the Contract Drawings, the specifications and the directions of the Engineer.

**END OF SECTION 01 22 00**

**SECTION 01 32 34****COMPUTER AIDED DESIGN COORDINATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. The Project shall utilize 3D Modeling for the coordination of all Structural Steel, Mechanical, Plumbing, Fire Protection, Electrical, Low Voltage Systems and Exterior Envelope. The 3D coordination shall be based on a coordinated design.
- B. This specification covers the intended scope for using BIM for construction purposes. The Contractor will develop a coordinated clash-free Model including Structure, Architecture and complete MEP services. The Construction Model will be used to generate all Shop Drawings that is directly referencing the Model. The coordinated Construction Model will be used to generate points for automated layout stations which ensure that the installation is accurate and verified. The scope also includes the production of a dimensionally accurate As-Built Model including embedded Facilities Management data.
- C. The Contractor agrees to participate in the use of digital/computer based three dimensional models and other related functionality, generally referred to as Building Information Modeling (such models and functionality are referred to herein as BIM) as Commissioner may determine to be beneficial for use in facilitating coordination, sequencing, scheduling and production of as- built depictions of the Project and performance of the Work and as hereafter provided. The contractor's costs of such participation are included in the contract amount unless explicitly outlined herein. The costs shall include, but not be limited to, licensing, additional programs, software, seminars and design participation meetings.
- D. Contractor agrees that neither the BIM nor the use of the BIM is in lieu of nor intended to relieve the Subcontractor of its responsibilities under the contract, including to (i) coordinate its Work with the work of others involved in the Project and (ii) strictly comply with the other requirements of the Subcontract Agreement and the Contract Documents. It is expressly understood and agreed that, notwithstanding the requirement for submittals in connection with the BIM, traditional shop drawings and other submissions shall be required of Subcontractor as per the Contract Documents.

**1.2 REFERENCE STANDARDS**

- A. Level of Development (LOD) Specification 2014
- B. National BIM Standard V3

**1.3 DEFINITIONS**

- A. General
  - 1. Building Information Modeling (BIM) – the process of creating data rich digital representations of the physical and functional characteristics of a facility.
  - 2. Virtual Design & Construction (VDC) – Information technologies used for effective BIM delivery.

**B. Models**

1. Information Model – The definition of the BIM product
2. Design Intent Model – An Information Model based on the design drawings. It is not intended for construction but provided to the Contractor as a basis of creating the Construction Model.
3. Construction Model – It is a composite of the Discipline Model.
4. Discipline Model(s) – BIM generated by each discipline or trade required on this Project. A Discipline Model may be comprised of multiple Models representing the various subsets of each discipline or trade.
5. As-built Model – The Revit/BIM Model developed by the Contractor at the completion of which is turned over to the CM and Commissioner.

C. “Facility Data” or “Attribute Data” or “FM” mean any of the data which is represented by, used for, or associated with the BIM Models for the entire building cycle of the facility, including design, construction and facility management.

D. “CM” means Construction Manager

E. “P6” means Primavera version 6

**1.4 BIM SUBMITTALS**

A. The following submittals by the Contractor shall be approved prior to initiating any modeling. Approval means approval by the Construction Manager and Commissioner.

1. Contractors BIM Manager’s Resume
2. BIM Implementation Plan.
3. P6 Activity Codes.

**1.5 CONTRACTOR SCOPE OF WORK**

- A. The Contractor will be provided a Design Intent Model consisting of Architecture, Structure and MEP trades in LOD 300.
- B. The Contractor shall provide digital submissions of information describing its respective Work in a form and manner that Commissioner may require, and that can be loaded into a BIM assembled by Commissioner.
- C. Work collaboratively with the Commissioner to ensure all field conditions are accurately documented in the Construction Model and ensure that they are using the most up to date documents for construction phase coordination.
- D. Do not rely on the accuracy of the Design Intent Model. The Design Intent Model can be used for reference only and all dimensions must be retrieved from the hard copy Drawings and verified.

- E. The Contractor's Construction Model shall be coordinated with the Design Intent Drawings. Any conflicts with the Models that need to be resolved prior to fabrication and construction shall be reported to Commissioner. Clash reports may also be issued by the Contractor as background information for submittals.
- F. The Contractor shall include required clearances for maintenance and other access, code clearances and other required clearances. In addition, all modeling to include proposed underground / utilities associated with the project scope to the extent of the property line of the site, in all directions.
- G. Clash detection and analysis: Perform on-going clash detection to identify and highlight spatial conflicts within and between the various trades and the building. This can be performed using Navisworks or equivalent application using subcontractor Construction Models, tracking file versions used in each clash analysis. Work collaboratively with subcontractors to recommend potential solutions to conflicts.
- H. Indicate where conflict resolution requires modification of design requirements by Commissioner.
- I. Prior to creating the construction schedule, submit four types of P6 activity codes lists indicating the following:
  - 1. Location
  - 2. Elevation (level)
  - 3. Grid or Room
  - 4. Work Element Category
  - 5. Activity Descriptions
- J. At the end of construction, the following deliverables shall be provided to the CM and Commissioner:
  - 1. All Discipline/Trade As-built models in editable Revit or DWG format.
  - 2. Composite Navisworks model (NWC and NWD)
  - 3. Facility asset data provided either in the model as element parameters or provided as a separate spreadsheet.
  - 4. Final As-Built PDF for each floor and each trade with proper annotations.
  - 5. Final As-Built DWG for each floor and each trade with proper annotations.
- K. Create an As-built Models that includes complete structure, architecture Models to LOD 400. MEP equipment and accessories that require FM attribute will be modeled to LOD 400. The Models will be populated with Facilities data using parameters provided by the Commissioner. Any ducts and pipes generated using CAD based authoring software will be linked in as reference to the Revit Model.



- L. The Contractor will insert relevant building element data as listed below in the As-Built Model. It may also be provided to the Commissioner as a separate spreadsheet. The Building Element Data must contain the following attributes for all MEP assets:
- 1) Asset name
  - 2) Room name
  - 3) Room number
  - 4) Manufacturer
  - 5) Model Number
  - 6) Serial Number
  - 7) Installation Date
  - 8) Bar Code (if any)
  - 9) Submittal Number
  - 10) Link to O&M
  - 11) System Served
- M. Provide the CM and Commissioner with all the necessary access to review the documents and interface with Contractor's team. Coordination meetings as per the coordination schedule shall occur between the Construction Manager, Commissioner, and Contractor to ensure the correct development of the Construction Model. All submitted BIM Models and associated Attribute Data (Facility Data) shall be fully compatible with Autodesk Revit BIM per paragraph 3.01. Steel and MEP shop drawings shall be generated from the 3D Model(s) prepared by the Contractor and his Trades.
- N. Utilize the Construction Model to generate layout points for automated layout stations so the installation can be laid out and verified to ensure proper positioning per the coordinated construction Model.
- O. Allow real time access to the Construction Model by the Commissioner.
1. Within 30 days of Notice to Proceed, provide a total of eight (8) licenses of Autodesk 360 Glue for the Commissioner, and upload the Revit and Navisworks NWD files on a weekly basis.
  2. Maintain and provide user accounts and folders/workspaces where each organization producing Construction Models can upload the Construction Model files for Coordination.
  3. During the coordination phase weekly publish all clash reports and current versions of all Coordination Models, with clash views, in NWD format to the collaboration website.

#### 1.6 TRADE COORDINATION PROCESS

- A. Once the Architectural/Structural models are posted on the Commissioner's Collaboration and data management platform, The Contractor and his Trades are required to download and use these files to create their system models by sequence or geographic area as dictated by the Commissioner. The process is to create and upload system models to the Collaboration and data management platform as frequently as required by the Commissioner for other trades to use while modeling their systems. The Commissioner's BIM coordination process in many respects follows a traditional sequence of drawing / modeling those systems with the most constraints on their routing, and then following with those trades that have more flexibility in their placement. Coordination will be expected to start as soon as contracts are awarded, and developed according to the typical sequencing, as follows:





1. Duct will be laid out in conformance with the design documents. Locations in which floor size permits, duct layout is to flow systematically across the floor allowing other trades to follow behind drafted areas.
  2. Thereafter all pitched plumbing systems are to be laid out and coordinated with the ductwork.
  3. Once duct and pitched pipe are coordinated, other major (3"+) constrained trade systems' components, including all HVAC, Fire Protection, electrical cable tray, conduit racks, plumbing racks, are to be drawn /modeled and coordinated.
  4. Upon completion of modeling and coordination of major system components of the constrained trades, the "minor" components are to follow including branch piping & smaller conduit runs.
- B. The Contractor and his Trades are required to have access to Autodesk Navisworks software. The NavisWorks software is required to compile the multiple model drawings, and for the subcontractor to run their own clash detection analysis. It is also required that the coordination representative for the Contractor and his Trades shall be equipped with a laptop and a Navisworks license with which to attend coordination meetings. This subcontractor coordination representative shall be authorized and prepared to make live, real-time changes to the "Shop Model" in these coordination meetings, to review the finalized, signed off coordinated models prior to and during the fabrication/installation process.
- C. The Contractor and his Trades are required to run the clash detection analysis for their respective trade system against the Architectural/Structural design models, to ensure that there are no conflicts between the architectural/structural elements and their system(s). The Contractor is to run NavisWorks Clash Detection on a weekly or as-needed basis for MEP coordination.
- D. The Contractor and his Trades are required to post to the Commissioner's Collaboration and data management platform, updated drawings/models at least once per week, and prior to the clash detection analysis run by the BIM Coordinator / Gatekeeper (day and time to be determined). This will continue until the area is completely coordinated.
- E. The clash reports will be run for MEP systems in conflict with other trades and systems. A clash analysis report will be generated by the Commissioner's BIM Coordinator / Gatekeeper, which involves reviewing each individual clash and documenting it, by saving the appropriate viewpoints. The Coordinator / Gatekeeper will create a NavisWorks .nwd file showing the clash viewpoints & corresponding Word Document showing clashes. This Clash report & NavisWorks .nwd file will be posted to the Collaboration and data management platform by the Coordinator / Gatekeeper, who will issue a corresponding notice to all parties involved that the report is posted. Alternatively, the Commissioner may elect to have the Contractor's HVAC trade to take the LEAD role as the "BIM Gatekeeper", and run the clash detection analysis as frequently as required for all systems modeled.
- F. The Contractor and his Trade are required to review the clash detection report generated by the BIM Coordinator / Gatekeeper prior to each coordination meeting and attend each meeting prepared to address the unresolved clashes in a constructive manner.
- G. The Contractor and his Trades are required to collaborate with each trade through e-mail, telephone, and in person, to resolve basic clashes outside of the Coordination meetings. It is expected that the daily/weekly Coordination meetings are held to address difficult work in areas that are not easily coordinated between the multiple trades themselves. At these



meetings, the resolution will be collectively agreed upon, and a trade will be identified as having to “move”. The Contractor and his trade will adjust its respective model, and repost it with enough time for other trades to review prior to the upcoming meeting. All the remaining trades are responsible to update and post the changes agreed upon at the coordination meeting with-in 1 week or as directed by the Commissioner.

- H. The Contractor is required to submit the number of copies of each trade's respective, coordinated system in a 2-Dimensional format as required, for approval through the regular submittal process. This is required for each floor as well as each riser. In addition to the development of 3-Dimensional coordination models, The Contractor and his Trades are responsible for producing a traditional 2-Dimensional coordination drawing, after cleaning up all resolved clashes and collisions. In the preparation of the final composite 2-Dimensional coordination drawings, large scale details, as well as cross and longitudinal sections developed at Coordination Meetings, shall be made by the Contractor and his Trades as required to fully delineate all conditions. The final Coordination CAD drawing file will be re-circulated through all trades after a BIM sign-off meeting. This electronic coordination drawing file shall include all coordinated drawing information, be fully dimensioned (especially elevation dimensions), and include text, tags, and any other required or pertinent indications.
- I. Compile and plot the number of color copies of the 2- Dimensional, multi-trade, coordinated drawings required by the contract documents for approval through the regular submittal process. This is required for each floor as well as each riser.
- J. The Contractor is required to ensure each trade maintains and provides the 3-Dimensional Model with respect to generating As-Built Drawings/Models. It is the responsibility of the Contractor to make sure each trade's respective 3-Dimensional Model is updated throughout the construction, to reflect field conditions and accurately document As-built conditions.
- K. The Contractor is required to submit three copies from each trade of CD's/USB's containing the 3-Dimensional As-Built models, once all issues are addressed from items above. This CD shall contain As-Built models in Autodesk .DWG and .NWD formats, as well as including the original authoring files in the native format of the program that created the models. The Commissioner reserves the right to request additional file formats as the needs of the client or project require.
- L. The Contractor is required to make sure each trade's model is consistently updated and post any changes originating from RFI's, Submittal's and Bulletin's that have changed their perspective work. Each Trade making changes shall post the revised model onto the Collaboration and data management platform site, and send out a corresponding notice indicating the changes and reasoning behind the change within two weeks from receipt of changes.
- M. Draw in a format that a 3rd party individual can highlight and track progress of work by selecting individual items in each trade's model through Navisworks.
- N. The Contractor is required to attend a separate bi-monthly meeting with his trades present to review accessibility of equipment, devices, panels, valves, or other materials and equipment above ceiling with the CM and Commissioner. Under separate drawing layer for the above listed items, each Trade is responsible to provide and identify Access doors and Accessibility requirements for maintenance purposes.

## 1.7 MISCELLANEOUS REQUIREMENTS

- A. Coordination is the responsibility of the Contractor. The Commissioner will hold meetings as required, which the Contractor and his trades must attend. Failure to attend will result in work by the absent contractor on sheets reviewed at meeting being declared improperly coordinated, and will require the Contractor to relocate work as shown by the Commissioner or to field run the work not coordinated.
- B. No extra compensation will be paid for relocating any duct, pipe, conduit, or other material that has been installed without proper coordination between all the trades involved. If any improperly coordinated work, or work installed that is not in accordance with the approved coordination composites, necessitates additional work by other trades, the cost of such additional work shall be assessed to the Contractor responsible as determined by the Commissioner. Errors due to a failure of attendance at coordination meetings, will be resolved by the contractor at his own expense.
- C. All work on the coordination drawings (including 3D models) shall be performed by competent draftsmen in a clear legible manner utilizing standard industry conventions. The Contractor shall be responsible for providing each trade's coordination drawing files per the established coordination schedule. It is the responsibility of the Contractor and his Trades to supply enough draftsmen, so as not to delay the BIM 3-Dimensional coordination process and shop drawing submittals.
- D. Coordination drawings are not to be construed as and not to relieve the Contractor from their shop drawing obligations required under the project specifications, and are distinctly separate from the requirements to provide final "As-Built" drawings.
- E. All files supplied will be as AutoDesk .dwg file format and be readable by other trades' CAD system and NavisWorks. Being 'readable' means the ability to open a file without any errors (such as proxy, xref resolution, geometry error) and with objects, layers, and other file properties remaining intact. In addition, all drawing files shall be saved down to the lowest common version which is 2007 file format.
- F. 3-Dimensional solid or surface models (not line & wireframe models) must represent the actual dimensions of the trade system elements and the equipment that will be installed.
- G. It is critical that use a mandated file naming convention is used for each trade's CAD file's name to track the version and date by each trade. The CM and Commissioner will provide the detailed file naming convention to all MEP trades. An example would be as follows:
  - 1. "Project Responsibility Phase Trade Floor Area Version Date".
  - 2. Any files that do not follow the file naming convention will be deleted and removed from the server at any time without any notification.
- H. All drawing and model files shall be based on an origin point provided by the Commissioner. The cost of any changes required by the Contractor to their drawings or models due to the use of an unauthorized origin shall be borne by the Contractor.

## 1.8 CONTRACTOR BIM MANAGER

- A. The Contractor shall designate an expert individual, subject to the approval of the CM and Commissioner to manage and interface among all trades, Commissioner & CM disciplines.



Duties includes enforce the CAD Standards to ensure the quality of BIM process during the development of the Construction Model.

**B. BIM Manager Qualifications:**

1. Understanding of project workflows and project management.
2. Minimum 3 years of experience in 3D Modeling Construction Models for projects of the same size and complexity, coordination between subcontractors and Commissioner, and managing of virtual design and construction process.
3. Technical knowledge of Virtual design and Construction methodologies and BIM application used, related systems and network infrastructure, and awareness of new technologies.
4. Versed in standards such as LOD 2014 & National BIM standards v3.
5. Communication and training skills (verbal and written).
6. Strong teaching and coaching skills to bring new team members up to speed.
7. Flexibility and ability to understand and implement BIM standards with a multifaceted construction team and manage the delivery of quality products throughout the process of construction

**1.9 BIM IMPLEMENTATION PLAN**

- A.** The Construction BIM Manager shall prepare the BIM Implementation Plan (BIM Plan) for the entire construction process including the updating of As-Built Models. The BIM Plan at minimum shall include the following:
1. General Requirements of Subcontractors
  2. Model Partitioning,
  3. Software Versioning, File Format & Naming for all Models.
  4. List of Construction Models to be developed.
  5. Organization and Contact Information of BIM coordinator responsible for each Construction Model.
  6. Any Required Software Object Enablers.
  7. Common Coordinate Systems and Units.
  8. Assurance that the fonts, dimensions, line styles, levels and other contract document formatting issues follow CAD Standard and the MTA/ BIM Workspace requirements.
  9. Strategy for achieving transfer from FM-Model into The City of New York specified forms.



10. List of Facility Data-set and Parameter included in the FM Model or in the Asset Spreadsheet.
  11. Strategy for recording the As-Built Model on an on-going basis.
  12. Description of data storage and data exchange, sharing, viewing, modeling protocols, and updating of information by Subcontractors.
  13. Milestones of quality control checking and reporting on the integrity of the Models to the client's Commissioner (Monthly).
  14. Protocols for the Process of RFI's, Shop Drawings, and Record Keeping.
  15. Design-Change Tracking Strategy.
  16. The BIM Template format adopted by the contractor shall be submitted and approved by the CM and Commissioner.
  17. The Structure and Organization of the Models shall be approved by the CM and Commissioner.
  18. Naming conventions of Components, work-sets (BIM) and Layers (CAD)
  19. Coordination/Clash Detection Process
  20. Coordination/Clash Detection Schedule
  21. Strategy for using BIM layout tools such for total stations to layout and verify positioning of installation.
  22. Strategy how the layout data will be used to update the As-Built Model.
  23. List of Clashes to be run including tolerances for each component category.
- B. The Contractor/BIM Manager shall, within 8 weeks after the Award of the Contract, present the Plan for the Commissioner's review. The Commissioner shall confirm acceptability of the Plan or advice as to additional processes and/or activities necessary to be incorporated into the Plan. If modifications are required, the Contractor shall execute the modifications and resubmit the final Plan for Commissioner's acceptance.
- 1.10 BIM KICKOFF MEETING
- A. The Commissioner shall schedule and conduct a BIM Kickoff Meeting. BIM Modeling work by subcontractors shall not commence prior to the BIM Kickoff Meeting. The Meeting shall review BIM requirements, standards and responsibilities.
  - B. Attendees: Participants in the BIM Kickoff Meeting shall be familiar with the project and shall be authorized to conclude matters relating to the BIM work. At a minimum include representatives of the following parties or their designated representatives:
    1. Commissioner
    2. Construction Manager



3. Construction Manager's BIM Coordinator
  4. Contractor's Project Manager
  5. Contractor's BIM Coordinator
  6. BIM Coordinators of all subcontractors producing Construction BIMs
  7. Project Coordinators of all trades producing Construction BIMs
- C. Agenda: Subjects for discussion shall include items significant to the effective use of BIM coordination techniques and correct production of Construction BIM, including but not limited to the following:
1. BIM expectations and project goals
  2. Coordination process
  3. Review of BIM Plan, including Model contents and standards
  4. Requirement to deliver equipment data in electronic format
  5. BIM deliverables to the Contractor.
  6. Final BIM deliverables by the Contractor.
- D. Reporting: The Commissioner shall distribute minutes of the meeting to each party present and to other concerned parties.
- 1.11 ACCEPTABLE CONSTRUCTION MODELING FORMATS
- A. All used software for Model authoring and coordination shall be submitted for approval by the CM and Commissioner. All Autodesk software shall be Version 2019 or above unless otherwise approved by the CM and Commissioner.
- B. The following software is acceptable for Authoring and Coordination:
1. Authoring
    - a. Architecture
      - 1) Autodesk Revit 2019
      - 2) Bentley MicroStation
      - 3) AllPlan Nemetschek
      - 4) or approved equal
    - b. Structure
      - 1) Autodesk Revit 2019
      - 2) Tekla Structures
      - 3) Bentley MicroStation
      - 4) or approved equal
    - c. MEP Discipline Model
      - 1) Autodesk Revit 2019 MEP,



- 2) Trade 3D CAD
- 3) Bentley MicroStation
- 4) or approved equal

2. Coordination:

- a. Coordination Model
  - 1) Autodesk NavisWorks 2019
  - 2) Autodesk BIM 360 Glue
  - 3) Bentley Navigator
  - 4) or approved equal
- b. As Built Model
  - 1) Autodesk Revit 2019
  - 2) Navisworks 2019
  - 3) AutoCAD MEP
  - 4) Bentley Navigator
  - 5) or approved equal

1.12 CONSTRUCTION MODEL REQUIREMENTS

- A. All Construction BIM Models shall be developed to include building systems and components meeting the following requirements:
  1. All Construction Model geometry to fulfill the following LOD standards:
    - a. Architectural: LOD 300
    - b. Structural: LOD 400
    - c. MEP Systems: LOD 400
- B. The Construction Model need to comply with the following criteria:
  1. All Models shall use the same Project Origin, Grids and Level naming as the provided Design Intent Model. For Construction Model generated with Revit, the project based coordinate system should be used.
  2. All the subsystems shall be defined either by system type or clearly named layers using an approved Model Color Standard.
  3. All included Modeled geometry for Structure and MEP shall follow the 2013 BIM forum LOD 400 requirement.
  4. Clearance areas required for equipment access shall be modeled as boxes and saved on a distinct, sub-category/layer named clearances.
  5. Any distributed Model files need to be purged and removed external links prior to distribution.
- C. Revit Specific Requirements
  1. All Revit based components need to be assigned to the correct CSI Unifomat category.



2. Function of the component should be assigned (Interior vs exterior doors, walls etc.)
3. All components should have a specific and clear naming convention. Naming convention need to be submitted as part of the implementation plan.
4. Columns, walls and other objects should be assigned to correct floor levels since different factors depending on the level might be used during cost estimate.
5. Columns, walls etc. should not be modeled as one single object across multiple floors. They should be modeled level by level.
6. Room finishes should be entered to the Model through parameters base finish, ceiling finish, wall finish, floor finish.
7. All enclosed spaces should for the Architectural Model include rooms.

#### 1.13 AS-BUILT MODEL

- A. The As-Built Model at minimum shall contain the following components and systems of the building reflecting all elements installed or constructed.
  1. As-built Models in Revit shall include complete structure per LOD 400, architecture Models to LOD 300. MEP equipment and accessories that require FM attribute will be modeled to LOD 400. The models will be populated with data using the following attributes –
    - Asset name
    - Room name
    - Room number
    - Manufacturer
    - Model Number
    - Serial Number
    - Installation Date
    - Bar Code (if any)
    - Submittal Number
    - Link to O&M
    - System Served

Any ducts and pipes generated using CAD based authoring software will be linked in as reference to the Revit Model.

2. All relevant site condition, topography, detailed drainage, storm water (including drainage catch basin manholes and catch basins), sanitary sewers, utilities (including property line box and concrete duct manhole), paving, fencing, and all the intelligence to produce 2D documents and details of features that are on quarter scale drawings.
3. All the Architectural, Structural, and Civil engineering components of the Model shall have necessary detail to produce accurate plans, elevations, sections, schedules & quantity take-offs.
4. The As-Built Model shall include, fire alarm/mass notification devices, detection systems, all components (i.e. sensors and control panels) with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules.





5. The As-Built Model shall include all product data, warranties, guarantees, operation manuals, for equipment and materials installed on the job linked to the Model.
- B. The As-Built Model shall allow the Commissioner to:
  1. Maintain records of maintenance work during the entire life of the facility.
  2. Generate long and short-term maintenance schedules.
  3. Confirm any potential conflict between electrical, mechanical, HVAC, conveying systems, ducts and conduit provided for use by others, or any other physical elements that cannot be readily managed using two dimensional combined services drawings.
- C. The As-Built Model need to be populated during the construction and reviewed monthly for compliance with the established protocols.'

#### 1.14 FINAL DELIVERABLES TO COMMISSIONER

- A. Contractor shall provide three (3) complete printed sets of As-Built drawings derived directly from the As-Built Models to the Commissioner.
  1. All systems that are shown on the as-built drawings should be modeled in the As-Built Models.
- B. Contractor shall verify that all Construction Models/As-Built Models (building, structure and building systems) represent to the best of their ability and professional standard of care as-built conditions, including but not necessarily limited to Architectural Supplemental Instructions, Change Notices, Commissioner defined actual material and manufacturer's information, and any/all field changes.
- C. The As-Built Models will be turned over to the Commissioner within 30 days of construction completion.
- D. Contractor shall confirm, and the Commissioner shall upon receipt of the Model verify, that the As-Built Models for each Model/ floor register in X, Y and Z dimensions and coordinates.
- E. At the end of construction, the following deliverables shall be provided by the Contractor to the Commissioner :
  1. All Discipline/Trade As-Built models in editable Revit or DWG format.
  2. Composite NavisWorks model (NWC and NWD)
  3. Facility asset data provided either in the model as element parameters or provided as a separate spreadsheet.
  4. Final As-Built PDF for each floor and each trade with proper annotation.
  5. Final As-Built DWG (bound including x-ref) for each floor and each trade with proper annotations.

#### PART II – PRODUCTS: (NOT USED)

PART III – EXECUTION: (NOT USED)

**END OF SECTION 01 32 34**

**SECTION 01 91 17 – BUILDING ENCLOSURE FUNCTIONAL PERFORMANCE TEST PROTOCOL****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. This section includes the functional performance testing requirements for the Building Enclosure systems.
- B. Related Sections may include, but not be limited to:
1. 07 10 00 – Foundation Waterproofing
  2. 07 21 00 – Thermal Insulation
  3. 07 27 26 – Fluid-Applied Membrane Air Barriers
  4. 07 42 13 – Insulated Metal Wall Panels
  5. 07 52 16 – Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing
  6. 07 62 00 – Sheet Metal Flashing and Trim
  7. 07 72 00 – Roof Accessories
  8. 07 92 00 – Joint Sealants
  9. 08 43 33 – Security Storefronts
  10. 08 44 13 – Glazed Aluminum Curtain Walls
  11. 08 80 00 – Glazing
  12. 08 88 53 – Security Glazing

**1.3 TESTING AGENCY**

- A. Building Enclosure Testing Agency shall be an independent agency retained by the Contractor. The BETA must be fully accredited for each of the materials, components or systems to be tested or evaluated for compliance with requirements of the contract documents as directed by the BECA. Accreditations to include but not be limited to American Architectural Manufacturers Association (AAMA), American National Standards Institute (ANSI), International Accreditation Service, Inc. (IAS), Safety Glazing Certification Council (SGCC), and Window and Door Manufacturers Association (WDMA).
- B. Submit BETA qualifications for testing indicated for acceptance by the Commissioner.

**1.4 COORDINATION**

- A. Functional Performance Team Members shall consist of:
1. Commissioning Agent (CxA)
  2. Building Enclosure Commissioning Agent (BECA)
  3. Building Enclosure Testing Agent (BETA)
  4. Commissioner



5. Contractor and all Building Enclosure Sub-Contractors

- B. Management: The Contractor shall hire the BETA. The Commissioner shall direct and coordinate the activities of the BETA in coordination with the BECA. All interactions between the BECA and the Contractor are to be coordinated by the Commissioner.

- C. Scheduling:

- 1. The Contractor and BETA shall work with the BECA and Commissioner to establish a functional performance testing schedule

1.5 REPORTING

- A. The Contractor shall provide reports from the BETA for all functional performance testing to the Commissioner and BECA.
- B. BECA shall submit non-compliance and deficiency observation reports to Commissioner, CxA, and Contractor, as needed.

1.6 PERFORMANCE REQUIREMENTS

- A. The performance criteria below apply to all mock-up and field testing of exterior enclosure components. Number of tests shall be at the discretion of the Commissioner.
- B. Air and water performance criteria summary table according to each component:



Component	Performance Criteria	
	Air	Water
Curtain Wall/Windows	<b>ASTM E 1186 (4.2.6)</b> – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s). <i>DIAGNOSTIC TESTING</i>	<b>AAMA 501.2</b> – No leakage when tested under a calibrated water spray at 30 psi. <i>DIAGNOSTIC TESTING, 3 LOCATIONS, PER COMMISSIONER</i>
	<b>ASTM E 783</b> – Maximum air leakage of 0.06 cfm/ft at an air pressure differential of 6.24 psf <i>2 TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>	<b>AAMA 501.1/ ASTM E 1105</b> - No evidence of water penetration when tested under a pressure difference equivalent to the greater of 20% of the maximum positive pressure in zone 5 of the ASCE 07 wind load calculations or 20% of the positive wind tunnel recorded pressure but not less than 15 psf <i>(AAMA 501.1/ ASTM E1105) 2 TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>
Aluminum Framed Entrances	<b>ASTM E 1186 (4.2.6)</b> – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s) <i>DIAGNOSTIC TESTING</i>	<b>AAMA 501.2</b> – No leakage when tested under a calibrated water spray at 30 psi. <i>DIAGNOSTIC TESTING</i>
	<b>ASTM E 783</b> – Maximum air leakage 1.0 cfm/ft at an air pressure differential of 1.57 psf <i>1 TEST @ EACH ENTRANCE TYPE, LOCATION PER COMMISSIONER</i>	<b>AAMA 501.1/ ASTM E 1105</b> - No evidence of water penetration when tested under a pressure difference equivalent to the greater of 20% of the maximum positive pressure in zone 5 of the ASCE 07 wind load calculations or 20% of the positive wind tunnel recorded pressure but not less than 10 psf <i>(AAMA 501.1/ ASTM E1105) 1TEST @ EACH ENTRANCE TYPE, LOCATION PER COMMISSIONER</i>



<b>Aluminum Windows</b>	<b>ASTM E 1186 (4.2.6)</b> – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s). <i>DIAGNOSTIC TESTING</i>	<b>AAMA 501.2</b> – No leakage when tested under a calibrated water spray at 30 psi. <i>DIAGNOSTIC TESTING</i>
	<b>ASTM E 783</b> – Maximum air leakage of 0.06 cfm/ft at an air pressure differential of 6.24 psf <i>2 TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>	<b>AAMA 501.1/ ASTM E 1105</b> - No evidence of water penetration when tested under a pressure difference equivalent to the greater of 20% of the maximum positive pressure in zone 5 of the ASCE 07 wind load calculations or 20% of the positive wind tunnel recorded pressure but not less than 12 psf <i>(AAMA 501.1/ ASTM E1105) 2 TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>
<b>Insulated Precast Concrete Wall Panels</b>	<b>ASTM E 1186 (4.2.6)</b> – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s). <i>DIAGNOSTIC TESTING</i>	<b>AAMA 501.2</b> – No leakage when tested under a calibrated water spray at 30 psi. <i>DIAGNOSTIC TESTING</i>
	<b>ASTM E 783</b> – Maximum air leakage of 0.06 cfm/ft at an air pressure differential of 6.24 psf <i>2 TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>	<b>AAMA 501.1/ ASTM E 1105</b> - No evidence of water penetration when tested under a pressure difference equivalent to the greater of 20% of the maximum positive pressure in zone 5 of the ASCE 07 wind load calculations or 20% of the positive wind tunnel recorded pressure but not less than 12 psf <i>(AAMA 501.1/ ASTM E1105) 2 TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>



<b>Air Barrier Assemblies</b>	<b>ASTM E 1186 (4.2.6)</b> – No major air leaks. A major air leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s) <i>2 TESTS @ EACH ANCHOR TYPE, LOCATION PER COMMISSIONER</i>	<b>AAMA 501.1/ ASTM E 1105</b> - No evidence of water penetration when tested under a pressure difference equivalent to the greater of 20% of the maximum positive pressure in zone 5 of the ASCE 07 wind load calculations or 20% of the positive wind tunnel recorded pressure but not less than 12 psf (min. 12 psf at windows, min. 15 psf at curtain wall) (AAMA 501.1/ ASTM E1105) 2 <i>TESTS @ EACH FENESTRATION TYPE, LOCATION PER COMMISSIONER</i>
	<b>ASTM E 1186 (4.2.7)</b> – Pass/Fail criteria shall be no bubbles observed in leak detection liquid. <i>2 TESTS @ EACH ANCHOR TYPE, LOCATION PER COMMISSIONER</i>	
	<b>ASTM E 2357</b> – Maximum air leakage 10% at penetrations and seams.	
<b>SBS Modified Bit Roofing Systems</b>		<b>ASTM C1153</b> – No wet insulation observed. Verify suspicious areas with test cuts. <i>IR SCAN @ 100% OF THE SYSTEM</i> <b>ASTM D5957</b> - Flood roof with a minimum of 1" of water above the high points. Water shall remain for a minimum of 24 hours. No leaks through membrane. <i>TESTS @ 100% OF ROOFS</i>
<b>Building Enclosure</b>	<b>ASTM E 779</b> – Whole building air infiltration shall not exceed 0.15 cfm/ft <sup>2</sup> at 0.3-inch w.g. (1.57 psf) at final test. Recommend: 1. First test shall be as soon as the building is made air tight, prior to installation of insulation, cladding, or interior finishes. 2. Second test shall be after installation of cladding, prior to installation of interior finishes. 3. Third test upon completion.	

C. Water leakage is only acceptable if all the following conditions are satisfied:

1. Water is contained and drained to the exterior.
2. There is no wetting of a surface that is visible to the building occupants.
3. There would be no staining or other damage to the completed building or finishes.



- D. Where testing indicates that performance requirements are not met, the contractor shall repair or replace the failed section and a retest shall be conducted at no additional fee to the City. Any repairs shall be conducted with observation by the BECA. Retesting shall be conducted by the BECA and coordinated by the Contractor at no additional fee to the City.
- E. In addition to retesting, failed tests shall typically result in testing of an additional specimen by the Contractor at a location selected by the Commissioner in coordination with the BECA at no additional fee to the City. Testing shall be concluded only when satisfactory results are achieved. Refer to DDC's General Conditions General Commissioning Requirements and Building Enclosure Commissioning Specifications.

## 1.7 FIELD TEST REQUIREMENTS

- A. All functional performance tests shall be conducted to project performance requirements as set forth in the Construction Documents.
- B. The baseline testing defined below is included in the contract and shall be performed at no additional cost to the City.
- C. The following shall be performed during the construction phase at the discretion of the Commissioner and BECA:
  - 1. Air Barrier Testing:
    - a. The performance criteria and test pressures for each test method shall be the same as the corresponding test outlined above. Large scale field testing includes the following baseline testing.
    - b. ASTM D4541: Adhesion testing of self-adhered and fluid applied air barriers.
      - 1) Allowable: All air barriers to achieve a minimum adhesion of 16 psi (sheathing) and/or 30 psi (concrete / masonry).
      - 2) Testing Extent: Perform periodic testing for each substrate at every 600sf installed to confirm results from mockup phase.
  - 2. Sealant Testing:
    - a. ASTM C1521, Pull testing of field installed weatherproofing sealants
      - 1) Allowable: Pass/Fail criteria shall be the adhesive failure of the joint.
      - 2) Testing extent: One (1) test for each joint type per 1000 lineal ft. installed.
    - b. ASTM C1401-14, Guide for Structural Sealant Glazing; Method A Hand Pull Tab (Destructive).
      - 1) Allowable: Pass/Fail criteria shall be the adhesive failure of the joint.
      - 2) Testing extent: One (1) test for each joint type per 1000 lineal ft. installed.
    - c. ASTM C1193-16, Guide for Use of Joint Sealants: Field-Applied Sealant Joint Hand Pull Tab
      - 1) Allowable: Pass/Fail criteria shall be the adhesive failure of the joint.
      - 2) Testing extent: One (1) test for each joint type per 1000 lineal ft. installed.





3. Expansion Control Testing:

- a. The performance criteria and test pressures for each test method shall be the same as the corresponding test outlined above. Large scale field testing includes the following baseline testing.
- b. AAMA 501.2, Water spray testing of representative water-tight expansion joints.
  - 1) Testing extent: Perform periodic testing for each substrate for a total of 600 lineal feet.
- D. In the event of water leakage through the test sample either during pre-testing or final testing; additional isolation testing shall be conducted to best determine the location of the water infiltration as required.
- E. Failure of any tests listed above shall result in subsequent repair and retesting of the failed specimen and the Commissioner's option to test an additional specimen.

**PART 2 – PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Refer to individual specifications for product performance requirements.

**PART 3 – EXECUTION**

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

**END OF SECTION 01 91 17**



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**SECTION 028013 – GENERAL CONTRACTOR WORK  
NOVEMBER 2017 VERSION**

**ALLOWANCE FOR INCIDENTAL ASBESTOS ABATEMENT**

**1.01 SCOPE FOR ASBESTOS ABATEMENT WORK**

- A. The "General Conditions" apply to the work of this Section.
- B. The asbestos abatement contractor shall remove asbestos containing materials as needed to perform the other work of this Contract when discovered during the course of work. When required, the asbestos abatement contractor shall replace the ACM with non-asbestos containing materials. An allowance of **\$30,000.00** for the **General Contractor** is herein established for this incidental work when so ordered and authorized by the Commissioner.
- C. All work shall be done in accordance with the applicable provisions of the rules and regulations of the asbestos control program as promulgated by Title 15 Chapter I of RCNY and New York State Department of Labor Industrial Code Rule 56 cited as 12 NYCRR Part 56, whichever is more stringent as per latest amendments to these laws and as modified herein by these specifications.
- D. All disposal of asbestos contaminated material shall be per Local Law 70/85.
- E. The asbestos abatement contractor's attention is directed to the fact that certain methods of asbestos abatement are protected by patents. To date, patents have been issued with respect to "negative pressure enclosure" or "negative-air" or "reduced pressure" and "glove bag".
- F. The asbestos abatement contractor shall be solely responsible for and shall hold the Department of Design and Construction and the city harmless from any and all damages, losses and expenses resulting from any infringement by the asbestos abatement contractor of any patent, including but not limited to the patents described above, used by the asbestos abatement contractor during performance of this agreement.
- G. "Asbestos" shall mean any hydrated mineral silicate separable into commercially usable fibers, including but not limited to chrysotile (serpentine), amosite (cummingtonite-grunerite), crocidolite (riebeckite), tremolite, anthrophyllite and actinolite.
- H. Prior to starting, the asbestos abatement contractor must notify the Commissioner of the Department of Design and Construction if he/she anticipates any difficulty in performing the Work as required by these Specifications. The asbestos



abatement contractor is responsible to prepare and submit all filings, notifications, etc. required by all City, State and Federal regulatory agencies having jurisdiction.

The asbestos abatement contractor is responsible for submitting the Asbestos Project Notification Form (ACP-7 Form) to the Department of Environmental Protection, Asbestos Control Program, as per Title 15, Chapter I of RCNY and to the NYSDOL as per Industrial Code Rule 56.

The asbestos abatement contractor is responsible for preparing, and submitting Asbestos Variance Application (ACP-9). If a Variance is required, the asbestos abatement contractor is responsible to retain a NYSDOL Asbestos Project Designer, as defined in Title 15, Chapter 1 of the RCNY to prepare and submit the required variance.

The general contractor is responsible for preparing and submitting an Asbestos Abatement Permit and/or Work Place Safety Plans (WPSP) that may be required for the completion of the Contract or incidental work. If such plans are required, the general contractor is responsible for retaining a registered design professional as defined in Title 15, Chapter 1 of the RCNY to prepare and submit the required plans.

The asbestos abatement contractor is responsible for the submission of all required documents to the NYCDEP to acquire the appropriate Asbestos Project Conditional Closeout (ACP-20) and/or Asbestos Project Completion Forms (ACP-21) on a timely basis for the completion of the incidental work encountered under this contract.

The asbestos abatement contractor will be required to attend an on-site job meeting with the Construction Project Manager prior to the start of work to examine conditions and plan the sequence of operations, etc.

The asbestos abatement contractor shall have a NYSDOL/NYCDEP Asbestos Supervisor onsite to oversee the work and conduct a final visual inspection as required by both Title 15, Chapter 1 of the RCNY and NYSDOL Industrial Code Rule 56.

- I. All work shall be done during regular working hours unless the asbestos abatement contractor requests authorization to work in other than regular working hours and such authorization is granted by the Commissioner. (Regular work hours are those hours during which any given facility, in which work is to be done, is customarily open and functioning, normally between the hours of 8:00 A.M. and 4:00 P.M. Monday - Friday.) If such work schedule is authorized by the Commissioner, the work shall be done at no additional cost to the City.
- J. The Commissioner may order that work be done in other than regular working hours as herein by defined and this order may require the asbestos abatement



contractor to pay premium or overtime wages to complete the work. If the Commissioner orders work in other than regular working hours, the asbestos abatement contractor shall multiply the unit price for that portion of the work requiring premium wages by 1.50 when computing payment in accordance with Paragraph 1.09. All requests for premium payment must be supported by certified payroll sheets and field sheets approved by the Construction Project Manager.

## **1.02 QUALIFICATIONS OF ASBESTOS ABATEMENT CONTRACTOR**

- A. Requirements: The asbestos abatement contractor must be approved through the Department's Request for Subcontractor Approval, administered by the Agency Chief Contracting Office (ACCO), Vendor Integrity Unit. The asbestos abatement contractor must demonstrate compliance with the special experience requirements set forth in subparagraphs (1) through (6) below. Such documentation shall include without limitation, all required licenses, certificates, and documentation.
1. The asbestos abatement contractor must, whether an individual, corporation, partnership, joint venture, or other legal entity, demonstrate for the three-year period prior to the work that it has been licensed by the New York State Department of Labor (NYSDOL), as an "Asbestos Abatement Contractor". The asbestos abatement contractor shall submit copies of the asbestos abatement contractors NYSDOL License for the past three years
  2. The asbestos abatement contractor must, for the three-year period prior to the work, have been in the business of providing asbestos abatement services as a routine part of its daily operations.
  3. The asbestos abatement contractor proposing to do asbestos abatement work must be thoroughly experienced in such work and must submit a list of five (5) asbestos abatement projects of similar size and complexity. The aggregate cost of these projects must be at least \$1,000,000 in each of the three years.
  4. For each project submitted to meet the experience requirements set forth above, the asbestos abatement contractor must submit the following information for the project; name and location of the project; name title and telephone number and email address of the owner or the owner's representative who is familiar with the asbestos abatement contractor's work; brief description of the scope of work completed as a prime or sub-asbestos abatement contractor; amount of contract or subcontract and the date of completion.
  5. The asbestos abatement contractor must demonstrate that it has the financial resources, certified supervisory personnel, and equipment



necessary to carry out the work and to comply with the required performance schedule, taking into consideration other business commitments. The asbestos abatement contractor must submit such documentation as may be required by the Department of Design and Construction to demonstrate that it has the requisite capacity to perform the required services of this contract. The Department may also conduct an inspection of the asbestos abatement contractor's facility to verify if the contractor has equipment and staffing to perform the work.

6. The asbestos abatement contractor must submit a copy of their Corporate Health and Safety Plan for review and acceptance. A Job Hazard Analysis (JHA) for the specific work conducted must be included.
- B. Throughout the specifications, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics thereof. Provide materials or workmanship that meet or exceed the specifically named codes or standards where required by these specifications.
- C. Site Investigation: Asbestos abatement contractor shall inspect all the specifications and related drawings, and will investigate and confirm the site conditions affecting the work, including, but not limited to (1) through (5) below. The asbestos abatement contractor will attend a walkthrough site inspection with the department's Project Manager and the Third-Party Air Monitor prior to the work. Such walkthrough will be scheduled at the Department's convenience.
1. Physical considerations and conditions of both the material and structure. These considerations include any obstacles or obstructions encountered in accessing or removing the material.
  2. Handling, storage, transportation, and disposal of the material.
  3. Availability of qualified and skilled labor.
  4. Availability of utilities.
  5. Exact quantities of all materials to be disturbed and/or removed

### **1.03 ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITIES**

The asbestos abatement contractor will visit the subject location within one (1) working day of notification to ascertain actual work required. If the project is identified as being "urgent", then work shall commence no later than 48 hours from the time of notification. In this event, the asbestos abatement contractor shall immediately notify when applicable EPA NESHAPS Coordinator, NYSDOL Asbestos Control Bureau and NYCDEP



Asbestos Control Program of start of the work and file the necessary Asbestos Notifications and any applicable Variance Applications with the regulatory agencies cited above.

In the event that the project is not classified as "urgent" the asbestos abatement contractor shall notify the EPA NESHAPS Coordinator, NYSDOL and NYCDEP by submitting the requisite asbestos project notification forms, postmarked 10 days before activity begins if 260 linear feet or more and/or 160 square feet or more of asbestos containing material will be disturbed.

The following information must be included in the notification:

- A. Name and address of building City or operator;
- B. Project description:
  - 1. Size - square feet, number of linear feet, etc;
  - 2. Age - date of construction and renovations (if known);
  - 3. Use - i.e., office, school, industrial, etc.
  - 4. Scope - repair, demolition, cleaning, etc.
- C. Amount of asbestos involved in work and an explanation of techniques used to determine the amount;
- D. Building location/address, including Block and Lot numbers;
- E. Work schedule including the starting and completion dates;
- F. Abatement methods to be employed;
- G. Procedures for removal of asbestos-containing material;
- H. Name, title, and authority of governmental representative sponsoring project.

#### **1.04 WORK INCLUDED IN UNIT PRICE**

The asbestos abatement contractor will be paid a basic unit price of **\$25.00** per square feet for the removal and disposal of asbestos containing material and replacement of the same with non-asbestos containing materials.

Unit price shall include all costs necessary to do the work of this Contract, including but not limited to: labor, materials, equipment, utilities, disposal, insurance, overhead and profit.



**1.05 AIR MONITORING – ASBESTOS ABATEMENT CONTRACTOR**

- A. “Air Sampling” shall mean the process of measuring the fiber content of a known volume of air collected during a specific period of time. The procedure utilized for asbestos follows the NIOSH Standard Analytical Method 7400 or the provisional transmission electron microscopy methods developed by the USEPA and/or National Institute of Standard and Technology which are utilized for lower detectability and specific fiber identification.
- B. Air monitoring of asbestos abatement contractor’s personnel will be performed in conformance with OSHA requirements, (All costs associated with this work are deemed included in the unit price.).
- C. Qualifications of Testing Laboratory:

The industrial hygiene laboratory shall be a current proficient participant in the American Industrial Hygiene Association (AIHA) PAT Program. The laboratory identification number shall be submitted and approved by the City. The laboratory shall be accredited by the AIHA and New York State Department of Health Environmental Laboratory Approval Program (ELAP).

Note: Work area air testing and analysis before, during and upon completion of work (clearance testing) will be performed by a Third Party Air Monitor under separate Contract with the City.

**1.06 THIRD PARTY MONITORING AND LABORATORY**

- A. The NYCDDC, at its own expense, will employ the services of an independent Third Party Air Monitoring Firm and Laboratory. The Third-Party Air Monitor will perform air sampling activities and project monitoring at the Work Site.
- B. The Laboratory will perform analysis of air samples utilizing Phase Contrast Microscopy (PCM) and/or Transmission Electron Microscopy (TEM).
- C. The Third-Party Air Monitoring Firm and the designated Project Monitor shall have access to all areas of the asbestos removal project at all times and shall continuously inspect and monitor the performance of the asbestos abatement contractor to verify that said performance complies with this Specification. The Third-Party Air Monitor shall be on site throughout the entire abatement operation.
- D. The NYCDDC will be responsible for costs incurred with the Third-Party Air Monitoring Firm and laboratory work. Any subsequent additional testing required due to limits exceeded during initial testing shall be paid for by the asbestos abatement contractor.





## **1.07 PAYMENT REQUEST DOCUMENTATION**

- B. The following information shall be included for each payment request:
1. Description of work performed.
  2. Linear footage and pipe sizes involved.
  3. Square footage for boiler & breaching insulation removed.
  4. Square footage of non-pipe and boiler areas removed, patched, enclosed, sealed, or painted.
  5. Square footage of encapsulation, sealing, patching, and painting involved.
  6. Total cost associated with compliance with the assigned task.
  7. Architectural, Electrical, HVAC, Plumbing, etc. work incidental to the Asbestos Abatement Work.
  8. A certified copy (in form 4312-39) to the Comptroller or Financial Officer of the New York City to the effect that the financial statement is true.
  9. A signed copy (in form 6506q-6) of certificate of compliance with non-discriminatory provisions of the Contract.
  10. Attach a copy of valid workmen compensation insurance.
  11. Valid asbestos insurance per occurrence.
  12. General liability insurance when required.
- C. Each payment request shall include a grand total for all work completed that billing period, the landfill waste manifests, and a copy of waste transporter permit. The Department of Design and Construction will inspect the work performed, review the cost, and approve or disapprove requests for payment.
- D. EXPOSURE LOG: With this final payment, the asbestos abatement contractor shall submit a listing of the names and social security numbers of all employees actively engaged in the abatement work of this Contract. This list shall include a summary showing each part of the abatement work in which the employee was engaged and the dates thereof.

## **1.08 QUANTITY CALCULATIONS**

In order to determine the square footage involved for the various pipe sizes of pipe insulation that might be encountered, the following table is to be used.



PIPE INSULATION SIZE O.D.	PIPE SIZE O.D.	SQUARE FOOTAGE PER LINEAR FOOT
2-1/2"	1/2"	0.65
2-3/4"	3/4"	0.72
3"	1"	0.79
3-1/4"	1-1/4"	0.85
3-1/2"	1-1/2"	0.92
4"	2"	1.05
4-1/2"	2-1/2"	1.18
5"	3"	1.31
6"	3-1/4"	1.57
7"	3-1/2"	1.83
8"	4"	2.09
9"	5"	2.36
10"	6"	2.62
12"	8"	3.14
14"	10"	3.67
16"	12"	4.19
18"	14"	4.71

#### **1.09 METHOD OF PAYMENT**

Payment shall be made in accordance with Items A through R below. Payment shall be calculated based on the actual quantity of the item performed by the asbestos abatement contractor, times the unit price specified below. Credits may apply to certain times, as specified below.

- A. REMOVAL, DISPOSAL, AND REPLACEMENT OF ASBESTOS CONTAINING PIPE INSULATION:** Actual linear footage, multiplied by the square footage factor listed for the respective pipe size in Section 1.08, multiplied by the unit price in Section 1.04.

EXAMPLE: 100 lin.ft. of 1/2" pipe and 100 lin.ft. of 6" pipe, including elbows, tees. Flanges, etc.

$$100 \times 0.65 = 65 \text{ sq.ft.} \quad 65 \times \text{unit price} = \text{Payment}$$

$$100 \times 2.62 = 262 \text{ sq.ft.} \quad 262 \times \text{unit price} = \text{Payment}$$

- B. REMOVAL, DISPOSAL, AND REPLACEMENT OF BOILER INSULATION:** (all types including Silicate Block and including the removal/replacement of metal jacketing) Payment shall be made at 1.5 times the unit price per square foot.

EXAMPLE: Item B. removal and replacement of 1000 S.F. of boiler insulation (incl. Silicate block)



1000 S.F. X (1.5) X the Unit Price = Payment

- C. **REMOVAL, DISPOSAL, AND REPLACEMENT OF TANK INSULATION:** (all types including removal/replacement of metal jacketing) Payment shall be made at 1.5 times the unit price per square foot.
- D. **REMOVAL, DISPOSAL, AND REPLACEMENT OF BOILER UPTAKE, & BREACHING INSULATION:** (all types including stiffening angles and wire lath) Payment shall be made at 2.0 times the unit price per square foot.
- E. **REMOVAL, DISPOSAL, AND REPLACEMENT OF DUCT INSULATION:** Payment shall be made at 1.0 times the unit price per square foot.
- F. **REMOVAL, DISPOSAL, AND REPLACEMENT OF SOFT ASBESTOS CONTAINING MATERIAL:** (Including sprayed-on fire proofing and sound proofing) Payment shall be made at 1.0 times the unit price per square foot of surface area. Area of irregular surfaces must be calculated and confirmed with DDC representative.
- G. **ACOUSTIC PLASTER REPAIR AND/OR ENCAPSULATION:** Payment shall be made at 0.5 times the unit price per square foot.
- H. **PATCHING OR REPAIR** of items listed in A through F will be paid at 0.33 times the unit price per square foot.
- I. **REMOVAL, DISPOSAL, AND REPLACEMENT OF WATERPROOFING ASBESTOS CONTAINING MATERIAL:** (including friable and non-friable waterproofing material from interior and exterior walls, floors, foundations, penetrations, louvers, vents, and openings other than windows, doors, and skylights) **Payment** shall be made at 0.5 times the unit price per square foot.
- J. **REMOVAL, DISPOSAL, AND REPLACEMENT OF ASBESTOS CONTAINING ELECTRICAL WIRING INSULATION:** (including friable and non-friable wiring insulation) Payment shall be made at 0.33 times the unit price per square foot.
- K. **PAINTING:** Payment shall be made at 0.05 times the unit price per square foot.
- L. **REMOVAL AND DISPOSAL OF ASBESTOS-CONTAINING PLASTER:** from ceilings and walls, including any wire lath and disposal as asbestos containing waste. Payment shall be made at 0.80 times the unit price per square foot.
- M. **REMOVAL AND DISPOSAL OF ASBESTOS-CONTAINING FLOOR TILES, CEILING TILES, TRANSITE PANELS:** (including any adhesive, glue, mastic and/or underlayment) and disposal as asbestos containing waste. Payment shall be made at 0.40 times the unit price per square foot. If multiple



layers are discovered, each additional layer shall be paid at 0.20 times the unit price per square foot.

- N. **ADDITIONAL CLEAN UP/HOUSEKEEPING OF WORK AREA:** (excluding pre-cleaning of work area required by regulations) HEPA vacuuming and wet cleaning of asbestos contaminated surface. Payment shall be made at 0.20 times the unit price per square foot. When GLOVE BAG is employed to remove ACM, cost of HEPA vacuuming and wet cleaning of floor area up to 3 feet on each side of glove-bag shall be included in unit price and no extra payment will be made.
- O. **REMOVAL, DISPOSAL OF ASBESTOS-CONTAINING ROOFING MATERIAL:** including mastic, flashing and sealant compound and provide temporary asbestos-free roof covering consisting of one layer of rolled roofing paper sealed with asphaltic roofing compound. Payment shall be made at 0.8 times the unit price per square foot. Credit at a rate of 0.33 times the unit price will be taken for each square foot of temporary roof covering which the asbestos abatement contractor is directed not to install.
- P. **PICK-UP AND DISPOSAL OF GROSS DEBRIS:** (excluding any waste generated from abatement under Item A-R) at a rate of \$150 per cubic yard for asbestos contaminated waste and \$75 per cubic yard for non-asbestos contaminated waste. This cost includes all labor and material cost associated with work.
- Q. **REMOVAL OF ASBESTOS-CONTAINING BRICK, BLOCK, MORTAR, CEMENT, OR CONCRETE:** along with all surfacing materials including wire lath and/or other supporting structures and disposal as ACM waste. Payment shall be made at a rate of \$25.00 per cubic foot of material removed.
- R. **REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING WINDOW/DOOR CAULKING:** including friable and non-friable caulking, weather-stripping, glazing, sealants or other waterproofing materials applied to windows, doors, skylights, etc. Payment shall be made at the rate of \$400.00 per opening regardless of size or configuration. This cost includes labor, consumable materials, set-up/breakdown, removal, and disposal, as required.

**Note 1: CREDIT:** For items listed in A through F, a credit at a rate of 0.33 times the unit price, times the respective multiplier (for each item) will be taken for each square foot of insulation which the asbestos abatement contractor is not directed to reapply.

**Note 2: MINIMUM PAYMENT:** The minimum payment per call at any individual job sites or various job sites during the same day will be eight hundred dollars (\$800.00).

**Note 3:** All payments shall be made as described in paragraph 1.09 herein.

**Note 4: WORKING HIGHER THAN 12 FEET ABOVE FLOOR LEVEL OR WORK REQUIRING COMPLEX SCAFFOLDING OR CONSTRUCTION WORK**



PLATFORMS: Provisions are made in this Contract to compensate the asbestos abatement contractor for work performed in locations that are difficult to access due to work at elevations that are significantly higher than the normal work level. The unit price for these items will be paid at 1.20 times the unit price described in Paragraphs 1.09, A through R for those portions of the work that are more than twelve (12) feet above the grade for that would be judged as the normal working level.

#### **1.10 GUARANTEE**

- A. Work performed in compliance with each task shall be guaranteed for a period of one year from the date the completed work is accepted by the Department of Design and Construction.
- B. The Commissioner of The Department of Design and Construction will notify the asbestos abatement contractor in writing regarding defects in work under the guarantee.

#### **1.11 OCCUPANCY OF SITE NOT EXCLUSIVE**

Attention is specifically drawn to the fact that contractors, performing the work of other Contracts, may be brought upon any of the work sites of this Contract. Therefore, the asbestos abatement contractor shall not have exclusive rights to any site of his work and shall fully cooperate and coordinate his work with the work of other contractors who may be brought upon any site of the work of this Contract. This paragraph applies to those areas outside the regulated Work Area as defined by Title 15, Chapter I of RCNY.

#### **1.12 SUBMITTALS**

- A. Pre-Construction Submittals:
  - 1. Attend a pre-construction meeting scheduled by the City of New York Department of Design and Construction. This meeting shall also be attended by a designated representative of the City of New York third party air monitoring firm, facility manager and the Construction Project Manager. At this meeting, the asbestos abatement contractor shall present three copies of the following items:
    - a. asbestos abatement contractor's scope of work, work plan and schedule.
    - b. Asbestos project notifications, approved variances, and plans to Government Agencies.
    - c. Copies of Permits, clearance and licenses if required.
    - d. Schedules: the asbestos abatement contractor shall provide to the Construction Project Manager a copy of the following schedules for

approval. Once approved, schedules shall be maintained and updated as received. asbestos abatement contractor shall post a copy of all schedules at the site:

- (1) A construction schedule stating critical dates of the project including, but not limited to, mobilization, Work Area preparation, demolition, gross removal, fine cleaning, encapsulation, inspections, clearance monitoring, and phase of refinishing and final inspections. The schedule shall be updated biweekly, at a minimum.
  - (2) A schedule of staffing stating number of workers per shift per activity, name, and number of supervisor(s) per shift, shifts per day, and total days to be worked.
  - (3) Submit all changes in schedule or staffing to the Construction Project Manager prior to implementation.
- e. Written description of emergency procedures to be followed in case of injury or fire. This section must include evacuation procedures, source of medical assistance (name and telephone number to nearest hospital) and procedures to be used for access by medical personnel (examples: first aid squad and physician). NOTE: Necessary Emergency Procedures Shall Take Priority Over All Other Requirements of These Specifications.
- f. Safety Data Sheets (SDS) for encapsulants, sealants, firestopping foam, cleaners/disinfectants, spray adhesive and all potentially hazardous materials that may be employed on the project. No work involving the aforementioned will be allowed to proceed until SDS are reviewed.
- g. Worker Training and Medical Surveillance: The asbestos abatement contractor shall submit a list of the persons who will be employed by him /her to perform the removal work. Present evidence that workers have received proper training required by the regulations and the medical examinations required by OSHA 29 CFR 1926.1101.
- h. Logs: Specimen copies of daily progress log, visitor's log, and disposal log.
- (1) The asbestos abatement contractor shall provide a permanently bound log book of minimum 8-1/2" x 11" size at the entrance to the Worker and Waste Decontamination enclosure system as hereinafter specified. Log book shall



contain on title page the project name, name, address and phone number of the asbestos abatement contractor; name, address and phone number of asbestos abatement contractor and City's third party air monitoring firm; emergency numbers including, but not limited to local Fire/Rescue Department. Log book shall contain a list of personnel approved for entry into the Work Area.

- (2) All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted. Any significant events occurring during the abatement project shall be entered into the log. Upon completion of the job, the asbestos abatement contractor shall submit the logbook containing a day-to-day record of personnel log entries countersigned by the Construction Project Manager every day.

- i. Worker's Acknowledgments: Submit statements signed by each employee that the employee has received training in the proper handling of ACM, understands the health implications and risks involved; and understands the use and limitations of the respiratory equipment to be used.

**B. During Construction Submittals:**

1. Security and safety logs showing names of person entering workspace, date and time of entry and exit, record of any accident, emergency evacuation, and any other safety and/or health incident.
2. Progress logs showing the number of workers, supervisors, hours of work and tasks completed shall be submitted daily to the Construction Project Manager.
3. Floor plans indicating asbestos abatement contractor's current work progress shall be submitted for review by the Construction Project Manager.
4. All asbestos abatement contractors' air monitoring and inspection results.

**C. Project Closeout Submittals:**

Upon completion of the project and as a condition of acceptance, the asbestos abatement contractor shall present two copies of the following items, bound, and indexed:



1. Lien Waivers from asbestos abatement contractor, sub-asbestos abatement contractors and Suppliers,
2. Daily OSHA air monitoring results,
3. All Waste Manifests (Asbestos and Construction Debris), seals and disposal logs,
4. Field Sign-In/Sign-Out Logs for every shift,
5. Copies of all Building Department Forms and Permits,
6. A Letter of Compliance stating that all the work on this project was performed in accordance with the Specifications and all applicable Federal, State and Local regulations,
7. All Warranties as stated in the Specifications,
  - a. Fully executed disposal certificates and transportation manifest.
8. Project Record: The asbestos abatement contractor shall maintain a project record for all small and large asbestos projects. During the project, the project record shall be kept on site at all times. Upon completion of the project, the project record shall be maintained by the building owner. The project record shall be submitted to DDC as part of the close out documents. The project record shall consist of:
  - a. Copies of licenses of all asbestos abatement contractors involved in the project;
  - b. Copies of NYCDEP and NYSDOL supervisor and handler certificates for all workers engaged in the project;
  - c. Copies of all project notifications and reports filed with NYCDEP, NYSDOL and USEPA for the project, with any amendments or variances;
  - d. Copies of all asbestos abatement permits, including associated approved plans and work place safety plan;
  - e. A copy of the air sampling log and all air sampling results;
  - f. A copy of the abatement asbestos abatement contractor's daily log book;





- g. Copies of all asbestos waste manifests;
- h. A copy of all Project Monitor's Reports (ACP-15).
- i. A copy of each ATR-1 Form completed for the asbestos project (if required).
- j. A copy of each Asbestos Project Conditional Closeout Report (ACP-20) if required.
- k. A copy of the Asbestos Project Completion Form (ACP-21).

### **1.13 PROTECTION OF FURNITURE AND EQUIPMENT**

Cover all furniture and equipment that cannot be removed from Work Areas. Movable furniture and equipment will be removed from Work Areas by the asbestos abatement contractor prior to start of work. At the conclusion of the work (after final air testing), the asbestos abatement contractor will remove all plastic covering on walls, floors, furniture, equipment and reinstall furniture and equipment. He shall remove and store all sheaths, curtains, and drapes, and reinstall same following final clean up.

### **1.14 UTILITIES**

#### **A. General:**

All temporary facilities shall be subject to the approval of the Commissioner. Prior to starting work at any site, locations and/or sketches (if required) of temporary facilities must be submitted to the Construction Project Manager for the required approval.

#### **B. Water:**

The Department of Design and Construction will furnish all water needed for construction, at no cost to the asbestos abatement contractor in buildings under their jurisdiction. However, it is the responsibility of the asbestos abatement contractor to ensure that hot water is provided for showering in the decontamination unit. The asbestos abatement contractor shall furnish, install and maintain any needed equipment to meet these requirements at his own expense.

#### **C. Electricity:**

The Department of Design and Construction will furnish all electricity needed for construction, at no cost to the asbestos abatement contractor in a building, under their jurisdiction. The asbestos abatement contractor is responsible for routing the electric power to the abatement Work Area.



All temporary lighting and temporary electrical service for Work Area shall be in weatherproof enclosures and be ground fault protected.

- D. In leased spaces, arrangements for water supplies and electricity must be made with the landlord. However, all such arrangements must be made through and are subject to approval of the Department of Design and Construction. Utilities will be provided at no cost to the asbestos abatement contractor. However, it is the asbestos abatement contractor's (or the general contractor's) responsibility to furnish and install a suitable distribution system to the Work Area. This system will be provided at no cost to the City.

### **1.15 FEES**

The asbestos abatement contractor shall be responsible for any and all fees or charges imposed by Local, State or Federal Law, Rule, and Regulation applicable to the work specified herein, including fees or charges which may be imposed subsequent to the date of the Bid opening.

**END OF SECTION**

**SECTION 03 10 00****CONCRETE FORMWORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

**1.2 SUMMARY**

- A. Section includes:
1. Formwork for cast-in-place concrete and related work.

**1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- |   |                  |
|---|------------------|
| A. Concrete Reinforcement and Embedded Assemblies | Section 03 20 00 |
| B. Cast-in-Place Concrete                         | Section 03 30 00 |
| C. Architectural Concrete                         | Section 03 33 00 |
| D. Thermal and Moisture Protection                | Division 7       |

**1.4 CODES AND STANDARDS**

- A. Building Code: Concrete work shall conform to the requirements of the 2014 New York City Building Code, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
  2. ACI 237 – Self Consolidating Concrete.
  3. ACI 301 – Specifications for Structural Concrete.
  4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
  5. ACI 347 – Guide to Formwork for Concrete.
  6. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multistory Buildings.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."



1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with DDC General Conditions Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- a) Submittal Schedule
- b) Shop Drawings
- c) Shoring/Reshoring Calculations
- d) Product Data
- e) Samples
- f) Compatibility Certification
- g) Hazardous Materials Notification

1. Submittal Schedule: See Section 03 30 00 "Cast-in-Place Concrete"

2. Shop Drawings:

- a. Submit for action: Formwork shop drawings sealed and signed by a Structural Engineer licensed in the state of New York. Shop drawings shall clearly indicate but not be limited to the following:
  - 1) Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)
  - 2) Form construction indicating structural stability and jointing including special form joints or reveals required by Contract Documents
  - 3) Location and pattern of form tie placement, and other items that affect the appearance of concrete that will remain exposed to view.
  - 4) Form finish clearly indicating proper locations and full coordination with concrete finishes required by Contract Documents.
  - 5) Layout, procedures, and sequencing of shoring and reshoring that correlates with the information contained in the shoring/reshoring calculations described below.
  - 6) Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification Section 03 30 00 – "Cast-in-Place Concrete."
  - 7) Location of proposed construction joints in walls, floors, slabs, and beams. See SUBMITTALS Section of Specification Section 03 30 00 – "Cast-in-Place Concrete."



3. Shoring/Reshoring Calculations: Submit for record. Calculations sealed and signed by a Structural Engineer licensed in the state of New York. Calculations shall clearly address but not be limited to the following:
  - a. Shoring removal and reshoring installation procedure including timing and sequencing.
  - b. Concrete age and strength at the time of each shoring/reshoring operation.
  - c. Description of construction loads assumed including concrete, formwork, and construction live load in accordance with ACI 347.
  - d. Description of the distribution of construction loads between the shored/reshored levels.
  - e. The total construction load imposed on all levels supporting shoring/reshoring at each stage of the shoring/reshoring cycle.
  - f. A written statement by the Structural Engineer licensed in the State of New York that the total construction load imposed on any level supporting shoring/reshoring, at all stages of the shoring/reshoring cycle, accounting for concrete age and relative strength at time of loading, meets the requirement of Section 3.2.
4. Product Data: Submit for action copies of manufacturers' product data and installation instructions for proprietary materials used in exposed concrete work, including form liners, release agents, manufactured form systems, ties, and accessories.
5. Samples: At request of Commissioner, submit for record samples of form ties and spreaders.
6. Compatibility Certification: Submit for record a written statement certifying that form release agent used is compatible with subsequent architectural finish materials applied to concrete surfaces. Submit along with manufacturer's data.
7. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the New York City Department of Buildings, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Refer to DDC General Conditions for submittal process and requirements.

C. Refer to Section 03 30 00 – "Cast-in-Place Concrete" for additional submittal requirements related to concrete trades.

#### 1.7 FORMWORK DESIGN

A. Design of Formwork, Shoring/Reshoring, and its removal is the Contractor's responsibility.

B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-02 that might be applied, until such loads can be supported by the concrete structure.

C. Design Requirements:



1. Forms shall be designed for fabrication and erection in accordance with Commissioner's requirements and recommendations of ACI 301, 318 and 347.
2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. See Section 3.2 for shoring/reshoring requirements.
3. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-02 unless otherwise controlled by local building code.
4. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.
5. The use of flowing concrete (8" (200mm) to 10" (250mm) slump) of Self-Consolidating Concrete requires a review of the formwork design based on the rate of placement and setting time of the mix. Unless shown to be sufficient otherwise, formwork design shall conform to the requirements of ACI 237.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with DDC General Conditions, include the following:

1. Store forms and form materials clear of ground and protect from damage.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

#### 1.10 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. The Contractor shall be responsible for, and bear all expenses associated with the filing and securing of approvals, if any, for Form TR3: Technical Report Concrete Design Mix, including, but not limited to, engaging the services of a New York City licensed Concrete Testing Lab for the review and approval of concrete design mix, testing, signatures and professional seals, etc., compliant with NYC Department of Buildings requirements, for each concrete design mix.
- C. Refer to Section 01 40 00 "Quality Requirements", Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.11 QUALITY ASSURANCE BY TESTING AGENCY

- A. Field Quality Assurance: Testing Agency shall test and inspect concrete formwork as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered.



- B. Contractor's testing agency shall provide properly instructed inspectors at site in presence of Commissioner to inspect formwork using the latest Contract Documents and approved shop drawings as follows:
  - 1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect suitability of concrete placement and tolerances stated herein.
  - 2. Inspect forms for location, configuration, compliance with specified tolerances, block outs, camber, shoring ties, seal of form joints and compliance with Contract Documents.
  - 3. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
  - 4. Verify proper use/application of form release agents.
  - 5. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or restoration work.
- C. The Testing Agency shall submit for record inspection, observation, and/or test reports to the Commissioner, as required herein and shall provide an evaluation statement in each report stating whether or not concrete formwork conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.

#### 1.12 QUALITY CONTROL

- A. Section 03 30 00 – “Cast-in-Place Concrete” and the DDC General Conditions.

#### 1.13 OBSERVATIONS BY COMMISSIONER

- A. Section 03 30 00 – “Cast-in-Place Concrete”

#### 1.14 PERMITS AND WARRANTY

- A. Permits: See Section 03 30 00 – “Cast-in-Place Concrete”
- B. See Section 03 30 00 – “Cast-in-Place Concrete.” Failures include but are not limited to the following:
  - 1. Discoloration of concrete scheduled to remain exposed to view.
  - 2. Damage of concrete finishes caused by forms.
  - 3. Damage of concrete caused by form stripping.
  - 4. Non-compliance with form finishes required for designated architectural finishes.
  - 5. Non-compatibility of form release agent with subsequent architectural finish materials applied to concrete surfaces.
  - 6. Excessive and/or noticeable bowing in placed concrete members caused by deflection of formwork during concrete placement.



**1.15 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.16 LEED BUILDING SUBMITTALS**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**PART 2 - PRODUCTS**

**2.1 FORMWORK REQUIREMENTS**

- A. General Requirements
  - 1. Formwork shall meet construction safety regulations for the State of New York.
  - 2. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
  - 3. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations).
    - a. Class A – For surfaces prominently exposed to public view where appearance is of special importance.
    - b. Class B – Coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
    - c. Class C – General Standard for permanently exposed surfaces where other finishes are not specified.





- d. Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.
- 4. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings, using form materials with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
- 5. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.
- B. Form Finishes for Exposed Surfaces:
  - 1. Type: Straight, smooth, free of cement paste leaks at butt-joints, surface imperfections and other irregularities detrimental to appearance of finished concrete, fully coordinated with requirements for required finish material.
  - 2. Form exposed areas of columns, beams, ledges, balcony fascias to achieve true alignment and level soffit of edge beams and concrete edges. All such areas must be sharp, straight and true to line and level. Edge beams and concrete canopies and ledges must have adequate shoring to prevent any visible amount of sag and sufficient bracing to prevent any lateral movement during construction.

## 2.2 FORM MATERIALS

- A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other approved panel-type materials.
  - 1. Provide materials with sufficient strength to prevent warping.
- B. Plywood: Of species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" (16mm) thick, complying with U.S. Product Standard PS-1.
  - 1. Other approved Sheet Materials: 14 gauge (2.0mm) sheet steel or fibrous glass reinforced resin.
- C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.
  - 1. Use only where entire width can be covered with one board 11-1/4" (285mm) or less in width.
- D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications.
  - 1. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.
- F. Chamfer for Form Corners:
  - 1. Types: Chamfer strips of wood, metal, PVC or rubber fabricated to produce smooth form lines and tight edge joints, 3/4" (20mm) size, maximum possible lengths.



2. Required for all exposed corners of beam, walls and column forms.

G. Form Ties:

1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
2. Ties used for architecturally exposed concrete shall be galvanized.
3. Ties shall not leave metal closer than 1-1/2" (40mm) to exposed surface.
4. When removed, ties shall not leave holes larger than 1" (25mm) diameter in concrete surface.
5. Removable Ties: Use type with tapered cones, 1" (25mm) outside diameter, for concrete walls which will remain exposed to view and scheduled for architectural finishes.
6. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
7. Wire Ties: Not acceptable.

H. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:

1. Type: Of size, strength and quality to meet the required quality of formwork.

I. Form Release Agent:

1. Type: Commercial formulation form release agent of non-emulsifiable type which will not bond with, stain, or adversely affect concrete surfaces. Form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Form release agent shall be compatible with subsequent architectural finish materials applied to concrete surfaces. Apply in compliance with manufacturers' instructions.
2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC's).
3. For Steel Forms: Non-staining rust-preventative type.

J. Reglets: Provide sheet metal reglets formed of same type and gauge as flashing metal, unless indicated otherwise on Drawings. Where resilient or elastomeric sheet flashing, or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge (0.55mm) galvanized sheet metal. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

K. Coordinate with materials as specified in Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies."

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 FORMWORK

#### A. General:

1. Inspect areas to receive formwork.
  - a. Immediately notify the Testing Agency and Commissioner in writing of conditions that will adversely affect the Work.
2. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
3. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
4. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
7. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
8. Erect forms for easy removal without hammering or prying against concrete surfaces.
9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
10. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
11. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
12. Chamfer exposed corners and edges as indicated on the architectural drawings, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth lines and tight edge joints.
13. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.
14. Where specifically shown on the Contract Documents as monolithic, upturned beams, curbs and similar members in connection with slabs shall be formed so that they can be poured integrally with slabs.

#### B. Concrete Accessories and Embedded Items:



1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.
    - a. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.
  2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
  3. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.
  4. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces.
  5. Coordinate with Section 03 20 00 "Concrete Reinforcement And Embedded Assemblies."
  6. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.
- C. Temporary Openings:
1. Locate temporary openings in forms at inconspicuous locations.
  2. For clean-outs and inspection before concrete placement, locate temporary openings where interior area of formwork would otherwise be inaccessible.
  3. For cleaning and inspections, locate openings at bottom of forms to allow flushing water to drain.
  4. Securely brace temporary openings and set tightly in forms to prevent loss of concrete.
  5. Close temporary openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be noticeable on exposed concrete surfaces.
- D. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.
1. Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.
  2. Accurately place and securely support items built into forms.
- E. Cleaning:
1. Normal Conditions:
    - a. Thoroughly clean forms and adjacent surfaces to receive concrete.
    - b. Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.



- c. Flush with water or use compressed air to remove remaining foreign matter.
    - d. Verify that water and debris can drain from forms through clean-out ports.
  - 2. During Cold Weather:
    - a. Remove ice and snow from within forms.
    - b. Do not use de-icing salts.
    - c. Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.
    - d. Use compressed air or other means to remove foreign matter.
- F. Form Release Agents
  - 1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.
  - 2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.
    - a. Coat steel forms with nonstaining, rust-preventative material.
  - 3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.
- G. Before Placing Concrete:
  - 1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.
    - a. Make necessary corrections or adjustment to formwork to meet tolerance requirements.
  - 2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.
  - 3. Notify Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.
- H. During Concrete Placement:
  - 1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.
  - 2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.
- I. Camber:



1. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.
2. Camber bottom forms where indicated on the drawings. Whenever forms are cambered, screeded levels for establishing top of concrete must be cambered to the same amount and to the same profiles such that scheduled depth of member is not reduced by lifting of forms. Check camber and adjust forms before initial set as required to maintain camber.

J. Surface Defects:

1. Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.

K. Formwork Loads on Grade

1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.

L. Footings and Grade Beams:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
2. When trench forms are used, provide an additional 1" (25mm) of concrete on each side of the minimum design profiles and dimensions indicated.

- M. For slabs-on-grade, secure edge forms in such a manner as to not move under weight of construction loads, construction and finishing equipment, or workers.

3.3 SHORES AND RESHORES

- A. Comply with ACI 347.2R for shoring and reshoring in multistory construction, and as specified herein.

1. For non-post tensioned flat plate concrete structures of five supported levels or more, extend shoring/reshoring at least four levels below the floor or roof being placed (shore formwork, reshore three levels below)
2. For non-post tensioned flat plate concrete structures of less than five supported levels, extend shoring/reshoring to ground.
3. For all other concrete structures of four supported levels or more, extend shoring/reshoring at least three levels below the floor or roof being placed (shore formwork, reshore two levels below)
4. For all other concrete structures of less than four supported levels, extend shoring/reshoring to ground.
5. For shoring/reshoring placed on mud sills, adjustments shall be made by contractor to account for ground settlement.
6. Locate shores/reshores such that the factored (ultimate) construction load imposed onto any slab or beam at any time during the construction cycle does not exceed 90% of the



factored (ultimate) design load for that slab or beam, scaled down to reflect effect on capacity of lower concrete strength at time of loading.

7. Construction load shall include the weight of wet concrete, total weight of formwork and shoring/reshoring, and a minimum construction live load of 50 psf (2.5kPa) (increase if construction operations will produce higher loading). Design load includes self-weight of the slab, and superimposed dead and live loads as indicated on the drawings.
8. For comparison of construction loads to design loads, compare factored (ultimate) construction loads to factored (ultimate) design loads. For construction dead and live loads, use the same load factors and load combinations as required by ACI 318 for design dead and live loads. The specified strength reduction factors from ACI 318 should also be applied during the strength evaluation of the partially completed structure.
9. For flat plate or flat slab construction “backshores” or “preshores” as defined in ACI 347 shall be permitted only if appropriate calculations and construction sequences are provided demonstrating that the accumulation of shore loads will not overload any slab. In the absence of such calculations and construction sequences, shores must be removed and reshores installed in a sequence such that each floor is permitted to deflect and carry its own weight prior to the installation of reshores.
10. Reshores shall not be removed until the concrete has attained its specified 28 day strength.

#### 3.4 REMOVING FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50oF (10oC) for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at least 75% of design compressive strength as proven by cylinder test. If stripping occurs before 3 days, 100% strength must be achieved.
  1. Provide reshores as required per ACI 347.
  2. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.
- D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- E. Reshore structural members where required due to design requirements, construction requirements, or construction conditions.
  1. Reshore on same day shoring and forms are removed.
- F. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 03 30 00 – “Cast-in-Place Concrete.”



- G. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.
- H. Form tie holes shall be filled as per approved samples submitted to the Commissioner.
- I. The Contractor shall assume responsibility for all damage due to removal of the forms.

### **3.5 RE-USING FORMS**

- A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas restored, and projecting nails withdrawn.
  - 1. Split, frayed, delaminated or otherwise damaged form-facing material will not be approved.
  - 2. Apply new form release agent on re-used forms.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.
- C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Commissioner. The Commissioner reserves the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are approvable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Commissioner.

**END OF SECTION 03 10 00**



## **SECTION 03 20 00**

### **CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

##### **1.2 SUMMARY**

- A. Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

##### **1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- |    |                                 |                        |
|----|---------------------------------|------------------------|
| A. | Submittals                      | DDC General Conditions |
| B. | Quality Control                 | DDC General Conditions |
| C. | Concrete Formwork               | Section 03 10 00       |
| D. | Cast-in-Place Concrete          | Section 03 30 00       |
| E. | Thermal and Moisture Protection | Division 7             |
| F. | Architectural Concrete          | Section 03 33 00       |

##### **1.4 CODES AND STANDARDS**

- A. 2014 New York City Building Code: Concrete work shall conform to the requirements of the 2014 New York City Building Code and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
  - 1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 – Specifications for Structural Concrete.
  - 3. ACI 315 – Details and Detailing of Concrete Reinforcement.
  - 4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
  - 5. ACI 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
  - 6. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary



7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
8. AWS D1.1 – Structural Welding Code-Steel.
9. AWS D1.4 – Structural Welding Code-Reinforcing Steel.
10. CRD C 572 – Specification for Polyvinylchloride Waterstops.
11. Concrete Reinforcing Steel Institute "Manual of Standard Practice"
12. ASTM D3963 Fabrication and Jobsite Handling of epoxy Coated Steel Reinforcing Bars.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with DDC General Conditions Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

- a) Submittal Schedule
- b) Shop Drawings
- c) Product Data
- d) Mill Reports
- e) Reinforcement Strain Test
- f) Hazardous Materials Notification

1. Submittal Schedule: Section 03 30 00 – "Cast-in-Place Concrete"
2. Shop Drawings: Submit for action shop drawings that shall clearly indicate, but not be limited to:
  - a. All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.
  - b. Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.
  - c. Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.
  - d. Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.



- 1) Do not use dimensions scaled from Contract Drawings to determine bar lengths.
- 2) Hooks and bends not specifically dimensioned shall be detailed per ACI 318.
- e. Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.
- f. Each type of supporting and spacing devices, including miscellaneous accessories.
- g. Construction joint type, details, and locations. Coordinate construction joint type, details, and locations with concrete pour schedule. Submittal shall include details for each type of construction joint in accordance with Contract Documents.
- h. Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section 03 30 00 – “Cast-in-Place Concrete”.
- i. Concrete accessories and embedded items. See SUBMITTALS article of Section 03 30 00 – “Cast-in-Place Concrete”.
3. Product Data: Submit for action for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.
4. Mill Reports: Submit for record.
5. Reinforcement Strain Test: For Grade 75 reinforcement, submit for record certification that steel has a yield strength of no less than 75 ksi as measured by both ASTM A615 and ACI 318 Section 3.5.3.2 procedures.
6. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the City of New York, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.
- B. Refer to DDC General Conditions for submittal process and requirements.
- C. Refer to Section 03 30 00 – “Cast-in-Place Concrete” for additional submittal requirements related to concrete trades.
- 1.7 DELIVERY, STORAGE, AND HANDLING
  - A. Comply with General Conditions and DDC General Conditions, including the following:
    1. Deliver reinforcing steel to Project site bundled, tagged and marked.
      - a. Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.
    2. Deliver welded wire fabric in sheets. Do not deliver in rolls.



3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.
4. Deliver and store welding electrodes in accordance with AWS D1.4.
5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.
6. Store reinforcing steel above ground so that it remains clean.
  - a. Maintain steel surfaces free from materials and coatings that might impair bond.
  - b. Keep covered.
  - c. Protect against corrosion or deterioration of any kind.

#### 1.8 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. The Contractor shall be responsible for, and bear all expenses associated with the filing and securing of approvals, if any, for Form TR3: Technical Report Concrete Design Mix, including, but not limited to, engaging the services of a New York City licensed Concrete Testing Lab for the review and approval of concrete design mix, testing, signatures and professional seals, etc., compliant with NYC Department of Buildings requirements, for each concrete design mix.
- C. Refer to Section 01 40 00 "Quality Requirements", Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

#### 1.10 QUALITY ASSURANCE BY TESTING AGENCY

- A. Field Quality Assurance : Testing Agency shall test and inspect concrete reinforcement and embedded assemblies as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Commissioner for final acceptance.
- B. The Testing Agency shall provide properly instructed inspectors at the site to inspect reinforcement, embedments, and accessories using the latest Drawings and reviewed shop drawings, as follows:
  1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
  2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.



3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.
  4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.
- C. Adhesive anchors shall be proof tested in tension as follows:
1. The Testing Agency shall submit an adhesive anchorage proof testing plan to the Commissioner for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
  2. Proof testing shall be performed as a confined tension test in accordance with the guidelines of ASTM E488 and the requirements of ACI 355.4.
  3. Testing shall be performed after the minimum curing period specified by the manufacturer.
  4. 5 percent of each type and size of an adhesive anchor assembly and 100 percent of anchors marked (CERT) shall be proof tested in tension by Testing Agency.
  5. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the Commissioner prior to performance of the testing.
  6. The adhesive anchors proof tension loads shall be as specified in the general notes of the structural drawings.
  7. Anchors shall have no visible indications of displacement or damage during or after proof load application. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
  8. If more than 10% of the tested adhesive anchors fail to achieve the specified proof load, 100% of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the Commissioner. Immediately notify the Commissioner of all failed proof tests.
- D. Mechanical post-installed anchors shall be proof tested as follows:
1. The Testing Agency shall submit a mechanical anchorage proof testing plan to the Commissioner for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
  2. 5 percent of each type and size of mechanical anchor shall be proof tested by Testing Agency. The required proof test for the anchors is as follows:
    - a. For torque-controlled mechanical anchors, a proof torque shall be applied to the anchor using a calibrated torque wrench and the proof torque shall be achieved with no more than one-half turn of the anchor nut.
  3. The required proof torque load for torque-controlled mechanical anchors shall be as specified in the general notes of the structural drawings.



4. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the Commissioner prior to performance of the testing.
  5. Concrete cracking in the vicinity of the anchor during or after proof torque load application shall be considered a failure.
  6. If more than 10% of the tested mechanical anchors fail to achieve the specified proof torque load or set, 100% of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the Commissioner. Immediately notify the Commissioner of all failed proof tests.
- E. Periodic inspection for post-installed adhesive and mechanical anchors shall be provided in accordance with the building code except that continuous inspection shall be provided for the conditions identified in section B.4. The inspector shall observe all aspects of the anchor installation and shall, at a minimum, verify the following items:
1. Hole drilling method in accordance with the Manufacturer's Published Installation Instructions (MPII) and these installation requirements.
  2. Anchor spacing and edge distance.
  3. Hole diameter and depth.
  4. Hole cleaning in accordance with the MPII.
  5. Anchor element type, material, diameter, and length.
  6. For adhesive anchors, adhesive identification and expiration date.
  7. For adhesive anchors, adhesive installation in accordance with the MPII.
  8. For torque-controlled mechanical anchors, the number of turns required to achieve the anchor set torque per the MPII.
- F. The Testing Agency shall submit for record inspection, observation, and/or test reports to Commissioner, as required herein and shall provide an evaluation statement in each report stating whether or not concrete reinforcement, embedded assemblies, and post-installed anchors conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
- G. Immediately notify the Contractor, and Commissioner of deficiencies.
- 1.11 QUALITY CONTROL BY CONTRACTOR
- A. See Section 03 30 00 – "Cast-in-Place Concrete"
- 1.12 OBSERVATIONS BY COMMISSIONER
- A. See Section 03 30 00 – "Cast-in-Place Concrete"
- 1.13 PERMITS AND WARRANTY
- A. Permits: See Section 03 30 00 – "Cast-in-Place Concrete"

- B. Warranty: See Section 03 30 00 – “Cast-in-Place Concrete.” Failures include but are not limited to the following:

1. Bars with kinks or bends not indicated on Drawings or on approved shop drawings.
2. Bars damaged due to bending, straightening or cutting.
3. Bars heated for bending.

#### 1.14 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Refer to the following sections:
2. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
3. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
4. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.
2. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
3. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 “INDOOR AIR QUALITY MANAGEMENT”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.15 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**PART 2 - PRODUCTS****2.1 REINFORCEMENT****A. Reinforcing Steel:**

1. Type: Deformed billet steel bars, ASTM A 615, Grade 60 or 75 as indicated on Drawings.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
  - a. Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Epoxy-Coated: ASTM A 775 where indicated on Drawings.
5. Weldable reinforcement: ASTM A 706 where indicated on Drawings.

**B. Welded Wire Reinforcement:**

1. Type: steel wire, deformed, ASTM A 496.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, welded wire reinforcement shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
  - a. Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Plain Steel Welded Wire Reinforcement: ASTM A 1064.
5. Deformed Steel Welded Wire Reinforcement: ASTM A 497.
6. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A.

**C. Shear Reinforcement At Slab-Column Connections:**

1. Type: Steel studrail assemblies for shear reinforcement at slab-column connections shall be DECON STUDRAILS supplied by DECON USA, Medford New Jersey.
  - a. Shear studs shall be in accordance with ASTM A108, Grade C1015.
  - b. Rails shall be low carbon steel Type 44W.
  - c. Studs shall be welded in accordance with AWS D1.1.
2. Size: As indicated on structural Drawings.
3. Installation: Per manufacturer's instructions.





4. Supports: Use plastic molded plastic chairs as provided by the manufacturer to maintain the bottom rebar cover as specified on the Drawings. Tie studrails to adjacent top bars to maintain vertical position.

D. Reinforcement Coating Restoration Materials:

1. Apply restoration materials in accordance with the manufacturer's written procedures.
2. Galvanized Repair Coating: Zinc-based solder, paint containing zinc dust or sprayed zinc complying with ASTM A780.
3. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/ A 775M.
  - a. The maximum amount of restored damaged areas shall not exceed 2% of the surface area in each linear foot of each bar. If more than 2% of the surface area in each linear foot of bar is damaged, bar shall be replaced.

2.2 ACCESSORIES

A. Tie Wire:

1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 510 and ASTM A 853.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:

1. Mechanical tension and compression splicing systems shall be used where indicated on Drawings or at contractor's option. For seismic design categories D, E and F, in plastic hinge regions, only Type 2 mechanical splices are permitted.
2. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
  - a. Bartec Couplers by Dextra, Santa Fe Springs, CA
  - b. Lenton Cadweld by Erico, Solon, OH
  - c. Bar Lock coupler system by Dayton Superior, Miamisburg, OH
  - d. Grip-Twist by Bar Splice, Dayton, OH
  - e. ZAP Screwlok by Bar Splice, Dayton, OH
  - f. Lenton Couplers by Erico, Solon, OH.
  - g. Or approved equal.
3. Splices shall be installed in compliance with manufacturer's requirements.



4. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
5. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Headed Bars:

1. For bar sizes #11 (ø36) or smaller where specifically detailed on Drawings, mechanical bar terminators shall be used.
2. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
  - a. Bartec End Anchors by Dextra, Santa Fe Springs, CA
  - b. Lenton Terminator by Erico, Solon, OH
  - c. Grip-Twist Doughnut by Bar-Splice, Dayton, OH
  - d. Bar Lock End Anchorage System by Dayton Superior, Miamisburg, OH.
  - e. Or approved equal.

D. Supports for Reinforcement:

1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, plastic, plastic protected steel, or epoxy coated to match supported reinforcement.
2. For Contact with Forms: Use types with not less than 3/32" (2.5mm) of plastic between metal and concrete surface.
  - a. Plastic tips shall extend not less than 1/2" (12mm) on metal legs.
3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound (1.5kN) load without damage or permanent distortion.
4. Unless otherwise indicated on Drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.
5. For Slabs on Grade: Use supports with sand plates or horizontal runners where base material will not support chair legs.

E. Deformed Bar Anchors:

1. Type: Automatic end welded, ASTM A 496 quality.
2. Size and Grade: As indicated on structural Drawings by Nelson Stud Welding.

F. Anchor rods and dowels:



1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the Drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on Drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.
2. Adhesive Anchors for anchor rods and dowels in existing concrete: See Anchorage Accessories.

G. Prefabricated Bent-In Dowel Keyway System:

1. Type, Size and Grade as indicated on Drawings.
2. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
  - a. Lenton Form Savers by Erico, Solon, OH
  - b. Stabox by Meadow Burke, Tampa, FL
  - c. Metalstrip by Dayton Superior, Miamisburg, OH.
  - d. Or approved equal.
3. Installation: Per Manufacturer's instructions.

2.3 ANCHORAGE ACCESSORIES

- A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:
1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi (345MPa), minimum tensile strength of 60,000 psi (415MPa).
  2. Anchor Rods: ASTM F1554, Grade as noted on Drawings.
  3. Threaded Inserts:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dayton/Richmond Screw Anchor Co.
      - 2) Powers Fasteners, Inc.
      - 3) Acrow-Richmond Limited
      - 4) Or approved equal.
  4. Adhesive Anchors:
    - a. Basis of Design: See General Notes in structural drawings.



- b. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - 1) HIT-RE 500-SD by Hilti, Inc., Tulsa, OK
    - 2) Epcon C6+ by ITW Red Head, Glendale Heights, IL
    - 3) Epcon G5 by ITW Red Head, Glendale Heights, IL
    - 4) PE 1000+ by Powers Fasteners, Brewster, NY
    - 5) Pure 110+ by Powers Fasteners, Brewster, NY
    - 6) SET-XP by Simpson Strong-Tie Co., Pleasanton, CA
    - 7) Or approved equal.
  - c. The adhesive anchor system used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.4 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
- 5. Expansion Anchors:
  - a. Basis of Design: See General Notes in structural drawings.
  - b. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - 1) Power Stud+ SD1 or SD2 by Powers Fasteners, Brewster, NY
    - 2) Power Stud + SD6 (SS) by Powers Fasteners, Brewster, NY
    - 3) Trubolt or Trubolt+ by ITW Red Head, Glendale Heights, IL
    - 4) Strong-Bolt by Simpson Strong-Tie Co., Pleasanton, CA
    - 5) Or approved equal.
  - c. The expansion anchors used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.2 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
- 6. Threaded Screw Anchors:
  - a. Basis of Design: See structural drawing General Notes.
  - b. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - 1) Wedge Bolt+ by Powers Fasteners, Brewster, NY
    - 2) Tapcon by ITW Red Head, Glendale Heights, IL
    - 3) Titan HD by Simpson Strong-Tie Co., Pleasanton, CA



- 4) Or approved equal.
7. Inserts and Coil Rods: Yield strength 65,000 psi (450MPa), ASTM B 633,
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Acrow-Richmond Limited
    - 2) Dayton Superior, Dayton, OH.
    - 3) Powers Fasteners
    - 4) Or approved equal.
8. Welding Electrodes: AWS 5.5, Series E70.
9. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equivalent.
- B. Dovetail Anchor Slots:
  1. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - a. Formed 22 gauge (0.85mm) galvanized steel manufactured by Heckmann Building Products, Chicago, Illinois
    - b. Hohmann and Barnard, Hauppauge, New York
    - c. Pro-Slot by BoMetals, Inc., Carrollton, GA.
    - d. Or approved equal.
  2. Location of Use: Continuous installation of anchor slots, full height of masonry walls, where masonry walls abut poured concrete walls.
  3. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
  4. Finish: Hot-dip galvanized or zinc-plated steel.
  5. Stainless steel anchors are acceptable.

## 2.4 JOINT FILLERS

- A. Permanent Compressible Joint Filler:
  1. Type: Closed-cell expansion joint filler, ultraviolet stable, minimal moisture absorption, non-impregnated, nonstaining and nonbleeding, inert and compatible with cold-applied sealants.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. W. R. Meadows: "Ceramar" (Basis-of-Design)
  - b. Peikko
  - c. Emseal
  - d. Or approved equal.
3. Location of Use: Slabs and curbs as indicated on Drawings or required.
  4. Thickness: As indicated on Drawings or required.
- B. Temporary Compressible Joint Filler:
1. Type: White molded polystyrene beadboard.
  2. Location of Use:
    - a. In slabs, curbs, and walls which must be removed prior to joint sealant installation.
    - b. Vertically to isolate walls from columns or other walls.
- C. Semi Rigid Joint Filler:
1. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - a. Product: Euclid Chemical Company "Euco 700" or "Euco QWIKjoint 200"
    - b. Product: Sika Corporation "Sikadur 51 SL"
    - c. Product: W.R. Meadows Sealtight "Rezi-Weld Flex"
    - d. Or approved equal.
- D. Noncompressible Joint Filler:
1. Type: Dow Chemical's "STYROFOAM 40" rigid closed-cell extruded polystyrene board, square edges, 40 psi (275kPa) compressive strength, ASTM C 578, Type IV.
  2. Thickness: As indicated on Drawings.
  3. Location of Use: As indicated on Drawings or required by 2014 NYCBC.
- E. Asphalt-Impregnated Joint Filler:
1. Type: W.R. Meadows Asphalt Expansion Joint Filler, preformed, ASTM D 994.
  2. Thickness: ½" (12mm) maximum, as indicated on Drawings or required by 2014 NYCBC.
  3. Location of Use: Sidewalks at foundation walls and as indicated on Drawings or required by 2014 NYCBC.

- F. Asphalt-impregnated fiberboard expansion joint filler for interior work:
  - 1. Type: ASTM D1751.
- G. Self-expanding cork board expansion joint filler for exterior work:
  - 1. Type: ASTM D1752.
- H. Construction Joints:
  - 1. Type: Tongue and groove type profile of galvanized steel, with knock-out holes at 6" (150mm) on center to receive dowelling, complete with anchorage.

## 2.5 WATERSTOPS

- A. Preformed Swellable Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.
  - 1. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - a. Volclay Waterstop RX" by CETCO Building Materials Group, Hoffman Estates, IL
    - b. "Adcor ES" by W. R. Grace & Co., Cambridge, MA
    - c. "Hydrotite" by Sika, Lyndhurst, NJ
    - d. Or approved equal
  - 2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).
  - 3. Location of Use: Concrete cold joints at footings, walls and slab joints.
  - 4. Comply with manufacturer product application and installation instructions.
- B. Polyvinyl Chloride Waterstops:
  - 1. Type: PVC Waterstops for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.
  - 2. Manufacturers and products: Subject to compliance with requirements, provide products by one of the following:
    - a. "PVC Waterstops" by BoMetals, Carrollton, GA
    - b. "Greenstreak" by Sika, Lyndhurst, NJ
    - c. "Sealtight PVC Waterstops" by W.R. Meadows, Hampshire, IL
    - d. Or approved equal.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 FABRICATION**

A. Reinforcing Steel Fabrication:

1. Fabricate in accordance with approved shop Drawings, ACI 315 and Contract Documents.
2. Heating of Reinforcement: Will be permitted only with specific prior approval of the Commissioner.
3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
4. Tolerances: Comply with ACI 117.
5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.
  - a. Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
  - b. Bends or kinks not indicated on Drawings or final shop drawings.
  - c. Bars with reduced cross-section due to excessive rusting or other cause.

B. Welded Wire Reinforcement:

1. Type: As fabricated in accordance with CRSI, unless otherwise noted.

C. Templates:

1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

D. Assemblies:

1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
2. Welding of deformed bar anchors and headed stud anchors shall be installed by full-fusion process equivalent to TRW Nelson Stud Welding Division or KSM Welding Services Division, Omark Industries or Tru-Weld Stud Welding, Medina, OH.
3. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by The Testing Agency.
4. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.





5. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of Commissioner.

### 3.3 INSTALLATION OF REINFORCEMENT

#### A. General:

1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.
2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Do not place concrete until the completed reinforcement steel work has been observed and accepted by The City of New York 's Testing Laboratory.
5. Reinforcement steel is not permitted to be "floated into position".
6. Bend bars cold.
  - a. Do not heat or flame cut bars.
  - b. No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the Commissioner and tested by Independent Testing Agency for cracks.
7. Weld only as indicated.
  - a. Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
  - b. See structural Drawings for additional requirements.
8. Tag reinforcement steel for easy identification.

#### B. Placement of Reinforcement Bars:

1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.
  - a. Place reinforcement bars within tolerances specified in ACI 117.
  - b. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.
3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, immediately notify the Commissioner for approval prior to concrete placement.



4. Avoid cutting or puncturing vapor retarder during reinforcement placement.
    - a. Restore damages before placing concrete.
  5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on Drawings.
  6. Bar Supports: Use type specified in this section.
  7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.
- C. Placement of Wire Reinforcement:
1. Install in lengths as long as practicable.
  2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
  3. Overlap the wire reinforcement 6" or one panel width + 2", whichever is larger.
    - a. Securely tie together with wire.
  4. Offset laps of adjoining widths to prevent continuous laps in either direction.
  5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural Drawings.
- D. At Construction Joints:
1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.
- E. At Expansion Joints:
1. Reinforcing bars and wire fabric shall NOT be continuous through expansion joints, unless otherwise indicated on Drawings.
- F. Splicing:
1. Unless otherwise indicated on Drawings provide lap splices for bar sizes #11 (ø36) and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on Drawings.
  2. At all #14 (ø43) and #18 (ø57) bars and where mechanical splices are specifically indicated on Drawings, comply with requirements specified in this Specification section under "Mechanical Splicing Systems".
  3. Do not splice reinforcement except as indicated on structural Drawings.
  4. Tension couplers may be used and installed per manufacturer's specifications where indicated on Drawings or as approved by Commissioner.
- G. Dowels in Existing Concrete:



1. Install dowels and dowel adhesive in accordance with supplier's recommendations.
2. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

### 3.4 INSTALLATION OF POST-INSTALLED ADHESIVE ANCHORS

#### A. General:

1. Post-installed adhesive anchors shall be installed in accordance with the Manufacturer's Printed Installation Instructions (MPII).
2. The adhesive anchors shall be supplied as an entire system. Provide all equipment required to install the adhesive anchor in accordance with the MPII.
3. Anchors shall be installed in holes drilled with a rotary impact hammer drill with carbide bit. Obtain prior written approval from Commissioner before using rock drilling or core drilling installation methods.
4. Anchor holes shall be thoroughly cleaned and dry prior to adhesive injection, in accordance with the MPII. Anchors to be installed in the adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings.
5. Concrete shall have a minimum compressive strength of 2500 psi (17MPa).
6. Concrete at time of adhesive anchor installation shall have a minimum of 21 days.
7. Concrete temperature at the time of adhesive anchor installation shall be at least equal to manufacture's requirements, or 50° F (10°C) if no requirement exists.
8. Support the anchor and protect it from disturbance or loading for the full cure time stated by the manufacturer at that base material temperature.
9. Unless specified otherwise in the contract documents, anchors shall be installed perpendicular to the concrete surface. Anchors displaced or disturbed prior to the adhesive cure time shall be considered damaged and reported to the Commissioner (see Observations and Corrections Section 03 30 00 "Cast-in-Place Concrete").
10. Locate, by non-destructive means, and avoid all existing reinforcement prior to installation of anchors. Immediately notify the Commissioner if existing reinforcement layout prohibits the installation of anchors as indicated in the drawings.
11. Reinforcement bars or all-threaded bars shall not be bent after being adhesively embedded in hardened, sound concrete, unless written approval is given by the Commissioner.
12. All installers installing anchors shall be properly instructed by the manufacturer on proper installation techniques. Submit for record certificate from training documentation from the manufacturer for each installer on this Project
13. Installation of adhesive anchors horizontally or upwardly inclined and anchors that are designated with a (CERT) after the anchor call-out, shall be performed by installers who are properly trained by the ACI/CRSI Adhesive Anchor Installer program.



**3.5 INSTALLATION OF ACCESSORIES AND EMBEDDED ITEMS**

- A. Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.
  - 1. Set and secure embedments, including embedded plates, bearing plates, and anchor rods, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
  - 2. Tolerances: Anchor rod and other embedded items placement tolerances shall comply with AISC 303, "Code of Standard Practice", Section 7.5.
  - 3. Inspect locations to receive concrete accessories.
  - 4. Immediately notify the Commissioner in writing of conditions that will adversely affect the Work or fail to meet Contract Document requirements.
  - 5. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by The Testing Agency.
- B. Construction and Contraction (Control) Joints:
  - 1. Construction and contraction (control) joints indicated on Drawings are mandatory and must not be omitted.
    - a. Provide construction joints in accordance with ACI 318.
    - b. Roughen surface at construction joints as indicated on the drawings.
    - c. Where specifically indicated on drawings, provide 1-1/2" (40mm) deep key type construction joints at end of each placement for slabs, beams, walls and footings.
      - 1) Bevel forms for easy removal.
  - 2. Provide waterstops in construction joints as indicated on the Contract Documents in sizes to suit joint.
  - 3. Install waterstops to form continuous diaphragm in each joint.
  - 4. Support and protect exposed waterstops during progress of Work.
  - 5. Field-fabricate joints in waterstops according to manufacturer's printed instructions.
- C. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

**END OF SECTION 03 20 00**

## **SECTION 03 30 00**

### **CAST-IN-PLACE CONCRETE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

##### **1.2 SUMMARY**

- A. Section includes: Cast-in-place concrete work, not including architectural finish requirements where they are required. For architectural finish requirements on cast-in-place concrete, see Section 03 33 00 "Architectural Concrete".

##### **1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- |    |  |                        |
|----|--|------------------------|
| A. | Submittals                                     | DDC General Conditions |
| B. | Quality Control                                | DDC General Conditions |
| C. | Concrete Formwork                              | Section 03 10 00       |
| D. | Concrete Reinforcement and Embedded Assemblies | Section 03 20 00       |
| E. | Thermal and Moisture Protection                | Division 7             |
| F. | Architectural Concrete                         | Section 03 33 00       |

##### **1.4 CODES AND STANDARDS**

- A. 2014 New York City Building Code: Concrete work shall conform to the requirements of the 2014 New York City Building Code, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
  - 1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 – Specifications for Structural Concrete.
  - 3. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
  - 4. American Concrete Institute "Manual of Concrete Practice", various committee reports as referenced herein.
  - 5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest addition.

6. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

#### 1.5 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. The Contractor shall be responsible for, and bear all costs associated with the filing and securing of approvals, if any, for Form TR3: Technical Report Concrete Design Mix, including, but not limited to, engaging the services of a New York City licensed Concrete Testing Lab for the review and approval of concrete design mix, testing, signatures and professional seals, etc., compliant with NYC Department of Buildings requirements, for each concrete design mix.
- C. Refer to Section 01 40 00 “Quality Requirements”, Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with DDC General Conditions Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.
  1. Submittal Schedule
  2. Mix Designs
  3. Concrete Travel Times to the Project Site
  4. Hot and Cold Weather Procedures
  5. Product Data
  6. Concrete Joint Locations
  7. Preconstruction Survey
  8. Survey of Flat Plate or Flat Slab Concrete Floors during construction
  9. FF/FL Testing
  10. Structural Restoration
  11. Patching Defective Concrete Finishes
  12. Conduit and Pipes Embedded in Concrete
  13. Hazardous Materials Notification



B. Detailed submittal requirements: See below for specific requirements for each required submittal.

1. Mix Designs: Submit for action concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete.
  - a. Mix designs shall be prepared or reviewed by Contractor's approved independent Testing Agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, sealed and signed by a Professional Engineer licensed in the State of New York, and shall be coordinated with design requirements and Contract Documents.
  - b. Before submitting to Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.
  - c. Mix materials shall be from the same production facility that will be used for this Project.
  - d. Mix Design data shall include but not be limited to the following:
    - 1) Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.
    - 2) Design Compressive Strength: As indicated on the Drawings.
    - 3) Proportions: ACI 301 and ACI 318.
    - 4) Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
    - 5) Water/cementitious material ratio.
    - 6) Evaluation and classification fly ash in accordance with ASTM D 5759.
    - 7) Report of chemical analysis of fly ash in accordance with ASTM C 618.
    - 8) Classification of blast furnace slag in accordance with ASTM C 989.
    - 9) Slump: ASTM C 143.
    - 10) Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218.
    - 11) Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
    - 12) Unit Weight of Concrete: ASTM C 138.
    - 13) Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.
      - a) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by Water-Cement Ratio is not permitted.



- b) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength.
  - c) If early concrete strengths are required, submit trial mixture results as required.
- 14) Manufacturer's product data for each type of admixture.
- 15) Manufacturer's certification that all admixtures used are compatible with each other.
- 16) All information indicating compliance with Contract Documents including method of placement and method of curing.
- 17) Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
- 18) Lightweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
- 19) Certification from Contractor's qualified testing agency indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity in accordance with ASTM C 33
- 2. Concrete Travel Times to the Project Site: Submit for record.
- 3. Hot and Cold Weather Procedures: Submit for record written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.
- 4. Product Data: Submit for action product data clearly marked to indicate locations to be used and all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility, and limitations for each of the following:
  - a. Bonding agents.
  - b. Curing compound and liquid sealer densifier. Submit for record to Commissioner a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.
  - c. Absorptive covers and moisture retaining covers.
  - d. Vapor Retarder: See Division 7, Thermal and Moisture Protection.
  - e. Self-leveling concrete topping.





- f. Grout: Submittal of grout by manufacturers not listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
- 5. Concrete Joint Locations: Submit for action plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.
  - a. Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of architectural finish drawings.
- 6. Comprehensive Layout Drawings: Submit for action comprehensive layout drawings (a single drawing per area/element):
  - a. Drawings shall show openings in structural members, including floor slab, shear walls, columns and beams.
  - b. Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor.
  - c. Drawings shall show concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement).
  - d. Submit with or prior to reinforcement and formwork submittals for same element/area.
- 7. Preconstruction Survey: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Commissioner.
- 8. Survey of Flat Plate or Flat Slab Concrete Floors during construction: Submit for record. Survey requirements are described on Drawings. Based on survey results, Commissioner may propose adjustments to formwork and camber.
- 9. FF/FL Testing: Submit for record to Testing Agency to test and report flatness (FF), levelness (FL) prior to shoring removal. For slabs that include camber, do not test for levelness (FL). Perform FF/FL testing in accordance with ASTM E 1155 requirements.
- 10. Structural Restoration: Submit for action procedures, intended locations, and product information.
- 11. Patching Defective Concrete Finishes: Submit for action procedures, intended locations, and product information.
- 12. Conduit and Pipes Embedded in Concrete: Submit for action layout of embedded conduit and pipes.
- 13. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by The City of New York, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.



**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with DDC General Conditions.
- B. Storage:
  - 1. Store materials in accordance with ACI 304R.
  - 2. Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminants.
  - 3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
  - 4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.
- C. Handling:
  - 1. Handle fine and coarse aggregates as separate ingredients.
  - 2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
  - 3. Do not use frozen or partially frozen aggregates.
  - 4. Allow sand to drain until it has reached relatively uniform moisture content before use.
  - 5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

**1.9 PRE-INSTALLATION CONFERENCE**

- A. At least 30 working days prior to the start of concrete construction, hold a meeting to review the approved concrete mix designs and to determine the procedures for producing proper concrete construction. Notify the Commissioner of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:
  - 1. Contractor.
  - 2. Testing Agency representative.
  - 3. Ready-mix concrete producer.
  - 4. Admixture manufacturer(s).
- B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:
  - 1. Commissioner.



- C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these Specifications.

1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

1.11 QUALITY ASSURANCE BY TESTING AGENCY

- A. Quality assurance is testing and inspection to assist The Commissioner in evaluating the Contractor's performance and quality control.
- B. Coordination with Testing Agency: The Contractor shall have sole responsibility for coordinating their work with Testing Agency to assure that all test and inspection procedures required by the Contract Documents and 2014 New York City Construction Codes are provided. Cooperate fully with Testing Agency in the performance of their work and shall provide the following:
  - 1. Information as to time of starting field construction and concrete placement schedule, one week prior to the beginning of the work
  - 2. Site File: At least one copy of each approved shop drawing shall be kept available in the Contractor's field office. Drawings not bearing evidence of approval and release for construction by the Commissioner shall not be kept on the job.
  - 3. Full and ample means of assistance for testing and inspection of material
  - 4. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field
- C. Duties of Testing Agency:
  - 1. Reports: Testing Agency shall prepare daily reports of the concrete work including progress and description/area of work, tests made and results. The daily reports shall be collected and delivered to the Commissioner weekly.
  - 2. Concrete Strength Spreadsheet Log: The Test Agency shall maintain a log that contains the results of all concrete strength tests. The log shall include the results of each test performed, be in electronic spreadsheet format, and updated and submitted along with concrete test data.
  - 3. Rejection: Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. Testing Agency shall immediately notify Commissioner, and Contractor of deficiencies.
  - 4. Remedial Work: Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Commissioner on a weekly basis.
  - 5. Certification: When all work has been approved by Testing Agency, Testing Agency shall certify in a letter to the Commissioner that the installation is in accordance with the design and Specification requirements.
- D. Field Quality Assurance
  - 1. General: Testing Agency and the Contractor's Independent Testing Agency shall test and inspect concrete materials and operations as Work progresses. Failure to detect any



defective work or material shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Commissioner for final acceptance.

2. Testing Agency is responsible for monitoring concrete placement as follows:
  - a. The Contractor's Independent Testing Agency shall provide properly instructed inspectors at site to monitor concreting operations as follows:
    - 1) Verify use of required design mix
    - 2) Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.
    - 3) Record temperature of concrete at time of placement.
    - 4) Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
    - 5) Record types and amounts of admixtures added to concrete at the project site.
    - 6) Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Commissioner.
    - 7) Monitor consistency and uniformity of concrete.
    - 8) Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:
      - a) Concrete curing.
      - b) Hot weather concreting operations.
      - c) Cold weather concreting operations.
3. Testing Agency shall conduct tests of concrete as follows and in accordance with ASTM C 1077:
  - a. Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete, nor less than once for each 2500 square feet of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by Testing Agency or Commissioner.
  - b. Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.
  - c. Determine air content of normal weight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173.



- d. Determine unit weight of lightweight concrete in accordance with ASTM C 567.
- e. Test water content of freshly mixed concrete on a random basis, a minimum of once per 100 cubic yards (75 cubic meters) or every 5000 square feet (500 square meters) of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:
  - 1) Hard troweled slabs exposed to view
  - 2) Slab to receive a bonded finish floor material
  - 3) Slabs with specified concrete compressive strength exceeding 6000 psi (42MPa)
- f. Conduct slump tests in accordance with ASTM C 143.
- g. Slump indicated in mix designs shall be achieved at point of placement. Correlation between slump at point of initial discharge from truck and point of placement must be established to determine amount of slump loss which occurs between initial discharge and point of placement. Adjustment may be necessary to achieve slump indicated in mix designs at point of placement.
- h. Conduct slump tests for Self Consolidating Concrete (SCC) as follows
  - 1) In accordance with ACI 237, where SCC is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Testing Agency, subject to review by Commissioner. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above paragraph.
  - 2) In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be reportioned at the direction of Testing Agency, subject to review by Commissioner.
- i. Conduct strength tests of concrete as follows:
  - 1) Secure sample sets in accordance with ASTM C 172.
  - 2) Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch (100mm) diameter x 8 inches (200mm) long. If 6 inch (150mm) diameter by 12 inch (300mm) long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of  $f'_c$ .



- 3) Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi (70MPa) and above, cylinders shall be ground and not capped.
  - 4) For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.
  - 5) For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.
  - 6) For 90 day mixes mold eight cylinders. Test one cylinder at seven days, one at cylinder at 28 days, two cylinders at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.
  - 7) When high early strength concrete is required by Contractor, additional cylinders shall be made and tested as required at Contractor's expense.
  - 8) If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.
4. Testing Agency shall evaluate concrete for conformance with Specifications as follows:
- a. Slump:
    - 1) Testing Agency shall maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.
  - b. Strength test:
    - 1) Testing Agency shall perform tests to ensure that the Contractor maintains a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in Work.
    - 2) Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi (3.5MPa).
    - 3) If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the Commissioner, be subject to further evaluation by core testing as specified herein or other testing methods.
  - c. Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.



- 1) Location of cores shall be coordinated with Commissioner so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.
  - 2) Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Commissioner whether cores are to be tested wet or dry.
  - 3) Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.
- d. Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.
5. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Testing Agency, and prior to the removal of shores and forms.
- E. Testing Agency shall submit for record inspection, observation, and/or test reports to Commissioner, as required herein and shall provide an evaluation statement in each report stating whether or not concrete placement conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
- F. Immediately report deficiencies to the Commissioner.

#### 1.12 QUALITY CONTROL BY CONTRACTOR

- A. Provide a program of quality control to ensure that the minimum standards specified herein are attained.
- B. Immediately notify the Commissioner of any deficiencies in the work which are departures from the Contract Documents. Propose corrective actions and their recommendations in writing and submit them for review by the Commissioner. After proposed corrective action is accepted by the Commissioner, correct the deficiency at no expense to The City of New York.
- C. Where SCC is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

#### 1.13 PERMITS AND WARRANTY

- A. Permits: Apply for, procure, renew, maintain, and pay for all permits required by the New York City Department of Buildings and 2014 New York City Building Code necessary to execute work under this Contract. Furnish copies of all permits to Commissioner.
- B. Warranty: Comply with DDC General Conditions, agreeing to restore or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:



1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
3. Areas which show surface failure or defects.
4. Areas which puddle water.
5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have an independent testing agency perform appropriate tests for bond and discoloration.
6. Patches that become crazed, cracked or sound hollow when tapped.
7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

**1.14 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  1. Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  1. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.
  2. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  3. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.15 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**PART 2 - PRODUCTS****2.1 CONCRETE MATERIALS & PRODUCTION****A. Portland Cement:**

- 1. ASTM C150, Type I or Type II
- 2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of the Commissioner. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
- 3. Provide the same brand of Portland Cement from a single source throughout the project, as required to meet Commissioner's requirements.
- 4. Provide Portland Cement that is uniform in color.

**B. Aggregates for Normal weight Concrete:**

- 1. ASTM C 33
- 2. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
- 3. Provide aggregates from a single source throughout the project for exposed concrete.
- 4. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
- 5. Do not use fine or coarse aggregates that contain substances that cause spalling.
- 6. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:
  - Size no. 57 (25mm max) for footings, drilled piers and caissons
  - Size no. 67 (20mm max) for all other locations
  - Size no. 467 or 457 for non-reinforced concrete at locations noted on Drawings.
- 7. Furnish concrete with maximum 3/8" (10mm) aggregate at no additional expense to The City of New York if areas of high reinforcement density require it for placement and consolidation.

**C. Aggregates for Lightweight Concrete:**

- 1. ASTM C 330.



2. Classification of Aggregates: As required to meet Commissioner's requirements.
  3. Provide aggregates from a single source throughout the project for exposed concrete.
  4. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.
  5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed  $\frac{3}{4}$ " (20mm)
- D. Water: ASTM C 94. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.
- E. Supplementary Cementitious Material
1. Fly Ash:
    - a. ASTM C 618, Class C or Class F.
    - b. Shall not be used unless part of an approved mix design.
    - c. Limit Loss on Ignition to 2.5%
  2. Ground Granulated Blast-furnace Slag (GGBFS)
    - a. ASTM C 989.
    - b. Shall not be used unless part of an approved mix design.
  3. Silica Fume (Microsilica):
    - a. ASTM C 1240
    - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) W. R. Grace "Force 10,000 D"
      - 2) Euclid Chemical Company "Eucon MSA"
      - 3) BASF "MasterLife SF 100"
      - 4) Sika Corporation "Sikacrete 950 DP"
      - 5) Or approved equal.
  4. For concrete subject to Exposure Class F3 conditions as defined in ACI 318, Table 4.2.1, limit the maximum content of supplementary cementitious materials to values shown in ACI 318, Table 4.4.1.
  5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.
  6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with Specifications.
  7. Fly ash and GGBFS used shall be from one source throughout the project. Substitution of sources will be approved only if testing of concrete mixes containing the substituted



material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Commissioner.

F. Ready Mixed Concrete:

1. Shall be batch-mixed and transported in accordance with ASTM C 94.

G. Self-Consolidating Concrete:

1. Produce in accordance with ACI 237R.
2. Perform the following tests and provide report prior to submitting mix design:
  - a. Resistance to Segregation: Achieve a maximum static segregation percentage of 15% when tested according to ASTM C 1610 with a VSI index of 1 maximum.
  - b. Slump Flow: ASTM C 1611 within a range of 20"-30"
  - c. Passing Ability: ASTM C 1621 with a maximum difference of 2" (50mm) between testing with and without the J-Ring.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings

B. Concrete Density (Unit Weight):

1. Shall be as indicated on the Structural Drawings

C. Air Entrainment

1. For concrete exposed to freeze/thaw cycles and/or deicing chemicals, and concrete intended to be watertight, provide entrained air content of  $6\% \pm 1.5\%$ , unless specified otherwise. This includes, but is not limited to, concrete at the following locations:
  - a. Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams, foundation walls, exterior walls and parapets, exposed columns and edge beams.
  - b. Concrete in parking garages.
  - c. Ramps and loading docks.
  - d. Balconies and terraces with no waterproof membrane.
2. For lightweight concrete less than 120 pcf ( $19 \text{ kN/m}^3$ ) density, air content may be up to 7% regardless of exposure condition.
3. For concrete with a specified compressive strength ( $f'_c$ ) greater than 5000 psi (35MPa), required air content may be reduced to  $5\% \pm 1.5\%$ .



4. Entrained air content noted above shall occur at point of delivery.
5. No entrained air content is required in concrete placed in the foundation with no surface exposed to weather.
6. All interior steel trowel finished, normalweight slabs shall have a maximum air content of 3%.

**D. Water-Cementitious Materials (W/cm) Ratio for Normalweight Concrete**

1. Unless lower limits are stated in the Contract Documents, all concrete exposed to freezing and thawing in moist condition and/or required to be watertight shall have a maximum W/cm ratio of 0.45.
2. All concrete exposed to deicing salts, brackish water seawater or spray from these sources shall have a maximum W/cm ratio of 0.40.
3. Absent the above conditions, all concrete with required strength of 4000 psi (28MPa) or higher shall have a maximum W/cm ratio of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash or pozzolanic admixtures shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

**E. Slump**

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in Testing Agency responsibilities:
  - a. Concrete with high range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" (75mm) for normalweight concrete and 4" (100mm) for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" (225mm) unless otherwise approved by the Commissioner.
  - b. Concrete without a water-reducing admixture: Slump shall not exceed 4".

**F. Self-Consolidating Concrete Slump/Flow:** Use for concrete exposed to view and heavily reinforced areas where indicated on the plans, and where conventional mixtures do not provide adequate consolidation. Minimum slump/flow diameter of 20" or as required by the successful test placement onsite, which shall verify proper workability, finish, and setting time. All self-consolidating concrete shall contain the specified high range water-reducing admixture. All self-consolidating concrete shall contain viscosity modifying admixture as required unless proper quantity and grading of fines can be achieved.

**G. Chloride Ion Content**

1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 4.3 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.



2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional expense to The City of New York.

## 2.3 ADMIXTURES

### A. General:

1. Admixtures specified below can be used only when established in the mix design with Commissioner prior written approval.
2. Each admixture approved by Commissioner shall be used in strict compliance with manufacturer's published instructions.
3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

### B. Air Entraining Admixture:

1. ASTM C 260
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. "MasterAir AE 200" or "MasterAir -AE 90"
  - b. W. R. Grace "Darex Series" or "Daravair Series"
  - c. Euclid Chemical Company "AEA -92 or Air 40"
  - d. Sika Corporation "Sika Air Series" or "Sika AEA Series"
  - e. Or approved equal.

### C. Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF "MasterPozzolith 210"
  - b. Euclid Chemical Company "EUCON NW" or "EUCON WR 91"
  - c. W. R. Grace "WRDA" Series, Zyla Series or "Mira" Series
  - d. Sika Corporation "Plastocrete Series"
  - e. Or approved equal.

### D. Retarding Admixture:

1. ASTM C 494, Type B
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF "Masterset R 100"
  - b. Euclid Chemical Company "EUCON RETARDER 100"
  - c. W. R. Grace "Daratard 17"
  - d. Sika Corporation "Plastiment Series"
  - e. Or approved equal.



- E. Non Corrosive Accelerating Admixture:
1. ASTM C 494, Type C
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF "POZZUTEC 20" or "Masterset NC 534"
    - b. Euclid Chemical Company "ACCELGUARD 80", "ACCELGUARD NCA" or "ACCELGUARD 90"
    - c. W. R. Grace "Daraset" Series, "Polarset", or "DCI"
    - d. Sika Corporation "Sikaset NC" or "Plastocrete 161 FL" or "Sika Rapid-1"
    - e. Or approved equal
- F. Water-Reducing and Retarding Admixture:
1. ASTM C 494, Type D
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF "Masterset R 100"
    - b. Euclid Chemical Company "EUCON RETARDER 75" or "EUCON DS"
    - c. W. R. Grace "Daratard 17" or "Recovery Series"
    - d. Sika Corporation "Plastiment Series"
    - e. Or approved equal.
- G. Water-Reducing and Accelerating Admixture:
1. ASTM C 494, Type E
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF "Masterset FP 20"
    - b. Euclid Chemical Company "ACCELGUARD 80" or "ACCELGUARD 90". R. Grace "Libricon NCA"
    - c. Sika Corporation "Sikaset NC" or "Plastocrete 161 FL"
    - d. Or approved equal.
- H. Mid-Range Water-Reducing Admixture:
1. ASTM C 494, Type A
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF "MasterPolyheed Series"
    - b. W. R. Grace "Daracem" or "Mira"
    - c. Sika Corporation "Sikaplast Series" or "Sikament Series"
    - d. Euclid Chemical Company: "Eucon MR" or "Eucon MRX"
    - e. Or approved equal.
- I. High-Range Water-Reducing Admixture:
1. ASTM C 494, Type F



2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF "PS 1466" or "MasterGlenium Series"
  - b. Euclid Chemical Company "EUCON 37" or "PLASTOL SERIES"
  - c. R. Grace "Daracem" or "ADVA" Series
  - d. Sika Corporation "Viscocrete Series" or "Sikament Series"
  - e. Or approved equal
- J. High-Range Water-Reducing and Retarding Admixture:
  1. ASTM C 494, Type G
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Euclid Chemical Company "EUCON 537"
    - b. W. R. Grace "Daracem Series" or "Adva Series"
    - c. BASF Rheobuild 561
    - d. Or approved equal.
- K. Viscosity Modifying Admixture (VMA) for Self-Consolidating Concrete (SCC):
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF "MasterMatrix VMA Series"
    - b. W.R. Grace "V-MAR3"
    - c. Euclid Chemical Company "EUCON ABS" or "EUCON WO" or "Visctrol"
    - d. Sika Corporation "Sika Stabilizer Series"
    - e. Or approved equal.
- L. Corrosion Inhibiting Admixtures:
  1. Calcium Nitrite Based: ASTM C 494, Type C, 30% + 2% solution
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) W.R. Grace "DCI or DCI-S"
    - 2) Euclid Chemical Company "EUCON CIA"
    - 3) Sika Corporation "Sika CNI"
    - 4) Or approved equal.
- M. Shrinkage Reducing Admixtures:
  1. ASTM C 157
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. W.R. Grace "Eclipse 4500" (for use with air-entrained concrete exposed to freeze/thaw), or "Eclipse Floor 200"
    - b. Euclid Chemical Company "EUCON SRA" or "Conex"
    - c. Sika Corporation "Sika Control 40"
    - d. Or approved equal

2.4 FIBER REINFORCEMENT

A. General:

1. Fiber reinforcement specified below can be used only with Commissioner prior written approval.
2. See Drawings for location of Fibers.
3. Where macro synthetic fiber reinforcement is proposed to replace welded wire reinforcement, demonstrate that proposed material and dosage rate provides equivalent performance to welded wire reinforcement indicated on Drawings.
4. Fiber reinforcement shall not replace reinforcing bars shown on Drawings.

B. Synthetic Fibrillated or Monofilament Micro Fibers (low volume synthetic used for reduction of plastic shrinkage)

1. ASTM C 1116, Type III
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. W.R. Grace "Grace Fibers", "Grace Microfibers"
  - b. Euclid Chemical Company "Fiberstrand 100 or Fiberstrand 150"
  - c. Sika Corporation "Sika Fiber PPM" or "Sika Fiber PPF" or Sika Fiber HP"
  - d. Or approved equal.

C. Macro Synthetic Fibers (high volume synthetics used for reduction of plastic and drying shrinkage cracking)

1. ASTM C 1116, Type III, minimum of 1.55 inches (40 mm) length, aspect ratio of 50 to 90. The fiber shall have a minimum average residual strength (ARS) of 200 psi (1.4MPa) measured as per ASTM C 1399/ASTM C 1609 "Test Method for Obtaining Average Residual Strength of Fiber-Reinforced Concrete".
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. W.R. Grace "Strux 90/40"
  - b. Euclid Chemical Company "Tuf-Strand SF"
  - c. Sika Corporation "Sika Fiber MS 20"
  - d. Or approved equal.

D. Carbon Steel Fibers (smooth or deformed)

1. ASTM C1116, Type 1 and A820
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bakaert Corporation's "Dramix 65/60"
  - b. Fiber con International, Inc's "Fibercon"
  - c. Sika Corporation "Sika Fiber S or Sika Fiber SH Series"
  - d. Or approved equal.



## 2.5 ADHESIVES

- A. Bonding Agent for Cured Concrete (existing concrete damp or dry, at least 28 days old, no surface water):
1. ASTM C 881 Type I and IV, Grade 3, Class B and C.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF "MasterEmaco ADH 327", Class C Only
    - b. Euclid Chemical Company "EUCO #452 Epoxy System"
    - c. Euclid Chemical Company "DURALCRETE LV Series"
    - d. Euclid Chemical Company "FLEXOCRETE System" for bonding topping
    - e. Or approved equal.

- B. Bonding Agent for Uncured Concrete: (existing concrete damp or dry, less than 28 days old, no surface water):
1. ASTM C 881, Type II and V, Grade 2, Class B and C.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Euclid Chemical Company "DURALCRETE MV System"
    - b. Sika Corporation "Sikadur 32 Hi-Mod"
    - c. BASF "MasterEmaco ADH 326" Class C Only
    - d. Or approved equal.

- C. Anti-Corrosive Epoxy Cementitious Bonding Compound and Corrosion Protection of Reinforcement (bonding agent for existing concrete saturated surface dry, no surface water):

This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "DURALPREP AC"
  - b. Sika Corporation "ARMATEC 110"
  - c. BASF "MasterEmaco P 124"
  - d. Or approved equal

- D. Adhesive Between Cured Concrete Elements:

1. ASTM C 881 Type I and IV, Grade 3, Class B and C
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Sika Corporation "Sikadur 31 Hi-Mod Gel (1:1 Mix Ratio)"
  - b. Euclid Chemical "Dural Fast Set Gel"
  - c. BASF "MasterEmaco ADH 1490"
  - d. Or approved equal

## 2.6 CURING COMPOUNDS AND SEALERS

### A. Interaction with finishes:

1. See architectural Drawings for finish material applied over concrete.
2. Use only curing and sealer compounds that are compatible with finish material.
3. Manufacturer's certification is required.
4. Where finish material is liquid rubberized asphalt, use only strippable type curing compound.

### B. Curing and Sealing Compound (VOC Compliant, 350 g/l):

1. ASTM C1315, Type I, Class A and ASTM C 309, Type 1, Class A or B
2. Water based acrylic, clear, 25% solids curing and sealing compound.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "Super Diamond Clear VOX"
  - b. Dayton Superior "Cure & Seal J22WB)
  - c. BASF (Sonneborn) "Kure 1315"
  - d. W.R. Meadows "VOCOMP-25"
  - e. Or approved equal

### C. Curing Compound-Dissipating/Strippable (VOC Compliant, 350 g/l):

1. ASTM C 309, Type I, Class A or B
2. Water based resin, clear curing compound that begins to dissipate when exposed to UV light and traffic.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "Kurez DR VOX" (Dissipating) or "Kurez RC" in combination with "Kurez RC-Off" (Strippable)
  - b. Dayton Superior "Clear Resin Cure J11W"
  - c. W.R. Meadows: "1100 Clear"
  - d. Or approved equal

## 2.7 SEALERS

### A. Surface Sealer:

1. ASTM C 309, Type I, Class A or B
2. Water based acrylic sealing compound.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "DIAMOND CLEAR VOX"
  - b. Dayton Superior "Cure & Seal 309 EF"



- c. BASF "MasterKure CC 200WB"
- d. "W.R. Meadows "VOCOMP 20"
- e. Or approved equal

**B. Liquid Densifier/Sealer:**

- 1. The liquid densifier compound shall be a silicate based compound that penetrates and chemically hardens concrete surfaces.
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "Euco Diamond Hard"
  - b. Dayton Superior "Densifier J13"
  - c. BASF "MasterKure HD 200WB"
  - d. W.R. Meadows "Liqui-Hard"
  - e. Or approved equal

**2.8 DRY SHAKE HARDENERS**

**A. Mineral Aggregate Hardener:**

- 1. The specified mineral aggregate hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specially processed graded mineral aggregate, selected Portland cement and necessary plasticizing agents
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company, "Surflex" to be used with "Kurez DR VOX"
  - b. BASF, "MasterTop 100 to be used with "Masterkure CC 200WB"
  - c. L&M Construction Chemicals "Ferrocon FF" to be used with "Dress & Seal WB 30"
  - d. Or approved equal

**2.9 MISCELLANEOUS CONCRETE PRODUCTS**

**A. Nonshrink Grout**

- 1. Provide pre-packaged natural aggregate grout, high-precision, nonshrink, ready-to-use, complying with the following requirements:
  - a. See General Notes in structural drawings for grout minimum compressive strength.
  - b. Grout shall conform to ASTM C 1107
- 2. All material used including water, mixer and pre-packaged grout must be initially at the 45°F (7°C) and 90°F (32°C) limits when testing is initiated.
- 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF "MASTERFLOW 928"
  - b. Euclid Chemical Company "HI-FLOW GROUT"
  - c. Five Star Products "Five Star Grout"
  - d. Sika Corporation "Sikagrout 328"
  - e. Or approved equal

2.10 MISCELLANEOUS PRODUCTS

A. Evaporation Retarder:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF "Masterkure ER50"
  - b. Euclid Chemical Company "Eucobar"
  - c. Sika Corporation "Sika Film"
  - d. Or approved equal

B. Moisture-Retaining Covers:

1. Conforming to ASTM C171. A naturally colored, non woven polypropylene fabric with a 4 mil non perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hydracure S-16 by PNA Construction Technologies, Inc., Matthews, NC
  - b. Transguard 4000 by Reef Industries (Armorlon Division), Incorporated, Houston TX
  - c. McTech Group "UltraCure DOT"
  - d. Or approved equal

C. Sand Cushion: Clean, manufactured or natural sand.

D. Expanded Polystyrene (EPS) used as Fill - Geofoam

1. Material: Rigid, closed cell polystyrene blocks formed by expansion of polystyrene beads by steam.
2. Comply with the requirements of ASTM D 6817
3. Unless noted otherwise on the drawings, provide the following types of EPS:
  - a. Fill between a lower slab and a raised slab area: EPS12 -2.2 psi (15 kPa) compressive resistance minimum at 1% deformation, 10 psi (70 kPa) flexural strength minimum
  - b. Typical below interior floor slabs supported on grade (soil fill over EPS fill) or directly on EPS fill: EPS15 - 3.6 psi (25 kPa) compressive resistance minimum at 1% deformation, 25 psi (170 kPa) flexural strength minimum
  - c. Fill below exterior floor slabs or slabs with truck loading: EPS19 - 5.8 psi (40 kPa) compressive resistance minimum at 1% deformation, 30 psi (200 kPa) flexural strength minimum
4. Thickness as indicated on Drawings.
5. Execution: Conform to manufacturer's instructions regarding preparation, installation and protection
6. Gripper plates shall be used as needed to restrain EPS from moving laterally in multi-layer applications



7. Sequence soil or concrete topping placement to avoid EPS block shift or flotation.
  8. Submit the following for review:
    - a. Manufacturer's product literature including physical properties in compliance with ASTM D 6817 and type specified
    - b. 10 year manufacturer warranty
    - c. Proposed plan layout of fill blocks showing gaps between blocks where required for stabilizing and/or load bearing reinforced concrete ribs as shown on drawings, in details or in notes.
  9. Submit the following for record:
    - a. Summary of test compliance with specified performance characteristics and physical properties
    - b. Product Certificates showing evidence of third party quality control
  10. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foam Control EPS Geofoam by AFM Corporation, Lakeville, MN
    - b. EPS Geofoam by Styrotech, Brooklyn Park, MN
    - c. EPS Geofoam by Universal Foam Products, Hunt Valley, MD
    - d. EPS Geofoam by Dyplast Products, Miami, FL
    - e. Or approved equal
- E. Vapor Retarder: See Division 7, Thermal and Moisture Protection
1. Minimum 15-mil thick polyolefin geomembrane
  2. Manufactured with prime virgin resins
  3. Water Vapor Retarder: ASTM E 1745, meets or exceeds Class A
  4. Water Vapor Transmission Rate: ASTM E 96, 0.008 gr./ft<sup>2</sup>/hr. (0.086 gr./m<sup>2</sup>/hr) or lower
  5. Permeance Rating: ASTM E 96, 0.03 perms or lower for new material and after conditioning tests in accordance with applicable sections of ASTM E 154
  6. Puncture Resistance: ASTM E 1745, minimum 2400 grams
  7. Tensile Strength: ASTM E 1745, minimum 45.0 lbs./in (8.0 kg/cm).
  8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. W.R.Grace, "Florprufe 120"
    - b. W. R. Meadows, "Perminator"
    - c. Stego Industry LLC, "Stego Wrap"
    - d. Raven Industries, "Raven Vapor Block 15".
    - e. Or approved equal
- F. Non-Slip Aggregate:



1. Abrasive aggregate shall be composed of an aluminum oxide abrasive bonded by a vitreous ceramic material. Use hard, homogeneous, non-glazing, rustproof aggregate which is unaffected by moisture or cleaning compounds.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "NON-SLIP AGGREGATE"
  - b. North Company "Alundum"
  - c. Anti-Hydro International "A-H A-2 Emery Shake-On" or "A-H Aloxx"
  - d. Or approved equal

## 2.11 CONCRETE RESTORATION MATERIALS

### A. Polymer Repair Mortar

1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Commissioner is required.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. (Horizontal Repairs): Euclid Chemical Company "Thin Top Supreme or Tammspatch II" (for 1/16" (2mm) to 3/8" (10mm) thickness), or "Concrete Top Supreme" (for 3/8" (10mm) to 2" (50mm) thickness).
  - b. (Horizontal Repairs): Sika Corporation "Sikatop 121 Plus" or "Sikatop 122 Plus".
  - c. (Vertical and Overhead Repairs): Euclid Chemical Company "Verticoat", "Verticoat Supreme", or "Duraltop Gel"
  - d. (Vertical and Overhead Repairs): Sika Corporation, "Sikatop 123 Plus".
  - e. (Horizontal, Vertical and Overhead Repairs): BASF, "EMACO 100"
  - f. Or approved equal.

### B. High Strength Flowing Repair Mortar

1. For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" (10mm) aggregate.
2. The product shall achieve 9000 psi (62MPa) @ 28-days at a 9-inch (225mm) slump.
3. Prior approval by the Commissioner is required for cold weather applications
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "Eucocrete"
  - b. BASF "EMACO S" Series
  - c. Sika Corporation "Sika Repair 211 SCC Plus"
  - d. Or approved equal

### C. Repair Topping

1. Latex and microsilica modified cementitious mortar topping, which meets or exceeds the bond strength requirements of ASTM C 1059.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Euclid Chemical Company, "Thin-Top Supreme or Tammspatch II"
- b. Sika Corporation "Sika Repair 211 SC Plus"
- c. W.R Meadows "Meadow-Crete GPS"
- d. Or approved equal

D. Epoxy Injection:

1. ASTM C881, moisture insensitive maximum viscosity 350 cps at 77°F (25°C).
2. Product: BASF "Concresive 1380"
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Euclid Chemical Company "Eucopoxy Injection Resin"
  - b. Sika Corporation "Sikadur 35, LV, LPL"
  - c. BASF "Masterinject 1380"
  - d. Or approved equal

E. Pressure-Injected Foam Resin:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. DeNeef "HA Sealform"
  - b. 3M "ScotchSeal 5600"
  - c. Sika Corporation "SikaFix HH"
  - d. Or approved equal

F. Semi Rigid Epoxy:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. METZGER/McGUIRE "MM-80 Semi Rigid Epoxy Joint Filler"
  - b. BASF "MasterSeal CR 190"
  - c. W.R Meadows "Rezi-Weld Flex"
  - d. Or approved equal

G. Methyl Methacrylate (MMA)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Transpo Industries, Inc. "T-78 Methyl Methacrylate Polymer Crack Healer/Sealer"
  - b. BASF "MasterSeal 360"
  - c. Epoxy Systems "MMA #684 LV"
  - d. Or approved equal

H. Sealant:

1. Silicone or Polyurethane Sealant (as selected based on project requirements such as loading, traffic, bond, coatings, etc.).
2. Joint to be routed and cleaned per manufacturer's written directions.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 PREPARATION**

A. Subgrade:

1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.
  - a. Omit when subgrade is already damp.
2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
3. Do not place concrete on frozen ground.

B. Forms:

1. Coordinate with Section 03 10 00 Concrete Formwork.
2. Remove dirt, sawdust, nails and other foreign material from formed space.
3. Dampen wood forms by sprinkling immediately before placing.
4. Cool metal forms by sprinkling immediately before placing.

C. Concrete Accessories:

1. Coordinate with Section 03 10 00 Concrete Formwork.

D. Dewatering:

1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to DDC General Conditions for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.

1. Vapor retarder installation shall be in accordance with manufacturer's instructions and ASTM E 1643.
2. Place vapor retarder under slabs-on-grade in position with longest dimension parallel with direction of pour.
3. Joints: Lap 6" (150mm) minimum and seal with manufacturer's recommended mastic or pressure-sensitive tape.





4. Prevent damage to moisture barrier.
5. If moisture barrier is damaged, place a piece of moisture barrier over damaged area (6" (150mm) larger all around) and tape in place with type of tape recommended by moisture barrier manufacturer.
6. Seal laps and intersections of walls with compatible trowel mastic or pressure-sensitive sealing tape.
7. Seal around pipes and other penetrations with compatible trowel mastic.
8. The vapor barrier must be approved prior to concrete placement.

### 3.3 JOINTS IN CONCRETE

- A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.
  1. Do not use contraction joints in framed floors or composite slabs.
  2. Locate and install construction joints so they do not impair strength or appearance of the structure, as approved by Commissioner.
  3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.
    - a. Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Commissioner.
  4. Maximum joint spacing is as indicated on Drawings.
- B. Construction Joints:
  1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.
  2. Horizontal Joints: Horizontal construction joints other than those shown on the Drawings will not be permitted unless approved by the Commissioner.
  3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen to 1/4" 6 mm amplitude. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces



C. Isolation Joints:

1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Contraction Joints in Floor Slabs-on-Grade:

1. Maximum slab area controlled by jointing is 400 square feet (35 square meters).
2. Space joints at 36 times slab thickness unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
3. Contraction joints can be provided by sawcuts, formed joints or appropriately detailed construction joints.
4. Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate. Early-entry dry cutting green concrete joint saw with anti-ravel skid plate shall be used to a depth of  $\frac{1}{4}$  of slab thickness immediately after final finishing. Conventional saw shall be used as soon as possible after final finish without raveling to a depth as indicated on the Drawings.
5. Where contraction joints coincide with construction joints, detail joint as indicated on Drawings.

E. Joint Fillers: Coordinate with Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies" and Division 7 requirements.

3.4 MIXING

A. Measurement of Materials: Conforming to ASTM C 94

B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of Testing Agency.
3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.

C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.

1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.
2. If the superplasticizer is redosed at the jobsite in air entrained concrete, air content must be checked after mixing.

- D. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

### 3.5 CONCRETE PLACEMENT

A. Prior to Concrete Placement:

1. Mechanical vibrators are required and must be available for placing concrete.
2. Remove debris from space to be occupied with concrete.
3. Notify Commissioner and Testing Agency 48 hours prior to starting concrete placement.
4. Approved mix designs must be maintained on file in Contractor's Field Office.
5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies" and Drawings.
6. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
7. Do not place concrete having a slump outside of allowable slump range.
8. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills. Placement upon soft mud or dry earth is not permitted.
9. Unless adequate protection is provided, concrete shall not be placed during rain.
10. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
11. At surfaces left exposed to view, do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
12. Keep subgrade moisture uniform without puddles or dry areas.
13. Place vapor retarder directly below slabs on grade as specified in Contract Documents.

B. For Conduits and Pipes Embedded in Concrete:

1. For concrete slab, wall, beam or column, conform to requirements of ACI 318, Chapter 6. For variations from these requirements, submit a written request for Commissioner review and response.
2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Commissioner.
3. Provide sleeves for pipes passing vertically through concrete.
4. Do not embed aluminum materials.



5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.
- C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.
- D. Placing Concrete in Forms:
1. Clean and prepare forms as specified in Section 03 10 00 "Concrete Formwork".
  2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
  3. Deposit concrete in forms in horizontal layers no deeper than 24" (600mm) and in a manner to avoid inclined construction joints.
  4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
  5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.
    - a. Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
  6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
  7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
  8. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
  9. Do not insert vibrators into lower layers of concrete that have begun to set.
  10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
  11. Do not vibrate Self-Consolidating Concrete (SCC).
- E. Placing Concrete Slabs:
1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
    - a. Place slabs on grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.
  2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
  3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.



4. Bring slab surfaces to correct level with a straightedge and strike off.
  - a. Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
  - b. Do not disturb slab surfaces prior to beginning finishing operations.
5. Maintain reinforcing in proper position on chairs during concrete placement.
6. Do not place materials on slabs or impose loads during period of setting.

**F. Placing Concrete on Steel Decks**

1. Exercise care during concrete placement on steel decks to prevent concentrated loads or high pile-ups of concrete and to avoid impacts caused by dumping or dropping of concrete on steel decks.
2. Do not use buggies on unprotected areas of deck. If buggies are used to place concrete, furnish and install planked runways to protect deck from damage.

**G. Placing Concrete at Construction Joints:**

1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.
2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7 inches (180mm) or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches (200 to 250mm)) while maintaining pressure against vertical joints by confinement.
4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

**H. Floor Topping Slabs:**

1. Place concrete topping slab to required lines and levels.
2. Minimum topping slab thickness is 2" (50mm).
3. Place dividers, edge strips and other items to be cast in place.
4. At all topping slabs, remove deleterious material before placing topping slab.
5. At topping slabs placed directly against base slab, remove deleterious material and dampen base slab with water immediately before placing concrete. Leave no standing water.



6. Unless noted as a “bonded” topping slab on the Drawings, topping slabs thinner than 4” (100mm) should be placed directly against dampened base slab with no bonding agent. Topping slabs 4” (100mm) or thicker should be placed on bond breaker consisting of two sheets of plastic film.
  7. Where noted on Drawings as a “bonded” topping slab, broom/vacuum clean unsealed surfaces or wire brush sealed or troweled surfaces to expose bare rough surface. Then place approved bonding grout or epoxy adhesive on the base slab per manufacturer’s instructions.
  8. The topping mix shall have a maximum water/cement ratio of 0.45.
  9. The topping mix shall have a maximum shrinkage of 0.04% in 28 days.
  10. The topping mix shall contain a minimum of 5 lbs. per cubic yard (2.43 kg/m<sup>3</sup>) of macro synthetic fibers and achieve an Average Residual Strength (ARS) of 200 psi (1.4MPa) unless a higher dosage or ARS is noted on the plans.
  11. The topping slab shall be moist cured for a minimum of 36 hours after placement.
  12. The topping slab shall have contraction joints located to match any joints in the base slab, to eliminate restraint conditions such as re-entrant corners and to isolate the slab from columns, walls, etc. and to limit the maximum distance between joints to 15 feet (4570mm).
- I. Cold-Weather Placement:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.
  2. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C), at point of placement.
  3. Do not use frozen materials or materials containing ice or snow.
    - a. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
  5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.
- J. Hot-Weather Placement:
1. Hot weather is defined as air temperature which exceeds 90°F (32°C) or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m<sup>2</sup> per hour) as determined by ACI 305R.



2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F.
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

### 3.6 CONCRETE FINISHES

#### A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117.
3. For shored floor or slab on grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than 72 hours of concrete placement by Testing Agency.
4. See architectural Drawings for locations of the various finishes listed below.
5. Comply with the specified overall SOFF and SOFL values listed below:
  - a. The specified overall area shall be each individual floor.
  - b.  $F_F/F_L$  shall be measured in accordance with ASTM E 1155.
  - c. The specified minimum local values of  $MLF_F/MLF_L$  shall be 3/5 of the  $SOF_F/SOF_L$  values listed below.
  - d. If an individual test section measures less than either of the specified minimum local  $MLF_F/MLF_L$  numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE RESTORATION.
  - e. If the composite value of the test surface measures less than either of the specified overall  $SOF_F/SOF_L$  numbers, then the entire slab may be rejected and remedial measures may be required.
  - f.  $F_L$  numbers shall not apply to unshored slabs or shored slabs with camber.



- B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural Drawings:
  - 1. Scratch Finish.
    - a. Finish surface to overall value of  $SOF_F=20$  and  $SOF_L=15$ .
    - b. Slope surfaces uniformly to drains where required.
    - c. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, as indicated on architectural Drawings:
  - 1. Float Finish.
    - a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
    - b. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
    - c. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
    - d. Finish surfaces to overall value of  $SOF_F=20$  and  $SOF_L=15$ .
    - e. Cut down high spots and fill low spots.
    - f. Uniformly slope surfaces to drains.
    - g. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural Drawings:
  - 1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
  - 2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
  - 3. Finish surface to overall value of  $SOF_F=20$  and  $SOF_L=15$ .
  - 4. Texture shall be approved by the Commissioner from sample panels.
- E. Finish for interior floor slab surfaces exposed to view and slab surfaces to be covered with resinous flooring, epoxy-resin terrazzo, paint or other thin film-finish coating systems, as indicated on architectural Drawings:
  - 1. Trowel Finish.





- a. After floating, begin first trowel-finish operation using a power-driven trowel.
  - b. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
  - c. The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
  - d. Grind smooth any surface defects that would telegraph through applied floor covering system.
2. Finish surface to overall value of  $SOF_F=25$  and  $SOF_L=20$ .
  3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
  4. Floor Edges at Expansion Joints: Tool edges minimum 3/8" (10mm).
  5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
  6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
  7. Dry Cement: Shall not be used during finishing.

**F. Tolerances at Slab Discontinuities**

1. Within 2 ft (600mm) of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the Contract Documents, the following equivalent straightedge tolerances shall apply:
  - a. Specified local  $MLF_F = 12$ , use 1/4" (6mm) over 4 ft (1200mm), no offset greater than 1/16" (2mm)
  - b. Specified local  $MLF_F = 15$ , use 1/8" (3mm) over 4 ft (1200mm), no offset greater than 1/32" (0.8mm)

**G. Dry Shake Finish:**

1. Non-slip aggregate where indicated on Drawings.
2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. (7.3 kg/m<sup>2</sup>) and in other locations so noted on the Drawings.
3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. (5.8 kg/m<sup>2</sup>) where noted on the Drawings.
4. Final finish type, method and tolerance as applicable by location and use.
5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.

**H. Rough Formed Finish:**

1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas restored and patched, and fins and other projections exceeding 1/4" (6mm) in height rubber down or chipped off.

**I. Smooth Formed Finish:**

1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural Drawings.
2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Restore and patch tie holes and defects. Remove fins and other projections completely.

**J. Smooth Rubbed Finish:**

1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural Drawings, which have received smooth form finish treatment not later than one day after form removal.
3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
  - a. Do not apply cement grout other than that created by the rubbing process.

**K. Grout-Cleaned Finish:**

1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural Drawings, that have received smooth-formed finish treatment.
2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

**L. Unformed Surfaces:**



1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.7 CURING AND PROTECTION

#### A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.
2. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High early strength concrete usage shall be maintained over 50°F (10°C) for three days.
3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
5. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
  - a. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
    - 1) Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).
    - 2) Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
    - 3) Recoat areas subjected to heavy rainfall within 3 hours after initial application.
    - 4) Maintain continuity of coating and repair damage during curing period.
    - 5) Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
    - 6) Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent.
    - 7) Hand-brooming and sweeping is not sufficient.
    - 8) Strippable curing compound may be used in lieu of a moist curing method when approved by the Commissioner.
  - b. Provide moist curing by the following methods:
    - 1) Keep concrete surface continuously wet by covering with water.
    - 2) Use continuous water-fog spray.



- 3) Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4" (100mm) lap over adjacent absorptive covers.
- c. Provide moisture-retaining cover curing as follows:
  - 1) Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" (75mm) and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period using cover material and waterproof tape
6. Cure slabs on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.
7. Cure surfaces exposed to deicing salts, brackish water, etc., such as loading dock slabs, parking garage slabs and ramps in accordance with ACI 308 recommendations for moist curing.
8. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by leaving forms in place for the full curing period (equivalent to moist curing).
  - a. If forms are removed prior to completion of full curing period, continue curing by methods specified above for Unformed Surfaces, as applicable.
- B. Cold-Weather Protection:
  1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F (4°C) for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.
- C. Hot-Weather Protection:
  1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.
    - a. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
  2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.
- D. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

### 3.8 CONCRETE RESTORATION

- A. Concrete Restoration refers to concrete work that is a required result of damage or adverse effects of other construction work.
- B. Perform patching and repairs in accordance with ACI 301.
- C. Submit patching and restoration methods and materials for review by Commissioner.
- D. When complete, all patches and restoration shall match color and texture of adjoining surfaces.
- E. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by Commissioner to verify restoration color and texture match before proceeding with restoration.
- F. Apply all patching and restoration materials in accordance with manufacturer's specifications.
- G. Restoring Cracks In Formed and Unformed Surfaces:
  - 1. Notify Commissioner of all cracks wider than 0.02" (0.50mm) and all cracks wider than 0.01" (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Commissioner deems restoration necessary, Contractor shall be responsible for restoring all such cracks per Commissioner recommendation at no expense to The City of New York. Restorations will generally require one or more of the following: Epoxy Injection, Semi-Rigid Epoxy, Pressure Injected Foam Resin, Methyl Methacrylate and/or Sealant with joint routed and cleaned. See Concrete Restoration Materials section of this Specification for approved products.
- H. Restoring Formed Surfaces
  - 1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
  - 2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
  - 3. Remove stains from rust, grease and oils, from release agents, etc.
  - 4. Remove and replace concrete having defective surfaces if defects cannot be restored to satisfaction of the Commissioner.
    - a. Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
    - b. Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" (25mm) and saw-cut edges to prevent feather edging of fill material.
  - 5. Restore concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be restored, remove and replace concrete.
  - 6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.



7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

I. Restoring Unformed Surfaces:

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.
  - a. Correct high areas by grinding after concrete has cured at least 14 days.
  - b. Correct low areas by applying leveling material. Finish leveling material as specified in this section.
2. Restore surfaces containing defects that affect durability of concrete.
  - a. Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
3. Restore defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.
  - a. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

- J. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.9 EVALUATION AND ACCEPTANCE OF CONCRETE

- A. In accordance with ACI 301, except where otherwise specified.
- B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 article of this section, - SUBMITTALS.

**END OF SECTION 03 30 00**

**SECTION 03 33 00****ARCHITECTURAL CONCRETE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. This specification covers requirements for the materials and production of cast-in-place architectural concrete walls with formliner surface finishes.
2. Concrete retaining walls at plaza raised plant beds.
3. Freestanding Perimeter Wall along the eastern perimeter of the 116<sup>th</sup> Precinct station House Parking Lot.
4. Between the 105th Precinct Annex parking lot and North Conduit Avenue.
5. Exterior architectural concrete column encasements beneath overhang on south side of building.

B. Related Sections:

1. Section 03 10 00 "Concrete Formwork"
2. Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies"
3. Section 03 30 00 "Cast-in-Place Concrete"
4. Section 03 45 00 "Precast Architectural Concrete"
5. Section 03 48 00 "Precast Concrete Specialties"
6. Section 07 92 00 "Joint Sealants"
7. Section 10 75 00 "Flagpoles"
8. Section 32 05 16 "Aggregate Materials"
9. Section 32 31 19 "Decorative Metal Fences"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 REFERENCES

- A. Standards of the organizations referred to in this specification are listed below with their serial designations. The most recently published versions of the referenced standards are declared to be a part of this specification as if fully set forth herein.
- B. American Concrete Institute (ACI)
  1. 117 Specifications for Tolerances for Concrete Construction and Materials
  2. 301 Specifications for Structural Concrete for Buildings
  3. 315 (Revised 1986; Reapproved 1991) Details and Detailing of Concrete Reinforcement
  4. 306.1 Specification for Cold Weather Concreting
  5. 318 Building Code Requirements for Reinforced Concrete
  6. 347 Guide to Formwork for Concrete
- C. American Society for Testing and Materials (ASTM)
  1. A185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  2. A493 Specification for Stainless and Heat Resisting Steel for Cold Heading and Cold Forging Bar and Wire
  3. A497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
  4. A615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
  5. A706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
  6. A767 Specification for Zinc-Coated (Galvanized) Bars for Concrete Reinforcement
  7. A775 Specification for Epoxy-Coated Reinforcement Steel Bars
  8. A884 Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Concrete Reinforcement
  9. C33 Specification for Concrete Aggregates
  10. C94 Specification for Ready-Mixed Concrete
  11. C144 Specification for Aggregate for Masonry Mortar
  12. C150 Specification for Portland Cement
  13. C156 Specification for Water Retention by Concrete Curing Materials
  14. C171 Specification for Sheet Materials for Curing Concrete
  15. C260 Specification for Air-Entraining Admixtures for Concrete
  16. C309 Specification for Liquid Membrane Forming Compounds for Curing Concrete
  17. C330 Specification for Lightweight Aggregates for Structural Concrete





18. C494 Specification for Chemical Admixtures
19. C595 Specification for Blended Hydraulic Cements
20. C618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
21. C834 Specification for Latex Sealants
22. C845 Specification for Expansive Hydraulic Cement
23. C881 Specification for Epoxy-Resin-Base Bonding Systems for Concrete
24. C920 Specification for Elastomeric Joint Sealants
25. C957 Specification for High Solids Content Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface
26. C979 Specification for Pigments for Integrally Colored Concrete
27. C989 Specification for Ground Granulated Blast- Furnace Slag for Use in Concrete and Mortar
28. C1017 Specification for Chemical Admixtures for Use in Producing Flowing Admixtures Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation
29. C1157 Performance Specification for Blended Hydraulic Cements
30. C1193 Guide for use of Elastomeric Joint Sealants
31. C1240 Specification for Silica Fume for Use In Hydraulic-Cement Concrete and Mortar

## 1.6 DEFINITIONS

- A. Coloring admixture/agent – A blended mixture of color oxides, water-reducing agent and a plasticizer.
- B. Design Reference Standard – Sample prepared under the Commissioner's direction to be used by reference for bidding purposes and construction of the Field Mockup; having a minimum size of 18 by 18 in. (by 2 in. thick, exhibiting the acceptable surfaces, color and texture; and listing the sources and proportions of materials used.
- C. Excessive Contrast – Degree of architectural concrete construction blemish determined unacceptable by comparison to the field mockup and remedial work or restoration is required.
- D. Field Mockup – A sample, which may be specified as to size, constructed in the field by the Contractor incorporating the forming, materials, and procedures proposed for the architectural concrete, which is to be used for comparison during periodic and final acceptance.
- E. Kerf – A saw cut placed on the backside of a wood rustication strip to allow for expansion due to possible water absorption, or a series of cuts on the backside of wood forms to increase flexibility of formwork to follow design radii while maintaining a uniform face.
- F. Overlaid Plywood – A plywood coated with a factory applied paper overlay that is impregnated with phenolic res- ins. MDO is a Medium Density Overlay containing 35–45 percent phenolic resin by weight of the overlay. HDO is a High Density Overlay containing 45–65 percent phenolic resin by weight of the overlay. Finnish birch has an over- lay which contains a minimum of 65 percent phenolic res- in overlay by weight of the overlay.
- G. Reveal – Projection of the aggregate from the mortar after completion of exposure operations. Amount of reveal is specified as brush-sufficient to dull surface sheen but not have any reveal:
  1. Light: a maximum 1/16 in. (2 mm) reveal
  2. Medium: a maximum reveal of 1/4 inch;
  3. Heavy: a maximum reveal of 1/3 of the large aggregate diameter

- H. Zones of influence – Surface area of concrete visibly affected by internal vibration. Size of area will vary with the size and type of internal vibrator used and concrete mixture characteristics and proportions.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.8 SUBMITTALS

- A. Product Data: Items including admixtures, joint systems, release agents, reinforcing, form ties, sealers, coatings, and others as requested by the Commissioner.
- B. Design Data:
  - 1. Submit concrete mix design. Submit separate mix designs when admixtures are required for the following:
    - a. Hot and cold weather concrete work.
    - b. Air entrained concrete work.
  - 2. Identify mix ingredients and proportions, including admixtures.
- C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test to the Commissioner.
- D. Form TR3: Technical Report Concrete Design Mix: The contractor shall be responsible for, and bear all costs associated with the filing and securing of approvals, if any, for Form TR3: Technical Report Concrete Design Mix, including , but not limited to, engaging the services of a New York City licensed Concrete Testing Lab for the review and approval of concrete design mix, testing, signatures and professional seals, etc., compliant with NYC Department of Buildings requirements, for each concrete design mix.
- E. Concrete Testing Service: Engage and pay for a testing laboratory acceptable to the Commissioner to perform material evaluation tests and to design concrete mixes.
- F. Materials and installed work may require testing and retesting at any time during progress of work. Tests, including testing of rejected materials for installed work, shall be done at Contractor's expense.
- G. Materials Certificates: Materials certificates certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- H. Shop Drawings: Plans, cross sections, elevation, and details showing overall pattern, joint locations, forming system, form tie locations, end locations and other special conditions.
- I. Samples:
  - 1. Form ties and description, showing method of break-back when forms are removed.
  - 2. Design reference samples for initial verification of design intent, for each type of finish indicated, on exposed surfaces of architectural precast concrete units, in sets of three,

representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

J. Field Mockup

1. Construct Field Mockups using procedures, equipment, materials, simulated restorations and quality control plan submitted for production of cast-in-place architectural concrete.
2. For walls, include vertical, horizontal, rustication and finish joints, demonstrate methods of restoration, curing, aggregate exposure, sealers and coating. Construct mockup to include a minimum of two lifts where design height requires multiple pours.

- K. Quality control plan: To be submitted by Contractor prior to commencing construction of architectural concrete.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Quality control plan—Submit quality control plan as outlined in Section 1.9 for acceptance prior to commencing any construction of architectural concrete.

1.10 QUALIFICATIONS AND RESPONSIBILITIES

- A. Contractor qualifications: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.

B. REPORTS

1. Maintain logs of concrete placements. Record date, location and quantities of concrete placement, air temperature, and location and identification of material and architectural concrete sampling. Maintain file of architectural concrete delivery tickets.
2. Report any proposed changes from procedures and materials used in the original Field Mockup. Submit new sample having the same dimensions and texture as the original Design Reference Sample for review. Upon acceptance construct another Field Mockup with the new materials and procedures for acceptance prior to proceeding further with construction of the architectural concrete. Further construction with the new materials shall be planned so as to minimize contrast with previously placed architectural concrete.

1.11 ACCEPTANCE

- A. Periodic acceptance: Failure of the completed architectural concrete to receive acceptance during a periodic review requires the submittal of a plan of remedial restoration and proposed revisions to methods of construction for acceptance before proceeding with additional architectural concrete construction.
- B. Final acceptance: Protect accepted architectural concrete from damage after completion of the architectural concrete construction until completion of project.

**1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to jobsite in manufacturer's original containers.
- B. Store materials in a clean dry location. Maintain method of storage and temperature of materials as required by manufacturer.

**1.13 ENVIRONMENTAL CONDITIONS**

- 1. Do not install during heavy rain or snowfall.
- B. Do not install over frozen base materials.

**1.14 GENERAL REQUIREMENTS**

- 1. Adhere to local ordinances requiring restrictions on sound, dust and work hours during construction of architectural concrete.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Scope: This section specifies requirements for cast-in-place architectural concrete walls having as-cast surfaces or treated surfaces which are listed in the specifications.
- B. Tolerances: Tolerances shall conform to ACI-117.

**2.2 FORMLINERS**

- A. Product: Textured Architectural Concrete shall be formed using an elastomeric formliner. Subject to compliance with requirements, formliner manufacturers whose products may be incorporated into the Work include the following:
  - 1. US Formliner (Basis of Design)
  - 2. Spec Formliners
  - 3. Architectural Polymers
  - 4. Or Approved Equal.
- B. Formliner Pattern 1 (Faux Sandblast):
  - 1. Basis-of-Design Product subject to compliance with requirements:
    - a. US Formliner; Reckli 2/103 Lena
  - 2. Subject to compliance with requirements, other products that may be incorporated into the Work include the following:
    - a. Spec Formliners; Light Sandblast 1651
    - b. Architectural Polymers; Light Sand Finish #403
    - c. Or approved equal.
- C. Required accessories:

1. Form Release Agent
  2. Rustication Strip 1-1/2" face: Reusable ABS plastic.
  3. Chamfer triangle continuous PVC strip with 1" leg.
  4. Drip line square continuous PVC strip 1"x1"
- D. Formliners for Textured Finish Concrete: Provide special forming materials to produce form surfaces with face design, texture, arrangement, and configuration as indicated on drawings.
- E. Form Release Agent: Formliners shall be coated prior to concrete placement with a biodegradable, water based, reactive – type release agent. Solvent and petroleum-based form release agents can degrade the form liner and will not be accepted.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement shall comply with the requirements of ASTM Designation C 150 and shall be of the following types:
    - a. Type I Normal
    - b. Type IA Air-entraining Normal
    - c. Type II Moderate Sulphate Resistant
    - d. Type IIA Air-entraining Moderate Sulphate Resistant
  2. Portland Cement shall be uniform in color. The brand shall have an established reputation of uniformity of character and have been successfully used for at least two (2) years unless otherwise approved by the Commissioner.
  3. Portland Cement shall be stored in such a manner as to permit easy inspection and to protect the cement from dampness and minimize warehouse set.
  4. Portland Cement may be supplemented with the following:
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: AASHTO M 302, Grade 100
- B. Aggregate
1. Normal-Weight Aggregates, uniformly graded, meeting ASTM C 33.
  2. Provide aggregates from a single source with documented service-record data of at least 3 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
  3. Coarse Aggregate: Broken Stone or gravel, moderately resistant to abrasion, Size No. 67, meeting the following requirements:

Sieve Size/No.	% Passing (by Weight)
1"	100
3/4"	90-100
1/2"	--
3/8"	20-55
#4	0-10

#8

0-5

4. Fine Aggregate: Hard, durable mineral particles, meeting the following requirements:

Sieve Size/No.	% Passing (by Weight)
3/8"	100
# 4	95-100
# 8	----
# 16	45-85
# 50	10-30
# 100	0-6

5. Sand shall not contain any deleterious substances in excess of that shown in Table 1 of ASTM Designation C 33. The calculated quantity of sodium chloride in Type 1A sand shall not exceed three-tenths (0.3) of one percent, by weight.
6. SOUNDNESS: For natural sand, intended for use in Portland cement mixtures, the loss by magnesium sulfate test after five (5) cycles shall not exceed ten (10) percent by weight. The soundness test shall be made only when required by the Commissioner.
7. ORGANIC IMPURITIES: Natural sand, intended for use in Portland cement mixtures, which, when subjected to the color test for organic impurities, produce a color in the sodium hydroxide solution darker than the standard color, will not be accepted, unless the subsequent test for structural strength indicates it to be suitable for use.
8. **STRUCTURAL STRENGTH**: Natural sand, intended for use in Portland cement mixtures, when subjected to the mortar strength test, shall produce a mortar having a compressive strength at the age of three (3) days and seven (7) days of not less than ninety (90) percent of that developed by an Ottawa sand mortar when tested in accordance with ASTM Designation C 87.

C. Water

- Potable and complying with ASTM C 94.
- Temperature of water for curing shall be not more than 20 F (10 C) lower than the concrete surface temperature.

D. Admixtures—Calcium chloride, or any admixture containing calcium chloride, shall not be used.

- Air-entraining agents shall meet ASTM C 260.
- Water-reducing admixtures shall meet ASTM C 494, Type A
- Water-reducing and retarding admixtures shall meet ASTM C 494, Type D.
- High-range water reducers (superplasticizers) shall meet ASTM C 494, Types F or G
- Accelerating admixtures shall meet ASTM C 494, Types C and E
- Admixtures for flowing concrete shall meet ASTM C 1017, Type I or II
- Mineral admixtures fly ash shall meet ASTM C 618, ground granulated blast-furnace slag shall meet ASTM C 989, and silica fume shall meet ASTM C 1240. Mineral admixtures shall be compatible with other admixtures.
- Coloring admixture/agents shall meet ASTM C 979 and ASTM C 494.

E. Concrete



1. Slump, strength and durability requirements shall be as shown in the Contract Documents.
  2. Concrete shall match color and surface of the Design Reference Standard and the accepted Field Mockup.
  3. Concrete shall comply with Section 6 of ACI 301.
  4. For colored concrete, prepare trial batches of the final design mix with specified slump at highest and lowest ambient temperatures anticipated during concrete placements. Adjust color amounts to match Design Reference Standard and the accepted Field Mockup.
  5. Concrete curing compound shall conform to ASTM C 309. The cured surface shall match the Design Reference Standard. Solids content shall be between 14–22 percent. For colored concrete use curing compounds recommended by pigment or color admixture manufacturer and accepted by Commissioner.
- F. Sheet materials for concrete curing: Plastic film, wet burlap or burlap-backed plastic film shall not be used for curing colored horizontal architectural concrete.
- G. Expansion Joint
1. ½" wide, full depth, pre-molded bituminous joint filler compatible with joint sealer, ASTM D1751.
  2. Joint Sealant: Subject to compliance with requirements, products that may be incorporated into the Work include the following:
    - a. Vulkem 200
    - b. SikaFlex 1A
    - c. Sealtight Purthane
    - d. or approved equal.
  3. Sealant must be color matched to adjacent architectural concrete, color subject to review and acceptance by Commissioner.

## 2.4 CONCRETE MIX

- A. Concrete Design Mix shall conform to NYC Department of Transportation specifications for Class A-40 designation for concrete and meeting the following requirements:
1. Design Mix Proportions (Cement/Sand/Gravel) – Based on dry-rodded volumetric measurement of ingredient materials: 1 : 1-3/4 : 2-3/4.
  2. Batch shall contain a minimum of seven (7) bags of cement per cubic yard
  3. Compressive Strength at 28 Days: 4000 psi
  4. Maximum W/C Ratio at Point of Placement: 0.44
  5. Fine Aggregate: 29-37% by weight of Total Aggregate
  6. Slump: 1 1/2" to 3 1/2". 4 inch maximum.
- B. Prepare design mixture, proportioned as per above and ACI 301, for normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- C. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.
- D. Cementitious Materials

1. Type IIA Portland Cement, Moderately Sulphate Resistant Air-Entrained.
2. Pozzolans: Use fly ash, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

E. Aggregate:

1. Diabase: clean crushed stone material with a fine, but visible texture of plagioclase feldspar crystals set in a finer matrix of clinopyroxenes and accessory minerals.

F. Admixtures:

1. Air-Entraining
  - a. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
2. Air Content (by volume of concrete): 6 1/2 percent plus or minus 1.5%.
3. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
4. Water-Reducing and Water-Reducing and Retarding Admixtures:
  - a. Use water-reducing admixture or water-reducing and retarding admixture in concrete as required for placement and workability.
  - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - c. Use of chemical admixtures permitted for pigmented concrete pavements only on color additive manufacturer recommendation and on approval by Commissioner.

## 2.5 REINFORCEMENT

- A. Reinforcing bars shall conform to ASTM A 615 or ASTM A 706. Welded wire fabric shall conform to ASTM A 185 or ASTM A 497.
- B. Epoxy coated reinforcement shall conform to ASTM A 775 and epoxy-coated welded wire fabric to ASTM A 884.
- C. Galvanized reinforcement shall conform to ASTM A 767.
- D. Use plastic coated tie wire for epoxy coated reinforcement. Use soft stainless-steel complying with ASTM A 493, or plastic coated tie wire, for securing other reinforcement.
- E. Bar supports shall be Class 1, as defined in CRSI MSP-1. Stainless steel for bar supports shall comply with ASTM A 493.

## 2.6 ARCHITECTURAL TREATMENTS

- A. General: This section specifies the additional requirements for cast-in-place architectural concrete where the resulting concrete face is specially treated after form removal.
- B. Acceptance: Receive acceptance of the appearance of the first day's aggregate exposure operations before proceeding further.
- C. Color and finish:





1. Landscape elements including architectural concrete retaining walls and freestanding perimeter wall along the 105th Precinct Annex parking lot and east end of site:
    - a. Color: Match color of Precast Concrete Institutes' "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers, as follows: Light Gray, PCI # 230, subject to review and acceptance by Commissioner.
    - b. Finish:
      - 1) Vertical Surfaces to be finished with formliners; see Section 2.1 FORMLINERS.
      - 2) Subgrade Vertical Surfaces: Fibered Liquid Asphalt Coating as manufactured by Black Jack, Gardner, Henry, or approved equal.
      - 3) Horizontal surfaces – Smooth Float Finish.
  2. Exterior architectural concrete column encasements beneath overhang on south side of building:
    - a. Match color of Precast Concrete Institutes' "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers, as follows: Light Gray, PCI # 230, subject to review and acceptance by Commissioner.
    - b. Finish:
      - 1) Vertical Surfaces to be finished with formliners; see Section 2.1 FORMLINERS.
      - 2) Subgrade Vertical Surfaces: Fibered Liquid Asphalt Coating as manufactured by Black Jack, Gardner, Henry, or approved equal.
      - 3) Horizontal surfaces – Smooth Float Finish.
- D. Forms and formliners: Use high density and non-vapor transmitting materials.
- E. Sealers or coatings: Use concrete sealers to match accepted Design Reference Standard and Field Mockup surface.
- F. Joint sealants in vertical surfaces and horizontal areas not subject to traffic shall conform to ASTM C 920, Use NT; joints subject to traffic shall conform to ASTM C 920, Use T.
1. Prepared expansion joints shall be coated with a primer followed by installation of a bond breaker and a self-leveling two-component polyurethane-based elastomeric sealant. Apply Sikaflex 429 primer with Sikaflex – 2C, SL sealant, or Sonneborn 733 primer with sonolastic SL 2 sealant, or MasterSeal P 173 primer with MasterSeal SL1 Sealant, or approved equal. Match color of adjacent architectural concrete, color subject to review and acceptance by Commissioner.
    - a. Asphalt cement will not be approved as a sealant.
    - b. Sikaflex products are manufactured by Sika Corp., Lyndhurst, NY.
    - c. Sonolastic products are manufactured by Sonneborn and Chem Rex, Inc., Shakopee, MN.
    - d. MasterSeal products are manufactured by BASF Construction Chemicals, LLC.
    - e. Or approved equal.
  2. Concrete sealer: Test compatibility with sealant on Field Mockup and conform to final color of Design Reference Standard.
  3. The granular base and bedding materials shall consist of granular material graded as specified in Section 32 05 16 "Aggregate Materials"

**2.7 WEEPS**

1. 341 Round Plastic Weep Holes as manufactured by Hohmann & Barnard, or an approved equivalent product by Sandell's, Advanced Building Products, or approved equal.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 REINFORCEMENT**

- A. Place reinforcement in accordance with ACI 315.
- B. Provide specified concrete cover over reinforcement and coated steel embedment's. Concrete cover shall be as specified after removal of rustication strips or face mortar by further treatment such as sandblasting or bush hammering.
- C. Use bar supports in sufficient number, size and location to prevent vertical displacement of the reinforcement and gouging of the forming. Use bar supports or spacers in walls and columns to maintain clear distance between reinforcement and face of concrete.
- D. Bend back and keep tie wires 2 in. from form face. Remove tie wire clippings from horizontal surfaces that will be sandblasted, exposed to view, or weather.
- E. Perform welding or similar heat processes on reinforcement or accessories prior to form erection.

**3.3 FORMWORK FOR ARCHITECTURAL CONCRETE**

- A. Verify locations, lines, and levels before proceeding with formwork. Ensure that dimensions agree with shop drawings.

**3.4 RUSTICATION STRIPS**

- A. Provide rustication joints and chamfers as shown on the Contract Drawings.
- B. Wood strips shall be kerfed on the back side.
- C. Provide minimum concrete cover of 2 inches over all reinforcement. Cover shall be measured from bar reinforcement to the most deeply recessed depth of rustication or other recess in the concrete surface.
- D. Provide closure backing materials when indented rustication is used over a ribbed form liner. Seal joint between rustication strip and form with non-absorbent caulking.
- E. Apply impermeable coating to wood rustications or chamfers.

**3.5 BATCHING, MIXING, AND TRANSPORTING**

- A. Deliver concrete in initially clean equipment which is exclusively limited to mix and transport the architectural concrete.

- B. Deliver concrete of uniform slump and proportions so the resulting concrete shall match the Field Mockup.
- C. Deliver colored concrete in full loads.

### 3.6 CONVEYING AND PLACEMENT

- A. Support runs or gangways for the concrete trans- porters, pump lines, wheel barrows, other similar equipment and foot traffic so as not to disturb reinforcement or interfere with concrete placing operations.
- B. Place concrete after forms and reinforcement have been set and accepted by Commissioner.
- C. Schedule arrival of concrete to avoid delays in placement.
- D. Take precautions to minimize mortar splatter on form faces. Remove accidental mortar splatter from architectural form face.
- E. Deposit concrete in the final position without segregation or loss of material. Do not move concrete horizontally.
- F. Place concrete in uniform horizontal layers not more than 36 in. (0. 9 m) high for consolidation.
- G. Place concrete continuously without exceeding rate of placement used in design of forms.
- H. Vibrate placed concrete for maximum consolidation of concrete. Overlap the zones of influence a minimum of 50 percent. Withdraw internal vibrators at a rate of 3 in. (75 mm) per second. Keep internal vibrators 2 in. (50 mm) away from the architectural face.
- I. Revibrate the top 6 in. (150 mm) layer of a concrete lift during delays of up to a maximum 30 minutes as long as the vibrator will penetrate of its own weight. After 30 minutes or failure of the vibrator to penetrate of its own weight, stop placement, level lift and set construction joint.

### 3.7 CURING

- A. Mist concrete surface with water before applying curing compounds. Apply curing compounds at rate recommended by manufacturer.
- B. Maintain complete contact when using cotton mat curing.
- C. Curing during cold weather shall comply with ACI 306.1.

### 3.8 RESTORATION AND CLEANUP

- A. Restore defects on as-cast architectural surfaces immediately to conform to that accepted on the Field Mockup.
- B. Cure by covering with curing seal or edge-taped waterproof cover or as accepted by trial on Field Mockup.
- C. Finish tie holes as accepted on Field Mockup.

### 3.9 FORM STRIPPING

- A. Strip formwork completely from vertical architectural concrete surfaces when the concrete has achieved a compressive strength of 1000 psi (7 MPa) or 24 hours after placement, whichever is later. Schedule formwork stripping to maintain surface appearance matching accepted Field Mockup.
- B. Loosen forms carefully and remove without hammering or prying against finished concrete surfaces.
- C. Protect concrete surface from damage. Store removed forms for re-use, as appropriate, and remove damaged forms from the site and dispose of.
- D. As soon as the forms have been stripped and the concrete surfaces exposed, commence finishing and restoration such as removal of fins and other projections, filling recesses left by the removal of form ties, and restore surface defects. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.

### 3.10 CLEANING AND STORAGE

- A. Clean forms after each use and discard damaged forms.
- B. Store steel forms horizontally and fully supported.
- C. Store plastic coated forms and liners horizontally and under cover.

### 3.11 ARCHITECTURAL TREATMENTS

- A. Restoration
  - 1. Restored areas shall be subject to final acceptance under comparison to Field Mockup restoration.
  - 2. Restore defects as required to match adjacent surface after architectural surface has been treated.
  - 3. Cure restored areas.
  - 4. Finish tie holes to match accepted Field Mockup.
- B. Finishing and final cleanup
  - 1. Protect completed architectural cast-in-place concrete surfaces from damage, staining or other contaminants by subsequent construction.
  - 2. Do not allow laitance from subsequent construction or restorations to stain or harden on surfaces that have been finished.
  - 3. Clean concrete surfaces just prior to project submittal for acceptance.
  - 4. Use cleaning materials and processes that do not change color or texture of the completed concrete surfaces.
  - 5. Rinse architectural surface thoroughly with clean water after cleaning.
  - 6. Protect adjacent materials during cleaning operations.
- C. Final acceptance of architectural concrete
  - 1. Upon completion of architectural concrete, final acceptance is based upon the matching of the architectural cast-in-place concrete with the accepted Field Mockups when viewed at a distance of 20 ft (6 m) in daylight.



2. Only concrete listed in the specifications or identified on the plans as architectural concrete is to be included in this final acceptance.
3. Defective work, including restoration areas not accepted, shall be removed and replaced.

3.12 MISCELLANEOUS

- A. Apply concrete joint sealants prior to any application of concrete sealer.
- B. Apply sealers and sealants in accordance to manufacturer's specifications.
- C. Match accepted Design Reference Standard and Field Mockup.

**END OF SECTION 03 33 00**



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## **SECTION 03 45 00**

### **PRECAST ARCHITECTURAL CONCRETE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section includes
  - 1. Insulated, architectural precast concrete units.
  - 2. Thin brick-faced, insulated architectural precast concrete units.
  - 3. Installation accessories.
- B. Related Sections:
  - 1. Section 03 30 00 "Cast-in-Place" Concrete for installing connection anchors in concrete.
  - 2. Section 03 45 10 "Thin Shell Precast Architectural Concrete."
  - 3. Section 04 20 00 "Unit Masonry" for thin brick products,
  - 4. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
  - 5. Section 05 50 00 "Metal Fabrications" for miscellaneous steel shapes.
  - 6. Section 07 21 00 "Thermal Insulation" for materials.
  - 7. Section 08 44 13 "Glazed Aluminum Curtain Walls" for units set into or installed in conjunction with architectural precast concrete units.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.



2. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
3. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate PCI project color selections with design mixes used.
- B. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

#### 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings:
  1. Detail fabrication and installation of architectural precast concrete units.
  2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
  3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
  4. Indicate details at building corners.
  5. Indicate rough openings for penetrating, adjacent, and adjoining work. Including but not limited to windows, curtain walls, storefronts, louvers, MEP/ FP fixtures, other penetrations, devices and fittings.





- D. Samples: Design samples for initial verification of design intent, for each type of finish indicated, on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
- E. Engineering Services Submittal: For architectural precast concrete units and connections, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.
- C. Material Test Reports: For aggregates.
- D. Field quality-control and special inspection reports.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Manufacturer (Fabricator) Qualifications: Manufacturer providing the material used in this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
  - 1. Firm shall assume responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 2. Designated as an APA-certified plant for production of architectural precast concrete products.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- D. Installer's Qualifications: Installer performing the work of this section shall, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- E. Welding Qualifications: Comply with qualify procedures according to the following:
  - 1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel"
  - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."



- F. Range Samples: After sample approval and before fabricating architectural precast concrete units, produce a minimum of three sets of samples, approximately 16 sq. ft. in area, representing anticipated range of each color and texture on Project's units. Maintain one set of range samples at Project site and remaining range sample sets at manufacturer's plant as color and texture approval reference.
1. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of restoration techniques proposed for restoration of surface blemishes.
  2. After acceptance of restoration technique, maintain one (1) sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
  3. Demolish and remove sample panels when directed by the Commissioner.
- G. On-site Facade Mockups: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
1. Provide complete insulated precast architectural concrete wall panels of each type, in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
  2. Incorporate full-scale details of the architectural features, approved finished and textures, structural attachment points, picking anchors, and insulation to be provided at full-scale building.
  3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
  4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design, Fabricators: Subject to compliance with requirements, provide precast architectural concrete panels as supplied by High Concrete Group or comparable product from one of the following, as approved by the Commissioner:
1. Altus Group
  2. Gate Precast Concrete.
  3. Oldcastle Building Envelope.
  4. Or approved equal.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design architectural precast concrete units including connections. All products of engineering services shall be submitted to Commissioner for review and acceptance prior to incorporation into the work.
1. Engineering Services shall include complete design calculations for precast units and connections required for this project.



- a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
  - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- C. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding design loads indicated within limits and under conditions indicated.
  - 1. Precast architectural concrete wall panels shall be engineered and reinforced as a composite panel, with both interior and exterior wythe performing in composite action to resist thermal bowing, as well as meeting load requirements.
  - 2. Precast architectural concrete wall panels shall be engineered to span the full vertical distance between the connection points indicated on drawings. Panels engineered to require additional connection points located vertically between the connection points indicated on drawings, such as at mid-story, will not be accepted.
  - 3. Subject to review and acceptance by Commissioner, the Contractor can propose horizontal changes to anchor locations, or additional connection points aligned horizontally with similar connection points, as necessary to meet panel engineering requirements or to coordinate connection point locations with other trades.

## 2.3 MOLD MATERIALS

- A. Configuration shall match Design Samples.
- B. Use with manufacturer's recommended form- release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

## 2.4 FORMLINER MATERIALS

- A. Description: Textured Architectural Concrete shall be formed using an elastomeric formliner.
- B. Formliner Pattern 1 (Faux Sandblast):
  - 1. Basis-of-Design, Product: subject to compliance with requirements, provide US Formliner; Reckli 2/103 Lena or one of the following:
    - a. Spec Formliners; Light Sandblast 1651
    - b. Architectural Polymers; Light Sand Finish #403
    - c. Or approved equal.
- C. Formliner Pattern 2 (Faux Broom):
  - 1. Basis-of-Design, Products: subject to compliance with requirements, provide US Formliner; Reckli 2/61 Thames or one of the following:
    - a. Spec Formliners; Broom/Rake Texture 1605
    - b. Architectural Polymers; Broom Finish: Broom #407



c. Or approved equal.

D. Other Manufacturers:

1. Spec Formliners.
2. Architectural Polymers.
3. Or Approved Equal.

E. Required Accessories:

1. Form Release Agent
2. Rustication Strip 1-1/2" face: Reusable ABS plastic.
3. Chamfer triangle continuous PVC strip with 1" leg.
4. Drip line square continuous PVC strip 1"x1"

F. Formliners for Textured Finish Concrete: Provide special forming materials to produce form surfaces with face design, texture, arrangement, and configuration as indicated on drawings.

G. Form Release Agent: Biodegradable, water based, reactive- type release agent. Solvent and petroleum-based form release agents may degrade the form liner and will not be accepted.

## 2.5 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from galvanized-steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M, flat sheet.

E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## 2.6 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A416/A416M, Grade 270, uncoated, seven-wire, low-relaxation strand.

1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

## 2.7 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.



1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

C. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C595, Type IP, portland-pozzolan cement.

D. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

E. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

G. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

## 2.8 MISCELLANEOUS MATERIALS

A. Bearing Pads: Multi-monomer plastic strips that are non-leaching and support construction loads with no visible overall expansion.

B. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

C. Carbon-Steel-Headed Studs: ASTM A108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

D. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

E. Malleable Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

F. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30.

G. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

H. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

I. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65.

J. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.



- K. Carbon-Steel Bolts and Studs: ASTM A307, Grade A or ASTM F1554, Grade 36; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F844.
- L. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
- M. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M.
  - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035B or SSPC-Paint 20.
- N. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

## 2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1-part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for dry pack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

## 2.10 INSULATED PANEL ACCESSORIES

- A. Wythe Connectors: Epoxy-coated interlaid carbon fiber mesh or approved equivalent performance low-thermal-conductivity wythe connectors
  - 1. Construction and architecture shall be supplied in accordance with minimum MARV tensile strength tow values, reported in pounds force per single end, complying with the following:
    - a. Yarn Type: Industrial Grade PAN based carbon fiber with suitable epoxy sizing as approved by the manufacturer (24K - 50K carbon fiber tows).
    - b. Binder Chemistry: Chomarat Formulation: Epoxy D1156 (standard Tg) and Epoxy D2047 (High Tg).
    - c. Yarn/Strand Direction: Warp and Weft Strands to be laid perpendicular to each other; warp yarns to be superimposed.
    - d. Cross over bond: Fully bonded to ensure proper tow integrity.



e. Strands: No missing, broken, or degraded strands.

B. Polyisocyanurate Board Insulation: Comply with Section 07 21 00 "Thermal Insulation" and the following:

1. Unfaced insulation with thickness of 4 inches; per ASTM C 591, Type I, 1.8 lbs. per cu. ft., unless higher density is required to obtain project thermal resistance.
2. Overall panel continuous thermal resistance: R- 25 minimum.
3. Provide minimum 1 inch continuous insulation at all structural embeds and anchor points.

## 2.11 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified architectural precast concrete plant at fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C1218/C1218M.

E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi minimum.

F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.12 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement.
2. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.



1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly radiused, unless otherwise indicated.

#### 2.13 THIN BRICK FACING

- A. Refer to Section 04 20 00 - Unit Masonry for products.
- B. Place templates accurately to provide grid for thin-brick facings. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.
- C. Securely place thin-brick units face down into pockets and place concrete backing mixture.
- D. Clean faces and joints of thin-brick facing.

#### 2.14 INSULATED PANEL CASTING

- A. Where required by project application, cast, screed, and consolidate bottom concrete wythe supported by mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation holes and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Ensure bottom wythe and insulation layer are not disturbed after bottom wythe reaches initial set.
- D. Cast, screed, and consolidate top wythe to meet required finish.
- E. Maintain temperature below 150 deg F in bottom concrete wythe.

#### 2.15 FABRICATION

- A. Make every effort to fabricate panels to allow the maximum possible thickness of continuous insulation at panel embedment, up 4 inches. At panel embedment, a minimum of 1 inch continuous rigid insulation shall be maintained, aligned with the insulation provided throughout the remainder of the insulated precast concrete panel.
  1. No solid concrete zones shall be allowed between the interior and exterior panel wythes, except as required at vertical grout tube connections as indicated on drawings.
  2. Solid concrete zones at vertical grout tubes shall be maximum of 9 by 9 inches at each occurrence, with proposed connection details, counts, and locations subject to review and acceptance by Commissioner.
- B. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations.
  1. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  2. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."





- C. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- D. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.
- H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless restoration meets requirements in PCI MNL 117 and has Commissioner's approval.



## 2.16 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

## 2.17 FINISHES

- A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp with canted edges as indicated on drawings.
- B. Finish exposed- face surfaces of architectural precast concrete units to match approved Sample Panels and as follows:
  - 1. As-Cast Surface, Finish; Inside Face: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
  - 2. Thin-Brick Facing: Refer to "Thin-Brick Facings" Article.
  - 3. Formliner Finishes:
    - a. Formliner Pattern 1 finish on outermost exterior surface: For exterior surfaces of 2<sup>nd</sup> Floor precast architectural concrete wall panels, .
    - b. Formliner Pattern 2 on recessed exterior surfaces. Refer to architectural drawings.
  - 4. Finish exposed exterior wythe edge surfaces of architectural precast concrete units to match exterior wythe face- surface finish.
  - 5. Finish unexposed surfaces of architectural precast concrete units with as cast finish.
- C. Colors, Exposed Surfaces: PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers, as follows:
  - 1. 1st Floor with thin brick on exterior surface: Dark Gray PCI #545.
  - 2. 2nd Floor: Light Gray, PCI #230.

## 2.18 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.
- B. City will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.



- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
  - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - 2. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself.
  - 1. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
  - 2. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
  - 3. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

### 3.4 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: City of New York will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.
- C. Testing agency will report test results promptly and in writing to Contractor and Commissioner.
- D. Restore or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.



- E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

### 3.6 RESTORATION

- A. Restore damaged architectural precast concrete units if permitted by Commissioner. Commissioner reserves the right to reject restored units that do not comply with requirements.
- B. Mix patching materials and restore units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and restored work, when viewed in typical daylight illumination from a distance of 20 feet.
  - 1. Restoration mixes provided shall match those approved on restored portions of submitted Sample Panels.
- C. Prepare and restore damaged galvanized coatings with specified material according to ASTM A780/A780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when restoration does not comply with requirements.

### 3.7 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

**END OF SECTION 03 45 00**

**SECTION 03 45 10****THIN- SHELL PRECAST ARCHITECTURAL CONCRETE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes
1. Thin- shell (Thin cast) architectural precast concrete units.
  2. Installation accessories.
- B. Related Sections:
1. Section 03 30 00 "Cast-in-Place Concrete" for installing connection anchors in concrete.
  2. Section 03 45 00 "Precast Architectural Concrete."
  3. Section 04 20 00 "Unit Masonry" for brick veneer products,
  4. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
  5. Section 05 50 00 "Metal Fabrications" for shelf angles and other miscellaneous steel shapes.
  6. Section 08 44 13 "Glazed Aluminum Curtain Walls" for units set into or installed in conjunction with architectural precast concrete units.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.



2. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
3. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate PCI project color selections with design mixes used.
- B. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.7 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings:
  1. Detail fabrication and installation of thin shell architectural precast concrete units.
  2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
  3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
  4. Indicate details at building corners.
  5. Indicate rough openings for penetrating, adjacent, and adjoining work. Including but not limited to windows, curtain walls, storefronts, louvers, MEP/ FP fixtures, other penetrations, devices and fittings.



- D. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of thin shell architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
- E. Engineering Services Submittal: For thin- shell architectural precast concrete units and connections, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York .responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior any incorporation into the work.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.
- C. Material Test Reports: For aggregates.
- D. Field quality-control and special inspection reports.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Manufacturer (Fabricator) Qualifications: Manufacturer providing the material used in this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer shall have been in satisfactory service for not less than five (5) years
  - 1. Firm shall assume responsibility for engineering thin shell architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 2. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or designated as an APA-certified plant for production of thin shell architectural precast concrete products.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- D. Welding Qualifications: Comply with qualify procedures according to the following
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- E. On-site Facade Mockups: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.



1. Provide complete thin- shell precast architectural concrete wall panels in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
2. Incorporate full-scale details of the architectural features, approved finished and textures, structural attachment points, picking anchors, and insulation to be provided at full-scale building.
3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design, Fabricators: Subject to compliance with requirements, provide thin shell precast architectural concrete panels as supplied by High Concrete Group or comparable product from one of the following, as approved by the Commissioner:
1. Altus Group
  2. Gate Precast Concrete.
  3. Oldcastle Building Envelope.
  4. Or approved equal.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design thin shell architectural precast concrete units including connections. All products of engineering services shall be submitted to Commissioner for review and acceptance prior to incorporation into the work.
1. Engineering Services shall include complete design calculations for thin shell precast units and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of thin shell architectural precast concrete units indicated.
- C. System Description: Thin precast cladding placed under compression with type 316 stainless steel prestressing tendons.
- D. Structural Performance: Provide thin shell architectural precast concrete units and connections capable of withstanding design loads indicated within limits and under conditions indicated.





## 2.3 REINFORCING MATERIALS

- A. Reinforcing: Type 316 stainless steel prestressing tendons: ASTM A492, ASTM A240.
- B. Supports: Hot dip galvanized after fabrication: ASTM A 123 Grade 100 or ASTM A653 G210.
- C. Fasteners to structure, Elco Industries drill flex, Elco Bi-Flex Stainless Steel, or approved equal.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
  - 1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
  - 2. Metakaolin: ASTM C618, Class N.
  - 3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
  - 4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
  - 5. Blended Hydraulic Cement: ASTM C595, Type IP, portland-pozzolan cement.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

## 2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.
- B. Carbon-Steel-Headed Studs: ASTM A108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.
- D. Malleable Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.
- E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30.



- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
- G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A or ASTM F1554, Grade 36; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F844.
- K. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
- L. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M.
  - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035B or SSPC-Paint 20.
- M. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

## 2.6 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.



- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified thin shell architectural precast concrete plant at fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C1218/C1218M.
- E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi minimum.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.8 BRICK VENEER FACING

- A. Refer to Section 04 20 00 - Unit Masonry for products.

## 2.9 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing thin shell architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in thin shell architectural precast concrete units as indicated on the Contract Drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- E. Reinforce thin shell architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- F. Prestress tendons for thin shell architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.



- G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- K. Identify pickup points of thin shell architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each thin shell architectural precast concrete unit on a surface that does not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- M. Discard and replace thin shell architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless restoration meets requirements in PCI MNL 117 and Commissioner's approval.
- N. Brick-Faced Thin Shell Architectural Precast Concrete Units: Restrict the following misalignments to 2 percent of number of bricks in a unit.
  - 1. Alignment of Mortar Joints:
    - a. Jog in Alignment: 1/8 inch.
    - b. Alignment with Panel Centerline: Plus or minus 1/8 inch.
  - 2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 inch.
  - 3. Tipping of Individual Bricks from the Panel Plane of Exposed Brick Surface: Plus 1/16 inch; minus 1/4 inch less than or equal to depth of form liner joint.
  - 4. Exposed Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 inch; minus 1/8 inch.
  - 5. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus 1/16 inch; minus 1/4 inch less than or equal to depth of form liner joint.



## 2.10 FABRICATION TOLERANCES

- A. Fabricate thin shell architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

## 2.11 FINISHES

- A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of thin shell architectural precast concrete units to match approved sample panels and as follows:
  - 1. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
  - 2. Finish exposed surfaces of thin shell architectural precast concrete units to match face-surface finish.
  - 3. Finish unexposed surfaces of thin shell architectural precast concrete units with as cast finish.
- B. Colors, Exposed Surfaces: PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers, as follows:
  - 1. 1st Floor: Light Gray, PCI #230.

## 2.12 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.
- B. City will employ an independent testing agency to evaluate thin shell architectural precast concrete fabricator's quality-control and testing methods.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

## 3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting thin shell architectural precast concrete units to supporting members and backup materials.
- B. Erect thin shell architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
  - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - 2. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.



- C. Connect thin shell architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
  - 1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
  - 2. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

### 3.3 ERECTION TOLERANCES

- A. Erect thin shell architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: City of New York will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.
- C. Testing agency will report test results promptly and in writing to Contractor and Commissioner.
- D. Restore or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

### 3.5 RESTORATION

- A. Restore thin shell architectural precast concrete units if permitted by Commissioner. Commissioner reserves the right to reject restored units that do not comply with requirements.
- B. Mix patching materials and restore units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and restored work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and restore damaged galvanized coatings with galvanizing restoration paint according to ASTM A780/A780M.



- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged thin shell architectural precast concrete units when restoration does not comply with requirements.

### 3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

**END OF SECTION 03 45 10**



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**SECTION 03 48 00****PRECAST CONCRETE SPECIALTIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. This specification covers requirements for the materials and production of precast architectural concrete forms with formliner surface finishes.
2. Precast Concrete Base for RPL Backless Bench "A" and "C".
3. Precast Concrete Base for RPL Raised Planter Bench "B".
4. Precast Concrete Base for RPL Bleacher.

- B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

1. Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies"
2. Section 03 30 00 "Cast-in-Place Concrete"
3. Section 03 33 00 "Architectural Concrete"
4. Section 07 92 00 "Joint Sealants"
5. Section 12 93 00 "Site Furnishings"
6. Section 32 05 16 "Aggregate Materials"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 REFERENCES

### A. American Society for Testing and Materials:

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
4. ASTM A416 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
5. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
6. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
7. ASTM C33 - Standard Specification for Concrete Aggregates.
8. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
9. ASTM C150 - Standard Specification for Portland Cement.
10. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
11. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

### B. Precast/Prestressed Concrete Institute:

1. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
2. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.
3. PCI MNL-122 - Architectural Precast Concrete.
4. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

## 1.6 DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Commissioner.
- B. Provide precast concrete materials suitable for exterior applications capable of withstanding freeze-thaw cycles, exposure to solar rays, rain, snow, and ice.

## 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.8 SUBMITTALS

- A. Design Mixtures: For each precast concrete mixture include compressive strength and water absorption rates.
- B. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Shop Drawings shall be at a sufficient scale to indicate unique and unusual conditions and to indicate adjacent construction or finishes affected by the Work. Shop Drawings shall indicate the location of all required seams.

- C. Samples: Submit samples for approval to illustrate quality, color, and texture of surface finish; slight variation in color/finish from approved sample shall be deemed acceptable. For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
- D. Templates: Templates taken shall supersede all Shop Drawing dimensions unless noted otherwise. Templates must be approved by the Commissioner.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Material Certificates: Signed by manufacturers.
- B. Material test reports: For aggregates.
- C. Field quality-control test reports.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Perform Work in accordance with PCI MNL-117, PCI MNL-120, PCI MNL-122, PCI MNL-123, and ACI 318.
- C. Qualifications
  - 1. Manufacturer qualified in accordance with PCI MNL-117 Group A1 - Architectural Concrete.
- D. Special Experience
  - 1. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work. In addition, the contractor or subcontractor must be licensed or approved by the manufacturer.
  - 2. The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Handle pre-cast units to position, consistent with their shape and design. Lift and support only from support points.
- B. Blocking and Lateral Support During Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.
- C. Protect units to prevent staining, chipping, or spalling of concrete.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Scope: This section specifies requirements for precast architectural concrete furnishings having treated surfaces which are listed in the specifications.
- B. Tolerances: Tolerances shall conform to ACI-117.

**2.2 FORMLINERS**

- A. Product: Textured Architectural Concrete shall be formed using an elastomeric formliner. Subject to compliance with requirements, formliner manufacturers whose products may be incorporated into the Work include the following:
  - 1. US Formliner (Basis of Design)
  - 2. Spec Formliners
  - 3. Architectural Polymers
  - 4. Or Approved Equal.
- B. Formliner Pattern 1 (Faux Sandblast):
  - 1. Basis-of-Design Product subject to compliance with requirements:
    - a. US Formliner; Reckli 2/103 Lena
  - 2. Subject to compliance with requirements, other products that may be incorporated into the Work include the following:
    - a. Spec Formliners; Light Sandblast 1651
    - b. Architectural Polymers; Light Sand Finish #403
    - c. Or approved equal.
- C. Required accessories:
  - 1. Form Release Agent
- D. Formliners for Textured Finish Concrete: Provide special forming materials to produce form surfaces with face design, texture, arrangement, and configuration as indicated on drawings.
- E. Additional backing may be needed depending on application.
- F. Form Release Agent: Formliners shall be coated prior to concrete placement with a biodegradable, water based, reactive – type release agent. Solvent and petroleum-based form release agents can degrade the form liner and will not be accepted.

**2.3 FABRICATORS**

- A. Subject to compliance with requirements, products that may be incorporated in the Work include the following:
  - 1. Concrete Works East, LLC., East Brunswick, NJ 08816 (732.390.9944)

2. Nelson Precast Products, LLC, 2501 west Lexington Street, Baltimore, MD 21223 (410.732.3408)
3. Southside Precast Products, 1951 Hamburg Turnpike, Buffalo, NY 14218, (716.825.9300)
4. Or Approved Equal.

## 2.4 MATERIALS

- A. Concrete Material: Units shall be composed of a proprietary mix of Portland Cement (ASTM C150), Aggregate (ASTM C33), and Pigment achieving a design weighing no less than 110 lbs./cf. and a compressive strength of 3500 psi minimum at 28 days.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
  1. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by the Commissioner.
- C. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
- F. Reinforcement: Primary Reinforcing: ASTM A 615, Grade 60 bar (note: may not be required for thin elements). strength and size commensurate with pre-cast unit design. Secondary Reinforcing (where applicable) will be glass fiber.

## 2.5 MORTAR

- A. Mortar Setting Bed: Shall be type "S" mortar

## 2.6 ARCHITECTURAL TREATMENTS

- A. General: This section specifies the additional requirements for cast-in-place architectural concrete where the resulting concrete face is specially treated after form removal.
  1. Landscape elements including precast concrete base for backless bench "A" and "C", precast concrete base for raised planter bench "B," and precast concrete base for bleacher. retaining walls and freestanding perimeter wall along the 105th Precinct Annex parking lot and east end of site:
    - a. Color: Match color of Precast Concrete Institutes' "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers, as follows: Light Gray, PCI # 230, subject to review and acceptance by Commissioner.
    - b. Finish:
      - 1) Vertical Surfaces to be finished with formliners; see Section 2.2 FORMLINERS.



- 2) Subgrade Vertical Surfaces: Fibered Liquid Asphalt Coating as manufactured by Black Jack or approved equal.
- 3) Horizontal surfaces – Smooth Float Finish.

## 2.7 SUPPORT DEVICES

- A. Stainless steel dowels and wall anchors as shown on the drawings. Subject to compliance with requirements, provide dowels and wall anchors from one of the following approved manufacturers:
  1. Hohmann & Barnard, Inc.,
  2. Halfen
  3. Hilti
  4. Or approved equal.

## 2.8 ACCESSORIES

- A. Provide all materials required to complete the work as shown on drawings and specified herein. Deliver, store, and transport materials to avoid damage to the product or to any other work. Return any products or materials delivered in a damaged or unsatisfactory condition.
- B. Store materials in a safe, secure location, protected from moisture and extreme temperature.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements

## 3.2 PREPARATION

- A. Examine and verify that job conditions are satisfactory for speedy and acceptable work prior to installation of precast units. This includes verifying accessibility to the site.
- B. Physical templates shall be taken and used for fabrication
  1. When templating for wall panels, level and plumb lines shall be established on the templates for reference during fabrication

## 3.3 MIX

- A. Prepare design mixture of precast concrete required.
  1. Limit use of silica fume and metakaolin to meet design requirements.
- B. Units shall be composed of a proprietary mix of Portland Cement (ASTM C150), Aggregate (ASTM C33), and Pigment achieving a design weighing no less than 110 lbs./cf. and a minimum compressive strength of 3500 psi at 28 days.
- C. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.



- E. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

### 3.4 FABRICATION

- A. All units shall be factory sealed. Sealer is to be determined by Manufacturer based on application of product.
- B. Units shall be cast in largest pieces practicable (approximately 8'L and 24sf) if applicable.
- C. Reinforcing bars shall be placed at the entire perimeter of product (minimum #3) and around all cutouts (minimum #2).
- D. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during pre-casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- E. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- F. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- G. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- H. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- I. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

- M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless restorations meet requirements in PCI MNL 117 and Commissioner's approval.

### 3.5 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items. Edges to be standard 1/8" eased unless otherwise specified.
- B. Dimensional Tolerances of Finished Units:
  - 1. Overall height, width or length:  $\pm 1/8"$ .
  - 2. Angular deviation of plane of side:  $1/16"$
  - 3. Warp (out of plane):  $1/8"$  per 5'

### 3.6 FINISHES

- A. Bench faces shall be free of joint marks, grain, pockets, sand streaks, and Honeycomb, and other obvious defects free of unless warranted by sample; with uniform color and texture to match approved control sample. Corners, including false joints shall be uniform, straight, and sharp. Entrapped air voids or similar casting variations will be filled with a portland cement based colored filler (unless otherwise specified). Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and as follows:
  - 1. Design Reference Sample: 825 T with a polished finish
- B. Finish exposed top, sides and back surfaces of architectural precast concrete units to match face-surface finish.
- C. Finish unexposed surfaces of architectural precast concrete units by float finish.

### 3.7 SOURCE QUALITY CONTROL.

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

### 3.8 INSTALLATION

- A. Tolerances





1. Installed units shall have seams no wider than 3/16" and shall be filled with corresponding colored caulk.

**B. Installation**

1. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
2. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
  - a. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - b. Installed units shall have seams no wider than 3/16" and shall be filled with corresponding colored caulk.
3. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
4. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
5. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
6. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
7. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
8. Installation shall be performed by experienced, well-trained workers competent to complete the work as specified.
9. Use only materials approved by the manufacturer for use with its product.
10. All work shall comply with 2014 NYCBC.

**C. Restoration and Touch-Up**

1. After installation, inspect all work for improper installation or damage.
2. Restore any work damaged during installation. Make restoration work undetectable. Slight variations from original condition are to be expected and deemed acceptable.
3. Patching of damaged exposed face surfaces is acceptable. Restorations will be accepted if unnoticeable from a distance of 3'
4. Mix patching materials and restore units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and restored work, when viewed in typical daylight illumination from a distance of 3'.
5. Prepare and restore damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
6. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
7. Remove and replace damaged architectural precast concrete units when restorations do not comply with requirements.



**D. Cleaning**

1. Clean surfaces of precast concrete units exposed to view.
2. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
3. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - a. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - b. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

**E. Erection Tolerances**

1. Maximum Variation from Plane of Location: 1/4 inch in 10 feet and 3/8 inch in 100 feet, non-cumulative.
2. Maximum Offset from Indicated Alignment Between Two Connecting Units: 1/4 inch.
3. Joint Tolerance: Plus or minus 1/4 inch.

**F. Adjusting**

1. Adjust units so joint dimensions are within tolerances.

**END OF SECTION 03 48 00**



**SECTION 03 49 00**

**GLASS-FIBER-REINFORCED CONCRETE (GFRC)**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes;
1. Glass-fiber-reinforced concrete (GFRC) fins used as vertical SunShade devices.
  2. Anchors and connection hardware.
- B. Related Sections:
1. Section 03 45 00 "Precast Architectural Concrete" for matching colors and design reference sample.
  2. Section 08 44 13 "Glazed Aluminum Curtain Walls."
  3. Section 07 92 00 "Joint Sealants" for elastomeric joint sealants and sealant backings.

**1.3 DEFINITIONS**

- A. Design Reference Sample: Sample of GFRC color, finish, and texture that has been preapproved by Commissioner.

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 COORDINATION

- A. Coordinate aluminum brackets for GFRC attachment to curtain wall mullions and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- B. Coordinate dead load, wind load, and attachment points and brackets of GFRC members with curtain wall manufacturer to ensure that curtain walls are designed and properly reinforced to bear all forces of the GFRC members without reducing either the curtain wall and GFRC manufacturer's warranties

#### 1.7 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include GFRC design mixes.
- B. Shop Drawings: Show fabrication and installation details for GFRC units including the following:
  1. Elevations, sections, and dimensions.
  2. Thickness of facing mix and GFRC backing.
  3. Finishes.
  4. Joint and connection details.
  5. Erection details.
  6. Locations and details of connection hardware attached to structure.
  7. Sizes, locations, and details of flex, gravity, and seismic anchors where required.



8. Relationship to adjacent materials.
  9. Description of loose, cast-in, and field hardware.
- C. Samples: For each type of finish indicated on exposed GFRC surfaces, representative of finish, color, and texture variations expected, approximately 12 by 12 inches by actual thickness.
- D. Engineering Services Submittal: For GFRC attachment, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

#### 1.10 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Source Quality-Control Program: For GFRC manufacturer.
- D. Source Quality-Control Test Reports: For GFRC, inserts, and anchors.

#### 1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Manufacturer (Fabricator) Qualifications: Manufacturer providing the material used in this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- C. Installer Qualifications: Manufacturer of GFRC units or installer properly trained by the manufacturer.
- D. Welding Qualifications: Comply with qualify procedures according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- E. On-site Facade Mockup: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  1. Provide complete GFRC fins in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
  2. Incorporate full-scale details of the architectural features, approved finished and textures, brackets, and attachments to be provided at full-scale building.



3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Handle and transport GFRC units supported on nonstaining material and with nonstaining resilient spacers between units.
- B. Store GFRC units off of ground on firm, level, and smooth surfaces supported on nonstaining material and with nonstaining resilient spacers between units. Place stored units so identification marks are clearly visible.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain GFRC units from single source from single manufacturer.
- B. Basis- of- Design, Fabricator: Subject to compliance with requirements, provide fibreC as supplied by Rieder Smart Elements GmbH or comparable product from one of the following as approved by the Commissioner:
  1. Stromberg Architectural
  2. Willis Construction Co. Inc.
  3. Or approved equal.
- C. Fin Size and Shape: 4 inch face by 2 inch deep, as indicated on drawings.
- D. Fin Heights: As indicated on the drawings.
- E. Product Characteristic:
  1. Materials shall comply with ASTM C1185.
  2. Non-combustible as per ASTM E 136 & ASTM E 84.
  3. Wind load test as per ASTM E 330.
  4. Weather resistance test as per ASTM 1186.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design GFRC units, including Fin frames, anchors, and connections.
  1. Engineering Services shall include complete design calculations for precast units and connections required for this project.



- a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
  - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.
- B. Structural Performance: GFRC units, including Fin frames, anchors, and connections, shall withstand the following design loads as well as the effects of thermal- and moisture-induced dimensional changes within limits and under conditions indicated:
  1. Wind Loads: 30 psf positive and negative, unless otherwise required by as required by 2014 New York City Building Code or ASCE/SEI 7.
  2. Deflection Limits: Design supports to withstand design loads without lateral deflections greater than 1/240 of wall span.
  3. Thermal Movements: Provide for thermal movements resulting from annual ambient temperature changes of 120 deg F.
  4. Design supports and connections to accommodate deflections and other building movements.
- C. PCI Manuals: Comply with requirements and recommendations in the following PCI manuals unless more stringent requirements are indicated by selected product fabricator:
  1. PCI MNL 128, "Recommended Practice for Glass Fiber Reinforced Concrete Units."
  2. PCI MNL 130, "Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products."
- D. AISC Specifications: Comply with AISC 360, "Specification for Structural Steel Buildings."

## 2.3 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous GFRC surfaces within tolerances; nonreactive with GFRC and capable of producing required finish surfaces.
  1. Mold-Release Agent: Commercially produced liquid-release agent that does not bond with, stain, or adversely affect GFRC surfaces and does not impair subsequent surface or joint treatments of GFRC.

## 2.4 GFRC MATERIALS

- A. Portland Cement: ASTM C 150/C 150M; Type I, II, or III.
  1. For surfaces exposed to view in finished structure, use gray or white of same type, brand, and source throughout GFRC production.
- B. Metakaolin: ASTM C 618, Class N.
- C. Glass Fibers: Alkali resistant, with a minimum zirconia content of 16 percent, 1 to 2 inches long, specifically produced for use in GFRC, and complying with ASTM C 1666/C 1666M.
- D. Sand: Washed and dried silica, complying with composition requirements in ASTM C 144; passing a No. 20 sieve with a maximum of 2 percent passing a No. 100 sieve.



- E. Coloring Admixture: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of GFRC and complying with chemical limits in PCI MNL 130.
- G. Polymer-Curing Admixture: Acrylic thermoplastic copolymer dispersion complying with PCI MNL 130.
- H. Air-Entraining Admixture: ASTM C 260/C 260M, containing not more than 0.1 percent chloride ions.

## 2.5 ANCHORS, CONNECTORS, AND MISCELLANEOUS MATERIALS

- A. Brackets and Reinforcement: Refer to Section 08 44 13 "Glazed Aluminum Curtain Walls."
- B. Stainless-Steel Plates: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Malleable-Iron Castings: ASTM A 47/ A 47M, Grade 32510.
- E. Bolts: ASTM A 307 or ASTM A 325, finished as follows:
  - 1. Finish: Zinc coated by hot-dip process according to ASTM A 123/A 123M, after fabrication, and ASTM A 153/A 153M, as applicable.

## 2.6 GFRC MIXES

- A. Mist Coat: Portland cement, sand slurry, and admixtures; of same proportions as backing mix without glass fibers.
- B. Face Mix: Proportion face mix of portland cement, sand, facing aggregates, and admixtures to comply with design requirements.
- C. Backing Mix: Proportion backing mix of Portland cement, glass fibers, sand, and admixtures to comply with design requirements. Provide nominal glass-fiber content of not less than 5 percent by weight of total mix.
- D. Polymer-Curing Admixture: 6 to 7 percent by weight of polymer-curing admixture solids to dry portland cement.
- E. Air Content: 8 to 10 percent; ASTM C 185.
- F. Coloring Admixture: Not to exceed 10 percent of cement weight.





## 2.7 MOLD FABRICATION

- A. Construct molds that result in finished GFRC complying with profiles, dimensions, and tolerances indicated, without damaging GFRC during stripping. Construct molds to prevent water leakage and loss of cement paste.
  - 1. Coat contact surfaces of molds with form-release agent.
  - 2. Coat contact surfaces of molds with surface retarder.
- B. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during GFRC application. Coat form liner with form-release agent.
- C. Locate, place, and secure flashing reglets accurately.

## 2.8 GFRC FABRICATION

- A. Proportioning and Mixing: For backing mix, meter sand/cement slurry and glass fibers to spray head at rates to achieve design mix proportions and glass-fiber content according to fabricator's procedures.
- B. Spray Application: Comply with general procedures as follows:
  - 1. Spray mist coat over molds to a nominal thickness of 1/8 inch on planar surfaces.
  - 2. Spray or place face mix in thickness indicated on Shop Drawings.
  - 3. Proceed with spraying backing mix before mist coat has set, using procedures that produce a uniform thickness and even distribution of glass fibers and matrix.
  - 4. Consolidate backing mix by rolling or other technique to achieve complete encapsulation of glass fibers and compaction.
  - 5. Measure thickness with a pin gage or other acceptable method at least once for every 5 sq. ft. of unit surface. Take no fewer than six measurements per Sunshade Fin.
- C. Hand form and consolidate intricate details, incorporate formers or infill materials, and overspray before material reaches initial set to ensure complete bonding.
- D. Build up homogeneous GFRC bonding pads over anchor feet, maintaining a minimum thickness of 1/2 inch over tops of anchor feet, before initial set of GFRC backing. Measure bonding pad thickness at 25 percent of anchor locations.
- E. Inserts and Embedment: Build up homogeneous GFRC bosses or bonding pads over inserts and embedment to provide enough anchorage and embedment to comply with design requirements.
- F. Curing: Employ initial curing method that ensures sufficient strength for removing units from mold.
  - 1. Keep moisture off of the surfaces of mixes with polymer curing admixtures during the first three hours of curing. Maintain temperature between 60 and 120 deg F during the first 16 hours.
  - 2. Prevent drying of moist curing mixes during the first 24 hours. Maintain units in surface-damp condition at a temperature above 60 deg F and 95 percent relative humidity for seven days.



- G. Fin Identification: Mark each GFRC Fin to correspond with identification mark on Shop Drawings. Mark each Fin with its casting date.

## 2.9 FABRICATION TOLERANCES

- A. Manufacturing Tolerances: Manufacture GFRC units so each finished unit complies with the following dimensional tolerances, unless otherwise required and indicated by selected product fabricator:

1. Edge Return Thickness: Plus 1/2 inch, minus zero inch.
2. Architectural Facing Thickness: Plus 1/8 inch, minus zero inch.
3. Backing Thickness: Plus 1/4 inch, minus zero inch.
4. Angular Variation of Plane of Side Mold: Plus or minus 1/32 inch per 3 inches of depth, or plus or minus 1/16 inch total, whichever is greater.
5. Variation from Square or Designated Skew (Difference in Length of Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches or plus or minus 1/4 inch total, whichever is greater.
6. Local Smoothness: 1/4 inch per 10 feet.
7. Bowing: Not to exceed L/240 unless unit complies with erection tolerances using connection adjustments.
8. Maximum Permissible Warpage of One Corner out of the Plane of the Other Three: 1/16 inch per 12 inches of distance from nearest adjacent corner.

- B. Fin Tolerances: As follows:

1. Vertical and Horizontal Alignment: 1/4 inch per 10 feet.

## 2.10 FINISHES

- A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints, shall be uniform, straight, and sharp. Finish exposed-face surfaces of GFRC to match approved design reference sample and as follows:

1. Finish: Provide the following as provided by Rieder, or equal as selected by the Commissioner:
  - a. FL | ferro light: Sandblasted: blasted at low pressure.
2. Refer to Section 03 45 00 "Precast Architectural Concrete" for matching color and design reference sample.
  - a. Custom Color: Match Dark Gray PCI #545.

## 2.11 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Establish and maintain a quality-control program for manufacturing GFRC units according to ISO 9001 and ISO 14001.

1. Test materials and inspect production techniques.
2. Quality-control program shall monitor glass-fiber content, spray rate, unit weight, product physical properties, anchor pull-off and shear strength, and curing period and conditions.



3. Prepare test specimens and test according to ASTM C 1228 and fabricator's procedures.
4. Test GFRC inserts and anchors according to ASTM C 1230 to validate design values.
5. Produce test boards at a rate of no fewer than one per work shift per operator for each spray machine and for each mix design.
  - a. For each test board, determine glass-fiber content according to ASTM C 1229 and flexural yield and ultimate strength according to ASTM C 947.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine structure and conditions for compliance with requirements for installation tolerances, bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 ERECTION

- A. Install brackets, clips, hangers, and other accessories required for connecting GFRC units to supporting members and backup materials.
- B. Install GFRC units level, plumb, square, and in alignment. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
  1. Maintain horizontal and vertical joint alignment and uniform joint width.
  2. Remove projecting hoisting devices.
- C. Connect GFRC units in position by bolting or welding, or both, as indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as possible after connecting is completed.
- D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.3/D1.3M requirements for welding, appearance, quality of welds, and methods used in correcting welding work.
  1. Protect GFRC units from damage by field welding or cutting operations, and provide noncombustible shields as required.
- E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.



### 3.4 ERECTION TOLERANCES

- A. Erect GFRC units to comply with the following noncumulative tolerances:
1. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet: 1 inch.
  2. Plumb in Any 10 Feet of Element Height: 1/4 inch.
  3. Maximum Offset in Alignment of Matching Edges: 1/4 inch.
  4. Face Width of Joint: As follows (governs over joint taper):
    - a. Fin Dimension 20 Feet or Less: Plus or minus 1/4 inch.
    - b. Fin Dimension More Than 20 Feet: Plus or minus 3/8 inch.
  5. Maximum Joint Taper: 3/8 inch.
  6. Maximum Joint Taper in 10 Feet: 1/4 inch.
  7. Differential Bowing, as Erected, between Adjacent Members of Same Design: 1/4 inch.

### 3.5 RESTORATION

- A. Mix patching materials and restore GFRC so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces.
- B. Wire brush and clean accessible weld areas on prime-painted components and paint with same type of shop primer.
- C. Remove and replace damaged GFRC units when restoration does not comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Perform cleaning procedures, if necessary, according to GFRC manufacturer's written instructions.
- B. Clean soiled GFRC surfaces with detergent and water, using soft fiber brushes and sponges, and rinse with clean water.
- C. Prevent damage to GFRC surfaces and staining of adjacent materials.

**END OF SECTION 03 49 00**



## **SECTION 04 20 00**

### **UNIT MASONRY**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

A. Section Includes:

1. Concrete masonry units.
2. Prefaced concrete masonry units.
3. Thin- brick units.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry-joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.

C. Related Sections:

1. Section 03 45 00 "Precast Architectural Concrete."
2. Section 03 45 10 "Thin Shell Precast Architectural Concrete."
3. Section 05 12 00 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
4. Section 07 62 00 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

##### **1.3 DEFINITIONS**

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

##### **1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.



B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.
2. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
3. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  1. For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
  2. Dimensioned plans and elevations of masonry partitions and walls containing prefinished glazing or special shapes, such as bullnoses or angles, as indicated on drawings,
    - a. Indicate any special shapes and extents of finishes for prefinished units.
    - b. Include drawings for each unique shape of glazed CMU block to be furnished by manufacturer, showing extents of finishes for prefinished units.
- C. Samples: For each type and color of exposed masonry unit and colored mortar.



## 1.8 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties and material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

## 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects.
  - 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 36 inches high, unless otherwise indicated.
- C. On-site Facade Mockups: Include as part of on-site facade mockup required by other sections, as indicated on the drawings, work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  - 1. Provide complete thin brick installation in sizes, quantities, and configuration indicated on the drawings.
  - 2. Incorporate full-scale details of the architectural features, approved finished and textures, brackets and attachment components required for installation.
  - 3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
  - 4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

## 1.10 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
  - 1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

### 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to the City of New York Department of Buildings and City of New York Fire Department.

### 2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. CMUs: ASTM C90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi unless otherwise indicated.
  - 2. Density Classification: Normal weight unless otherwise indicated.





- C. Concrete Building Brick: ASTM C55.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi unless otherwise indicated.
- D. Prefaced CMUs: Lightweight, solid concrete units complying with ASTM C90, with manufacturer's standard smooth resinous facing complying with ASTM C744.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
    - a. Echelon/ Trenwyth Architectural Masonry Blocks.
    - b. Spectra Glaze, A Hi-Standard Family of Companies.
    - c. Westbrook Concrete Block Co., Inc.
    - d. Approved equal.
  - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi unless otherwise indicated.
  - 3. Size: Manufactured with pre-faced surfaces having 1/16-inch-wide returns of facing to create 1/4-inch-wide mortar joints.
  - 4. Colors and Patterns: As selected by Commissioner from manufacturer's full range.

## 2.5 CONCRETE LINTELS

- A. Concrete Lintels, where indicated: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

## 2.6 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
- B. Thin Brick: ASTM C 1088, Type TBX.
  - 1. Initial Rate of Absorption: Tested according to ASTM C 67.
  - 2. Efflorescence: Tested according to ASTM C 67 and is rated "not effloresced."
  - 3. Size (Dimensions As indicated on drawings): Thin brick, modular face., 1/ 2 inch thick.
  - 4. Color and Texture: Manganese Ironspot, Smooth.
- C. Trim Units: Matching thin brick, unless otherwise indicated.
- D. Basis- of- Design, Manufacturers: Subject to compliance with requirements, provide products as supplied by the following, or equal as approved by the Commissioner:
  - 1. Endicott Clay Products Co. (Endicott Thin Brick & Tile, LLP).
- E. Other Manufacturers:
  - 1. Sioux City Brick
  - 2. Glen-Gary
  - 3. Approved equal.



## 2.7 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
  - 1. Colored Portland Cement-Lime Mix:
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
    - a. Essroc.
    - b. Holcim (US) Inc.
    - c. Lafarge North America Inc.
    - d. Lehigh Hanson; HeidelbergCement Group.
    - e. Approved equal.
- E. Aggregate for Mortar: ASTM C144.
  - 1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  - 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C404.
- G. Water: Potable.

## 2.8 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Hot-dip galvanized carbon steel.
  - 2. Exterior Walls: Stainless steel.
  - 3. Wire Size for Side Rods: 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

## 2.9 TIES AND ANCHORS



- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
  - 3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
  - 1. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized-steel wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized-steel wire.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized-steel wire.
- E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication
  - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized-steel wire.
- F. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
  - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

## 2.10 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
  - 2. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
  - 3. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.



- B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.11 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/ Cavity Vent Products: Use the following unless otherwise indicated:
  - 1. Mesh Weep/ Vent Description: Free-draining mesh; made from polyethylene strands that will not degrade within the wall cavity, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
    - a. Advanced Building Products Inc.
    - b. CavClear/Archovations, Inc.
    - c. Heckmann Building Products, Inc.
    - d. Hohmann & Barnard, Inc.
    - e. Keene Building Products.
    - f. Mortar Net Solutions.
    - g. Approved equal.
  - 3. Configuration, unless otherwise indicated and required by project application: Strips, full depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.

## 2.12 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  - 1. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
  - 2. EaCo Chem, Inc.
  - 3. PROSOCO, Inc.
  - 4. Approved equal.



## 2.13 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For masonry below grade or in contact with earth, use Type M.
  - 2. For reinforced masonry, use Type S.
  - 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  - 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.



3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

**B. Lines and Levels:**

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

**C. Joints:**

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

### **3.4 LAYING MASONRY WALLS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### **3.5 MORTAR BEDDING AND JOINTING**

**A. Lay CMUs as follows:**

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.



- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Lay structural clay tile as follows:
  - 1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
  - 2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
  - 3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch-thick joints.
- D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space not less than 1/2-inch-wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.



### 3.8 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
  - 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install weep holes in exterior wythes in head joints of first course of masonry immediately above embedded flashing.
  - 1. Use weep/ cavity vent products to form weep holes.
  - 2. Space weep holes 24 inches o.c. unless otherwise indicated.
  - 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

### 3.9 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.





### 3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: City of New York will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B, unless otherwise indicated and required, in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Grout Test (Compressive Strength) where required by project application: For each mix provided, according to ASTM C1019.
- F. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

### 3.11 RESTORING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 3. Protect adjacent surfaces from contact with cleaner.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.12 MASONRY WASTE DISPOSAL

- A. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

**END OF SECTION 04 20 00**



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**SECTION 05 12 00****STRUCTURAL STEEL****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

**1.2 SUMMARY**

- A. The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the Drawings and as specified herein.

**1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- |                           |                        |
|---------------------------|------------------------|
| A. Submittals             | DDC General Conditions |
| B. Quality Control        | DDC General Conditions |
| C. Cast-in-Place Concrete | Section 03 30 00       |
| D. Steel Joists           | Section 05 12 00       |
| E. Steel Deck             | Section 05 30 00       |
| F. Metal Fabrications     | Section 05 50 00       |
| G. Applied Fireproofing   | Section 07 81 00       |
| H. Painting               | Section 09 91 00       |

**1.4 CODES AND STANDARDS**

- A. Building Code: Structural steel work shall conform to the requirements of the 2014 New York City Building Code, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
1. American Institute of Steel Construction (ANSI/AISC 360) "Specification for Structural Steel Buildings" per Structural General Notes.
  2. American Institute of Steel Construction (AISC 303), "Code of Standard Practice", shall apply except:
    - a. Where a conflict exists between the Code of Standard Practice and the Contract Documents, the Contract Documents shall govern.



- b. In item 3.1.2 delete all references to item 4.4 and replace with the requirements of the project Specification.
  - c. Item 3.6 shall be deleted.
  - d. Item 4.4 shall be deleted and replaced with the requirements of the project Specification.
  - e. The second paragraph of item 7.10.3 shall be revised from "... The Owner's designated representatives for design and construction" to "The Commissioner".
  - f. The last sentence of items 8.5.2 and 8.5.4 shall be deleted.
  - g. Item 8.5.3 shall be deleted.
- 3. American Welding Society, AWS D1.1, "Structural Welding Code".
  - 4. Research Council on Structural Connections (RCSC) - "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
  - 5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
  - 6. The Society for Protective Coatings (formerly Steel Structures Painting Council, "SSPC") "Steel Structures Painting Manual".

C. Definitions:

- 1. The term "Heavy Shapes" in this Specification is defined to include hot rolled steel shapes with flanges exceeding 2 inches (50mm) in thickness and built up cross sections with plates exceeding 2 inches (50mm) in total thickness.
- 2. The term "High Restraint Weld" describes welds in which there is almost no freedom of movement for members joined due to geometry or material thickness.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 SUBMITTALS

- A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with DDC General Conditions Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted.
  - 1. Submittal Schedule
  - 2. Calculations, Shop Drawings and Erection Drawings
  - 3. Submittal Letters
  - 4. Pre-construction Survey



5. Quality Control Program
  6. Product Data
  7. Samples
  8. Welding Procedures Specification (WPS)
  9. Welder Certifications
  10. Mill Reports
  11. As-built surveys
- B. Detailed submittal requirements: See below for specific requirements for each required submittal.
1. Calculations, Shop Drawings and Erection Drawings (including Field Work drawings): Submit for action required connection calculations, shop drawings and erection drawings for all structural steel indicated on the Contract Documents.
    - a. Material shall not be fabricated or delivered before the shop and erection drawings have been approved or approved as noted by the Commissioner and returned to the Contractor.
    - b. Connection engineering calculations: Calculations are required for all structural steel connection details. Each calculation package shall be sealed and signed by the Contractor's Engineer licensed in the State of New York.
    - c. Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.
    - d. Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on Contract Documents, and shall not be scaled from Contract Documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pretensioned high strength bolts and identify surface preparation requirements at slip critical connections.
    - e. Welds: All welds shall be indicated by standard welding symbols in the "Standard Code for Arc and Gas Welding in Building Construction" or as accepted by the Commissioner. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.
    - f. Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; specify approved slip critical coatings; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.
    - g. Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or anchor rods and other embedded items.



All field connections not specifically shown on shop drawings shall be shown on erection drawings, including field bolt size, type, number, location and any special installation requirements, and field weld size, type, length and location.

2. **Preconstruction Survey:** Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Commissioner. For all steel construction, before steel erection commences, perform and submit to the Commissioner a complete survey for position and alignment at all points where construction by other trades will support steel elements, including but not limited to pockets, embedded plates, anchor rods and base plates. Include plan location positions relative to the building gridlines and elevations of bearing surfaces and tops of bolts relative to building Datum elevation. Immediately notify the Commissioner of elements that are not within tolerance.
3. **Quality Control Program:** Submit for record complete details of the Contractor's quality control program.
4. **Product Data:** Submit for action manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.
5. **Samples:** Submit for record (2) samples each, (2) of shop painted products and (2) of field touch-up painted products. Samples shall be steel material.
6. **Welding Procedures Specification (WPS):** Submit for record written welding procedures for all AWS D1.1 prequalified joints, and qualification procedures for all joints not prequalified by Section 3 of AWS D1.1. Submit written welding procedures developed by Contractor's welding consultant for Heavy Shapes and High Restraint Welds described in this Specification. Use the forms in AWS D1.1, Annex M. Submit all welding and qualification procedures to Testing Agency for approval before submitting to the Commissioner.
7. **Mill Reports:** Submit for record copies of all mill reports to the Commissioner and to the Testing Agency, covering the chemical and physical properties of all structural steel and accessories (as defined in this Specification) for the project
  - a. Such certificates shall be obtained from the mills producing the steel and shall certify in a cover letter submitted with the certificates, that the steel meets the minimum requirements as to physical properties, inspection, marking and tests for structural steel as defined by the current edition of the relevant ASTM Standard Specifications. Any steel that does not meet the ASTM requirements must be clearly identified in a cover letter submitted with the certificates.
  - b. Prior to commencing steel erection, deliver certificates to The Commissioner in number and form as may be required by the New York City Department of Buildings.
8. **As-Built Surveys:** Execute and submit for record a comprehensive survey of steel structure at each level adequate to assess if the structure has been built within the tolerances specified in the Contract Documents. Each survey, performed by a professional surveyor registered in the State of New York and employed by the Contractor, shall be submitted to the Contractor's Engineer licensed in the State of New York and the Commissioner for their approval before proceeding to the next stage of erection. If deviations from the tolerances are discovered, present corrective measures to the Commissioner within 48 hours of



completion of that stage of erection. Upon completion of steel erection, submit the complete package of steel surveys for record to the Commissioner.

**C. Submittal Process**

1. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
2. Connection design calculations: Calculations are required for all structural steel connection details. Calculations shall be prepared by Contractor's structural engineer licensed in the State of New York. Submit connection engineering calculations and receive approval from Commissioner prior to submitting shop drawings related to those calculations. The shop drawings shall incorporate all comments provided on the calculations.
3. Shop and erection drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop and erection drawings shall be referenced on each shop and erection drawing to facilitate checking. Unless the piece marks are self-indexing, furnish index sheets with the shop drawings, relating piece marks for all beam, girder and column details to the sheet numbers on which they are located.

**D. Submittal Review**

1. The review of connection engineering and the review and approval of shop and erection drawings and other submittals by the Commissioner shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor from:
  - a. Responsibility for the adequacy of the connections engineered by the Contractor's Engineer licensed in the State of New York.
  - b. Responsibility for all required detailing.
  - c. Responsibility for the proper fitting of construction work in strict conformance with the contract requirements.
  - d. The necessity of furnishing material and workmanship required by contract Drawings and Specifications which may not be indicated on the shop and erection drawings.
  - e. Conforming to the Contract Documents.
  - f. Coordination with other trades.
  - g. Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

**1.7 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME**

- A. The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc. The analysis of such shall be performed by the Contractor's Engineer licensed in the State of New York.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by The Commissioner at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.
- B. Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.
- C. Store fasteners in a protected place.
- D. Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use. Storage and handling shall be per AWS D1.1.

## 1.9 CONNECTION ENGINEERING AND DETAILING CONFERENCE

- A. At least 20 working days prior to starting connection engineering and detailing, the Fabricator shall hold a meeting to verify all connection engineering assumptions and procedures and shop drawing preparation and submittal procedures.
- B. Prepare an agenda and require responsible representatives of every party who is concerned with the connection engineering and detailing to attend this meeting, including but not limited to:
  - 1. Contractor
  - 2. Fabricator
  - 3. Detailer
  - 4. Contractor's Connection Engineer licensed in the State of New York
  - 5. Commissioner
  - 6. Erector
- C. The Fabricator shall prepare an agenda prior to the meeting, and shall distribute meeting minutes to all parties within 5 working days of the meeting.

## 1.10 ENGINEERING SERVICES FOR CONNECTIONS

- A. All engineering services shall be conducted by Contractor's engineer licensed in the state of New York, and submitted for review and acceptance by Commissioner.
- B. All connections and details shown on shop and erection drawings shall be prepared under the supervision of the Contractor's Engineer licensed in the State of New York, in accordance with AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings."
- C. Provide and engineer any stiffener plates, doubler plates, reinforcing plates, etc. and their connections that may be required to develop and/or transfer the forces and/or connection design criteria called for in the Contract Documents.



- D. Engineer connections to withstand the combined effects of shears, axial forces, moments and torques and as required by 2014 NYCBC and the Contract Documents.
- E. All forces shown on the Drawings are to be assumed reversible unless noted otherwise and must be checked for both directions. If no transfer/pass-through forces are shown on the Contract Documents, the most critical combinations of member forces and directions shall be assumed for the connection design.
- F. Use types of shop and field connections shown on Contract Documents or, in absence of such indication, propose appropriate type for Commissioner review.
- G. Welding of High Restraint Welds: Use double bevels in lieu of single bevels where practical. Detail joints to allow for weld shrinkage. In cases of plates in more than one plane, show welding operation sequence on the drawings. In general, start welding at the most restrained part of the weldment and proceed to the least restrained.
- H. All welded connection must utilize pre-qualified joints or joints that have been qualified by AWS D1.1, section 2.
- I. Comply with all connection notes on Drawings in conjunction with these Specifications.
- J. The connection design calculation submittals shall meet the following criteria:
  - 1. Number each calculation in a logical and orderly system. Once submitted for review, calculations shall not be renumbered. Resubmitted calculations shall be indicated by using the same number with an "R" suffix. All changes must be clouded.
  - 2. Provide sketches for results of each calculation, with all pertinent dimensions relating to the calculations (including pitch, gage, edge distance, unbraced lengths, Whitmore lengths, etc.) clearly shown. Geometry must be shown accurately and to scale. Provide enough sketches to clearly document the full range of geometric conditions applicable to each connection design calculation proposed.
  - 3. For repetitive connections provide a spreadsheet or computer program summary table for each specific location, and a standard calculation which shows how the spreadsheet or program calculation applies.
  - 4. Provide drawings showing the overall locations of the connections that are keyed/referenced to each connection calculation.
  - 5. Calculations shall be typed, or performed by spreadsheet, or by computer program, or by other method approved by the Commissioner. All spreadsheet calculations shall show the input and results for every calculation step and include appropriate text and sketches explaining all calculation assumptions.
  - 6. Provide calculation checks for all forces shown on the Drawings. All AISC code requirements apply. Provide calculations for each check. "OK by inspection" is not permitted.

#### 1.11 STRUCTURAL STEEL PRE-ERECTION CONFERENCE

- A. At least twenty (20) working days prior to the commencing of steel erection, hold a meeting to review the detailed requirements of the steel erection.

- B. Prepare an agenda and require responsible representatives of every party who is concerned with the steel erection to attend the conference, including but not limited to the following:
  - 1. Contractor
  - 2. Steel Erector / Steel Fabricator
  - 3. Erector's Surveyor
  - 4. Roof Deck trade
  - 5. All Testing and Inspection Agencies
  - 6. Commissioner
  - 7. Precast or Cladding trade as appropriate.
- C. Minutes of the meeting shall be recorded, typed and distributed by the Contractor to all parties listed above within 5 working days of the meeting.
- D. The minutes shall include a detailed outline of the erection procedure including a schedule of milestone dates for surveys and sign-offs on erection stages which represents an agreement reached by all parties involved. It shall also include the surveying program and submission schedule for approval.
- E. Notwithstanding any provision of the Specification, the Commissioner shall not be responsible for and not have charge over any safety programs or precautions at the site of the Project.

#### 1.12 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Contractor Qualifications: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.

#### 1.13 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. Refer to Section 01 40 00 "Quality Requirements", Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.14 QUALITY ASSURANCE BY TESTING AGENCY

- A. Quality assurance is testing and inspection to assist the Commissioner in evaluating the Contractor's performance and quality control in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program (see the following section on quality control).
- B. Coordination with Testing Agency: The Contractor shall have sole responsibility for coordinating their work with Testing Agency to assure that all test and inspection procedures required by the



Contract Documents and NYCDOB are provided. Cooperate fully with the Testing agency in the performance of their work and provide the following:

1. Information as to time and place of starting shop fabrication and a field construction and erection schedule, one week prior to the beginning of the work.
2. Site File: At least one copy of each approved shop drawing shall be kept available in the contractor's field office and the drawings not bearing evidence of approval and release for construction by the Commissioner shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.
3. Representative sample pieces requested by the inspection agency for testing, if necessary.
4. Full and ample means of assistance for testing and inspection of material.
5. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.

C. Duties of the Testing Agency:

1. Reports: The Testing Agency shall prepare daily reports of the structural steel work including progress and description/area of work, tests made and results. Reports of inspection of welding shall include deficiencies noted and corrections made, and other items pertinent to acceptance or rejection of the work. The reports shall state whether specimens comply with or deviate from contract requirements. The daily reports shall be collected and delivered to the Commissioner weekly.
2. Rejection: Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall immediately notify Commissioner and Contractor of deficiencies.
3. Structural steel work and general testing requirements: The Testing Agency shall perform the following shop and field inspections in addition to any other inspections enumerated above or specified on the Contract Documents:
  - a. Shop inspection of steel shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, weld access holes and copes of Heavy Shapes as defined in this Specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of Heavy Shapes, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the Commissioner and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the required percentage of tested cambers may be increased by the Commissioner to 100% at no expense to The City of New York.
  - b. Field inspection of steel shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed welds, headed studs and deformed bar anchors and field painting, including touch-up.
  - c. Check the following in the shop and in the field:



- 1) Welding certificates and procedures.
  - 2) Stud welding setup and operators
  - 3) Bolting procedure and crew
- d. Where testing is required for less than 100% of locations, select test locations at random and throughout the project.
- e. Review mill certifications for compliance with the Contract Documents.
4. High Strength Bolting: The Testing Agency inspector shall inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:
  - a. Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
  - b. Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
  - c. Visually inspect all bolted connections.
  - d. For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
  - e. For all bolted connections that are indicated as pretensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.
  - f. For all bolted connections that are indicated as pretensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pretensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
    - 1) "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.
  - g. Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.
5. Welding:
  - a. Review of submittals: Welding procedures including prequalification, qualifications test and, for Heavy Shapes and High Restraint Welds, the welding procedure prepared by the Contractor.
  - b. Complete Joint Penetration welds: Test all complete joint penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be restored and retested by the Contractor at the Contractor's expense.



- c. Partial Joint Penetration welds: Test all partial joint penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be restored and retested by the Contractor at the Contractor's expense.
  - d. Testing of welds at Heavy Shapes and High Restraint Welds shall be performed not less than 48 hours after the weld has been completed.
  - e. Fillet welds: Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure, but test at least one weld in each location with 6 or more welds per connection. If, in the opinion of the Commissioner and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the Commissioner to 100%, all at the Contractor's expense.
  - f. Inspection and Testing by the Testing Agency of High Restraint Welds and where Heavy Shapes are to be joined by partial or complete joint penetration welds in tension:
    - 1) Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.
    - 2) Test Complete Joint Penetration Welds in accordance to the requirements of this Specification section, ultrasonically in accordance with AWS D1.1 procedures. On T or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.
    - 3) Test Partial Joint Penetration Butt Joints in accordance with this Specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex Q7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Commissioner for review.
  - g. At Heavy Shapes and High Restraint Welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.
6. Headed Studs and Deformed Bar Anchors: Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).
- a. Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition, for each member with any defective studs, test an additional member.



- b. Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.
- 7. Cleaning & Painting:
  - a. Examine shop painting to verify conformance with this Specification.
  - b. Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.
- 8. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Commissioner on a weekly basis.
- 9. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Commissioner that the installation is in accordance with the design and Specification requirements (including 2014 New York City Building Code).

#### 1.15 QUALITY CONTROL BY CONTRACTOR

- A. Provide a program of quality control to ensure that the minimum standards specified herein are attained.
- B. The Commissioner's general review during construction and activities of the Testing Agency are undertaken to inform the Commissioner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
- C. Immediately notify the Commissioner of any deficiencies in the work which are departures from the Contract Documents which may occur during construction. Propose corrective actions and their recommendations in writing and submit them for review by the Commissioner. After proposed corrective action is accepted by the Commissioner, correct the deficiency at no expense to The City of New York.

#### 1.16 OBSERVATIONS BY COMMISSIONER

- A. Observations: The Commissioner will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.

#### 1.17 PERMITS AND WARRANTY

- A. Permits: Apply for, procure, renew, maintain, and pay for all permits required, necessary to execute work under this Contract. Furnish copies of all permits to the Commissioner.
- B. Warranty: Comply with General Conditions, agreeing to restore or replace specified materials or Work that has failed within the warranty period.

#### 1.18 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.19 LEED BUILDING SUBMITTALS

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### PART 2 - PRODUCTS

#### 2.1 STRUCTURAL STEEL

- A. Structural steel shall conform to the requirements listed on the Structural Drawing General Notes.

#### 2.2 SHOP COATINGS

- A. Standard Primer: Rust inhibitive, universal phenolic alkyd metal primer 2-4mls. Color to be determined by Commissioner. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.
- B. Zinc Rich Primer: SSPC-Paint 20, Type I or Type II, Zinc rich primer utilizing either an organic or inorganic binder with a minimum zinc content of 80 percent by weight in the dry film. The primer shall provide a surface meeting AISC Slip Critical Class B (slip coefficient =0.50 min) requirements. Color to be determined by Commissioner. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.
- C. Hot Dip Galvanizing: ASTM A123, weight of coating shall average not less than 2.3 oz per square foot, with no individual thickness less than 2.0 oz per square foot.
- D. Galvanizing Repair Paint: ZRC Cold Galvanizing Compound, or other coating complying with SSPC-Paint 20.

## 2.3 ACCESSORIES

- A. High Strength Bolts: Conform to the provisions of the Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using High-Strength Bolts" except that nuts shall be ASTM A563 Grades DH or DH3 (hardened) for both A325 and A490 bolts. Twist off type bolts (Tension Control bolts) shall additionally conform to ASTM F1852 or ASTM F2280.
- B. All bolts shall be new, and not re-used.
- C. Where A325 galvanized bolts nuts and washers are required, they shall be in accordance with ASTM F2329 and ASTM A153, Class C. Where A588 steel is used, bolts, nuts and washers shall be Type 3.
- D. Direct Tension Indicators: Meet requirements of ASTM F959.
- E. Anchor Rods: Per structural General Notes.
- F. Washers:
  - 1. Round washers shall conform to American Standard B 27.2 type b
  - 2. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard F436.
  - 3. Beveled washers shall be square, smooth and sloped so that contact surfaces of the bolt head and nut are parallel.
  - 4. The diameter of the hole of square beveled washers shall be 1/16 inch (1.5mm) greater than the bolt size for bolts smaller than one inch (25mm), and shall be 1/8 inch (3.0mm) greater than the bolt size for bolts larger than one inch (25mm).
  - 5. Comply with requirements of RCSC for all washers including thickness, size and hardness, depending on connection details.
- G. Welding Electrodes: Electrodes shall be low hydrogen and shall be selected from Table 3.2 of AWS D1.1.
  - 1. Shielded Metal-Arc Welding: Welding electrodes for manual shielded metal-arc welding shall conform to the specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1 E70 or 80, or the specification for Low-Alloy Steel Covered Arc-Welding Electrode, AWS A5.5.
  - 2. Submerged-Arc Welding: Bare electrodes and granular flux used in submerged-arc welding shall conform to F70 or F80 AWS flux classifications of the specification for Mild Steel Electrodes and Fluxes for submerged-arc Welding, AWS A5.17.
- H. Headed Studs (shear connectors) shall be per Structural General Notes.
- I. Deformed Bar Anchors shall be as specified in Structural General Notes.
- J. Steel Castings shall conform to ASTM A27, Grade 65-35, medium strength carbon steel.
- K. Grout: Refer to General Notes.



- L. Post-installed Anchors shall be per Structural General Notes.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PREPARATION

- A. Examine all work prepared to receive work of this Section and report any defects affecting installation to Commissioner. Commencement of work will be construed as complete acceptance of preparatory work. The Contractor alone shall be responsible for checking the dimensions and coordination of the structural steel work with other portions of the work.
- B. Anchor Rods: At least 20 working days prior to the start of the structural steel erection, ascertain by accurate survey the existing location, alignment, and elevation of the anchor rods embedded in the concrete. Immediately notify the Commissioner of any discrepancies observed between the Contract Documents and the as-built conditions. Steel erection shall not start until corrective measures, if required, have been performed.

#### 3.3 FABRICATION

- A. Fabricate and assemble structural steel in the shop to the greatest extent possible.
- B. Tolerances:
  - 1. Conform to the tolerances of the AISC "Code of Standard Practice," compensate for the difference between the temperature at time of fabrication and the mean temperature in service.
  - 2. Elevator shafts used for temporary hoists shall conform to the detailed requirements of the hoist manufacturer.
- C. Holes: Holes shall be provided in members to permit connections to the work of other trades or contracts, and for passage through the member of work of other trades. All holes shall be accurately drilled or punched at right angles to the surface of the metal in accordance with AISC Specifications. Holes shall not be made or enlarged by burning. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Drift pins will be allowed only to bring together the several parts for connection. Holes in base plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed with a suitable tool.
- D. Camber: Provide camber as indicated on the Contract Documents. Where no camber is indicated, provide natural camber up.
- E. Cutting: Manual gas-cutting in the shop may be used only if automatic or semi-automatic methods are not possible. If manual shop cutting is required, it shall be done only with a mechanically guided torch, except that an unguided torch may be used where the cut is more than 1/2 inch (12mm) from the finished dimension and final removal is completed by means such as chipping or grinding to produce a gouge-free surface of quality equal to that of the base metal. At restrained joints and as indicated elsewhere, weld access holes shall be ground smooth.



- F. Cutting of Heavy Shapes: Where Heavy Shapes are to be joined by partial or complete joint penetration welds in tension, preheating shall be required for all thermal cutting operations. Preheat shall be sufficient to prevent cracking but in no case less than 150 degrees F (65°C). Weld access holes and copes shall be ground to a smooth radius after cutting and tested for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.
- G. Anchor Rods: Rigid steel templates and anchor rods shall be furnished, labeled and shipped in sets indicating sizes and locations of columns, together with instructions for setting of anchor rods. Plate washers per Typical Details shall be provided.
- H. Bolting: Bolts shall be driven accurately into the holes without damaging the threads. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing under the head or nut.
- I. Bolts indicated as "finger tight" on the Contract Documents shall be prevented from backing off by using lock nuts, thread compound or deformed threads.
- J. Installation of High Strength Bolts:
  - 1. Except where "snug tight" installation is specifically permitted on design Drawings, all high strength bolts shall be installed with full pretensioning using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning or Direct-Tension-Indicator (DTI) Pretensioning in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
  - 2. Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.
  - 3. All high strength bolt assemblies (including Tension Control bolts and DTI's) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.
  - 4. Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer.
- K. Welding of Structural Steel:
  - 1. Pre-Weld Inspection: The surface to be welded and the filler material to be used shall be subject to inspection before welding is performed.
  - 2. Welds indicated on the Contract Documents or the approved shop or erection drawings shall be created by electric arc welding processes that comply in all respects with the codes and specifications herein noted covering the design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. Control the heat input, weld length, weld sequence and cooling process to prevent distortion of the completed assembly.
  - 3. Each welder's work shall be traceable.
  - 4. Special Requirements: For High Restraint welds and welds at Heavy Shapes, follow approved welding procedures for weld process, sequence, pre-heating and cooling. Use



stress relieving techniques where shown in the approved procedure developed by the Contractor's Welding Consultant.

- a. Special Procedures: Prior to the start of production welding, demonstrate to the Testing Agency that preheat can be maintained without relying on heat from the arc. For field welding, provide a shelter to protect each joint from inclement weather (rain, snow, etc.), from start until completion of the joint.
  - b. Preheat and Postheat: Preheat shall be sufficient to prevent cracking, but in no case less than required by AWS D1.1. Prepare a written welding sequence and distortion control plan to be included in the welding procedures submittal. Assembly sequence of adjoining parts shall balance applied induced heat from preheat and welding processes to minimize distortion and shrinkage. The preheat shall be maintained throughout the thickness of the material for a distance equal to twice the material thickness on both sides of the joint at a minimum. Where different thicknesses of steel are being joined, the greater thickness shall govern. Preheat shall be measured on the face opposite the side of the heat application. Preheat shall be applied uniformly in a manner that does not harm the surface of the material nor cause surface temperatures to exceed 1100 degrees F (600oC). Should stress relief heat treatment be required, submit a written procedure.
  - c. Prior to heat treatment on a production weld, prepare and treat a test sample per the Contractor's written procedure for tests in accordance with ASTM requirements.
5. Deficient Welds: Welds found deficient in dimensions but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by grinding or melting and the weld shall be remade.

L. Bearing:

1. Bearing ends of columns shall be milled or sawn square perpendicular to axis of the column.
2. Finish bearing areas of base plates per AISC M2.8.

M. Stiffeners: Fitted stiffeners shall be ground to fit closely against flanges.

N. Cleaning and Preparation of Steel Surfaces:

1. Clean all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure. Steel work to be painted shall be painted within the same day that it is cleaned.
  - a. Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): SSPC-SP-2, Hand Tool Cleaning.
  - b. Interior, Exposed in the Finished Building: SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
  - c. Exterior (exposed to weather or in unconditioned space): SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
  - d. Members to be Hot Dipped Galvanized: SSPC-SP3, Power Tool Cleaning, before galvanizing.



O. Shop Coating:

1. Where painting is specified, paint all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure and in accordance with manufacturer's written instructions. Paint steel work the same day that it is cleaned.
  - a. Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): No Paint.
  - b. Interior, Exposed in the Finished Building: SSPC – Paint 25
  - c. Exterior (exposed to weather or in unconditioned space): SSPC – Paint 20
2. Protect finished bearing surfaces with a rust-inhibiting coating which is to be removed immediately prior to erection.
3. Do not paint:
  - a. Surfaces within six (6) inches (150mm) of field welds
  - b. Surfaces to be encased in concrete or to receive cementitious fireproofing
  - c. Contact surfaces of high-strength bolted Slip Critical connections (unless surface prep and paint has been specifically prequalified by the contractor or approved for use in this location by the Commissioner)
  - d. Surfaces required for testing and preheat, until all testing and preheat has been performed
  - e. Finished bearing surfaces (use removable rust-inhibiting coating)
  - f. Top flange of the beam where steel deck or headed studs are to be attached
4. Paint shall be applied thoroughly and evenly to dry surfaces only when surface temperatures are above dew-point, in strict accordance with manufacturer's instructions.
5. Surfaces of exterior members which are inaccessible after assembly or erection shall receive their second coat of the approved paint, in a different shade, in the shop.
6. Hot-dip galvanize the following steel members:
  - a. All angles, steel plates and shims supporting exterior masonry or exposed to the weather, including shelf, arch and relieving angles
  - b. All connections between the above angles and steel plates and the supporting structural member, including clip angles and hardware
  - c. Any other steel members indicated as "Galvanized" on the Contract Documents.
  - d. All miscellaneous metal, angles, clips, etc. on exterior masonry walls.

### 3.4 ERECTION

- A. Tolerances: Erect all work plumb, square and true to lines and levels in strict accordance with the structural requirements of the building within tolerances of the AISC Code of Standard Practice, unless otherwise indicated on the Contract Documents. Compensate for the difference between the temperature at time of erection and the mean temperature in service.
- B. Bracing: Brace the frame during erection in accordance with the Contractor's erection procedure.
- C. Errors: Immediately notify the Commissioner of any errors in shop fabrication, deformations resulting from handling and transportation, and improper erection that affects the assembly and fitting of parts. Prepare details for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously at the sole expense of the Contractor.
- D. Column Base Plates: Support and align on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, tighten anchor rod nuts in preparation for grouting. Cut off wedges and shims flush with edges of plates and leave in place. The use of leveling plates will not be permitted.
- E. Grouting: Refer to General Notes. Grout base plates immediately after the first tier of columns are plumbed. Do not proceed with steel erection above the first tier until base plates are grouted.
- F. Bolting and Welding of Structural Steel: See Section on "Fabrication".
- G. Bearing Surface: Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.
- H. Splices: Splices will be permitted only where indicated on the Contract Drawings or the reviewed shop drawings. Fasten splices of compression members only after surfaces are cleaned and abutting surfaces have been brought completely into contact. Fill any remaining gaps with steel shims driven into place and cut flush. Tack weld shims to each other and to members. Use runoff tabs at bevel weld splices. Cut off runoff tabs and ground smooth after weld completion.
- I. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such a manner as to distort or damage the metal. Correct poor matching of holes by drilling to the next larger size and using a larger size bolt. Plug welding and redrilling will not be permitted, unless a specific instance arises and is approved by the Commissioner.
- J. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, remove erection bolts.
- K. Hammering: Hammering which may damage or distort the members will not be permitted.
- L. Do not use cutting torches in the field without the specific approval of the Commissioner for each application. Where cutting torch use is permitted, all the requirements of the Section on "Fabrication" shall apply.
- M. Additional Material and Labor: If the Contractor furnishes additional material and labor for the purpose of erection or if the erection method requires that material be added to certain members, the required modifications shall be at the sole expense of the Contractor.



- N. Alignment: Following erection, accurately align, level, and adjust all members prior to final fastening. Conform to AISC standard tolerances unless otherwise noted in the Contract Documents.
- O. Touch-Up and Field Applied Paint: After erection, clean all damaged areas in the shop coat, exposed surfaces of bolts, bolt heads, nuts and washers and all field welds and unpainted areas adjacent to field welds according to manufacturers recommendations and paint with the same paint used for the shop coat. Match the touch up and field applied paint color to the as-built paint color. After touch up, at exterior (exposed to the weather or in unconditioned space) steel members apply a full coat of the specified paint in a different shade than the shop applied coat.
- P. After erection, clean all damaged galvanized areas, welds and areas adjacent to welds and paint with the specified galvanizing repair paint.
- Q. Clean all steel members of mud and debris and construction residue prior to erection.
- R. Headed Studs and Deformed Bar Anchors:
  - 1. End weld headed studs and deformed bar anchors with an automatic process in accordance with section 7 of AWS D1.1.
  - 2. Areas to which studs are to be attached must be free of foreign material, such as rust, oil, grease, paint etc. When mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand blasting.
  - 3. Remove ceramic ferrules from studs and work after welding.

**END OF SECTION 05 12 00**

**SECTION 05 30 00****STEEL DECK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

**1.2 SUMMARY**

- A. The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the installation of composite and non-composite structural steel floor deck systems, steel roof deck systems and related work with all attachments, flashings, metal closures, concrete stops, accessories and fittings as required for a complete installation in accordance with the Drawings and as specified herein.

**1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- |    |                      |                        |
|----|----------------------|------------------------|
| A. | Submittals           | DDC General Conditions |
| B. | Quality Control      | DDC General Conditions |
| C. | Concrete             | Section 03 30 00       |
| D. | Structural Steel     | Section 05 12 00       |
| E. | Miscellaneous Metals | Division 5             |
| F. | Applied Fireproofing | Section 07 81 00       |
| G. | Painting             | Section 09 91 00       |

**1.4 CODES AND STANDARDS**

- A. Building Code: Steel deck work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
1. All steel floor and roof deck manufacturers shall be listed in the Underwriter's Laboratories "Fire Resistance Index of Companies".
  2. American Iron and Steel Institute (AISI) "Specification for the Design of Cold-Formed Steel Structural Members".
  3. American Welding Society AWS D1.3 , "Structural Welding Code – Sheet Steel."



4. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
5. Steel Deck Institute (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks".

C. Definitions:

1. See Section 05 12 00 "Structural Steel".

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 SUBMITTALS

- A. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

1. Submittal Schedule
2. Shop Drawings and Erection Drawings
3. Manufacturer's Certification
4. Manufacturer's Installation Instructions
5. Welder Certifications
6. Research Reports or Evaluation Reports

- B. Detailed submittal requirements: See below for specific requirements for each required submittal.

1. Shop Drawings and Erection Drawings (including Field Work Drawings): Submit for record manufacturers standard load tables and calculations for items designed by the Contractor's Engineer licensed in the State of New York. Submit for approval shop drawings and erection drawings for all steel deck indicated on the Contract Documents.
  - a. Materials shall not be fabricated or delivered to the site before the shop drawings have been approved or approved as noted by the Commissioner and returned to the Contractor.
  - b. Shop Drawings shall clearly indicate:
    - 1) Deck types (profiles), steel gauges, and deck finishes.
    - 2) Deck layout, including panel locations, number of deck spans per panel, structural support locations and joint locations.
    - 3) Deck dimensions and sections keyed to layout plans, including side and end details and bearing requirements.
    - 4) Deck fastener types (welds, screws, pins, manufactured systems) and layout patterns at panel sides, ends and interior supports.





- 5) Deck manufacturer, profiles, properties, vertical load capacity and in-plane diaphragm shear capacity for all as-detailed conditions.
  - 6) Details and locations of accessories including hardware, framing reinforcement anchorage, sump pans, cant strips, ridge plates, valley plates and closure plates.
  - 7) Fabrication necessary to incorporate steel deck into the job.
  - 8) Correlation with other requirements, openings and flashings.
  - 9) Fully dimensioned layout of field-installed headed studs (shear connectors).
  - 10) Contractor-coordinated openings for mechanical, electrical, plumbing, fire protection and other trades.
- c. A letter shall be submitted along with the shop drawings. It shall bear the registration number seal, signature and address of the Structural Engineer Licensed in the state of New York who prepared or supervised the calculation and reviewed the shop drawing submittal.
2. **Manufacturer's Certification:** Submit for record a letter of certification from the deck manufacturer stating that the design, the detailing and fabrication of the steel deck to be installed under this Section are in accordance with the SDI Design Manual for Composite Decks, Form Decks and Roof Decks.
  3. **Manufacturer's Installation Instructions:** Submit for record Manufacturer's literature providing recommended installation instructions.
  4. **Welder Certifications:** Submit for record welder certificates signed by the Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
  5. **Research or Evaluation Reports:** Submit for record research reports or evaluation reports of the model code organization acceptable to the New York City Department of Buildings that evidence steel deck's compliance with the 2014 New York City Building Code.
- C. Refer to DDC General Conditions for submittal process and requirements.
- D. Refer to Section 03 30 00 – "Cast-in-Place Concrete" for additional submittal requirements related to concrete trades.
- 1.7 COORDINATION AND TEMPORARY SUPPORT**
- A. Coordinate any special support requirements such as shoring of deck for wet concrete loads.
  - B. Coordinate any construction loads on deck before concreting, and on completed deck in excess of the design loads shown. Such conditions may include both gravity and lateral loads.
- 1.8 DELIVERY, STORAGE, AND HANDLING**
- A. Do not bend or mar decking.
  - B. Store off ground with one end elevated for drainage.

- C. Cover decking with waterproof material, ventilated to avoid condensation.
- D. Do not store deck bundles on framing unless material is securely tied down and the framing has been analyzed to ensure that such storage will not cause an overload.

#### 1.9 STRUCTURAL STEEL PRE-ERECTION CONFERENCE

- A. See Section 05 12 00 "Structural Steel".

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

#### 1.11 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. Refer to Section 01 40 00 "Quality Requirements", Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.12 QUALITY ASSURANCE

- A. Testing Agency:
  - 1. Reports: The Testing Agency shall include in the daily reports of the structural steel, steel deck progress and description/area of work, tests made and results.
  - 2. Coordination: The Contractor shall have sole responsibility for coordinating his work with the Testing Agency to assure that all test and inspection procedures required by the Contract Documents and/or 2014 New York City Building Code, are properly provided. Cooperate fully with the Testing Agency in the performance of their work.
- B. Decking is subject to inspection and testing once connected in place:
  - 1. Remove work found to be defective and provide acceptable work at no additional expense to The City of New York.
- C. Field Inspection:
  - 1. All steel deck shall be inspected after erection to ascertain the following relative to approved shop drawings:
    - a. Deck profile, type (acoustic, cellular, vented), gage and finish
    - b. Deck orientation, alignment, bearing and laps (if applicable)
    - c. Supplementary items including secondary supports, closures, pour stops, sumps and their connections to deck and to other members
    - d. Damage of members during transportation, storage and erection
    - e. Installation for proper erection



- f. Connections (for quantity, size and spacing, and quality of welds) including inspection of deck welding
- 2. Headed studs (shear connectors):
  - a. At the start of each day's operations for attaching headed studs, first weld a minimum of two studs to demonstrate proper welding set up for that day's typical deck and support conditions. Testing Agency to observe Contractor hammer-bending the studs to an angle 15 degrees from the vertical without weld failure.
  - b. Should failure occur in the weld zone of either stud, adjust welding set up and repeat the test until two consecutive studs are, tested and found satisfactory before any production welding of studs may begin.
  - c. Perform demonstration tests at each significant change in conditions including deck thickness, deck coating (painted to galvanized) or number of deck layers.
  - d. Do not weld studs through more than one layer of steel deck, except where cellular deck is specified.
  - e. Failed test studs shall be removed and replaced by production studs.
  - f. During production installation, bend testing of headed studs is required where incomplete weld flash is observed, and at random locations on each floor. For production testing requirements see Section 05 12 00 "Structural Steel".

**D. Testing Agency Reports & Certifications:**

- 1. Indicate to the Contractor where remedial work must be performed. Track and retest all locations of remedial work.
- 2. Upon completion of work and resolution of remedial items, certify in a letter to the Commissioner and that the installation is in accordance with the design and Specification requirements, and 2014 New York City Building Code.

**1.13 QUALITY CONTROL**

- A. See Section 05 12 00 "Structural Steel".

**1.14 OBSERVATIONS BY COMMISSIONER**

- A. See Section 05 12 00 "Structural Steel".

**1.15 PERMITS AND WARRANTY**

- A. See Section 05 12 00 "Structural Steel".

**1.16 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

#### 1.17 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  1. **Recycled Content:** Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.18 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. All steel deck units shall be of the same depth and profile as shown on the Drawings and the product of one manufacturer. Provide products from approved manufacturers that are equivalent to the basis of design product.

#### 2.2 MANUFACTURERS:

- A. **Basis-of-Design Product:** Subject to compliance with requirements provide Vulcraft; or comparable product by one of the following:
  1. Wheeling
  2. Verco Manufacturing Co.
  3. Or approved equal.

## 2.3 DESIGN

- A. Section properties of the steel deck units shall be calculated in accordance with the AISI "Specification for the Design of Cold-Formed Steel Structural Members". The minimum positive and negative section moduli so obtained shall be used in calculations involving positive and negative moments, respectively, in determining the required gauges of steel deck units.

## 2.4 MATERIALS

- A. Prime Painted Cold Rolled Steel Sheet for deck and accessories: ASTM A1008 SS Grade 33 (minimum) with minimum yield strength of 33ksi (230MPa). Surface in contact with concrete (typically top) to be phosphatized. Exposed surface (typically bottom) to have oven cured gray or white lead- and chromate-free rust-inhibitive primer to 0.3 mil nominal dry film thickness.
- B. Galvanized Steel: roof steel deck, floor galvanized steel deck and all closures and flashings shall be formed from steel sheets conforming to ASTM A653, Structural Quality Grade 33 (minimum) with minimum yield strength of 33 ksi (230MPa). Before forming, the steel sheet shall be coated with a zinc coating conforming to ASTM A653 Zinc coated per ASTM A653 G60.
- C. Floor decking shall be formed with integral locking lugs or embossments to provide a mechanical lock between the steel floor and the concrete slab sufficient to resist at least twice the design shear force. Minimum depth of embossments or locking lugs shall be .050"(1.3mm).
- D. All steel decking shall be roll formed for uniformity in dimension and strength.
- E. Floor and roof decking shall be classified by Underwriters' Laboratories, Inc. Each unit or bundle shall be labeled and marked as required by UL, indicating manufacturer, testing, and inspection.

## 2.5 ACCESSORIES

- A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.
- B. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter. Where Factory Mutual is indicated in the Contract Documents, fasteners must be approved by Factory Mutual as a method for securing steel roof deck for Class indicated.
- C. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated, but not less than the deck gauge.
- D. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.
- E. Hanger Tabs: Manufacturer's standard UL rated piercing steel sheet hanger attachment devices for floor deck panels.
- F. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch (1.8mm) thick minimum, of same material as deck panels, with 1-1/2-inch (40mm) minimum deep level recessed pans and 3-inch (75mm) wide flanges. Cut holes for drains in the field.
- G. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071" (1.8mm) thick minimum units, of same material as deck panels.

- H. Miscellaneous Roof Deck Accessories: Steel sheet ridge and valley plates, finish strips, and reinforcing channels, of same material and thickness as roof deck unless otherwise indicated.
- I. Headed Studs (shear connectors) shall be per Structural General Notes.
- J. Steel Sheet Accessories: ASTM A 653, galvanized to G 90 coating class.
- K. Galvanizing Repair Paint: SSPC Paint 20 or MIL-P-21035, with dry film containing a minimum of 94% zinc dust by weight.
- L. Flexible Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.
- M. Sound-Absorbing Insulation: As required by the Contract Documents, provide manufacturer's standard premolded roll or strip glass fiber or mineral fiber.

## 2.6 SIDE JOINT HANGER SYSTEM FOR USE IN COMPOSITE STEEL FLOOR DECK ONLY

- A. Provide hanger tabs along the side joints of units at 1'-0" (300mm) centers.
- B. Side joint hanger tabs shall have a minimum allowable static load capacity of at least 100 lbs (45kg). and shall accommodate a flat bar hanger (no rod hangers).
- C. All hangers, their installation, and tab activation shall be by trades requiring the tabs.
- D. No plastered ceilings shall be hung from side joint hanger tabs.
- E. No mechanical, electrical, plumbing or fire protection loads shall be hung from deck side joint hanger tabs.

## 2.7 MISCELLANEOUS MATERIALS

- A. Arc-Welding Electrodes: AWS A5.1 E70XX Series, as required for the conditions of use.
- B. Touch Up Paint: use galvanized repair paint specified above.
- C. Closure Tape as required to maintain cells clear of concrete at abutting panel ends.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Examine all work prepared to receive work of this Section, especially plan and elevation locations of supporting frames and walls. Report any defects affecting installation to Commissioner. The Contractor alone shall be responsible for checking the dimensions and coordination of the steel deck work.
- B. Do not place deck units on supports with debris or unapproved coatings that could affect full, level bearing and proper connections.
- C. Do not place deck units on concrete supporting structures until concrete has cured and is dry.

- D. Coordinate the location of decking bundles with a structural steel erector to prevent overloading of structural members.

### 3.3 ERECTION – PLACEMENT

- A. Erect steel deck in accordance with the decking manufacturer's recommendations and the requirements of the Drawings and these Specifications.
- B. Place steel deck on the supporting framework and adjust to final position with ends accurately aligned and bearing on supporting members before making permanent connections. Do not stretch or contract sidelap interlocks.
- C. Place deck units flat, square, without warping or excessive deflections, in straight alignment for entire length of run of cells and with close alignment between the cells at ends of abutting units.
- D. Abutting ends of deck panels shall occur over supports. End bearing shall be a minimum of 2 inches (50mm), or greater if required (web crippling) by deck manufacturer.
- E. Where deck panels nest, laps shall be a minimum of 2" (50mm) and shall occur over supports. Nesting is permitted only where profiles are designed to nest and are fabricated with offset ends.
- F. Install slab edge closures and pour stops at the theoretical position with maximum tolerance of + 3/8" (10mm). Closures and pour stops shall have adequate adjustments to maintain this tolerance while accommodating the structural steel frame tolerances.

### 3.4 ERECTION - CONNECTIONS

- A. Connect steel deck to the steel framework at ends of units and at intermediate supports as shown on the Contract Documents and approved shop drawings.
- B. Deck to support welds shall be puddle welds of diameter and spacing shown on Contract Documents and/or approved shop drawings.
- C. Use welding washers for puddle welding at deck thinner than 22 gauge (0.85mm) and where recommended by the manufacturer
- D. Where headed studs occur, if fused to deck for full weld perimeter each headed stud may be considered to replace one puddle weld
- E. Fasten side laps and perimeter edges of panels between supports by button punching, side seam welding or screws, or as noted on Construction Drawings.

### 3.5 ERECTION – OPENINGS AND CLOSURES

- A. Contractor to coordinate location of all openings with other trades (see Submittals).
- B. Cut and install sleeves and holes through decking for openings indicated on the Architectural, Structural, and/or Mechanical, Electrical, Plumbing, and Fire Protection Drawings. Sleeves will be furnished by the various trades requiring them. Provide and install reinforcement as required around sleeves. Where possible, leave deck intact and use block outs to hold back concrete at openings. Cut deck after concrete cures.

- C. Provide miscellaneous headers and other steel reinforcing and supports welded to decking and structural steel as required at penetrations, around columns, etc. per typical details and manufacturer's recommendations.
- D. Field cutting parallel to flutes shall be done in the low flutes, taking care to leave sufficient horizontal material to permit satisfactory welding of deck to supporting steel.
- E. Openings required for work of other trades and not indicated on Architectural, Structural, Mechanical, Electrical, Plumbing, Fire Protection, and Telecom Drawings shall be permitted only upon approval of the Commissioner as to size and location.
- F. Furnish and install tight-fitting closures at locations including but not limited to
  - 1. Open ends of flutes and sides of decking (neoprene or sheet steel)
  - 2. Open ends of all flutes at columns, walls and openings shown on Contract Drawings
  - 3. Panel ends where panels change direction or abut (sheet steel or closure tape)
  - 4. Between deck units and columns (sheet steel)
  - 5. Between columns and exterior cladding (sheet steel)
  - 6. Welding hole cover, with friction fastening, to close excess holes when required (sheet steel).

### 3.6 WELDING

- A. Welding of steel deck shall follow the technique outlined by the steel deck manufacturer.
- B. Welding of headed studs shall conform to all AWS requirements, including workmanship, quality control, and inspection, which shall be performed by the Contractor and observed by the Commissioner and Testing Agency for Special Inspections.

### 3.7 ROOF SUMP PANS

- A. Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches (300mm) o.c. with at least one weld at each corner. Cut opening in roof sump bottom to accommodate drain size shown, coordinate with Plumbing Drawings.

### 3.8 CONCRETE PLACEMENT

- A. Concrete with admixtures containing chloride salts or other deleterious materials shall not be used with steel deck.
- B. Steel deck used to support concrete buggy runways shall be adequately protected against wheel damage. Decking and any runways or shoring shall be evaluated and engineered by Contractor's Engineer licensed in the State of New York to be submitted for review and approval by the Commissioner.

### 3.9 TOUCH-UP

- A. After installation touch-up welds on galvanized decking with specified galvanized repair paint to a dry film thickness of 2 mils, at all locations that will not receive concrete fill.





- B. Touch-Up Painting: Where exposed to view, wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.
  - 1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
  - 2. Where shop-painted surfaces are exposed in-service, apply touch-up paint to blend into adjacent surfaces.

**END OF SECTION 05 30 00**

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**SECTION 05 40 00**

**COLD-FORMED METAL FRAMING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Exterior non-load-bearing wall and soffit framing.
  2. Installation accessories.
- B. Related Sections:
1. Section: 07 42 13 "Insulated Metal Wall Panels."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold- formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Engineering Services Submittal: For cold- formed steel framing and connections, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York .responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Product Tests: Mill certificates or data from a qualified independent testing agency.
- C. Welding Qualifications: Comply with qualify procedures according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- D. On-site Facade Mockups: Include as part of on-site facade mockup required by other sections, as indicated on the drawings, work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.



1. Provide complete cold- formed steel framing installation in sizes, quantities, and configuration indicated on the drawings.
2. Incorporate full-scale details of the architectural features, approved finished and textures, brackets and attachment components required for installation.
3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products as supplied by one of the following, as approved by the Commissioner:
  1. CEMCO; California Expanded Metal Products Co.
  2. ClarkDietrich.
  3. MarinoWARE.
  4. Telling Industries.
  5. Approved equal.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design architectural precast concrete units including connections.
  1. Engineering Services shall include complete design calculations for cold- formed steel framing and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.

### 2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  1. Grade: As required by structural performance.
  2. Coating: G90 or equivalent.

### 2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:



1. Minimum Base- Metal Thickness: 0.0428 inch minimum and greater where required to meet performance requirements.
  2. Flange Width: 1- 3/8 inches unless otherwise required by project application.
  3. Section Properties: As required to meet performance requirements.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

## 2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base- Metal Thickness: Same as wall framing unless otherwise required to meet performance requirements.
  2. Flange Width: As required by project application.
  3. Section Properties: As required to meet performance requirements.

## 2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

## 2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report for project substrate, acceptable to the New York City Department of Buildings.
1. Uses: Securing cold-formed steel framing to structure.



2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report based on ICC-ES AC70, acceptable to the New York City Department of Buildings.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

## 2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.



### 3.4 COLD- FORMED METAL FRAMING, GENERAL

- A. Comply with combined written instructions of manufacturers, unless more stringent requirements are indicated, including those in referenced publications.

### 3.5 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.6 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.





- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.7 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.8 FIELD QUALITY CONTROL

- A. Testing: City will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Commissioner.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.9 RESTORATION AND PROTECTION

- A. Restoration: Prepare and restore damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, and approved by the Commissioner, to ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 05 40 00**



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**SECTION 05 50 00**

**METAL FABRICATIONS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Ladders and transfer platform with ladder- assist post to serve as safety railing.
4. Elevator pit sump covers.
5. Miscellaneous steel trim.
6. Metal bollards.
7. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete.

C. Related Sections:

1. Section 07 52 16 "SBS Modified Bituminous Membrane Roofing."
2. Section "12 93 00 Site Furnishings."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate installation of covers for steel bollards.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For the following:
  1. Fasteners.
  2. Shop primers.
  3. Shrinkage-resisting grout.
  4. Slotted channel framing.
  5. Ladders.
  6. Metal bollards.
  7. Abrasive metal nosings.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Include shall include but not be limited to the following:
  1. Metal bollards.
  2. Abrasive metal nosings.
  3. Aluminum ladders.



- C. Engineering Services Submittal: For aluminum ladders and transfer platforms, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.
- D. Samples: For each type and finish of nosing.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Welding Qualifications: Qualify procedures according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design aluminum ladders and transfer platforms.
  - 1. Engineering Services shall include complete design calculations aluminum ladders and transfer platforms required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. Structural Performance of Aluminum Ladders: Ladders including transfer platforms shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.



- C. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316 and 316L.
  - D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316.
  - E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
  - F. Rolled-Stainless Steel Floor Plate: ASTM A793.
  - G. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface.
  - H. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
  - I. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
  - J. Zinc-Coated Steel Wire Rope: ASTM A741.
    - 1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
  - K. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
    - 1. Size of Channels: 1-5/8 by 1-5/8 inches unless otherwise indicated.
    - 2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.
    - 3. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
  - L. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
  - M. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
  - N. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
  - O. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
  - P. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).
  - Q. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or UNS No. C84400 (leaded semired brass).
  - R. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- 2.3 FASTENERS
- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.



- B. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- F. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

#### 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.



- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches from ends and corners of units and 24 inches o.c.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- B. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
  - 1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

## 2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.





- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.8 METAL LADDERS

- A. Aluminum Ladders: Comply with ANSI A14.3.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal as approved by the Commissioner:
    - a. Halliday Products.
    - b. O'Keeffe's Inc.
    - c. Precision Ladders, LLC.
    - d. Or approved equal.
  - 2. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
- B. Wall- mounted ladders at Roof: Comply with the following unless otherwise indicated.
  - 1. Space siderails 16 inches apart unless otherwise indicated.
  - 2. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2 1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.
  - 3. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
  - 4. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
  - 5. Provide transfer platforms, at ladder top rung, as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 1/2 inch in least dimension.
  - 6. Support each ladder at top and bottom and not more than 60 inches on center with welded or bolted aluminum brackets.
  - 7. Provide minimum 72-inch- high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.
- C. Ladder-Assist Post (Pass-through Side Rail Guards): Manufacturer's standard device for attachment to ladders .
  - 1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  - 2. Height: 42 inches above finished upper roof surface.
  - 3. Material: Aluminum.
  - 4. Post: 1-5/8-inch- diameter pipe.
- D. Finish: Mill.

## 2.9 METAL FLOOR PLATE

- A. Fabricate from rolled-stainless steel floor plate of thickness indicated
- B. Provide stainless steel angle supports as indicated.



- C. Provide flush stainless steel bar drop handles for lifting removable sections, one at each end of each section.

#### 2.10 ELEVATOR PIT SUMP COVERS

- A. Fabricate from 1/8-inch rolled-steel floor plate with four 1-inch-diameter holes for water drainage and for lifting.

#### 2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

#### 2.12 METAL BOLLARDS

- A. Crash Rating: M50 (formerly K12) in accordance with ASTM 2656. Fabricate metal bollards as follows:
  - 1. Type B1, Fixed with Cover: 10 inch round, Schedule 140 steel pipe with 1 inch thick, continuous steel stiffener plate. Set in concrete foundation/ footing.
  - 2. Type B2, Removable with Cover: 10 inch round, Schedule 140 steel pipe with 1 inch thick, continuous steel stiffener plate. Install with steel sleeve set in concrete.
  - 3. Height: 36 inches above finished pavement.
- B. Type B3, Site Bollards: Fabricate metal bollards as follows:
  - 1. 8 inch round, Schedule 80 galvanized steel pipe.
  - 2. Cap bollards with 1/4-inch-thick steel.
  - 3. Height: 48 inches above finished pavement.
- C. Bollard Covers, where indicated: Refer to Section "12 93 00 Site Furnishings."
- D. Concrete foundation/ footings: As indicated on structural drawings.
- E. Steel Finishes: Shop prime steel bollards with zinc-rich primer ready for field painting. Galvanized steel bollards shall be shop- primed with field painted with compatible coating.

#### 2.13 ABRASIVE METAL NOSINGS

- A. Cast-Metal Units: Cast aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.



- B. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
  - 1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
  - 2. Provide solid-abrasive-type units without ribs.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
- E. Apply bituminous paint to concealed surfaces of cast-metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.

#### 2.14 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

#### 2.15 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize and shop- prime loose steel lintels located in exterior walls.

#### 2.16 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

#### 2.17 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Finish metal fabrications after assembly to the greatest extent possible.
- C. Appearance of Finished Work: Noticeable variations in the same piece are not acceptable. Variations in appearance of components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.



## 2.18 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with unless zinc-rich primer.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## 2.19 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## 2.20 ALUMINUM FINISHES

- A. As-Fabricated Finish (Mill): AA-M12.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.3 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors and other items securely to, and rigidly brace from, building structure.
- C. Anchor shelf angles securely to construction.
- D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

### 3.4 INSTALLATION OF METAL BOLLARDS

- A. Anchor bollards in place with concrete foundation/ footings as indicated on structural drawings.
- B. Fill metal- capped bollards solidly with concrete and allow concrete to cure seven days before installing cap.



**3.5 INSTALLATION OF BOLLARD COVERS**

- A. Refer to Section “12 93 00 Site Furnishings.” .
- B. Secure to bollard in a manner to maintain bollard crash rating indicated.

**3.6 INSTALLATION OF BEARING AND LEVELING PLATES**

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

**3.7 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and restorer galvanizing to comply with ASTM A780/A780M.

**END OF SECTION 05 50 00**

**SECTION 05 51 13****METAL PAN STAIRS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Preassembled steel stairs with precast terrazzo treads and platforms.

B. Related Sections:

1. Section 05 52 13 "Pipe and Tube Railings."
2. Section 09 66 21 "Resinous Matrix" Terrazzo matrix color requirements and accessories.
3. Section 10 22 13 "Wire Mesh Partitions."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Loads of Attached Work: Coordinate with manufacturers of precast terrazzo treads and risers, wire mesh partitions, and pipe and tube railings, as indicated on drawings, to confirm that metal pan stairs and stringers will fully support all loads imposed by products proposed for installation onto stair components.
- C. Coordinate installation of anchorages for metal stairs.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.
- D. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For metal pan stairs and the following:
  - 1. Shop primer products.
  - 2. Precast terrazzo.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
  - 3. Include plan at each level.
  - 4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.
- C. Engineering Services Submittal: For metal stairs, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York .responsible for their preparation.





1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.
- D. Design Calculations: Include all loads for all work supported by stair pans and stringers, including but not limited to precast terrazzo tread and risers, pipe and tube railings, wire mesh partitions, and metal framed gypsum board soffits and fascia.

## 1.8 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Welding Qualifications: Qualify procedures according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
  1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  2. Protect steel members and packaged materials from corrosion and deterioration.
  3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Restore or replace damaged materials or structures as directed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design metal stairs including stringer and framing, and attachment to building construction.
  1. Engineering Services shall include complete design calculations for stairs required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.



- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft.
  2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
  3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
  5. Limit deflection of treads, platforms, and framing members to  $L/720$  or  $1/4$  inch, whichever is less.
- C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

## 2.2 METALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Tubing for Railings: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

## 2.3 FASTENERS

- A. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.



## 2.5 PRECAST TERRAZZO TREADS AND PLATFORMS

- A. Treads and Platforms: Precast Terrazzo Units complying with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated.
1. Colors: Match terrazzo mixes as indicated in Section 09 66 21 - Resinous Matrix Terrazzo.
  2. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer.
  3. Finish exposed-to-view edges and reveals to match face finish.
  4. Ease exposed edges to 1/8-inch radius.
  5. Abrasive Strips: Abrasive nosing strip and two-line abrasive inserts at nosing. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
    - a. Width: 1/2 inch unless otherwise indicated.
    - b. Depth: As required by terrazzo thickness.
    - c. Length: 4 inches less than stair width unless otherwise indicated.

## 2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
1. Join components by welding unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
1. Disassemble units only as necessary for shipping and handling limitations.
  2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.



- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  - 2. Locate joints where least conspicuous.
  - 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
  - 4. Provide weep holes where water may accumulate internally.

## 2.7 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Fabricate stringers as indicated on Drawings.
    - a. Stringer Size: As indicated on Drawings, unless otherwise required by Engineering Services analysis.
    - b. Provide closures for exposed ends of channel and rectangular tube stringers.
    - c. Finish: Shop primed.
  - 2. Construct platforms of steel plate or channel or rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel and rectangular tube framing.
    - b. Finish: Shop primed.
  - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
  - 4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.
    - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
  - 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
  - 1. Steel Sheet: Uncoated, cold-rolled steel sheet unless otherwise indicated.
  - 2. Directly weld metal pans to stringers; locate welds where they will be concealed by finish. Do not weld risers to stringers.
  - 3. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedment for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLING METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
  - 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates.
    - a. Clean bottom surface of plates.
    - b. Set plates for structural members on wedges, shims, or setting nuts.
    - c. Tighten anchor bolts after supported members have been positioned and plumbed.
    - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.



- e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
  - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
  - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
  - 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Install precast concrete treads set in mortar with clips attached to back of precast.

#### 3.4 RESTORATION

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

**END OF SECTION 05 51 13**

**SECTION 05 52 13****PIPE AND TUBE RAILINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Stainless-steel pipe and tube railings.
- B. Related Sections:
1. Section: 10 22 13 "Wire Mesh Partitions."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.
- D. Coordinate installation of pipe and tube railings with wire mesh infill panels.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Engineering Services Submittal: For railings and connections, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".





1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design railings, including attachment to building construction.
  - 1. Engineering Services shall include complete design calculations for railings, including attachment to building construction required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STAINLESS STEEL

- A. Tubing: ASTM A554, Grade MT 316L.



- B. Pipe: ASTM A312/A312M, Grade TP 316L.
- C. Castings: ASTM A743/A743M, Grade CF 8M or CF 3M.
- D. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 316L.

## 2.4 FASTENERS

- A. General: Provide the following:
  - 1. Stainless-Steel Railings: Type 316 stainless-steel fasteners.
- B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- E. Form changes in direction by bending or by inserting prefabricated elbow fittings.



- F. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- G. Close exposed ends of railing members with prefabricated end fittings.
- H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

## 2.7 STAINLESS-STEEL FINISHES

- A. Stainless Steel Tubing Finishes:
  - 1. 180-Grit Polished Finish: Uniform, directionally textured finish.
- B. Stainless Steel Sheet and Plate Finishes:
  - 1. Directional Satin Finish: ASTM A489/A480, No. 4.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.3 INSTALLATION, GENERAL

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.



- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

#### 3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

#### 3.5 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

#### 3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and restore galvanizing to comply with ASTM A780/A780M.

**END OF SECTION 05 52 13**

**SECTION 05 53 13****BAR GRATINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Galvanized steel bar gratings at catwalk.
  2. Metal frames and supports for gratings.
  3. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



**1.5 COORDINATION**

- A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.7 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Clips and anchorage devices for gratings.
  - 2. Paint products.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Engineering Services Submittal: For gratings and transfer platforms, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Welding Qualifications: Qualify procedures according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

**1.10 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
1. Alabama Metal Industries Company; a Gibraltar Industries company.
  2. Fisher & Ludlow; a NUCOR Company.
  3. Ohio Gratings, Inc.
  4. Harsco Industrial IKG, a division of Harsco Corporation.
  5. Approved equal.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design gratings including connections.
1. Engineering Services shall include complete design calculations for gratings and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft.
  2. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft.
  3. Limit deflection to L/360 or 1/4 inch, whichever is less.
- C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.0 unless otherwise indicated and required by project application.

**2.3 METAL BAR GRATINGS**

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual" as applicable to project application.
- B. Pressure-Locked, Galvanized Steel Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.
1. Bearing Bar Spacing: 7/16 or 1/2 inch o.c.



2. Bearing Bar Depth: As required to comply with structural performance requirements.
3. Bearing Bar Thickness: As required to comply with structural performance requirements.
4. Crossbar Spacing: 4 inches o.c.
5. Traffic Surface: Plain or Serrated.
6. Finish: Galvanized steel, unless otherwise selected by the Commissioner.

## 2.4 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

## 2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.
- C. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

## 2.6 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.7 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly.
  1. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces.
  2. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.





- E. Welding: Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- G. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
  - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- H. Do not notch bearing bars at supports to maintain elevation.

## 2.8 GRATING FRAMES AND SUPPORTS

- A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
  - 1. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.
- B. Galvanize steel frames and supports in the following locations:
  - 1. Exterior.

## 2.9 STEEL FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.

### 3.3 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

### 3.4 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and restore galvanizing to comply with ASTM A 780/A 780M.

**END OF SECTION 05 53 13**



## **SECTION 05 58 13**

### **COLUMN COVERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section includes:
  - 1. Snap-together metal column covers.
  - 2. Installation accessories.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for column covers.
- C. Samples: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator, anodic finisher, and powder-coating applicator.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Fabricator Qualifications: A firm experienced in producing column covers like that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and conducts continuing, effective quality-control program to ensure compliance with requirements.
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups of typical column covers, as directed by the Commissioner.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.



## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

## PART 2 - PRODUCTS

### 2.1 SNAP-TOGETHER COLUMN COVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  - 1. ATAS International, Inc.
  - 2. Ceilings Plus.
  - 3. Fry Reglet Corporation.
  - 4. Pittcon Industries.
  - 5. Approved equal.
- B. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.
  - 1. Aluminum Sheet: ASTM B 209, with not less than strength and durability properties of Alloy 5005-H32, 0.063 inch thick.
    - a. Finish: Baked enamel or Powder-Coat.
  - 2. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
  - 3. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
  - 4. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
  - 5. Form returns as indicated on drawings:
    - a. At vertical joints to provide hairline V-joints.
    - b. At vertical joints to provide 1/2-inch-wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals 1/2 inch deep or flush, as indicated.
    - c. At vertical joints to accommodate backer rod and sealant.
  - 6. Fabricate column covers as indicated on drawings:
    - a. With hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
    - b. Column covers without horizontal joints.
    - c. Column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
    - d. Column covers with 1/2-inch-wide reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.



7. Fabricate base and ceiling ring, where indicated, to match column covers.
8. Fabricate with calk stop/stiffener ring where ceiling ring is not used.
9. Apply manufacturer's recommended sound-deadening insulation or mastic to backs of column covers.

## 2.2 MISCELLANEOUS MATERIALS

- A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
  1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless exposed fasteners are unavoidable or are the standard fastening method.
  2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- B. Sound-Deadening Materials:
  1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
  2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Backing Materials: Provided or recommended by column cover manufacturer.

## 2.3 PAINTS AND COATINGS

- A. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.4 FABRICATION, GENERAL

- A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect finishes on exposed surfaces from damage in accordance with coating manufacturers requirement.
- C. Apply organic finishes to formed metal after fabrication unless otherwise indicated.



- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: White, semi-gloss.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
  - 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorage unless unavoidable.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.



### 3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean abraded areas of shop paint and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

### 3.5 PROTECTION

- A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

**END OF SECTION 05 58 13**



**SECTION 05 59 63****DETENTION ENCLOSURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Bar-grille assemblies and swing doors.
2. Detention benches.
3. Installation accessories.

B. Related Sections:

1. Section 03 30 00 "Cast-in-Place" Concrete for installing connection anchors in concrete.
2. Section 04 20 00 "Unit Masonry" for CMU and accessories for installation.
3. Section 05 50 00 "Metal Fabrications" for miscellaneous steel shapes.
4. Section 08 70 00 "Finish Hardware" for detention hardware.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 COORDINATION

- A. Coordinate installation of anchorage. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall and ceiling attachments are made only to completed walls.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For detention enclosures and benches.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For factory-applied color finishes.
- D. Samples for Verification:
  - 1. Include 12-by-12-inch cut-away corner section of bar-grille assembly.

1.9 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material Certificates: For tool-resisting steel.
- C. Anchor-inspection reports.

1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Welding Qualifications: Qualify procedures according to the following:



1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### PART 2 - PRODUCTS

#### 2.1 BAR-GRILLE ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  1. Maximum Security Products Corp.
  2. Southern Steel Company.
  3. Sweeper Metal Fabricators Corp.
  4. Or approved equal.

#### 2.2 STEEL GRILLE HOLDING CELL - FRONT CONSTRUCTION

- A. Cell front construction shall consist of panels constructed of 7/ 8-inch diameter steel vertical bars spaced as indicated on the Drawings.
- B. Vertical bars shall be rotated and interlocked at each intersection with flat horizontal bars.
- C. Top, bottom and side frame members shall be of the same size as the horizontal bars.
- D. Vertical bars shall extend into the top and bottom horizontal base half of the depth of the horizontal bar and shall be securely welded to the top and bottom horizontal frame members.
- E. Horizontal flat intermediate bars shall be shouldered and tenoned and back or plug-welded to the vertical side frame bars. Horizontal top and bottom frame members shall be welded to vertical side frame members.
- F. Panel construction shall be anchored to slab as detailed. Cell front shall be attached to masonry walls as detailed.
- G. Where indicated, provide steel wire 2 by 2 by 1/ 4-inch mesh in steel channel welded to flat bar as indicated.

#### 2.3 STEEL GRILLE HINGED DOOR

- A. Steel grille hinged door shall be constructed to the same materials, sizes and spacing as specified for the cell front panel construction.
- B. Door frame shall consist of 3/16-inch steel formed frame, welded at corners, and provided with three adjustable anchors at each jamb, and with head reinforcing and anchors, and sill as detailed.



- C. The door shall be provided with the following hardware, as manufactured by the Folger Adam Co., or approved equal:
- D. Back plate of mounting shall be welded to channel frame. Lock shall be mounted to back plate with four flat-head spanner screws.
- E. Front cover plate of lock mounting shall be attached to channel frame with eight Torx prison-type security screws.
- F. Keeper shall be installed with two Torx prison-type security screws. Door pull and escutcheon shall each be installed with Torx prison type security screws.
- G. Each hinge shall be installed with six countersunk rivets or prison-type security screws.
- H. Door, Food Pass:
  - 1. Door: Flat steel door with reinforcement plate.
  - 2. Frame: Steel frame, 4 sides, cut and notched at each at each corner to create a square corner as indicated.
  - 3. Size: As indicated.
  - 4. Hinges: Two steel butt hinges with non-removable pin with 90 degree hold open bracket prepped for detention deadbolt lock, concealed bolt receiver.

## 2.4 DETENTION BENCH ASSEMBLIES

- A. Product Description: Detention furniture in form of benches for use at Holding Cells and Juvenile Interview rooms.
- B. Basis-of-Design, Product: Subject to compliance with requirements, provide products by Cornerstone Detention, an equivalent product by one of the approved manufacturers listed below, as approved by the Commissioner:
  - 1. Bluff Manufacturing
  - 2. Prisoner Bench, LLC
  - 3. Or approved equal
- C. Dimensions: As indicated on drawings.
- D. Finish and Materials: As indicated on drawings.

## 2.5 ACCESSORIES

- A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.
- B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.
  - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.



- C. Embedded Plate Anchors: Fabricated from mild-steel shapes and plates, minimum 3/16-inch-thick; with minimum 1/2-inch-diameter, headed studs welded to back of plate.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly.
- B. Coordinate dimensions and attachment methods of detention enclosures with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- C. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Form and grind edges and corners to be free of sharp edges or rough areas.
- E. Form metal in maximum lengths to minimize joints. Form sheet-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- F. Weld corners and seams continuously to comply with referenced AWS standard.
- G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention enclosures rigidly in place and to support indicated loads.
- H. Cut, reinforce, drill, and tap detention enclosures as indicated to receive hardware, security fasteners, and similar items.
- I. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.
- J. Form exposed connections with hairline joints flush and smooth using concealed fasteners where possible.

## 2.7 SECURITY FASTENERS

- A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.

## 2.9 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with unless zinc-rich primer.
- B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:



1. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- D. Field Finish: refer to Section 099100 – Painting for requirements.
  1. Color as selected by the Commissioner.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of detention enclosures.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention enclosure connections before installation.
- C. Inspect built-in and cast-in anchor installations, before installing detention enclosures, to verify that anchor installations comply with requirements. Prepare inspection reports.
- D. Proceed with installation only after unsatisfactory conditions have been correct to the satisfaction of the Commissioner,

#### 3.3 INSTALLATION, GENERAL

- A. Install detention enclosures plumb, rigid, properly aligned, and securely fastened in place, complying with manufacturer's written recommendations.
- B. Install detention enclosures and benches in accordance with approved Shop Drawings and manufacturers requirements.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention enclosures to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
- D. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention enclosures. Set detention enclosures accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into adjacent construction.



- F. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- G. Field Welding: Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

#### 3.4 INSTALLATION OF BAR- GRILLE ASSEMBLIES

- A. Wall and Ceiling Anchorage: Weld framing to continuous angles with continuous welds. Anchor angles to embedded anchors by welding, unless bolting is standard with enclosure fabricator.
- B. Partitions: Weld adjacent framing members to each other with continuous 1/4-inch-deep welds on both sides; grind smooth.
- C. Doors: Install 2 inches above finish floor. Adjust to operate easily without binding.

#### 3.5 FIELD QUALITY CONTROL

- A. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Prepare field quality-control certification that states installed products comply with requirements in the Contract Documents.

**END OF SECTION 05 59 63**



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**SECTION 05 73 20****DECORATIVE METAL SCREENS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Rooftop Architectural Metal Screen.
2. Aluminum fence panels for compactor enclosure aluminum screens and screens at end of 1-story wing.
3. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 COORDINATION**

- A. Coordinate installation of anchorages for screens. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support screens temporarily by any means that do not meet structural performance requirements.

**1.6 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.7 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.8 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of screens assembled from standard components.
  - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: For rooftop architectural metal screen and aluminum fence panels.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish required.
  - 1. Fittings and brackets.
  - 2. Welded connections.
  - 3. Brazed connections.
  - 4. Assembled Samples of screen systems, made from full-size components, including top rail, post, and infill. Show method of finishing members at intersections. Samples need not be full height.



- D. Engineering Services Submittal: For metal screens and connections, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York responsible for their preparation.

1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Evaluation Reports: For post-installed anchors, from ICC-ES.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer's Qualifications: Installer performing the work of this section shall, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work
- C. Welding Qualifications: Qualify procedures according to the following:
1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- D. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
1. Do not modify intended aesthetic effects, as judged solely by Commissioner, except with Commissioner's approval. If modifications are proposed, submit comprehensive explanatory data to Commissioner for review.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockups for each form and finish of screens consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.11 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with screens by field measurements before fabrication and indicate measurements on Shop Drawings.

1.12 WARRANTY

- A. Special Finish Warranty: Standard form in which manufacturer agrees to restore finishes or replace aluminum that shows evidence of deterioration of finishes within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of metal screen from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design metal screen.
  - 1. Engineering Services shall include complete design calculations for screens, including attachment to building construction required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria specified herein.
- B. General: In engineering screens to withstand structural loads indicated, determine allowable design working stresses of screens materials based on the following:
  - 1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
- C. Structural Performance: Screens, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under project conditions.

2.3 ROOFTOP ARCHITECTURAL METAL SCREENS

- A. Description: Aluminum decorative screens with guard infill.
- B. Basis of Design, Products: Subject to compliance with requirements, provide 'EcoScreen' as supplied by Centria or comparable product from one of the following, as approved by the Commissioner:
  - 1. Architectural Screens & Grilles, Inc.
  - 2. VIVA Screens, LLC.



3. Wagner, R & B, Inc.
4. Approved equal.

C. Finish: Three-coat fluoropolymer.

## 2.4 ALUMINUM FENCE PANELS

A. Description: 7 inch face, concealed-fastener, flush formed aluminum panel with interlocking design and no reveals.

1. Panel thickness: 1 inch.

B. Basis of Design, Products: Subject to compliance with requirements, provide 'Pac-Clad Flush Panel' as supplied by Petersen Aluminum Corp. or comparable product from one of the following, as approved by the Commissioner:

1. ATAS.
2. Centria.
3. MBCI.
4. Or approved Equal

C. Finish: Three-coat fluoropolymer.

## 2.5 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

1. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
2. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

## 2.6 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B 221, Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.



- E. Plate and Sheet: ASTM B 209, Alloy 5005-H32.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.
- H. Perforated Metal: Corrugated, aluminum sheet, ASTM B 209, Alloy 6061-T6, 0.063 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.

## 2.7 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Aluminum Components: Type 316 stainless-steel fasteners.
  - 2. Dissimilar Metals: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring screens to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting screens components and for attaching screens to other work unless exposed fasteners are unavoidable.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to the New York City Department of Buildings, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.8 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum screens, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.9 FABRICATION

- A. General: Fabricate screens to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.



- B. Assemble screens in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate screens with welded or nonwelded connections to suit project application.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.
- I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
  - 1. As detailed.
  - 2. By bending to smallest radius that will not result in distortion of screens member.
    - a. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow screens members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect screens members to other work unless otherwise indicated.



- N. Provide inserts and other anchorage devices for connecting screens to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by screens. Coordinate anchorage devices with supporting structure.
- O. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as screens in which they are installed.
  - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
  - 2. Orient perforated metal with pattern as indicated on Drawings.

## 2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual" recommendations for applying and designating finishes.
- B. Protect finishes on exposed surfaces from damage in accordance with coating manufacturers requirements.
- C. Apply organic finishes to formed metal after fabrication, unless otherwise indicated.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- E. Exposed fasteners where used, shall have finish matching appearance, including color and texture, of screens.

## 2.11 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
  - 1. Color and Gloss: As selected by Commissioner from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.





### 3.2 INSTALLATION

- A. Install rooftop architectural metal screen and aluminum fence panels in accordance with approved shop drawings.
- B. Fit exposed connections together to form tight, hairline joints.
- C. Perform cutting, drilling, and fitting required for installing screens. Set screens accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of screens components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- E. Adjust screens before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing screens and for properly transferring loads to in-place construction.

### 3.3 CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting screens components. Use wood blocks and padding to prevent damage to screens members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of screens.
- B. Welded Connections: Use fully welded joints for permanently connecting screens components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### 3.4 ANCHORING POSTS

- A. Anchor posts to metal and concrete surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to supporting structure as follows:



1. For aluminum screens, attach posts as indicated using fittings designed and engineered for this purpose.

### 3.5 ATTACHING SCREENS

- A. Anchor screen ends to concrete and masonry with brackets connected to screen ends and anchored to wall construction with anchors and bolts.
- B. Secure wall brackets to building construction as follows:
  1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  2. For hollow masonry anchorage, use toggle bolts.

### 3.6 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

### 3.7 PROTECTION

- A. Protect finishes of screens from damage during construction period with temporary protective coverings approved by screens manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.
- C. Remove and replace screens that they do not comply with project requirements, unless they can be restored in a manner satisfactory to Commissioner and comply with specified requirements.

**END OF SECTION 05 73 20**

**SECTION 06 10 00****ROUGH CARPENTRY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Wood blocking, cants, and nailers.
  2. Wood furring.
  3. Plywood backing panels.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the Submittal Requirements of this Section.
  2. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the Submittal Requirements of this Section.
  3. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.



4. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency periodically who performs inspections to verify that the material bearing the classification marking is representative of the material tested and be acceptable to the New York City Department of Buildings and New York City Fire Department,
- C. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
  1. SPIB - Southern Pine Inspection Bureau.
  2. WCLIB - West Coast Lumber Inspection Bureau.
  3. WWPA - Western Wood Products Association.
- D. Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

**PART 2 - PRODUCTS****2.1 WOOD PRODUCTS, GENERAL**

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
  3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  4. Provide dressed lumber, S4S, unless otherwise indicated.

**2.2 WOOD-PRESERVATIVE-TREATED LUMBER**

- A. Preservative Treatment by Pressure Process: AWWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWWPA C31 with inorganic boron (SBX).
1. Preservative Chemicals: Approved products containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry that has not been fire-retardant-treated, unless otherwise indicated.

**2.3 FIRE-RETARDANT-TREATED MATERIALS**

- A. Identify fire-retardant-treated wood with appropriate classification marking of Testing and Inspecting agency. Comply with performance requirements in AWWPA C20 (lumber) and AWWPA C27 (plywood).
1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
  2. Use treatment that does not promote corrosion of metal fasteners.
  3. Use Exterior type for exterior locations and where indicated.
  4. Use Interior Type A High Temperature (HT), unless otherwise indicated.
  5. Comply with 2014 New York City Building Code.



6. Products: Subject to compliance with requirements, provide one of the following:

- a. "Dricon," Hickson Corporation.
- b. "Pyro-Guard," Hoover Treated Wood Products.
- c. "Flameproof LHC-HTT," Osmose Wood Preserving Co, Inc.
- d. Approved equal.

B. Application: Treat all rough carpentry, unless otherwise indicated.

1. Concealed blocking.
2. Roof construction.
3. Plywood backing panels.

## 2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 15 percent maximum moisture content of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used if it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.5 PLYWOOD BACKING PANELS

A. Telephone, Radio Room and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

## 2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

## 2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- C. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
  - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.



- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Fastening Schedule: As per 2014 New York City Building Code.
- G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

### 3.3 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.4 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.





**3.5 PROTECTION**

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 06 10 00**



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## **SECTION 06 16 00**

### **SHEATHING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Wall sheathing.
  - 2. Sheathing joint and penetration treatment.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

##### **1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."



1.6 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. CertainTeed Gypsum; CertainTeed GlasRoc Type X Sheathing.
  - 2. Continental Building Products, LLC; Weather Defense.
  - 3. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
  - 4. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
  - 5. USG Corporation; Securock.
  - 6. Approved equal.
- C. Type and Thickness: Type X, 5/8 inch thick.
- D. Size: 48 by 96 inches for vertical installation.

## 2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  - 1. For sheathing, provide fasteners of Type 304 stainless steel.
- B. Power-Driven Fasteners: NES NER-272.
- C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
  - 1. For steel framing less than 0.0329-inch-thick, attach sheathing to comply with ASTM C 1002.
  - 2. For steel framing from 0.033 to 0.112-inch-thick, attach sheathing to comply with ASTM C 954.

## 2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing Board: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing, and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
- B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.



- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

### 3.3 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
- B. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
- C. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**END OF SECTION 06 16 00**

**SECTION 06 40 23****INTERIOR ARCHITECTURAL WOODWORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Main desk and other desks as indicated.
2. Benches.
3. Plastic laminate- clad cabinets, shelving, vertical and horizontal supports, and other surfaces, as indicated.
4. Solid surfacing materials including window stools, countertops, vertical assemblies and other surfaces, as indicated.
5. Epoxy resin countertops at main desk.
6. Stainless steel vertical and horizontal surfaces, as indicated.
7. Cabinet hardware and accessories.
8. Coat hooks.
9. Closet and utility shelving.
10. Installation accessories.

B. Related Sections:

1. Section 05 52 13 "Pipe and Tube Railings" for handcuff rail at main desk.
2. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
3. Section 09 66 21 "Resinous Matrix Terrazzo" for precast unit materials at main desk.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS



C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the Submittal Requirements of this Section.
2. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the Submittal Requirements of this Section.
3. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.
4. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

#### 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For the following:
  1. Anchors.
  2. Adhesives.





3. Shop finishing materials.
  4. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
  2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  3. Show locations and sizes of cutouts and holes for all devices, plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
  4. Provide coordination drawings with electrical, telecommunication, fire alarm and systems by others to be incorporated into architectural woodwork.
  5. Indicate location of joints in countertops.
- C. Samples for Initial Selection:
1. Plastic laminates.
  2. Solid surface materials.
  3. Metals.
- D. Samples for Verification:
1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material.
  2. Metals, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material.
  3. Solid-surfacing materials, 6-inches square.
  4. Epoxy resin countertops.
  5. Exposed cabinet hardware and accessories, one unit for each type and finish.

## 1.9 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For the following:
1. Composite wood and agrifiber products.
  2. Adhesives.
- B. Evaluation Reports: For preservative-treated and fire-retardant-treated wood materials, from ICC-ES.

## 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.



1. Build mockups of interior architectural woodwork as follows:
  - a. Typical section of the main desk, 36- inches wide, including all precast terrazzo vertical and horizontal surfaces, plastic laminates, solid surfaces, handcuff rail, shelving, blocking, fasteners, and wood elements.
    - 1) Provide any blocking and support required to allow the mockup to stand freely without obscuring portions of the mockup that will be exposed to view in the final installation.
  - b. Staff Lounge Typical Wall Cabinet: 30 inches wide, including all finishes, hardware, shelving, trims, and two cabinet doors.
  - c. Staff Lounge Typical Base Cabinet: 17 inches wide including all finishes, countertop, backsplash, hardware, shelving, drawer, trims, and cabinet door.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
  1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

#### 1.12 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.



## PART 2 - PRODUCTS

### 2.1 WOOD MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood, unless otherwise indicated.
- C. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Softwood Plywood: DOC PS 1.
  - 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
- D. Plywood: Veneer core, minimum 3/4 inch thick unless otherwise noted, interior grade using exterior type waterproof glue.

### 2.2 PLASTIC- LAMINATE SURFACES

- A. High-Pressure Decorative Laminate: NEMA LD 3, matte finish, 0.05 in. thick for all exposed surfaces; backing grade and cabinet liner grade where appropriate.
- B. Manufacturers: Subject to compliance with requirements, provide products as supplied by one of the following, as approved by the Commissioner:
  - 1. Arborite.
  - 2. Formica Group.
  - 3. Wilsonart.
  - 4. Or approved equal.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
  - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade HGS.
  - 4. Edges: Grade HGS.
- D. Materials for Semiexposed Surfaces:
  - 1. Horizontal and Vertical Surfaces: High-pressure decorative laminate, Grade VGS.
    - a. Edges of Plastic-Laminate: Matching laminate in color, pattern, and finish.
    - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
- E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.



## 2.3 SOLID- SURFACING MATERIALS

- A. Description: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
- B. Manufacturers: Subject to compliance with requirements, provide products as supplied by one of the following, as approved by the Commissioner:
  - 1. E. I. Dupont.
  - 2. Wilsonart.
  - 3. Formica Group.
  - 4. Or approved equal.
- C. Solid-Surfacing-Material for Horizontal and Vertical Surfaces:
  - 1. Horizontal surfaces: 3/4 inch.
  - 2. Vertical surfaces: 1/2-inch.
  - 3. Fabricate tops and sides as indicated on the Drawings. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
    - a. Fabricate tops and sides with shop-applied edges of materials and configuration indicated on the Shop Drawings.
    - b. Drill holes in countertops for required electrical openings in shop.

## 2.4 EPOXY RESIN COUNTERTOPS

- A. Description: Factory-molded, modified epoxy-resin formulation with smooth, non-specular finish with no embossment or drip edges. Ease exposed edges.
  - 1. Thickness: 1 inch.
- B. Manufacturers: Subject to compliance with requirements, provide products as supplied by Durcon Inc. or comparable product from one of the following, as approved by the Commissioner:
  - 1. Chemtops.
  - 2. Duratop.
  - 3. Laboratory Design and Supply.
  - 4. Blair Company.
  - 5. Or approved equal.
- C. Physical Properties:
  - 1. Flexural Strength: Not less than 10,000 psi.
  - 2. Modulus of Elasticity: Not less than 2,000,000 psi.
  - 3. Hardness (Rockwell M): Not less than 100.
  - 4. Water Absorption (24 Hours): Not more than 0.02 percent.
  - 5. Heat Distortion Point: Not less than 260 deg F.
- D. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:



1. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
2. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

## 2.5 STAINLESS STEEL

- A. Description: Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.
- B. Products: Subject to compliance with requirements, provide products as approved by the Commissioner:
- C. Specialty Steel Finish for Horizontal and Vertical Surfaces and Trim at Main desk:
  1. Sizes and Profiles: As shown on the Drawings.
  2. Material: 1/16 inch (2 mm) thick; hot-rolled, colored stainless steel with protective coating.
  3. Finish and Texture: 'Ultra Gloss' finish with mottled color as indicated on drawings.
  4. Manufacturers: Subject to compliance with requirements, provide products supplied by Pure + Freeform or comparable product from one of the following, as approved by the Commissioner:
    - a. Zahner
    - b. Forms+Surfaces
    - c. Or approved equal.
  5. Fabrication: Form custom stainless steel fabrications to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- D. Stainless Steel for Horizontal and Vertical Surfaces and Trim:
  1. Vertical Surfaces: Provide custom fabricated siding formed from stainless steel sheet, laminated to a 3/4" thick plywood core, as indicated. Secure stainless steel sheet to surface using recommended adhesive or as indicated on the Drawings. Form and fabricate items in the shop to greatest extent possible to minimize field splicing and assembly.
  2. Horizontal Surfaces: Fabricate from 1/4-inch thick solid stainless steel sheet as indicated on the Drawings.
    - a. Sizes and Profiles: Provide horizontal and vertical surfaces, of sizes, and profiles as shown on the Drawings.
  3. Finish and Texture: No. 4, directional finish, smooth texture, match approved samples.
- E. Stainless Steel Hand Rail and Support at Desk:
  1. Performance Requirements: Refer to Section 05 52 13 "Pipe and Tube Railings."
  2. Materials: Stainless steel; refer to Section 05 52 13 "Pipe and Tube Railings" for additional information.



3. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

- a. Provide vandal proof flat head bolts as indicated and required by project application.

## 2.6 FIRE-RETARDANT-TREATED MATERIALS

- A. Comply with requirement as specified in Section 06 10 00 – Rough Carpentry and the following:
  1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
  2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  3. Identify fire-retardant-treated materials with appropriate classification marking of testing and inspecting agency.

## 2.7 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware."
- B. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- C. Grommets for Cable Passage through Countertops: 2- inch OD, stainless steel grommets and matching stainless steel caps with slot for wire passage.
- D. Cabinet pulls: Stainless steel edge pull, wrapping cabinet door face and mechanically attached with two screws at interior face. 304 Stainless steel finish, 1/16 inch bent stainless steel plate. 6 inch in length, 1 15/32 inch projection, 1 inch width.
  1. Basis-of-Design, Products: Subject to compliance with requirements, provide "Richelieu, BP57606170" or comparable product from the following, as approved by the Commissioner:
    - a. Assa Abloy, Rockwood RM753
    - b. Sugatsune, SN Series
    - c. Or approved equal.
- E. Cabinet hinge: Silent, 110-degree European-style (concealed) cabinet hinge with spring closing mechanism and 3-dimensional adjustment at mounting plate. Screw attachment. Full overlay.
  1. Basis-of-Design, Products: Subject to compliance with requirements, provide "Richelieu, CLIP top hinge 110-degree # 71T355180" or comparable product from the following, as approved by the Commissioner:
    - a. Hafele, Salice PUSH 110 # C2PPA99
    - a. Sugatsune H110C-34/28
    - b. Or approved equal.



## 2.8 SHELVING AND ACCESSORIES

- A. Grade: Premium.
- B. Shelf Material: High-Pressure Decorative Laminate: Grade HGS.
- C. Shelf Brackets and Supports: Shelf brackets and supports shall be sized to support shelving widths indicated, Provide the following to suit project application, as approved by the Commissioner:
  - 1. Low- profile concealed type.
  - 2. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
  - 3. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04102; with shelf brackets, B04112.
  - 4. BHMA No. B 84112, nickel zinc-plated steel.
- D. Coat Hooks:
  - 1. Description: Double- prong unit.
  - 2. Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- E. Clothes Pole and Supports: Provide stainless steel clad pipe or tubing cut to lengths required, with brushed chrome flanges; with one open top.
  - 1. Size: 1- 1/16 inch O.D. with 0.087 inch wall thickness.
  - 2. Finish: Brushed.

## 2.9 MISCELLANEOUS MATERIALS

- A. Furring, Blocking and Shims: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Fasteners: Fasteners: All fasteners to be concealed, unless otherwise indicated, where indicated to be exposed provide material, driver type and head profile as approved by Commissioner.
  - 1. Wood Screws: FS FF-S-111, type, size, material and finish as required for the condition of use.
  - 2. Nails: FS FF-N-105, type, size, material and finish as required for the condition of use.
  - 3. Staples: Type, size, to provide sufficient strength to hold upholstered fabric taut and in place without sagging.
  - 4. Anchors: Type, size, material and finish as required for the condition of use.
- D. Adhesives:
  - 1. For Laminating Plastic Laminate Surfaces: Melamine, phenol-resin, or resorcinol-resin complying with FS MMM-A-181; type, grade and class best suited for the purpose.



2. For Countertops: Two-part epoxy or polyester adhesive, formulated specifically for bonding material to material, with an initial set time of not more than 2 hours at 70 degrees F.
  3. For Other Uses: Moisture resistant complying with FS MMM-A-125, Type II, or MMM-A-188, Type I, II or III; type best suited for the purpose.
- E. Sealants: Single-component, nonstaining neutral acid-curing silicone sealant, as per Division 07 Section "Joint Sealants."
1. Colors: As selected by the Commissioner.
- F. Inspection Agencies: Refer to Section 06 10 00 – Rough Carpentry.
- G. Grade Stamps: Refer to Section 06 10 00 – Rough Carpentry.
1. For exposed lumber furnish pieces with grade stamps applied to ends or back of each piece or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.

## 2.10 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
1. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated on the Drawings.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Notify the Commissioner seven days in advance of the dates and times woodwork fabrication will be complete.
  2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
1. Seal edges of openings in countertops with a coat of varnish.





## 2.11 MAIN, RECEPTION AND MUSTER ROOM DESKS

- A. Fabricate cladding assemblies in one piece to the greatest extent possible. Where unavoidable, provide shop fitted hairline-type jointed assemblies with tooled edges in the profiles indicated. Comply with manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
- B. Provide custom fabricated supports and trim assemblies of the sizes and profiles indicated. Comply with all requirements and recommendations of AWI for premium grade materials and workmanship.

## 2.12 FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. Field Finishing: The primary and prefinishing (if any) of interior architectural woodwork required to be performed at factory is work of this section. Refer to Division-9 sections for final finishing of installed architectural woodwork, requiring an opaque finish, and for material and application requirements of prime coats for woodwork not specified to receive final finish as work of this section.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- D. Where finishes are indicated to be field applied, refer to Section 09 91 00 - Painting for additional opaque field applied finishes.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.



### 3.3 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and restore damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Countertops: Anchor securely to base supports as indicated.
  - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Seal space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- H. Cladding: Anchor solid surface and stainless steel cladding materials to properly prepared main desk surrounds and other support systems as indicated, or as required. Use the manufacturer's premium grade neoprene-based, permanent adhesive specifically designed for this purpose.
- I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

### 3.4 RESTORATION

- A. Restore damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.
- B. Where not possible to restore, replace defective woodwork.
- C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
  - 1. Fill nail holes with matching filler where exposed.
  - 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.



- D. Field Finish: Refer to Section 099100 "Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

### 3.5 CLEANING

- A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

**END OF SECTION 06 40 23**



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**SECTION 07 10 00****FOUNDATION WATERPROOFING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 03 30 00 – Cast-In-Place Concrete
- C. Section 31 00 00 – Earthwork
- D. Section 31 50 00 – Excavation Support and Protection
- E. Section 31 61 00 – Footings
- F. Section 31 68 00 – Foundation Soil Anchor

**1.2 SUMMARY**

- A. Work of this section, as shown or specified, shall be in accordance with the requirements of the Contract Documents. Contractor shall examine all contract drawings to determine the sequence of operations and relation to work of other trades. Start of work will signify acceptance of field conditions and will acknowledge coordination with other trades.
- B. Provide waterproofing in accordance with the requirements of the Contract Documents. Work of this section includes, but is not necessarily limited to, the following:
  - 1. Below-grade foundation waterproofing of horizontal (footings, pile caps including pile penetrations, footings, and slabs) and vertical foundation walls and pit walls.
  - 2. Installation accessories including sealers, flashings, fasteners, tapes, reglets, liquid membranes, and similar accessories.
  - 3. Installation of working surface for horizontal and vertical surfaces.

**1.3 REFERENCES**

- A. Latest editions of the American Society for Testing and Materials (ASTM) Standards:
  - 1. ASTM C836 – Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
  - 2. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
  - 3. ASTM D570 – Standard Test Method for Water Absorption of Plastics
  - 4. ASTM D903 – Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
  - 5. ASTM D1876 – Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
  - 6. ASTM D3767 – Standard Practice for Rubber-Measurement of Dimensions



7. ASTM D5385 – Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
  8. ASTM E 96 – Water Vapor Transmission of Materials
  9. ASTM E154 – Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
  10. ASTM E175-11 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
- B. Geotechnical Engineering Study – 116th Precinct Station House, Queens, New York, prepared by Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C., dated 15 December 2017.
- C. 2014 New York City Building Code
- 1.4 SUSTAINABLE DESIGN REQUIREMENTS
- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- 1.5 LEED BUILDING SUBMITTALS:
- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.
- 1.6 SUBMITTALS PROCEDURES
- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- 1.7 SUBMITTALS
- A. Submit the following information for review by the Commissioner:
1. Manufacturer's product data, specifications, installation instructions, product samples.
  2. Laboratory test results demonstrating the properties of the product meet or exceed the required values in Part 2.02 of this Section.
  3. Quality Assurance Submittal for the Installer.
  4. Project-specific shop drawings shall contain:
    - a. Penetrations, curbs, drains, projections, and point of entry terminations.



- b. Flashing details, including inside and outside corner reinforcement and terminations.
- c. Typical installation details, showing details at the intersection of horizontal and vertical surfaces and penetrations in the membrane system.
- d. Crack and joint treatments, including expansion joints.
- e. Interface with contiguous materials.
- f. Location of One-Phase and Two-Phase Wall pours, and overlap details at the location of transitions.
- g. Location of post-injection ports for the injectable water-stops

**B. Prior to commencing work, submit the following:**

- 1. **Contractor's Review:** Before commencing work submit written statement signed by the Installer stating that the Contract Documents have been reviewed with a qualified representative of the Manufacturer of the waterproofing system, and that he is in agreement that the selected materials are proper, compatible with contiguous materials and adequate for the application shown. Indicate by transmittal form that a copy of the statement has been sent to the Manufacturer.
- 2. **Substrate Acceptability:** Submit a certified statement issued by the Manufacturer of the waterproofing materials, and countersigned by the Installer, attesting that all areas and surfaces designated to receive waterproofing have been inspected and found satisfactory for the reception of the Work covered under this Section; and are not in conflict with the "Warranty" requirements. Installation of materials will be construed as acceptance of surfaces.

**C. Upon project closeout, submit the following:**

- 1. **Statement of Supervision:** Upon completion of Work submit a written statement signed by the Manufacturer stating that the field supervision by the Manufacturer's representative was sufficient to ensure proper application of the materials, that the Work was installed in accordance with the Contract Documents and that the installation is acceptable to the Manufacturer.
- 2. **Warranty:** Submit Manufacturer's Warranty upon date of substantial completion, further described later in this Part.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. **Contractor Qualifications:** The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) project similar in scope and type to the required work. In addition, the contractor or subcontractor must be licensed or approved by the manufacturer.
- C. **Single-Source Responsibility:** Obtain waterproofing materials from a single manufacturer regularly engaged in manufacturing waterproofing.
- D. **Pre-installation Conference:**

1. Before installing waterproofing, meet with the Commissioner, independent testing agency, waterproofing manufacturer, waterproofing trade, and other concerned entities.
  2. Review requirements for waterproofing, including surface preparation specified under other Sections waterproofing manufacturer's requirements, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, inspection and testing procedures, and protection and repairs.
  3. Notify participants at least seven days before pre-installation conference.
- E. Contractor shall provide a daily waterproofing observation report each day when there are waterproofing installation activities. Any deficiencies and non-conformances shall be recorded in the reports, which shall be sent to the Commissioner for review. The reports shall have detailed descriptions and photos of the waterproofed areas, waterproofing details, and waterproofing materials.
- F. Observation by Manufacturer's Representative and Contractor's Certification:
1. Representative of the waterproofing material manufacturer shall be required to provide field instructions and supervision for the installation of the waterproofing systems at the start of the work of this Section.
  2. The manufacturer's representative shall be required to make sure that the workmen for waterproofing systems on the site of the project are fully instructed in the handling and application of all the materials, and shall see that all the materials are correctly installed. Manufacturer's representative shall submit a waterproofing observation report to the Commissioner for review and acceptance after each site visit.
  3. Upon completion of the installation, submit to the Commissioner a certification that the manufacturer of the waterproofing material has observed the work of this Section and that all materials are installed per manufacturer recommendations and instructions.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packaging with seals unbroken, labeled with manufacturer's name, product, date of manufacture and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer. Protect stored materials from direct sunlight.
- C. Liquid Materials, such as adhesives, thinners, and primers, shall be stored in areas away from sparks, open flames and excessive heat.

#### 1.10 PROJECT CONDITIONS

- A. Maintain adequate ventilation during the preparation and application of waterproofing materials.
- B. Environmental Conditions: Apply waterproofing within range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

#### 1.11 WARRANTY



- A. Special Warranty: Submit a written warranty signed by waterproofing manufacturer agreeing to repair or replace waterproofing that does not meet requirements or that does not remain watertight during the specified warranty period.
  - 1. Warranty Period: 2 years after the date of "Substantial Completion."
  - 2. Manufacturer to perform periodic site visit inspections to verify installation in accordance with Manufacturer's recommendations and requirements.

#### 1.12 PROTECTION

- A. Against Loads: Protect work of this Section against concentrated loads and any other loads or equipment that would damage the materials or work.
- B. Against Traffic: Do not permit traffic on horizontally installed work of this Section, except for workmen doing the work, during the installation, and after the installation until membrane systems are covered with protective boards or with the specified finishing materials.
- C. Against Damage: Protect vertically installed work of this section from damage by reinforcing and placement.
  - 1. Take and maintain necessary preventative measures to protect work of this Section from damage until Project is accepted.
  - 2. Rejection of Damaged Work
    - a. Damaged materials or work will be rejected.
    - b. Rejected materials or work must be immediately removed and replaced with new materials.

#### 1.13 SUBSURFACE STRUCTURES AND UTILITIES

- A. The Contractor shall become acquainted with the existence and location of all surface and subsurface structures and utilities within the project area and beneath the surrounding streets. Contractor shall not damage any of those that are to remain and shall leave them accessible and make the necessary provision by sheeting, hanging, supporting or other means necessary to obtain this result, subject to the approval of the New York City Transit Authority, New York City Building Department and Department of Transportation, and the utility companies involved.

#### 1.14 DEFINITIONS

- A. Temporary Support System: Support system utilized to support earth excavation sides. Support system includes but not limited to anchors, soldier piles, concrete piers, rakers, lagging, etc.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Provide below grade foundation vapor barrier and waterproofing system of vertical foundation walls, horizontal slabs, pits, and pile caps. The vapor barrier shall consist of 20 mil polyethylene or approved equal. Subject to compliance with requirements, waterproofing shall be manufactured by one of the following approved manufacturers:
  - 1. GCP Applied Technologies (Basis-of-Design)
  - 2. Carlisle Coatings and Waterproofing



3. CETCO
4. Or approved equivalent.
- B. Horizontal Applications, horizontal surfaces below slabs, and Sidewalks: "Preprufe 300R" as specified on Contract Documents, or an equivalent product from approved manufacturer listed above.
- C. Vertical Applications, "Blind-Side Walls", or "One-Phase Walls". Conditions: "Preprufe 160R", as specified on Contract Documents, or an equivalent product from approved manufacturer listed above.
- D. Vertical Applications, "Two-Phase Walls". Conditions: "Bituthene 4000", as specified on contract documents, or an equivalent product from approved manufacturer listed above.
- E. Waterproofing Protection: 1/4-inch-thick semi-rigid protection board, Bituthene Asphaltic Hardboard, or an equivalent product from approved manufacturer listed above.
- F. Waterstops, at the interface between concurrent concrete pours (e.g., slab to wall interface), shall consist of the multiple injection grout hose – "TRIOject" manufactured by de neef, or an equivalent product from approved manufacturer listed above.
- G. Vapor Barrier shall meet or exceed the requirements specified for Class A performance in ASTM E175-11 standard specification for plastic water vapor retarders used in contact with soil or granular fill under concrete slabs.
- H. Provide "One-Phase Wall" waterproofing complying with the following:
  1. Tensile Strength, Film: 4,000 psi minimum; ASTM D412
  2. Low-Temperature Flexibility: Unaffected at -10°F; MOAT 31:6D.
  3. Peel Adhesion to Concrete: 5 lbs/in; MOAT 27:5.1.3.
  4. Lap Adhesion: 2.5 lbs/in minimum; ASTM D1876, modified.
  5. Hydrostatic-Head Resistance: 231 feet; ASTM D5385, modified.
- I. Provide "Two-Phase Wall" waterproofing complying with the following:
  1. Compressive Strength: 3,000 psi minimum; ASTM C109, modified
  2. Bond/Adhesion: 220 psi minimum; ASTM C321
  3. Hydrostatic-Head Resistance: 234 ft; ASTM D5385, modified.

## 2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for the intended use and compatible with waterproofing sheet membrane.
- B. Furnish liquid-type auxiliary materials that meet VOC limits of the DDC General Conditions.
- C. Primer: Liquid primer recommended by the manufacturer of sheet waterproofing material for the substrate.
- D. Sheet Flashing: Self-adhering, rubberized asphalt composite sheet of same material, construction and thickness as waterproofing sheet membrane.

- E. Liquid membrane: Elastomeric, 2-component, liquid, cold-fluid applied, trowel grade or low viscosity, as recommended by waterproofing manufacturer and vapor barrier manufacturer for the application.
- F. Patching Membrane: Low-viscosity, 2-component, asphalt modified coating.
- G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer and vapor barrier manufacturer.
- H. Penetration Seal: Self-adhering reinforced membrane, 2 ½-inches wide, with a tack-free protective adhesive coating on one side and release the film on the self-adhering side.
- I. Metal Termination Bars: Aluminum bars, approximately 1-inch by 1/8-inch thick, predrilled at 22-mm-centers.
- J. Waterproofing Protection: 1/4" thick semi-rigid protection board.
- K. Vapor Barrier Protection: Approved manufacturer's rigid protection board.
- L. Protection Board Adhesive: Protection board adhesive recommended by the manufacturer to secure protection board to waterproofing membrane.
- M. Joint Tape: 1/16 inches felt reinforced self-adhesive tape, 6-inches wide, with a release film on the adhesive side.

## 2.3 CONCRETE WORKING SLAB

- A. Concrete fill shall be composed of materials proportioned to provide a minimum compressive strength of at least 3,000 psi at 28 days. Slump shall be between 4 and 7 inches at the time of placement. All other requirements related to concrete transportation, handling, etc. shall conform to the requirements of the applicable specifications of the American Concrete Institute (ACI).

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions under which waterproofing systems will be applied, with Installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Do not proceed with installation until after minimum concrete curing period recommended by waterproofing manufacturer.
- C. Verify substrate is visibly dry and free of moisture. Test for capillary moisture for plastic sheet method according to ASTM D4263.
- D. Notify Commissioner in writing of anticipated problems using waterproofing over the substrate.

### 3.3 SUBGRADE SURFACE PREPARATION

- A. Clean, prepare, and treat working surface according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage affecting other construction.
- C. Remove grease, oil, form release agents, and other penetrating contaminants.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in the substrate. Remove dust and dirt from joints and cracks according to ASTM D4258.
- F. Install membrane strip and center over construction and control joints and cracks exceeding a width of 1/16 inch.
- G. Inside Corners: Prepare, prime, and treat inside corners according to waterproofing manufacturer's written instructions.
- H. Install membrane strip centered over vertical inside corners. Install 19 mm fillets of the liquid membrane on horizontal inside corners. All pile cap-to-wall intersections extend liquid membrane each direction from corner or install membrane strip centered over the corner.
- I. Outside Corners: Prepare and treat outside corners according to waterproofing manufacturer's written instructions.
  - 1. Install strips of membrane 12-inches-wide, centered over the corner.
- J. Prepare, treat, and seal horizontal and vertical surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to waterproofing manufacturer's written instructions.
  - 1. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge and cover with sheet membrane strips.

### 3.4 SOIL SUBGRADE PREPARATION

- A. Install a minimum 3-inch-thick concrete working slab beneath all building slabs, pits and foundations receiving waterproofing.
- B. Prepare the surface of concrete working slab in accordance with paragraph 3.2 above.
- C. Place membrane waterproofing directly on top of concrete working slab, in accordance with paragraph 3.2 above.

### 3.5 PREPARATION FOR VERTICAL BLINDSIDE (ONE-PHASE WALLS) APPLICATIONS

- A. Provide a continuous, smooth, rigid vertical facing to receive the waterproofing material per manufacturer's recommendations. The material may consist of plywood or rigid insulation. Vertical bracing to be sufficiently braced and supported so as not to displace during placement of concrete.
- B. Support of Excavation Systems (Steel sheet piles, etc.) must be treated with a rigid facing.
- C. Timber lagging must be close-buttressed to provide support and to be less than 0.5 inches out of plumb.

### 3.6 INSTALLATION OF WATERPROOFING FOR ACCESSIBLE WALLS (TWO-PHASE WALLS)



- A. General: Conform to recommendations and published specifications of the manufacturer including environmental requirements.
- B. Wall Applications
  - 1. General: The membrane, when in place, must withstand a minimum static groundwater pressure of 150 feet.
  - 2. Priming: Application of primer shall be limited to what can be covered with post-applied waterproofing membrane in a given work day. Primed areas not covered by membrane during the work day will be reprimed. Apply primer by spray, roller or brush at a rate of 250 - 350 sq. ft. per gallon. Roller shall be natural material such as lamb's wool, having a nap of approximately one inch. Primer shall be applied to a clean, dry, frost-free and dust-free surface. Sufficient primer must be used on the day surface to condition it to a dust-free state suitable for the application of post-applied waterproofing membranes.
    - a. Post-applied Waterproofing Surface Conditioner shall not be applied below 40 deg. F. on vertical surfaces. Allow primer to dry 30 minutes.
  - 3. Membrane Installation: Apply post-applied waterproofing membrane vertically in sections of 8 feet in length or less. On higher walls apply two or more sections with the upper overlapping the lower by at least 2.5 inches. Press all membrane in place with heavy hand pressure or rollers during application.
  - 4. Sealing Edges: Post-applied waterproofing membrane shall be applied over the edge of the slab or the top of the foundation or parapet wall. If the membranes are terminated on the vertical surface, a reglet or counter flashing may be used, or the membrane may be terminated directly on the vertical surface by pressing very firmly to the wall. Press edges with a metal or hardwood tool such as a hammer or knife handle. Apply a troweled bead of post-applied waterproofing mastic to all vertical and horizontal terminations. Waterproofing liquid membrane can be used as an alternative method at the Contractor's option. Refer to Contract Drawings for termination details.
  - 5. Sealing Seams: All edges and end seams must be overlapped at least 2.5 inches. Apply succeeding sheets with a minimum 2.5 inches overlap and stagger end laps. Roll or press the entire membrane firmly and completely as soon as possible. Patch misaligned or inadequately lapped seams with post-applied waterproofing membrane. Slit any fish mouths, overlap the flaps, and repair with a patch of post-applied waterproofing membrane and press or roll in place. The edges of the patch shall be sealed with a troweling of mastic. Laps within 12 inches of all corners shall be sealed with a troweling of mastic.
  - 6. Corner Forming: Outside corners must be free of sharp edges. Inside corners shall receive a fillet formed with waterproofing liquid membrane, latex-modified cement mortar, mixed with cement mortar or epoxy mortar. Do not use fiber or wood cants. One of two methods may be used for treating corners at the Contractor's option:
    - a. Apply waterproofing liquid membrane 6 inches in each direction from the corner and form a fillet with a minimum 3/4-inch face.
    - b. Install an 11-inch minimum strip of post-applied waterproofing membrane centered on the corner. Install post-applied waterproofing membrane over the treated inside and outside corners.



7. Over waterproofing, apply protection, and/or drainage composite board per contract documents by adhering board to the cured membrane using tape or adhesive per manufacturer's recommendations.
8. Seal penetrations through the membrane to provide a watertight seal with penetration seal patches or wrapping and liquid membrane fillet as recommended by the waterproofing system manufacturer.

### 3.7 INSTALLATION OF WATERPROOFING FOR BLINDSIDE WALLS (ONE PHASE WALLS) AND UNDERSLAB WATERPROOFING

- A. General: Install blindside wall membrane sheet according to waterproofing manufacturer's written instructions.
- B. Wall Applications
  1. Refer to manufacturer's literature for complete installation instructions not limited to the following:
    - a. Apply membrane in accordance with the manufacturer's recommendations to the soil retention system or adjacent foundation.
    - b. Apply succeeding sheets by overlapping the previous sheet 3 inches along the uncoated edge of the membrane.
    - c. Overlap the ends of the membrane 3 inches. Apply waterproofing tape centered over the end lap and roll firmly. Remove release liner.
    - d. Concrete must be poured within 30 days of membrane application.
    - e. Protect membrane until concrete pour.
    - f. If membrane ties into a vertical membrane, leave an additional 12-inch flap of blindside wall membrane to tie into post-applied waterproofing membrane.
- C. Underslab Applications
  1. Refer to manufacturer's literature for complete installation instructions not limited to the following:
    - a. Apply membrane in accordance with the manufacturer's recommendations to the approved substrate. Remove the release liner and fasten membrane to substrate firmly.
    - b. Apply a waterproofing liquid membrane termination bead at the edge of the sheet membrane.
    - c. Secure the sheet membrane and liquid membrane by applying Waterproofing Tape centered over the end lap and roll firmly. Remove the release liner.
    - d. Concrete must be poured within 30 days of membrane application.
    - e. Protect waterproofing membrane until concrete pour.

### 3.8 SEAM REINFORCEMENT FOR BLINDSIDE WATERPROOFING SHEETS ONLY

- A. Provide a 6-inch strip of Waterproofing Tape centered behind all laps.



- B. At locations where a salvage edge is not present and at end laps, lap sheets 6 inches, apply a 1/8-inch thick by 6-inch wide application of liquid membrane between sheets, to provide a 6-inch wide seal.
- C. Integration of old onto new Blindside Sheet Membrane.
  - 1. Integration of sheet membrane onto sheet membrane that has been installed in excess of 30 days prior.
    - a. Lap sheets 12 inches, apply a 1/8-inch thick by 12-inch wide application of fluid membrane between sheets, to provide a 12-inch wide seal at this location.
    - b. Install Waterproofing Tape centered at the edge of lap and roll firmly into place with an approved roller.
    - c. Install additional Waterproofing Tape to cover white film that has been installed over 30 days prior.
  - 2. Patching Damaged Blindside Sheet Membrane
    - a. Scratch on white coating exposing underlying black surfacing of sheet membrane: Install waterproofing tape at areas where the white coating of the membrane is damaged, including boot scuff marks and abrasions by rebar.
    - b. Damage or Puncture of sheet membrane: Install patch of sheet membrane set in liquid membrane. The patch must extend 3 inches in every direction around the extent of the damaged area. Install waterproofing tape centered over the edge of the patch. If the damaged area does not have 5 inches of sound material around it, inject liquid membrane into puncture until liquid membrane backs out, and proceed with the patch as space allows.

### 3.9 PROTECTING AND CLEANING

- A. Protect waterproofing from damage and wear during application and remainder of the construction period, especially during installation of steel reinforcement, according to manufacturer's written instructions.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by the manufacturer of affected construction.
- C. Horizontal Applications: Protect the top surface of the membrane with protection board from punctures, tears, or burns.
- D. Vertical Applications: Protect membrane waterproofing from damage due to the uneven substrate. This includes placement of a rigid barrier such as plywood or rigid insulation between the membrane waterproofing and the soil backfill material.

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## **SECTION 07 21 00**

### **THERMAL INSULATION**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Polyisocyanurate foam-plastic board.
3. Glass- fiber blanket.
4. Mineral- wool blanket.
5. Installation accessories.

B. Related Sections:

1. Section 03 45 00 "Precast Architectural Concrete."
2. Section 04 20 00 "Unit Masonry."
3. Section 06 16 00 "Sheathing" for foam-plastic board sheathing installed directly over steel framing.
4. Section 07 52 16 "SBS Modified Bituminous Membrane Roofing" for roof insulation requirements.
5. Section 08 44 13 - Glazed Aluminum Curtain Walls for mineral- wool insulation at shadow boxes.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. On-site Facade Mockups: Include as part of on-site facade mockup required by other sections, as indicated on the drawings, work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  - 1. Provide each type of insulation installation in sizes, quantities, and configuration indicated on the drawings.
  - 2. Incorporate full-scale details of the architectural features, approved finished and textures, brackets and attachment components required for installation.
  - 3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
  - 4. Maintain on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.



## PART 2 - PRODUCTS

### 2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Exterior wall insulation below grade at foundation walls, grade beams, and exposed edges of slabs on grade. Provide the following types as indicated and required by project application:
  - 1. Extruded Polystyrene Board, Type VI: ASTM C578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.
  - 2. Type VI, Drainage Panels, 40-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
  - 3. Minimum thermal resistance by nominal thickness, as determined using ASTM C518 at 75 degrees mean temperature: R-5 per inch.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  - 1. Dow Chemical Company (The); STYROFOAM Brand insulation.
  - 2. DiversiFoam Products.
  - 3. Kingspan Insulation Limited.
  - 4. Owens Corning;
  - 5. Or approved equal.

### 2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

- A. Exterior Insulation above grade- Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.
  - 1. Minimum thermal resistance by nominal thickness, as determined using ASTM C518 at 75 degrees mean temperature, for thickness as follows:
    - a. 2 inch - R-12.1.
    - b. 3 inch - R-18.5.
    - c. 4 inch - R-25.0.
- B. Precast Concrete Panel Insulation: ASTM C 591, Type I, 1.8 lbs. per cu. ft., unless higher density required to obtain project thermal resistance; unfaced, with thickness of 4 inches.
  - 1. Minimum Thermal resistance: R- 25.
- C. Manufacturers: Subject to compliance with requirements, provide products as supplied by Rmax, Inc. or comparable product from one of the following, as approved by the Commissioner:
  - 1. Carlisle Coatings & Waterproofing Inc.
  - 2. Hunter Panels.
  - 3. Or approved equal.



- D. Fire Propagation Characteristics, where required by project application: Passes NFPA 285 testing as part of an approved assembly.

## 2.3 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  - 1. CertainTeed Corporation.
  - 2. Guardian Building Products, Inc.
  - 3. Johns Manville.
  - 4. Knauf Insulation.
  - 5. Owens Corning.
  - 6. Or approved equal.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

## 2.4 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
- B. Products: Subject to compliance with requirements, provide one of the following, as approved by the Commissioner:
  - 1. Johns Manville; a Berkshire Hathaway company; MinWool Sound Attenuation Fire Batt.
  - 2. Rockwool International; AFB, AFB evo, or COMFORTBATT.
  - 3. Thermafiber, Inc.; an Owens Corning company; FS-15 or SAFB (Sound Attenuation Fire Blankets).
  - 4. Or approved equal.

## 2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
  - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following, as approved by the Commissioner:
    - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
    - b. Gemco; Spindle Type.
    - c. Gripnail Fastening Systems.
    - d. Or approved equal.
  - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
  - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.



- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
  - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following, as approved by the Commissioner:
    - a. ADO Products.
    - b. AGM Industries, Inc.; RC150 or SC150.
    - c. Gemco; Dome-Cap, R-150 or S-150.
    - d. Or approved equal.
  - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Provide capped washers to tops of spindles where foundation wall insulation is not covered by building materials and where indicated.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
  - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following, as approved by the Commissioner:
    - a. AGM Industries, Inc.; TACTOO Adhesive.
    - b. Gemco; Tuff Bond Hanger Adhesive.
    - c. SIMPSON STRONG-TIE; Epoxy Anchor Adhesive.
    - d. Or approved equal.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

#### 3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.



- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
  - 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
  - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
  - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

### 3.5 INSTALLATION OF WALL INSULATION

- A. Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
  - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

### 3.6 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
  - 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.



- a. Exterior Walls: Set units with facing placed toward interior of construction.
  - b. Interior Walls: Set units with facing placed toward areas of high humidity.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

### 3.7 INSTALLATION OF INSULATION FOR SOUND ATTENUATION

- A. Where mineral fiber blankets are indicated for sound attenuation, install blanket insulation solid between framed spaces in thicknesses indicated.

### 3.8 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 07 21 00**



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**SECTION 07 21 19****FOAMED-IN- PLACE INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Closed-cell spray polyurethane foam.
2. Installation accessories.

B. Related Sections:

1. Section 03 45 00 "Precast Architectural Concrete."
2. Section 07 42 13 "Insulated Metal Wall Panels."
3. Section 08 44 13 "Glazed Aluminum Curtain Walls."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Engineered wood, not including salvaged wood, shall contain a minimum of 10% (combined) post-industrial/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the Submittal Requirements of this Section.
2. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI). Certification of these products shall be in accordance with the Submittal Requirements of this Section.



3. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.
4. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. On-site Facade Mockups: Include as part of on-site facade mockup required by other sections, as indicated on the drawings, work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  1. Provide complete foamed-in-place insulation installation in sizes, quantities, and configuration indicated on the drawings.
  2. Incorporate full-scale details of the architectural features, approved finished and textures, brackets and attachment components required for installation.
  3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.



- D. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

## PART 2 - PRODUCTS

### 2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lbs. per cu. ft. and minimum aged R-value at 1-inch thickness of 6.5 deg F x h x sq. ft./Btu at 75 deg F.
- B. Basis of Design, Products: Subject to compliance with requirements, provide one of the following to suit project application:
  - 1. Icynene MD- C- 200, Icynene ProSeal, or Ecolcynene ProSeal LE as supplied by Icynene- Lapolla, or comparable product from one of the following, as approved by the Commissioner:
    - a. Dow Chemical Company (The); STYROFOAM Spray Polyurethane Foam Insulation.
    - b. Gaco Western LLC.
    - c. SWD Urethane Company.
    - d. Volatile Free, Inc.
    - e. Or approved equal.

### 2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrate.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

### 3.3 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.



- B. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer.  
Do not spray into rising foam.

#### 3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

**END OF SECTION 07 21 19**



## **SECTION 07 27 26**

### **FLUID-APPLIED MEMBRANE AIR BARRIERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Vapor- permeable fluid-applied air barriers.
  - 2. Installation accessories.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

##### **1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 COORDINATION**

- A. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.

**1.7 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

**1.8 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

**1.9 INFORMATIONAL SUBMITTALS**

- A. Product certificates.
- B. Product test reports.
- C. Field quality-control reports.

**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Mockups: Build mockups to set quality standards for materials and execution.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Physical and Performance Properties:
  - 1. Air Permeance: As indicated by manufacturers product designation; per ASTM E2178.



2. Vapor Permeance: As indicated by manufacturers product designation; per ASTM E96/E96M, Desiccant Method.
3. Elongation: As indicated by manufacturers product designation; per ASTM D412, Die C.
4. Adhesion to Substrate: As indicated by manufacturers product designation; when tested according to ASTM D4541.
5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

## 2.2 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. High-Build, Vapor-Permeable Air Barrier: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrate.
- B. Products: Subject to compliance with requirements, provide one of the following or equal product, as approved by the Commissioner:
  1. GCP Applied Technologies Inc.; Perm-A-Barrier VP.
  2. Henry Company; Air-Bloc 17MR.
  3. Tremco Incorporated; ExoAir 230.
  4. Or approved equal.

## 2.3 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
  1. Comply with Section 07 92 00 - Joint Sealants.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  1. Verify that substrate is sound and free of oil, grease, dirt, excess mortar, or other contaminants.



2. Verify that substrate has cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrate is visibly dry and free of moisture.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

### 3.4 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  1. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  3. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
- D. Restore punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond restored areas in strip direction.
- E. Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
- F. Do not cover air barrier until it has been tested and inspected by testing agency.





- G. Correct deficiencies in or remove air barrier that does not comply with requirements; restore substrates and reapply air-barrier components.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Where required by project application, City of New York will engage a qualified testing agency to perform tests and inspections.
- B. Tests: As determined by testing agency from among the following tests:
  - 1. Air-barrier dry film thickness.
  - 2. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.
  - 3. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
  - 4. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.
- C. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- D. Restore damage to air barriers caused by testing; follow manufacturer's written instructions.
- E. Prepare test and inspection reports.

### 3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Remove masking materials after installation.

**END OF SECTION 07 27 26**



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## **SECTION 07 42 13**

### **INSULATED METAL WALL PANELS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:

- 1. Foamed- insulation- core metal wall panels.
  - 2. Installation accessories.

- B. Related Sections:

- 1. 05 40 00 "Cold-Formed Metal Framing" for related metal framing at insulated metal panel wall and soffit areas.
  - 2. 07 21 00 "Thermal Insulation" for related insulating materials
  - 3. Section 07 92 00 "Joint Sealants" for elastomeric joint sealants and sealant backings.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

- 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

- 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.



2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.



1.10 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Manufacturer Qualifications: Manufacturer providing the material used in this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- C. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- D. On-site Facade Mockup: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  - 1. Provide complete insulated metal panel system in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
  - 2. Incorporate full-scale details of the architectural features, sealant joints, and trim to be provided at full-scale building.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  - 4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.13 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.14 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to restore or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to restore finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft...
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to New York City Department of Buildings and New York City Department of Buildings. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
  - 2. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
  - 3. Potential Heat: Acceptable level when tested according to NFPA 259.



4. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

## 2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
  1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
    - a. Closed-Cell Content: 90 percent when tested according to ASTM D6226.
    - b. Density: 2.0 to 2.6 lbs. per cu. ft. when tested according to ASTM D1622.
    - c. Compressive Strength: Minimum 20 psi when tested according to ASTM D1621.
    - d. Shear Strength: 26 psi when tested according to ASTM C273.
    - e. Thermal performance for 3 inch panel: R- 22 in accordance with ASTM C1363.
- B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
    - a. CENTRIA Architectural Systems.
    - b. Kingspan Insulated Panels.
    - c. MBCI.
    - d. Metl-Span.
    - e. Approved equal.
  2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.028 inch.
    - b. Exterior Finish: Three-coat fluoropolymer.
      - 1) Color: As selected by Commissioner from manufacturer's full range.
    - c. Interior Finish: Siliconized polyester.
      - 1) Color: As indicated by manufacturer's designations.
  3. Panel Thickness: 3 inch nominal, unless otherwise indicated.



## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2-inch-wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.





## 2.5 FINISHES

### A. Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrate, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  2. Examine sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.



### 3.4 INSULATED METAL WALL PANEL INSTALLATION

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
  - 1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
  - 2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
  - 3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
  - 4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  - 5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
  - 6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- B. Metal wall panels will be considered defective if they do not pass test and inspections.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.6 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

**END OF SECTION 07 42 13**

## **SECTION 07 52 16**

### **SBS MODIFIED BITUMINOUS MEMBRANE ROOFING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Hybrid roofing system that combines built-up ply sheets with styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
  - 2. Substrate board.
  - 3. Roof insulation.
  - 4. Cover board.
  - 5. Walkways.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 COORDINATION

- A. Coordinate attachment of rubber roof paver tile with paver manufacturer and installer to ensure proper adhesion to roof membrane. Coordinate shop drawings with rubber roof paver tile system.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:
  - 1. Layout and thickness of insulation.
  - 2. Base flashings and membrane terminations.
  - 3. Flashing details at penetrations.
  - 4. Tapered insulation, including slopes.
  - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
  - 6. Crickets, saddles, and tapered edge strips, including slopes.
  - 7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  - 8. Tie-in with adjoining air barrier.
- C. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.8 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates:
  - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

1.9 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer performing the work of this section shall be a company regularly engaged in performing roofing projects with its own workforce and have successfully completed



in a timely fashion at least three (3) roofing projects similar in scope, size and type to the required work within the last three (3) consecutive years prior to the bid opening.

1. At least one of those projects shall have been performed within the last twelve (12) months.
2. The three (3) qualifying projects shall have utilized one or more of the roofing systems specified for the project being bid herein, been installed by the company utilizing its own workforce and shall have qualified for, and have been issued, the warranty provided by the manufacturer of the roofing system.
3. In addition, the installer shall be a certified or authorized installer of selected manufacturer for this project roofing system and shall submit proof of same.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to restore or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: 20 years from date of Substantial Completion.
- B. Include rubber roof paver tile as an overburden item in the Roof system warranty.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of each of the following products, as approved by the Commissioner.
- B. Asphalt Primer and Asphalt:
  1. Johns Manville Roofing Systems Group.
  2. GAF Building Materials Corp.
  3. Tamko Asphalt Products.
  4. Approved equal.
- C. Base Sheet:
  1. Johns Manville; GlasPly Premier.
  2. GAF; GAFGLAS #75.
  3. Tamko; Glass-Base.
  4. Approved equal.
- D. Vent Base Sheet:
  1. Johns Manville; Ventsulation.
  2. GAF; GAFGLAS Stratavent or Stratavent Perforated.
  3. Tamko; Vapor-Chan.
  4. Approved equal.
- E. Roofing Membrane, Vapor Barrier and Cover Strip:
  1. Johns Manville; GlasPly Premier.



2. GAF; GAFGLAS Ply 6.
3. Tamko; TamGlas Premium.
4. Approved equal.

F. Insulation, complying with project Performance Requirements:

1. Two Layer:
  - a. Base Layer
    - 1) Johns Manville; ENRGY 3 .
    - 2) GAF; GAFTEMP Isotherm R.
    - 3) Atlas Energy Products; AC Foam II .
    - 4) Approved equal.
  - b. Top Layer:
    - 1) Johns Manville; 1/2" Retro-Fit Board.
    - 2) GAF 1/2" High density fiber board.
    - 3) Atlas 1/2" Perlite Board.
    - 4) Approved equal.

G. Tapered Insulation, complying with project Performance Requirements:

1. Base layer:
  - a. Johns Manville; Tapered ENRGY 3.
  - b. GAF; GAFTEMP Tapered Foam Insulation
  - c. Atlas; AC Foam II (tapered).
  - d. Approved equal.
2. Top layer:
  - a. Johns Manville; 1/2" Retro-fit board.
  - b. GAF; 3/4" Perlite.
  - c. Atlas; 1/2" Perlite.
  - d. Approved equal.

H. Base Flashing:

1. Four base plies:
  - a. Johns Manville; GlasPly Premier.
  - b. GAF; GAFGLAS Ply 6.
  - c. Tamko; TamGlass Premium.
  - d. Approved equal.
2. One ply cap sheet:
  - a. Johns Manville; DynaKap FR T1 CR G.
  - b. GAF; RUBEROID MOP FR.
  - c. Tamko; Awaplan Premium.
  - d. Approved equal.



I. Mineral- Surfaced Asphalt Membrane:

1. Johns Manville; DynaKap FR T1 CR G.
2. GAF; GAFGLAS mineral surfaced cap sheet.
3. Tamko; Tam-cap.
4. Approved equal.

J. Flashing Cement:

1. Johns Manville; MBR two-part Flashing Cement or Type III Steep Asphalt (or equivalent by GAF or Tamko) or approved equal.

K. Elastomeric Cement:

1. Tremco Manufacturing Co.; "Poly roof".
2. Durok Bldg. Materials; "Durok Rubber Cement".
3. Karnak Chemical Corp.; "AR Elastomeric".
4. Approved equal.

L. Perlite Cant Strip:

1. Johns Manville.
2. GAF.
3. Atlas.
4. Approved equal.

M. Walkway Pads:

1. Johns Manville; "Dyna Tread Plus".
2. GAF; Equivalent product.
3. Tamko; ; Equivalent product.
4. Approved equal.

N. Raised Rubber Roof Pavers: Refer to Section 07 72 00 "Roof Accessories."

2.2 MATERIALS FOR VAPOR BARRIER

A. Vapor Barrier:

1. For asphalt vapor barriers:
  - a. Primer: Asphalt primer; ASTM D41.
  - b. Steep Asphalt: ASTM D312, Type III.
2. Asphalt Fiberglass Felt: Asphalt impregnated glass mat, ASTM D 2178, Type VI. UL Classified.

B. Asphalt Vapor Barrier Over Concrete Deck and concrete fill/screed.

1. Primer: Asphalt primer, ASTM D41.
2. Steep Asphalt: ASTM D 312, Type III.
3. Asphalt Fiberglass Felt: Asphalt impregnated glass mat, ASTM D 2178, type VI. UL Classified.



## 2.3 MATERIALS FOR BUILT-UP MEMBRANE

### A. Smooth- Surfaced Asphalt Membrane:

1. Steep Asphalt (Slopes 0" to 3" per Foot): 190°, Type III.
2. Special Steep Asphalt: 220°, Type IV, (Slopes 3" to 6" per Foot).
3. Asphalt Fiberglass Felt: Asphalt impregnated glass mat, ASTM D 2178, Type VI. UL Classified.
4. Asphalt Emulsion: Fibrated emulsion coating, ASTM D 1227, Type IV. UL Classified.
5. Aluminized Coating: Fibrated, bituminous aluminized coating, ASTM D 2824, Type III. UL Classified

### B. Mineral- Surfaced Asphalt Membrane Cap Sheet:

1. Color: White, with reflective top surface complying with either of the following:
  - a. Minimum initial solar reflectance index (SRI) in accordance with ASTM E1980: 88 and 3-year aged SRI of 77.
  - b. Minimum initial reflectivity in accordance with ASTM C 1549: 0.72.

## 2.4 FLASHINGS

### A. Built-Up Base Flashing:

1. Asphalt Fiberglass Felt: Asphalt impregnated glass mat, ASTM D 2178, Type VI. UL Classified.
2. Reinforced Modified Cap Sheet: Reinforced modified bitumen flashing that incorporates the properties of both a strong fiberglass or polyester mat with an elastomeric base material consisting of modified bitumen material and fire retardant additives: ASTM D-412; UL Classified.
3. Steep Asphalt: 190°, ASTM D312 Type III.
4. Modified Flashing Cement.

### B. Coverstrips:

1. Asphalt Fiberglass Felt: Asphalt impregnated glass mat, ASTM D 2178, Type VI. UL Classified.
2. Plastic Cement: Flashing grade, fibrated asphalt roofing cement, ASTM D 4586. UL Classified.

### C. Elastomeric Liquid-Applied Flashing Membranes:

1. Johns Manville; PermaFlash.
2. Siplast; Parapro 123 Flashing.
3. GCP Applied Technologies Inc.; PERM-A-BARRIER Liquid Flashing.
4. Approved equal.

## 2.5 INSULATION

- ### A. General:
- Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.





1. Approval of insulation is contingent upon approval by the membrane manufacturer for use with specified roof system.
- B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.
- C. Provide preformed saddles, crickets, cant strips, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- D. Isocyanurate insulation shall have a 15-year time weighted average Long Term Thermal Resistance (LTTR) as determined in accordance with ASTM C1289 or CAN/ULC-S770, Standard Test Method for Determination of Long Term Thermal Resistance of Closed Cell Thermal Insulating Foams).
  1. Types as follows:
    - a. Perlite - ASTM C728
    - b. Fiberboard - ASTM C208
    - c. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 2, glass-fiber mat facer on both major surfaces.
  2. All insulation: Factory Mutual, Class 1 or U.L. Class A.
- E. Rigid Insulation:
  1. Two Layers of Insulation: Two layers of insulation consisting of base layer of isocyanurate insulation, and top layer of fiberboard or perlite insulation.
    - a. Base Layer Insulation: Closed cell isocyanurate foam core skinned on both sides with factory applied facers of the generic type recommended by the membrane manufacturer.
    - b. Top layer: 1/2 inch perlite board insulation complying with ASTM C-728.
    - c. Required total roof insulation thickness: 3 inch minimum at vertical and horizontal surfaces of roof curbs, as indicated on drawings, and 6 inch at thinnest point within horizontal roof field area, or as indicated on drawings.
    - d. Minimum Long-Term Thermal Resistance (LTTR) values of insulation board, by nominal thickness of flat insulation board:
      - 1) 2 inch : R- 11.4.
      - 2) 4 inch : R- 23.6.
  2. Composite Insulation Board: Consists of a base layer of isocyanurate foam integrally bonded to a layer of perlite or wood fiberboard on one side and a non- asphaltic fiberglass mat on the other.
- F. Tapered Insulation System: Insulation system has achieved project fire hazard classification when tested in conjunction with UL Classified built-up roofing membranes. Other tapered insulation systems which conform to project criteria may be submitted for approval.
  1. Tapered Insulation: 1/8 inch slope per foot factory tapered and mitered closed cell isocyanurate foam core skinned on both sides with factory applied facers of the generic type recommended by membrane manufacturer and Factory Mutual approved for direct application over steel decks. One-inch minimum thickness at drains and valleys unless shown otherwise on Contract Drawings.



2. Tapered Insulation Crickets: 1/ 2 inch slope per foot factory tapered and mitered isocyanurate insulation cricket system.
3. Overlay Insulation: Perlite UL Classified. 3/ 4 inch thick.
4. Minimum Long-Term Thermal Resistance (LTTR) values of insulation board, by nominal thickness of flat insulation board:
  - a. 2 inch at thick edge: R- 10.
  - b. 4 inch at thick edge: R- 22.1.

## 2.6 FASTENERS

- A. Fasteners for Securing Built-Up Base Flashing:
1. Wood Surfaces: Annular ring roofing nail with one-inch solid cap or equivalent fastener.
  2. Metal Surfaces: Hardened, self-tapping #10 sheet metal screw thru one-inch diameter sheet metal disk.
  3. Masonry Surfaces: Hardened, masonry nail or drive pin, thru one-inch dia. sheet metal disk.

## 2.7 MISCELLANEOUS MATERIALS

- A. Cant Strips (For built-up base Flashings)
- B. Preformed fiberboard, ASTM C 208.
- C. Tapered Edgestrips (around drains and at other areas where insulation must be feathered down)
- D. Preformed fiberboard, ASTM C 208.
- E. Walkway Pads/ Splash Pads/ Protection Pads at access equipment locations indicated.
1. Homogeneous core of asphalt, plasticizers and inert fillers, bonded by heat and pressure between two saturated and coated sheets of organic felt and coated on top surface with ceramic granules. Minimum thickness 3/ 4 inch.
  2. Size: min. 3/8 inch thick by 32 by 32 inches.
  3. Color: White, with reflective top surface complying with either of the following:
    - a. Minimum initial solar reflectance index (SRI) in accordance with ASTM E1980: 88 and 3-year aged SRI of 77.
    - b. Minimum initial reflectivity in accordance with ASTM C 1549: 0.72.
- F. Materials for Pitch Pockets:
1. Mortar: ASTM C 270, Type S.
  2. Elastomeric Cement: Non-sag, cold applied, trowel grade, single component rubber elastomer. Minimum elongation 400 percent.
- G. Broadcast Granules: Manufacturers standard material for coverage of bleed- out areas.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Verify that Work of other trades which penetrates the roof deck has been completed.
- B. Examine surfaces for inadequate anchorage, foreign material, moisture, and unevenness which would prevent the execution, and quality of application, of the built-up roofing system as specified.
- C. Do not proceed with application of built-up roofing system until defects are corrected.

**3.3 PREPARATION**

- A. Restore fill/ screed in accordance with Section 03 30 00 - Cast-in - Place Concrete.
- B. Moisture Testing for Roof Deck.
- C. All roof decks where new roofing is to be installed shall be thoroughly dried out and free of moisture before installing new membrane. There shall be two (2) test areas for every 2500 square feet of area to be roofed.
  - 1. Commissioner shall be present at tests to confirm tests have been performed and obtain test results for each area.
  - 2. Roof Deck Dryness Test per NRCA Approved Method:
    - a. Use approximately one pint of bitumen that is specified for use in the roof membrane, heated to a temperature that will ensure an application temperature of 400° F. See Built-up Roofing, Section IV-B, (Equiviscous Temperature) NRCA roofing and waterproofing manual.
    - b. Pour the bitumen on the surface of the deck. If the bitumen foams, the deck is NOT dry enough to roof.
    - c. After the bitumen has cooled, an attempt shall be made to strip the bitumen from the deck surface. If the bitumen strips clean from the deck, the deck is NOT dry enough to roof.
    - d. If the tests prove the deck is damp, it shall be allowed to dry and be retested until dry enough for the roofing to be installed.
- D. Priming for concrete decks: Prior to application of vapor barrier, and after the deck has passed the dryness test, apply asphalt primer to concrete deck surface at the rate of one gallon per square.

**3.4 HEATING BITUMEN**

- A. Preparation:
  - 1. Heating bitumen shall be performed in accordance with FDNY, NYS DOL, and New York City Department of Buildings regulations.



2. Use separate kettles or tankers for heating different types of asphalt.
3. The heating process shall be strictly regulated by means of an automatic thermostatic control of an approved type for positive temperature control. Kettles or tankers shall be the immersion tube type, fire by Liquid LP gas, and shall have 100% safety shutoff.
4. Equip each kettle or tanker with a recording thermometer that will graphically indicate and record on a chart the maximum and minimum temperatures to which materials have been heated. Recording thermometers shall be capable of accurately recording temperatures as high as 600 degrees F. and as low as 0 degrees F. The thermometers shall be properly maintained at all times.
  - a. Kettles or tankers without recording thermometers in good working condition shall not be used.
  - b. At the end of each working day, turn the chart from the thermometer on each kettle or tanker over to Commissioner.
  - c. If any bitumen is overheated, remove it from the site in the presence of Commissioner.
5. If any underheated or overheated bitumen has been applied on the roof, remove that portion of the roof.
6. On multi-storied buildings, when directed, locate the heating kettles on the roof. Place kettle on a heavy sheet metal tray on dunnage. Metal tray shall extend 18" beyond the sides and ends of the kettle and be turned up 1" at all edges.
  - a. Only one gas cylinder shall be on the roof at any one time. Locate the cylinder at least four feet away from the kettle. Vertically brace the cylinder and shade it from the sun.
  - b. Provide fire extinguishers on the roof in the vicinity of the kettles as required to ensure the safety of the roof.

**B. Heating Asphalt Bitumen:**

1. Heat the bitumen in accordance with the Equiviscous Temperature information furnished by the bitumen manufacturer for that specific run of bitumen.
  - a. In no case shall be asphalt be heated to or above the actual COC Flash Point (ANSI/ASTM D-92); or the finished blowing temperature for more than 4 hours.
  - b. Maintain the temperature of the bitumen at the point of application within the Equiviscous Temperature Range. Use insulated pipes, buckets, luggers, and other insulated roofer's equipment as required by the field conditions.
  - c. Provide a minimum of one hand- held thermometer for each crew installing hot asphalt in order to ensure compliance with EVT.
2. Application temperature: The accepted application temperature range for asphalt is the equiviscous temperature, (EVT) 25 F. All felt installation must occur in this range to be acceptable.

**3.5 INSTALLING VENT BASE SHEET**

- A. Install one ply of vent base sheet. Vent sheets shall be butted.
- B. Using vent base sheet, start at the low edge of the roof. Install vent base sheet by spot mopping. The spot mopping shall be applied by machine at the rate of approximately 7 lbs. per square. The spots shall be approximately 12" in diameter and 24" o.c. Stagger each row.



- C. Run vent base sheet up the perimeter or parapet walls to the height of the counter flashing, spot adhering as required. This will allow for proper perimeter venting detail.

### 3.6 INSTALLING VAPOR BARRIER

- A. Installing Vapor Barrier Over Concrete Deck or Light Weight Fill/Screed:
  - 1. Install 2 plies of asphalt fiberglass felt shingle fashion. Lap plies 19" over each preceding ply.
  - 2. Embed each ply in a solid mopping of hot steep asphalt applied at the rate of 20 lbs per square. Broom in each ply for complete embedment.
- B. Extend the vapor barrier beyond all edges and openings of the roof so that it can be turned up over the insulation a minimum of 6".
  - 1. If vapor barrier is punctured, restore immediately with fiberglass felt embedded in hot bitumen.
  - 2. Install the insulation and roofing membrane immediately (same day) as the vapor barrier is installed. Where not possible, protect the vapor barrier with a glaze coat of hot bitumen applied at the rate of 15 lbs. per square.

### 3.7 INSTALLING INSULATION

- A. Installing Single Layer Insulation: Install the insulation with the long joints running in a continuous straight line perpendicular to the direction of the roof membrane. Stagger end joints. Butt edges and ends snugly. "Occasional" joint widths up to 1/8" will be allowed.
  - 1. Set the insulation in a full hot mopping of Type III steep asphalt applied at the rate of 30 lbs. per square. Press the insulation into the bitumen to a firm and uniform bearing.
- B. Installing Double Layer Insulation: Install the insulation in 2 separate layers with the long joints of each layer running in the same direction in a continuous straight line perpendicular to the direction of the roof membrane. Stagger end joints. Install the top layer of insulation with joints staggered from the joints of the base layer.
  - 1. Set each layer of insulation in a full hot mopping of Type III steep asphalt applied at the rate of 30 lbs. per square. Press the insulation into the bitumen to a firm and uniform bearing.
- C. Installing Tapered Insulation: Follow the manufacturer's Shop Drawings and instructions for laying out the tapered insulation system, and cricket system (if any). Install the overlay insulation over the tapered insulation system, with joints staggered from each layer.
  - 1. Butt edges and ends snugly. "Occasional" joint widths up to 1/8" will be allowed.
  - 2. Set each layer of insulation in a full hot mopping of Type III steep asphalt applied at the rate of 30 lbs. per square. Press the insulation into the bitumen to a firm and uniform bearing.
  - 3. Install the insulation manufacturer's fiberglass roof tape over all joints of the overlay insulation. Embed the tape in hot steep asphalt.
- D. Keep insulation dry at all times. Discard insulation that contains moisture.
  - 1. Install only as much insulation as can be covered with roofing membrane the same day.



2. Discard all units with broken corners or similar defects.
3. At roof drains, terminate the insulation with tapered edge strips so that all flashing and coverstrip joint laps can be made within the tapered portion.
4. Set all cant strips in a solid application of hot bitumen so they are firmly anchored to the deck and the vertical surface.

E. Installation of insulation shall be in strict compliance with the Manufacturer's recommendations.

### 3.8 INSTALLING BUILT-UP ROOF

A. Before application of roof membrane, turn vapor barrier over insulation at all edges and openings and embed in a full hot application of bitumen. At round openings, seal the edges of the insulation with a trowel coat of plastic roof cement.

B. Installing Built-Up Roof Membrane:

1. For asphalt built-up roofs, install built-up roof membrane consisting of 5 plies of asphalt fiberglass felt. Embed each ply in solid mopping of hot asphalt applied at the rate of 25 lbs. per square.
2. Ply felts installation:
  - a. Start at low edge of the roof deck.
  - b. Apply one 12 inch wide piece of ply felt.
  - c. Apply over 12 inch felt one 24-inch wide felt.
  - d. Apply over 24 inch felt, a full 36 inch wide felt.
  - e. Install the final (4<sup>th</sup>) ply at full width.

1) Rate: 23 pounds per square for each layer of felt.

3. Install each felt so that it is firmly and uniformly set, in hot asphalt, without voids.
4. Dry edges of any depth will not be tolerated.
5. All such edges shall be cut out and patched with an equal number of plies.

C. Laying Felt:

1. Start laying felts, using split sheets as necessary to secure the required number of plies and laps. Provide 10" minimum end laps. Roll all roofing felt not more than 5'-0" behind the mop as it spreads the bitumen, brooming and pressing the felts into the bitumen from the center outward to the edges so as to ensure thorough sticking and a smooth, firm surface, free of blisters, wrinkles, or buckles.
2. Use three persons for the application of roofing felt as follows; one person to spread bitumen in front of the roll, one person to roll out the felt and one person to smooth out the felt with a stiff street broom or squeegee. The roofing may be installed with an approved applying machine and broomed or squeegeed smooth producing an equivalent result. In no case shall the felt be rolled out dry and then laid in the bitumen.
3. Where gravel stops are required, install felt pitch dam as follows: At the parallel edge to the felt runs, extend the bottom felt 4" beyond the roof edge. Across the end of the felt runs, install a 12" wide continuous starter strip, extended 4" past the roof edge. After all ply felts are installed and edge trimmed, fold the 4" extension back over the roof surface. Adhere with hot bitumen and broom smooth, leaving the exposed top surface dry.
4. Where built-up flashings are required, extend the mopped roofing felts 2" beyond the top edge of the cant.
5. Where sheet metal base flashings are required, turn up mopped roofing felts a minimum of 4" on all vertical surfaces or apply additional felt plies.



6. Where cant type gravel stops (fascia) are required, carry all membrane plies past the edge of the water dam member and cut off flush with the face of the cant.
7. Any protection ply or temporary ply shall not be deemed a part of the 5-ply system.

**D. Phasing of Roofing Membrane Installation:**

1. Phasing of ply felt application will not be allowed in any case.
2. Where necessitated by job conditions and with approval of the Commissioner, a protective glaze coating may be applied as follows:
  - a. Apply protective glaze coatings in addition to other coating or mopping indicated and required by project application. Reduction or omission of specified prime coats, mopped bitumen, flood coats or finish coats in lieu of glaze coatings is not permitted.
  - b. Gravel Surfaced Roofs: If aggregate is not applied the same day, apply glaze coating of hot bitumen at the rate of 15 lbs. per square to the completed membrane.
  - c. Smooth Surface Roofs: If permitted under the manufacturer's Specifications, apply glaze coating of hot bitumen at the rate of 15 lbs. per square, unless asphalt emulsion is applied the same day.
3. All exposed felts, regardless of type, must be protected with specified surfacing or glaze coating by the end of each working day.
4. Asphalt shall bleed out past the edge of the sheet by a minimum of 1/4 inch, then broadcast granules over bleed out area. Take great care to ensure that the roof has a consistent and monolithic look.
5. Continue the installation of roofing materials on the following work day (weather permitting). Glaze coated surfaces must be clean and dry to ensure complete bonding of felts or coatings.

**E. Temporary Flashings:**

1. Provide a temporary waterproof seal at all membrane edges, penetrations, drains, etc. Unless complete flashings are installed immediately (same working day) following the membrane application.

**F. Installing Built-Up Flashings:**

1. Apply asphalt primer to all vertical surfaces before application of built-up flashings.
2. Install built-up flashing consisting of 2 plies of asphalt fiberglass felt, topped with one ply of modified bitumen flashing membrane.
3. Cut all felts into strips not longer than 12 feet. Provide 3" minimum end laps. Stagger all end laps. Cut modified bitumen flashing membrane the width of the roll.
4. Install all plies in hot steep asphalt or if desired install felt in plastic cement, and modified flashing in MBR adhesive.
5. Fasten the top edge of the built-up flashings 8" oc.
6. Seal top edge of flashing with a trowel coat of plastic cement and fabric. If roof system is vented do not seal the top edge.

**G. Installing Metal Flashings and Coverstrips:**

1. Asphalt Roofs: Plastic Asphalt Cement.
2. Prime metal surfaces and embed portions of all metal flashing which extend over the roof surface in plastic cement.



3. Completely cover all portions of metal flashings which extend over the roof surface with two asphalt fiberglass felt cover strips, each set in plastic cement. Provide strips that are at least 8" and 12" wide respectively. In all cases, carry the strips past the edge of the metal flange and beyond the edge of the preceding felt 4" min. Seal junction of metal and coverstrip with plastic cement.
4. Coat and surface the top ply to match the adjacent roofing membrane.
  - a. Cap Sheet Joints: Asphalt must bleed out past the edge of the sheet by a minimum of 1/4" inch. Treat bleed-out as directed by Commissioner. Broadcast granules over bleed out area. Take great care to ensure that the roof has a consistent and aesthetically uniform monolithic look.
5. At roof drains, install cover strips within the slope to the drain so that they do not impede the flow of water from the roof.
6. For Gravel Surfaced Roofs: At cant type gravel stops coat the top ply of the built-up roofing membrane that extends up the cant with aluminized coating applied at the rate of 1-1/2 gal per square.

H. Installing elastomeric liquid-applied flashing membrane:

1. At pipe, vent, stanchion, and miscellaneous roofing penetrations, unless otherwise indicated.
- I. Filling Pitch Pockets: Fill bottom half of pitch pocket with cement mortar. Fill remaining half of pitch pocket with elastomeric cement. Slope surface to shed water.

3.9 FLOOD TESTING

- A. After completion of roofing work specified above, all drains shall be plugged and all roofs of above locations of Work shall be flooded with a minimum of 1" of water above the high points. Water shall remain for a minimum of 24 hours. If leaks occur, Perform necessary work to correct leaks and repeated flood testing, until no leaks occur.
- B. Refer to Sections "01 91 15 Building Enclosure Commissioning Requirements" and 01 91 17 "Building Enclosure Functional Performance Test Protocol" for testing procedures and requirements.

3.10 FIELD QUALITY CONTROL

- A. Field Samples
- B. Draw a quart sample from each load of bitumen arriving at the job site in the presence of Commissioner for laboratory analysis.
- C. Test Strip if requested by Commissioner
  1. When and where directed by Commissioner, and before surfacing is applied to the completed membrane, cut a strip 3" wide by 40" long thru all plies of the built-up roofing. Number of such test strips may be as required by the Commissioner.
    - a. After removal of the strip, immediately restore the area by applying the same number of plies of the same kind of felt and bitumen to fill the hole level.





- b. Repeat the same number of plies of the same kind of felt and bitumen over the filled strip with the first ply lapping each edge 12" and each succeeding ply lapping the preceding ply by at least 3" on all edges.
    - c. Apply surfacing material to match the adjoining roof. Turn the test strips over to Commissioner for examination.
  - 2. If the test strips indicate the roofing system complies with the project requirements, Commissioner's will bear the expense of the test strip Work.
  - 3. If the strips indicate the roofing system does not comply with the project requirements, assume expense of the test strip Work and shall restore or replace all roofing Work as required for compliance, at no expense to the City of New York.
- D. Non-Compliance: Failure of the bitumen samples or the test strip samples to meet the Specification requirements will be cause for rejection of the Work including removal and reinstallation of the work at the expense of the Contractor.
- E. Inspection: After roofing system Work is completed, an inspection shall be made by the roofing system manufacturer's representative. The representative shall certify that roofing system has been installed according to the Specifications.
- 1. Inform the Commissioner of scheduled inspection date a minimum of one (1) week in advance of the inspection.
- 3.11 CLEANING
- A. Remove bitumen from surfaces other than those requiring bituminous coatings.
  - B. Remove all debris from roof area.
  - C. Maintain roof area free from debris throughout the period of construction and during construction activities following roof insulation until date of Substantial Completion.

**END OF SECTION 07 52 16**



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**SECTION 07 62 00**

**SHEET METAL FLASHING AND TRIM**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Manufactured reglets with counterflashing.
  2. Formed roof-drainage sheet metal fabrications.
  3. Formed low-slope roof sheet metal fabrications.
  4. Formed wall sheet metal fabrications.
  5. Formed equipment support flashing.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

#### 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each of the following
  1. Underlayment materials.
  2. Elastomeric sealant.
  3. Butyl sealant.
  4. Epoxy seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
  1. Include plans, elevations, sections, and attachment details.
  2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
  3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  4. Include details for forming, including profiles, shapes, seams, and dimensions.
  5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  6. Include details of termination points and assemblies.
  7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  8. Include details of roof-penetration flashing.
  9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  10. Include details of special conditions.
  11. Include details of connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.



1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing approved and used in project.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.10 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
  - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- C. On-site Facade Mockups: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  - 1. Provide complete roof edge coping and fascia installation in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
  - 1. Incorporate full-scale details of the architectural features, approved finishes, rackets, and attachments to be provided at full-scale building.
  - 2. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
  - 3. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.



## 1.13 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to restore finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- B. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish: Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.



2. Color: As selected by Commissioner from manufacturer's full range.
  3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
1. Finish: 2D (dull, cold rolled).
  2. Surface: Smooth, flat.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc; CCW WIP 300HT.
    - b. GCP Applied Technologies Inc.; Grace Ice and Water Shield HT.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Approved Equal.
  2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
    - b. Blind Fasteners: Stainless-steel rivets suitable for metal being fastened.
  2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Stainless-Steel Welding Rods: Type recommended by stainless-steel sheet manufacturer for type of metal sheets furnished.



- E. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2-inch-wide and 1/8 inch thick.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.
  - 1. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  - 2. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
  - 3. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
  - 4. Products: Subject to compliance with requirements, provide products from one of the following:
    - a. Fry Reglet Corporation.
    - b. Heckmann Building Products, Inc.
    - c. Hohmann & Barnard, Inc.
    - d. Approved equal.
  - 5. Accessories:
    - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
  - 6. Finish: As selected by the Commissioner.
- I. Manufactured Flashing: For use under sills and other applications indicated.
  - 1. Flashing Material: Type 304 stainless steel, 0.019 inch thick.
  - 2. Products: Subject to compliance with requirements, provide STF Sawtooth Flashing as supplied by Hohmann & Barnard, Inc. or comparable product as approved by the Commissioner from one of the following:
    - a. Cheney Flashing Company.
    - b. Fry Reglet Corporation.
    - c. Heckmann Building Products, Inc.
    - d. Approved equal.





## 2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
  - 1. Fabricate sheet metal flashing in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 2. Obtain field measurements for accurate fit before shop fabrication.
  - 3. Form sheet metal flashing without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Fabricate attachment devices from same material as accessory being anchored.
- E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- F. Do not use graphite pencils to mark metal surfaces.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
  - 1. Stainless Steel: 0.019 inch thick.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
  - 1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
  - 2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
  - 3. Fabricate from one of the Following Materials:
    - a. Aluminum: 0.050 inch thick.
    - b. Stainless Steel: 0.019 inch thick.



- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
2. Fabricate from the Following Materials:
  - a. Aluminum: 0.050 inch thick.

- C. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

- D. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

## 2.8 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Construction: Fabricate flashings to extend a minimum of 4 inches beyond wall openings and the same dimension onto ducts.

1. Stainless Steel: 0.016 inch thick.

## 2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
  2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.3 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

### 3.4 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. Install sheet metal flashing to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 3. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  - 4. Install sealant tape where required by installation conditions.
  - 5. Torch cutting of sheet metal flashing and trim is not permitted.
  - 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
  - 1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
- C. Seal joints as shown and as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - Joint Sealants.
- D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
  - 1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.



2. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.5 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

### 3.6 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
  1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
  2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

### 3.7 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components.



**3.8 MISCELLANEOUS FLASHING INSTALLATION**

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

**3.9 ERECTION TOLERANCES**

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

**3.10 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing that have been damaged or that have deteriorated beyond successful restoration by finish touchup or similar minor restoration procedures.

**END OF SECTION 07 62 00**



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## **SECTION 07 72 00**

### **ROOF ACCESSORIES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
1. Hatch- type, automatic heat and smoke vents including safety railings.
  2. Roof crossover stairs and platforms.
  3. Rubber roof paver tile.
  4. Installation accessories.
- B. Related Sections:
1. Section 05 50 00 "Metal Fabrications" for steel finish requirements.
  2. Section 07 92 00 "Joint Sealants" for elastomeric joint sealants and sealant backings.
  3. Section 07 52 16 "SBS Modified Bituminous Membrane Roofing."
  4. Division 26 sections for electrical connection and other requirements.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
- C. Coordinate attachment of rubber roof paver tile with roof membrane manufacturer and installer to ensure proper adhesion to roof membrane. Coordinate shop drawings with shop drawings for membrane roofing system.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to indicate color
- D. Engineering Services Submittal: For roof crossover stairs and platforms, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any contract the work.

1.8 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  - 1. Size and location of roof accessories.
  - 2. Method of attaching roof accessories to roof or building structure.
  - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
  - 4. Required clearances.





- B. Warranty: Sample of special warranty.
- C. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

#### 1.10 WARRANTY

- A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to restore finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: Ten(10) years from date of Substantial Completion.
- B. Special Warranty: Include rubber roof paver tile as an overburden item in the Roof system warranty.
  - 1. Warranty Period: Manufacturer's standard from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to engineer roof crossover stairs and platforms.
  - 1. Engineering Services shall include complete design calculations required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

#### 2.2 AUTOMATIC HEAT AND SMOKE VENTS

- A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with single- walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double- walled lid and continuous weathertight perimeter lid gaskets and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 165 degrees F. Include manufacturers standard automatic smoke actuator tied to smoke detector at ceiling locations for stairs and elevators where indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products as supplied by one of the following, as approved by the Commissioner:



1. Babcock-Davis.
2. BILCO Company (The).
3. Dur-Red Products.
4. Milcor; Commercial Products Group of Hart & Cooley, Inc.
5. Approved equal.

C. Type and Size: Single-leaf lid, of size indicated.

D. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load, unless otherwise required by project application.

E. Hatch Material: Zinc-coated (galvanized) steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Baked enamel or powder coat.
3. Color: As selected by Commissioner from manufacturer's full range.

F. Construction:

1. Board Insulation: 2- inch thick, polyisocyanurate with R- Value of 12.0 per ASTM C1363.
2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. Fabricate curbs to minimum height of 12 inches above roofing surface, unless otherwise indicated.

G. Hardware: Manufacturer's standard, corrosion resistant or hot-dip galvanized; with hinges, hold-open devices, and independent manual-release devices for inside operation of lids.

H. Fall Protection Safety Assembly: Manufacturer's standard meeting impact load requirements of 29 CFR 1910.23 and New York City Department of Buildings, equipped galvanized steel wire mesh screen, that is manually openable from exterior without special tools.

I. Safety Railing System: Hatch railing system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and New York City Department of Buildings:

1. Products: Subject to compliance with requirements, provide Bil-Guard 2.0 as supplied by BILCO Company (The), or comparable product from one of the following, as approved by the Commissioner:
  - a. Dur-Red Products
  - b. Kee Safety, Inc.
  - c. PS Access Solutions.
  - d. Approved equal.

## 2.3 ROOF CROSSOVER STAIRS AND PLATFORMS

A. Manufacturers: Subject to compliance with requirements, provide products as supplied by one of the following, as approved by the Commissioner:

1. EBERL Iron Works, Inc.
2. PHP Systems/ Design.



3. Miro Industries, Inc.
4. Approved equal.

- B. Treads, Platforms and Railings: Manufacturers standard. heavy- duty galvanized steel grating with slip resistant surface.
- C. Steel Framing/ Supports, Manufacturers standard. heavy- duty galvanized steel .
- D. Weighted Bases for Supports (Ballast): Manufacturers standard. recycled rubber weighted to withstand project design wind uplift, in sizes as required by project application.
- E. Steel Finish: Zinc-coated (galvanized) steel sheet.

#### 2.4 RUBBER ROOF PAVER TILE

- A. Description: Rubber roof paver tile, self-interlocking to adjacent tiles and adhered to roofing membrane.
- B. Products: Subject to compliance with requirements, provide duraSTRONG Premium Series as supplied by sofSurfaces rubber tile solutions or comparable product from by one of the following:
  1. Hanover Architectural Products
  2. RB Rubber.
  3. Or approved equal.
- C. Thickness: 4 inch nominal.
- D. Size: 24 by 24 inch, unless otherwise indicated.
- E. Color: Bedrock.
- F. Adhesives: Manufacturers standard product that is compatible with selected membrane roofing product.

#### 2.5 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to New York City Department of Buildings and New York City Fire Department.
  1. Products shall not contain arsenic or chromium.
  2. Refer to Section 06 10 00 – Rough Carpentry for requirements.
- D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- E. Elastomeric and Butyl Sealants: Refer to Section 07 92 00 "Joint Sealants."



- F. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Zinc-Coated (Galvanized) Steel Sheet per ASTM A653, G90 coating designation
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two- coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.



3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Install heat and smoke vents with safety railings in accordance with approved shop drawings and manufacturer's instructions.
  - C. Install roof crossover stairs and platforms accordance with approved shop drawings and manufacturer's instructions
  - D. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - E. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.
  - F. Adhere rubber roof paver tile to membrane roofing paver tile in accordance with approved shop drawings and manufacturer's instructions.
- 3.4 RESTORATION AND CLEANING
- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and restore galvanizing according to ASTM A780/A780M.
  - B. Clean exposed surfaces according to manufacturer's written instructions.
  - C. Replace roof accessories that have been damaged or that cannot be successfully restored by finish touchup or similar minor restoration procedures.

**END OF SECTION 07 72 00**



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**SECTION 07 81 00**

**APPLIED FIREPROOFING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
  - 1. Sprayed fire-resistive materials (SFRM).
  - 2. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.



1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Field quality-control reports.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the fireproofing material manufacturer.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects to set quality standards for materials and execution.
  1. Build mockup of each type of fireproofing and different substrate as shown on Drawings.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.



**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Material Emissions and Pollutant Control: Field-applied coatings shall comply with either of the following:
  - 1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
  - 2. VOC content shall not exceed limits of the following, unless otherwise required by the New York City Department of Buildings:
    - a. Flat Coatings: 50 g/L.
    - b. Nonflat Coatings: 100 g/L.
    - c. Primers, Sealers, and Undercoaters: 100 g/L.
- E. Asbestos: Provide products containing no detectable asbestos.

**2.2 CONCEALED SPRAYED FIRE-RESISTIVE MATERIAL**

- A. Material Composition: Manufacturer's standard product, as follows:
  - 1. Concealed Cementitious Sprayed Fire-Resistive Material: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
- B. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
  - 1. Bond Strength: Minimum 430 lbf/sq. ft. per ASTM E 736 based on laboratory testing of 0.75-inch minimum thickness of sprayed fire-resistive material.
  - 2. Density: Not less than density specified in the approved fire-resistance design, for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."



3. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:
  - a. Where the referenced fire-resistance design lists a thickness of 1 inch or more, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch.
  - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch or 75 percent of the design thickness.
  - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft.
4. Combustion Characteristics: ASTM E 136.
5. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 10 or less.
  - b. Smoke-Developed Index: 0.
6. Compressive Strength: 5.21 lbf/sq. in. minimum per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified but not less than 15 lbs. per cu. ft.
7. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
8. Deflection: No cracking, spalling, or delamination per ASTM E 759.
9. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. Insert value in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lbs. per cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
11. Fungal Resistance: No observed growth on specimens per ASTM G 21.
12. Finish: Spray-textured finish.

## 2.3 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to the New York City Department of Buildings for use in fire-resistance designs indicated.
- B. Topcoat: Type recommended in writing by manufacturer of each sprayed fire-resistive material for application over concealed sprayed fire-resistive material.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 EXAMINATION

- A. Examine substrate, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
  - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
  - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
  - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.
- C. Prime substrates where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive sprayed fire-resistive material.

### 3.4 APPLICATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by sprayed fire-resistive material manufacturer, install body of fire-resistive covering in a single course.



- D. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
- E. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply sprayed fire-resistive material that differs in color from that of encapsulant over which it is applied.

### 3.5 APPLICATION, CONCEALED SPRAYED FIRE-RESISTIVE MATERIAL

- A. Apply concealed sprayed fire-resistive material in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition but apply in greater thicknesses and densities if specified in Part 2 "Concealed Sprayed Fire-Resistive Material " Article.
- B. Cure concealed sprayed fire-resistive material according to product manufacturer's written recommendations.
- C. Apply topcoat to concealed sprayed fire-resistive material where indicated.

### 3.6 FIELD QUALITY CONTROL

- A. Special Inspections: The City of New York will engage a qualified special inspector to perform the following special inspection and prepare reports:
  - 1. Sprayed fire-resistive material.
- B. Testing Agency: Engage a qualified testing agency to perform field tests and inspections required by fireproofing manufacturer and Building Code.
  - 1. Testing and inspecting agency will interpret tests and prepare reports as to whether tested work complies with or deviates from requirements.
- C. Tests and Inspections: Testing and inspecting of completed applications of sprayed fire-resistive material shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of sprayed fire-resistive material for the next area until test results for previously completed applications of sprayed fire-resistive material show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
  - 1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
  - 2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
  - 3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWC Technical Manual 12-A, Section 5.4.5, "Displacement Method."



4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
    - a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
    - b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. minimum per ASTM E 736.
  5. If testing finds applications of sprayed fire-resistive material are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- D. Remove and replace applications of sprayed fire-resistive material that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
- E. Apply additional sprayed fire-resistive material, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

### 3.7 CLEANING, PROTECTING, AND RESTORATION

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect sprayed fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.
- C. Coordinate application of sprayed fire-resistive material with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect sprayed fire-resistive material and patch any damaged or removed areas.
- D. Restore or replace work that has not successfully protected steel.

**END OF SECTION 07 81 00**



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## **SECTION 07 84 10**

### **FIRESTOPPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

##### **1.5 COORDINATION**

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.



- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval from New York City Department of Buildings prior to submittal.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

#### 1.9 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer, that has been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

#### 1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.





## PART 2 - PRODUCTS

### 2.1 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
  - 1. Fire-resistance-rated walls including fire partitions.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
  - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling, or exceeding fire-resistance rating of constructions penetrated.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
  - 2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.



3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

## 2.3 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products as indicated in other Part 2 articles or by one of the following as approved by the Commissioner:
  1. A/D Fire Protection Systems, Inc.
  2. Passive Fire Protection Partners.
  3. Tremco, Inc.
  4. Or approved equal.

## 2.4 FIRE-SAFING INSULATION

- A. Provide material tested, listed and labeled by UL and listed by UL in designs like applications indicated. Provide semi-rigid, non-asbestos mineral fiber board, rated noncombustible when tested according to ASTM E 136:
  1. k-Value: 0.25 at 75 deg F.
  2. Thickness: 4 in., unless otherwise indicated, and not less than thickness necessary to obtain required fire-rating.
  3. Density: Nominal 4 pct.

## 2.5 MINERAL WOOL FIRESTOPPING

- A. Provide loose mineral wool, rated noncombustible when tested in accordance with ASTM E 136, free of asbestos and glass fiber, and suitable for stuffing into metal deck flutes to an in-place density of 6 to 12 pcf.

## 2.6 FIRESTOPPING CAULK AND PUTTY

- A. Products: Subject to compliance with requirements, provide products by one of the following:
  1. 3M Fire Protection Products; Fire-Barrier Series.
  2. International Protective Coatings Corp.; Flamesafe.
  3. Dow Corning Corp.; Silicone Firestop Foam 2001 and Sealant 2000;
  4. Approved equal.

## 2.7 FIRESTOP COLLARS

- A. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and vented piping systems).
- B. Products: Subject to compliance with requirements, provide products by one of the following:
  1. Hilti, Inc.; CP 642, and CP 643 Firestop Collar.
  2. 3M Fire Protection Products; Fire Barrier PPD Plastic Pipe Device.
  3. Specified Technologies, Inc.; STI Firestop.
  4. Approved equal.



## 2.8 FIRESTOP PILLOWS

- A. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Firestop Pillows; Bio Fireshield.
  - 2. KBS Sealbags; International Protective Coatings Corp.
  - 3. Hilti; CP 657 Fire Block.
  - 4. Approved equal.

## 2.9 CAST-IN-PLACE FIRESTOP DEVICES

- A. Cast-in place firestop devices for use with non-combustible and combustible plastic pipe (closed and vented systems) penetrating concrete floors.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hilti; CP 680 Cast-in Place Firestop Device.
  - 2. Metacaulk; Cast-In-Place Device (CID) Integral intumescent firestop.
  - 3. Specified Technologies Inc.; Spec Seal CID Cast-In Firestop Device.
  - 4. Approved equal.

## 2.10 SEALANTS AND CAULKING MATERIALS FOR FIRE RATED UNITS

- A. Sealants or caulking materials used for openings between structurally separate sections of wall and floor.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hilti CP 672 Firestop Spray.
  - 2. Hilti CP601S Elastomeric Firestop Sealant.
  - 3. Hilti CP 606 Flexible Firestop Sealant.
  - 4. 3M Fire Barrier CP 25 WB.
  - 5. Approved equal.

## 2.11 FIRESTOP FASTENERS

- A. Provide anchorage accessories complying with UL designs and other components and accessories as needed.

## 2.12 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.



- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
  - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
  - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

## 2.13 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

### 3.4 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.



**3.5 FIELD QUALITY CONTROL**

- A. Inspecting Agency: Commissioner may engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, restore or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

**3.6 CLEANING AND PROTECTING**

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

**END OF SECTION 07 84 10**

**SECTION 07 92 00****JOINT SEALANTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Nonstaining silicone joint sealants.
  2. Urethane joint sealants.
  3. Mildew-resistant joint sealants.
  4. Latex joint sealants.
- B. Related Sections:
1. 09 66 21 - Resinous Matrix Terrazzo.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Field-Adhesion-Test Reports: For each sealant application tested.
- D. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.9 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.





3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.10 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to restore or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 JOINT SEALANTS, GENERAL

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- C. Colors of Exposed Joint Sealants: As selected by Commissioner from manufacturer's full range.

#### 2.2 SILICONE SEALANTS

- A. One-Part Neutral Cure Silicone Sealant: Type S; Grade NS; Class 25; where specifically approved by the Commissioner. When tested per ASTM C 719, shall withstand 50 percent increase and decrease of joint width as measured at time of application.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corp.; Dow Corning 795.
    - b. Momentive Performance Materials; GE Construction 1200.
    - c. Tremco, Inc.; Spectrum 2.
    - d. Approved equal.
  2. Locations: General purpose use within and around windows, door frames, louvers and other junctures. Non-traffic (NT), masonry (M), glass (G), aluminum (A) and, as applicable to substrates indicated, other materials (O). For all exterior vertical joints.



- B. One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25: Formulated with fungicide for sealing interior joints with nonporous substrates at plumbing fixtures.

1. Products: Subject to compliance with requirements, provide one of the following

- a. Dow Corning Corp.; Dow Corning 786.
- b. Momentive Performance Materials; SCS 1702.
- c. Tremco Corp.; Proglaze White.
- d. Approved equal.

2. Locations: Interior Uses; Non-traffic (NT), glass (G), aluminum (A) and nonporous joint substrates indicated. For interior joints at wet areas.

## 2.3 ACRYLIC SEALANTS

- A. Manufacturer's standard one-part, nonsag, solvent-release-curing acrylic terpolymer sealant complying with AAMA 808.3 or FS TT-S-00230 or both, with capability when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage change in joint width existing at time of application and remain adhered to joint substrates indicated for Project without failing cohesively. Products shall have 7-1/2 percent movement in both extension and compression for a total of 15 percent.

- B. Products: Subject to compliance with requirements, provide one of the following:

1. Protective Treatments, Inc.; PTI 738 or PTI 767.
2. Tremco, Inc; Mono.
3. Pecora Corp.; 60+Unicrylic.
4. Approved equal.

- C. Locations: For filling small interior joints and cracks 1/4" or less in width and where movement is limited to the amounts specified above.

## 2.4 BUTYL SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

- B. Products: Subject to compliance with requirements, provide one of the following:

1. Bostik, Inc; Chem-Calk 300.
2. Pecora Corporation; BC-158.
3. Tremco Butyl Sealant, Tremco, Inc.
4. Approved equal.

- C. Locations: For standing seam roof, roof accessories, sheet metal flashing and trim.

## 2.5 SECURITY SEALANTS

- A. Description: Pick proof sealants that contain materials and have properties to prevent idle tampering and vandalism.



B. Products: Subject to compliance with requirements, provide one of the following:

1. Pecora Corp.; Dynapoxy EP-1200.
2. SUREBOND; SB – 190 EVERSEAL
3. SIKA; EVERBUILD TECNIC STAYSEAL 75 or ANTI-PICK 109.
4. Approved equal.

## 2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Pecora Corporation; AC-20.
2. Sherwin-Williams Company (The); 850A Siliconized Acrylic Latex Caulk.
3. Tremco Incorporated; Tremflex 834.
4. Approved equal.

## 2.7 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Products shall be effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.

B. Products: Subject to compliance with requirements, provide one of the following:

1. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical
2. Pecora Corporation; AC-20 FTR.
3. USG Corporation; SHEETROCK Acoustical Sealant.
4. Approved equal.

## 2.8 PREFORMED FOAM SEALANTS

A. Preformed Foam Sealants: Manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water repellent agent; factory-produced in precompressed sizes and in roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by manufacturer; and complying with the following requirements:

B. Properties: Permanently elastic, mildew-resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.

C. Impregnating Agent: Manufacturer's standard.

D. Density: Manufacturer's standard.

E. Backing: None, unless otherwise indicated.



## 2.9 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Either flexible, open cell polyurethane foam or non-gassing, closed-cell polyethylene foam, unless otherwise indicated or as recommended by the sealant manufacturer.
- C. Elastomeric Tubing Joint Fillers: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.10 MISCELLANEOUS MATERIALS

- A. Joint Cleaners: Provide joint cleaning compounds as recommended by sealant manufacturer(s).
- B. Joint Prime Sealer: Provide type(s) of joint primers as recommended by sealant manufacturer(s).
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape wherever applicable.
- D. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer. Provide size and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize possibility of sealant extrusion from compressed joint.
- E. Joint Filler: Provide expanded neoprene complying with ASTM D1056, Class SC (oil-resistant and medium swell), of 2 to 5 psi compression deflection (Grade SCE 41); except provide 13 to 17 psi compression deflection (Grade SCE 44) wherever filler is applied under sealant exposed to traffic.



## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.4 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.



- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
  - 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
  - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.5 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed, and cured sealant joints as follows:
    - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.



4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Restore sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.6 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.7 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION 07 92 00**



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## **SECTION 08 11 13**

### **HOLLOW METAL DOORS AND FRAMES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section includes:
  - 1. Interior standard steel doors and frames.
  - 2. Exterior standard steel doors and frames.
  - 3. Security doors and frames.
  - 4. Acoustical doors and frames.
  - 5. Glass lites in doors, borrowed lites in partitions and other hollow metal work as indicated.
  - 6. Installation accessories.

##### **1.3 DEFINITIONS**

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to SDI A250.8.

##### **1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.



2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirement.

#### 1.6 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.
- C. Packaged Acoustical Doors and Frames: Coordinate with manufacturer to provide hardware, including door and jamb seals, auto door bottom, door threshold, hinges, and door seal for openings indicated.

#### 1.7 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
  1. Elevations of each door type.
  2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.



1.10 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Door and Frame Products: Subject to compliance with requirements manufacturers offering steel doors and frame assemblies which may be incorporated in the Work include the following, as approved by the Commissioner:
  - 1. Curries Company.
  - 2. Steelcraft Manufacturing Co.
  - 3. Ceco Corp.
  - 4. Approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Hollow metal doors and Frames: Comply with SDI-Specifications for Standard Steel Doors and Frames (SDI-100).
- B. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to the New York City Department of Buildings and New York City Fire Department, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.



1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to the New York City Department of Buildings and New York City Fire Department, based on testing according to UL 1784 and installed in compliance with NFPA 105.
  2. Provide fire rated door assemblies as indicated or required by adjacent construction.
- C. Sound-Rated (Acoustical) Assemblies: Provide door and frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.
1. Acoustical assemblies with STC sound ratings as indicated in other Part 2 articles or on drawings, unless otherwise indicated.
- D. Thermally Rated Door Assemblies: Unless otherwise indicated and required by project application, provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. when tested according to ASTM C 518 or ASTM C 1363.

## 2.3 INTERIOR STEEL DOORS AND FRAMES

- A. Construct hollow- metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Interior Doors and Frames: As per SDI A250.8, Level 4; SDI A250.4, Level A.
1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.067 inch (14-gage).
    - d. Face at 'Wet Area' Doors: Metallic-coated steel sheet, minimum thickness of 0.067 inch (14-gage), with minimum A60 coating.
    - e. Edge Construction: Model 2, Seamless unless otherwise indicated.
    - f. Reinforcing vertical sheet steel channel or interlocking Z minimum 22 gauge, full height of door, every 6 inch spot weld 4" on center.
    - g. Top and Bottom Edges: Edges shall be joined and reinforced full height with 16 gauge continuous strip. Joints ate edges shall be continuously welded, thoroughly filled with metallic filler and ground smooth.
    - h. Seams: Exposed seams on edges, corners and/or faces are not acceptable.
    - i. Core: Vertical steel stiffener.
    - j. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
  2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.067 inch (14-gage).
    - b. Materials: at 'Wet Area' Doors: Metallic-coated steel sheet, minimum thickness of 0.067 inch (14-gage), with minimum A60 coating.
    - c. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
    - d. Construction: Full profile welded (continuously welded).
    - e. Provide temporary spreaders on bottom of welded door frames.



3. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:

- a. Hinges Steel Plate: Minimum 3/16-inch-thick by 1-1/2 inches wide by full height of door continuously weld.

4. Exposed Finish: Prime.

C. Security Doors and Frames:

1. Type: As indicated in the Door and Frame Schedule.
2. Thickness: 2 inches.
3. Face: Uncoated Steel Sheet, nominal 0.102 inch (10 gage).
4. Frame: Uncoated Steel Sheet, nominal 0.144 inch (7 gage),
5. Exposed Finish: Prime.

D. Borrowed Lites:

1. Type/ Thickness: As indicated in the Door and Frame Schedule.
2. Materials for Frames: Uncoated steel sheet, minimum thickness of 0.067 inch (14-gage).
3. Materials for Security Frames: Uncoated Steel Sheet, nominal 0.144 inch (7 gage),
4. Exposed Finish: Prime.
5. Provide glass as indicated; refer to Division 08 sections for glazing materials and requirements.

## 2.4 EXTERIOR STEEL DOORS AND FRAMES

- A. Construct hollow- metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Custom Exterior Doors and Frames: As per SDI A250.8 and SDI A250.4,

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches.
- c. Face: Stainless steel sheet, minimum thickness of 0.067 inch (14-gage).
- d. Edge Construction: Model 2, Seamless unless otherwise indicated.
- e. Reinforcing vertical galvanized sheet steel channel or interlocking Z minimum 22 gauge, full height of door, every 6 inch spot weld 4" on center.
- f. Top and Bottom Edges: Edges shall be joined and reinforced full height with 16 gauge continuous strip. Joints at edges shall be continuously welded, thoroughly filled with metallic filler and ground smooth.
- g. Seams: Exposed seams on edges, corners and/or faces are not acceptable.
- h. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
- i. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.



- j. Core: Polystyrene insulation, Minimum R- 18, Rating 4 or better, with fully operable minimum U-Factor 0.374 and R-Value 2.53, including insulated door and frame, as determined using CTS method in ASTM C1199.
- 2. Frames:
  - a. Materials: Stainless steel sheet, minimum thickness of 0.081 inch (12-gage).
  - b. Construction: Full profile welded (continuously welded).
  - c. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames: Thermal performance tested in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400.
  - d. Where indicated, provide thermally broken frame profiles available for use in both masonry and drywall. Fabricate with 1/ 16 inch positive thermal break and integral weatherstripping.
- 3. Exposed Finish: Bright, Directional Satin No. 4, matching approved samples.
- C. Alarms: Refer to access control and hardware sections for requirements.

## 2.5 ACOUSTICAL DOORS AND FRAMES

- A. Description: Proprietary, cased hollow metal opening and steel door including hardware.
  - 1. Hardware Set: Refer to Section 08 70 00 "Finish Hardware."
- B. Products: Subject to compliance with requirements, provide the following:
  - 1. HMF Express; STC 54, 3- Sided Single Frame (Cased Open) and Sound- rated Door.
- C. Dimensions: As scheduled on drawings.
- D. Acoustical Frames: 14 gauge steel "case open" continuously welded frame.
- E. Acoustical Doors: 14 gauge flush steel door with 3/8 inch UC Core by HMF. 1-3/4" thickness. Reinforced hinge and lock channels. 14 gauge steel top and bottom channels with 16 gauge flush steel strips.
- F. Whole Opening Acoustical Rating: STC 54, as tested in accordance with ASTM E 1408, and classified according to ASTM E 413.
- G. Shop-applied Primer: Grey, Manufacturers standard baked- on product.
- H. Field-painted Finish: Color as scheduled.

## 2.6 LITES IN DOORS

- A. Provide glass lites with stops of 18 gage steel, using countersunk machine screws uniformly spaced, not more than 12 inch on centers.



1. Provide non-removable fully welded stops in one-piece lengths on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors, unless otherwise indicated.
  2. Provide equal spaced security screw applied on removable glazing stops on inside of frame, louvers, and other panels in doors, removable stops shall have butt jointed corners.
    - a. Removable stops between corridor and other areas shall be not be located on the corridor side, unless otherwise indicated.
    - b. Stops shall fit hairline tight at butt edges.
    - c. Confirm spacing of stops with required glass thickness.
- B. Prepare doors for glazing as indicated; refer to Division 08 sections for glazing materials and requirements.

## 2.7 LOUVERS

- A. Provide louvers according to SDI 111C for interior doors where indicated, with blades or baffles formed of 0.0239-inch-thick cold-rolled steel sheet set into minimum 0.0359-inch-thick steel frame.
1. Sight-Proof Louvers: Stationary louvers constructed with inverted V-shaped or Y-shaped blades. Louvers shall have a minimum 50 percent free area, unless otherwise indicated.
  2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible links at 150 deg F and labeled and listed for use in fire-rated door assemblies of type and fire-resistance rating indicated by the same inspecting and testing agency who established fire-resistance rating of door assembly.

## 2.8 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

## 2.9 ACCESSORIES

- A. Door Silencers, Interior Doors: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.
- B. Grout Guards: Provide 26 gage steel boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation and to close off openings.
- C. Weatherstripping, Exterior Doors: Refer to Division 08 Hardware section.



## 2.10 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

## 2.11 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366.
- C. Galvanized Steel Sheets: Zinc-coated steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.
- D. Stainless-Steel Sheets: Commercial-quality stainless steel, Type 304, complying with ASTM A 167. Provide not less than 14 gage sheets.
- E. Supports and Anchors: Not less than 18 gage galvanized sheet steel.
  - 1. Provide stainless steel supports and anchors at stainless steel door and frame applications.
- F. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.
  - 1. Provide stainless steel fasteners at stainless steel door and frame applications.
- G. Shop Applied Primer: Rust-inhibitive paint, suitable as a base for specified finish paints. Provide zinc-rich primer complying with SSPC Paint 20 for touching up galvanized coatings.





## 2.12 FABRICATION, GENERAL

- A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory- assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.
  - 1. Internal Construction: Manufacturer's standard honeycomb, polyurethane, polystyrene, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
- B. Fabricate frames, concealed stiffeners, reinforcement, edge channels, and moldings from either cold-rolled or hot-rolled steel.
  - 1. Provide stainless steel fabrications at stainless steel door and frame applications.
- C. Fabricate exterior and interior wet area doors, panels, and frames from materials specified. Close top and bottom edges of exterior doors and interior doors in wet areas as integral part of door construction or by addition of inverted steel channels.
- D. Exposed Fasteners: Where approved by Commissioner and as indicated, provide countersunk flat Phillips heads for exposed screws and bolts.
- E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
  - 1. Locate hardware as indicated, or if not indicated, according to ANSI/NAAMM- HMMA 861.
  - 2. Reinforce doors and frames to receive nontemplated, mortised and surface- mounted door hardware.
  - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  - 4. Reinforce doors and frames to receive hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.
  - 5. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.
- F. Coordinate fabrication of frames indicated to receive glazing with glazing installation.

## 2.13 SHOP PAINTING

- A. Clean, treat, and paint welds and exposed surfaces of steel door and frame units, including galvanized surfaces.
- B. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
- C. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.



## 2.14 STAINLESS STEEL FINISHES

- A. Stainless-steel Finishes: Finish designations prefixed by AISI conform with the system established by the American Iron and Steel Institute for designating finishes for stainless-steel sheet.
  - 1. Remove or blend tool and die marks and stretch lines into finish.
  - 2. Grind and polish surfaces to produce uniform, textured, polished finish indicated, free of cross scratches.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make restored area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with SDI A250.11.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  - 2. Fire-Rated Openings: Install frames according to NFPA 80.
  - 3. Floor Anchors: Secure with postinstalled expansion anchors.
  - 4. Solidly pack mineral-fiber insulation inside frames.
  - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.



7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.4 ACOUSTICAL DOORS AND FRAMES

- A. Install in accordance with approved shop drawings and manufacturer instructions.
- B. Acoustical Frames: Fill voids solidly with mortar. Install scheduled head and jamb seals within acoustical frame with mechanical fasteners. Set in full bed of sealant per door manufacturer instructions and details.
- C. Hardware: Install in accordance with acoustical door and frame manufacturer's instructions.

### 3.5 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and restore with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and restore with same material used for factory finish according to manufacturer's written instructions.

**END OF SECTION 08 11 13**



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**SECTION 08 31 13****ACCESS DOORS AND FRAMES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Access doors and frames for walls and ceilings.
  2. Security access doors and frames for walls and ceilings.
  3. Installation accessories.
- B. Related Sections:
1. Section 07 72 00 "Roof Accessories" for roof hatches.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirement.

1.5 COORDINATION

- A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.
- B. Furnish inserts and anchoring devices for access doors that are to be built into other construction. Coordinate delivery with other work to avoid delay.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details materials, individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified.
- C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.2 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acudor Products, Inc.
  - 2. Babcock-Davis.
  - 3. Karp Associates, Inc.
  - 4. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - 5. Nystrom, Inc.
  - 6. Approved equal.



## 2.3 STAINLESS-STEEL MATERIALS

- A. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316

## 2.4 ACCESS DOORS AND FRAMES

- A. Flush, Non-Rated Access Doors with Exposed Trim: Units consisting of frame, door, hardware, and complying with the following requirements:
  - 1. Door Size: As indicated o drawings.
  - 2. Door: Minimum 0.075-inch-thick (14 gage) stainless steel sheet, set flush with surrounding finish surfaces.
  - 3. Frame: Minimum 0.075-inch-thick (14 gage) stainless steel sheet, with minimum 1" wide, surface mounted trim.
  - 4. Hinges: Continuous piano hinge.
  - 5. Locks: Mortise cylinder, self-latching device with detention lock at locations required.
- B. Flush, Insulated, Fire-Rated Access Doors with Exposed Trim: Units consisting of frame, door, hardware, and complying with the following requirements:
  - 1. Door Size: As indicated o drawings.
  - 2. Fire-Resistance Rating: As indicated to meet the fire resistance rating of the wall construction where the access door shall be installed.
  - 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
  - 4. Door: Minimum 0.035-inch-thick (20 gage) stainless steel sheet with a core of mineral-fiber insulation, flush panel construction, or 0.060 inch thick stainless steel sheet, set flush with surrounding finish surfaces.
  - 5. Frame: Minimum 0.075-inch-thick (14 gage) stainless steel sheet with minimum 1 inch wide, surface mounted trim.
  - 6. Hinges: Continuous piano hinge.
  - 7. Automatic Closer: Spring type.
  - 8. Lock: Mortise cylinder, self-latching device with detention lock at locations required.

## 2.5 SECURITY ACCESS DOORS AND FRAMES

- A. High-Security Flush Access Doors:
  - 1. Door Size: As indicated on drawings.
  - 2. Stainless-Steel Sheet for Door: Nominal 0.141 inch (10 gage).
  - 3. Stainless-Steel Frame: Nominal 0.141 inch (10 gage); Minimum 3/16-by-2-by-2-by-3-inch angle welded with joints ground smooth.
  - 4. Hinges: Manufacturer's standard security hinge.
  - 5. Latch and Lock: Detention deadbolt with parametric key or prepared for mortise cylinder, as indicated on Drawings with interior release where required.

## 2.6 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.



- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Stainless Steel Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
  - 1. Exposed Flange: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
  - 2. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
- D. Locking Devices: Furnish number required to hold door in flush, smooth plane when closed.
  - 1. For cylinder lock, furnish 2 keys per lock and key all locks alike.
  - 2. Mortise Cylinder Preparation: Where indicated and required, prepare door panel to accept cylinder; refer to Section 08 70 00 "Finish Hardware."
- E. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating or by other permanent separation as recommended by manufacturers of dissimilar metals.

## 2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Stainless-Steel Finishes:
  - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
  - 2. Polished Finish: Bright, Directional Satin No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
    - a. Run grain of directional finishes with long dimension of each piece.
    - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.





**3.2 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces.

**3.4 ADJUSTING AND CLEANING**

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

**END OF SECTION 08 31 13**



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## **SECTION 08 33 23**

### **OVERHEAD COILING DOORS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Insulated overheard coiling doors.
  - 2. Installation accessories.
- B. Related Sections:
  - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports and door-opening framing.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirement.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 2. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.
- C. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
  - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.



- D. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to restore or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis- of- Design, Products: Subject to compliance with requirements, provide THERMISER, insulated rolling door as supplied by Cornell iron Works or comparable product from one of the following:
  - 1. Overhead Door Corporation.
  - 2. Clopay Building Products Company; a Griffon Company.
  - 3. Raynor.
  - 4. Or approved equal.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
  - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
    - a. Uniform pressure (velocity pressure) of 30 psf, unless otherwise indicated on the Structural Drawings, acting inward and outward.
  - 2. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283.
    - a. Maximum Rate: 0.08 cfm at 15 mph.
  - 3. Impact Test for Flying Debris: Comply with ASTM E 1996, tested according to ASTM E 1886.
    - a. Level of Protection: Enhanced Protection.
    - b. Wind Zone One: 110 mph, pressure test to 3/4 and 1-1/2 x design pressure (positive and negative).
- B. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 100,000 cycles.

#### 2.3 OVERHEAD COILING STEEL DOORS

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to



withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Door Curtain Slats: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, G90 coating designation.
    - a. Minimum Base- Metal (Uncoated) Thickness: 0.036 inch (20 gage).nominal.
  2. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
  3. For insulated doors, provide door sections with continuous thermal-break construction, separating faces of door.
- B. Door Sizes: As indicated on the drawings.
- C. Endlocks and Windlocks for Service Doors: Malleable-iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- D. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1- 1/2 by 1- 1/2 by 1/ 8 inch thick; fabricated from manufacturer's stainless steel extrusions to match curtain slats and finish.
- E. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.
- F. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
1. At door head, use 1/8-inch- thick, replaceable, continuous sheet secured to inside of hood.
  2. At door jambs and bottom, use replaceable, adjustable, continuous, bulb-style compressible EPDM gasket weatherstripping at bottom of bar, extending into guides.
- G. Thermal Insulation: Insulate inner core of steel sections with door manufacturer's standard polystyrene or polyurethane foamed-in-place insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84, with Minimum thermal resistance of R- 8.0.
1. Secure insulation to door section. Enclose insulation completely within steel sections that incorporate the following inside facing material, with no exposed insulation material evident:
- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15 mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers,



sulfur components, and other deleterious impurities.

## 2.4 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
- B. Hood Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, G90 coating designation.
  - 1. Minimum Base- Metal (Uncoated) Thickness: 0.024 inch (24 gage).nominal.

## 2.5 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware."
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.6 CURTAIN ACCESSORIES

- A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
  - 1. Provide pull-down straps or pole hooks for doors more than 84 inches high.

## 2.7 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.



## 2.8 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- B. Comply with NFPA 70.
- C. Disconnect Device: Hand-operated disconnect device or mechanism for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator, so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V, ac or dc.
- F. Door-Operator Type: Unit consisting of electric motor. Provide motor and drive assembly of horsepower and design as determined by door manufacturer for size of door required.
- G. Electric Motors: High-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or service factor.
  - 1. Service Factor: Comply with NEMA MG 1, unless otherwise indicated.
  - 2. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
  - 3. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
  - 4. Provide totally enclosed, nonventilated or fan-cooled motor, fitted with plugged drain, and controller with NEMA ICS 6, Type 4 enclosure where indicated.
- H. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop." Provide full-guarded, surface-mounted, heavy-duty-type interior unit with general-purpose, NEMA ICS 6, Type 1 enclosure.
  - 1. Provide 1 remote control station within Evidence Vehicles room interior wall, location as indicated on drawings.
  - 2. Provide 1 remote control station behind Main Desk in building first floor lobby / waiting area, location as indicated on drawings. Wiring runs shall be made within cable tray or within rigid conduits concealed in wall construction where wiring passes through areas with finished ceilings.
- I. Provide key-activated control mechanism where indicated.
- J. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.





1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction. Provide electrically actuated automatic bottom bar.
  - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
- K. Limit Switches: Adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

## 2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
  1. Color: As selected by Commissioner from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. General: Install door, track, and operating equipment complete with necessary hardware, jamb



and head molding strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.

- B. Fasten vertical track assembly to framing, spaced not less than 24 inches apart. Hang horizontal track from structural overhead framing with angle or channel hangers fastened to framing by welding or bolting or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

### 3.4 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup services.
  - 1. Complete installation and startup check according to manufacturer's written instructions.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.5 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and with weathertight fit around entire perimeter.
- B. Adjust belt-driven motors as follows:
  - 1. Use adjustable motor-mounting bases for belt-driven motors.
  - 2. Align pulleys and install belts.
  - 3. Tension belt according to manufacturer's written instructions.
- C. Touch-up Painting: Immediately after welding galvanized track to track supports, clean field welds and abraded galvanized surfaces and restore galvanizing to comply with ASTM A 780.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service staff to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION 08 33 23**



## **SECTION 08 34 63**

### **DETENTION DOORS AND FRAMES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Swinging detention doors.
  - 2. Detention frames.
  - 3. Security sealants.
- B. Related Sections:
  - 1. Section 08 70 00 Finish Hardware

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirement.

1.5 COORDINATION

- A. Coordinate installation of anchorages for detention frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: In addition to plans, elevations, sections, and attachment details, provide a schedule using same reference numbers for details and openings as those on Drawings:
- C. Samples: For each exposed finish required.

1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Test Reports: For each type of detention hollow-metal door and frame assembly including vision and side lights, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Examination reports, documenting inspection of substrates, areas, and conditions.
- E. Anchor inspection reports, documenting inspections of built-in and cast-in anchors.
- F. Field quality-control reports, documenting inspections of installed products.

1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."



- B. **Manufacturer Qualifications:** Manufacturer providing the material used in this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- C. **Installer Qualifications:** Installer shall be properly trained by the manufacturer.
- D. **Welding Qualifications:** Qualify procedures according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver detention hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver detention frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store detention hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Source Limitations:** Obtain detention doors and frames from single source from single manufacturer.
- B. **Products:** Subject to compliance with requirements, provide products by one of the following, or equal as approved by the Commissioner:
  - 1. Ceco Door; ASSA ABLOY.
  - 2. Pioneer Industries.
  - 3. Trussbilt.
  - 4. Approved equal.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. **Fire-Rated Assemblies:** Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to New York City Department of Buildings for fire-protection ratings and temperature-rise limits where indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. **Smoke- and Draft-Control Assemblies:** Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to the New York City Department of Buildings and New York City Fire Department, based on testing according to UL 1784 and installed in compliance with NFPA 105.



- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing and inspecting agency acceptable to the New York City Department of Buildings and New York City Fire Department for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Detention Door and Frame Assemblies: ASTM F1450 for security grades specified.
  - 1. Bullet Resistance: Level 3 rated when tested according to UL 752.
  - 2. Tool-Attack Resistance: Small-tool-attack-resistance rated when tested according to UL 437 and UL 1034.
- D. Detention Frames: Comply with ASTM F1592 and removable stop test according to NAAMM-HMMA 863.

## 2.3 DETENTION DOORS

- A. General: Provide flush-design detention doors of seamless hollow construction, 2 inches thick unless otherwise indicated. Construct detention doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges.
- B. Core Construction: Provide the following core construction of same material as detention door face sheets, welded to both detention door faces:
  - 1. Steel-Stiffened Core: 0.042-inch-thick, steel vertical stiffeners extending full-door height, with vertical webs spaced not more than 4 inches apart, spot welded to face sheets a maximum of 3 inches o.c. Fill spaces between stiffeners with insulation.
- C. Vertical Edge Channels: 0.123-inch-thick, continuous channel of same material as detention door face sheets, extending full-door height at each vertical edge; welded to top and bottom channels to create a fully welded perimeter channel.
- D. Top and Bottom Channels: 0.123-inch-thick metal channel of same material as detention door face sheets, spot welded, not more than 4 inches o.c., to face sheets.
  - 1. Reinforce top edge of detention door with 0.053-inch-thick closing channel, welded so channel web is flush with top door edges.
- E. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention door face sheets to comply with the following minimum thicknesses:
  - 1. Full-Mortise Hinges and Pivots: 0.187 inch thick.
  - 2. Maximum-Security Surface Hinges: 0.250 inch thick.
  - 3. Strike Reinforcements: 0.187 inch thick.
  - 4. Lock Fronts, Concealed Holders, and Surface-Mounted Closers: 0.093 inch thick.
  - 5. All Other Surface-Mounted Hardware: 0.093 inch thick.
  - 6. Lock Pockets: 0.123 inch thick at non-inmate side, welded to face sheet.
- F. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware of same material as detention door face sheets, interconnected with UL-approved, 1/2-inch-diameter conduit and connectors.
  - 1. Access Plates: Where indicated for wiring installation, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least four security fasteners spaced not more than 6 inches o.c.



- G. Interior Detention Doors: Construct interior doors to comply with NAAMM-HMMA 863 and as specified.

- 1. Provide doors with face sheets of 0.1382-inch-minimum-thickness, cold-rolled steel.

## 2.4 DETENTION FRAMES

- A. General: Provide fully welded detention frames with integral stops, of seamless construction without visible joints or seams. Fabricate detention frames with contact edges closed tight and corners mitered, reinforced, and continuously welded full depth and width of detention frame.
- B. Stop Height: Provide minimum stop height of 0.625 inch for detention door openings and minimum stop height of 1-1/4 inches in security glazing or detention panel openings.
- C. Interior Detention Frames: Construct interior frames to comply with NAAMM-HMMA 863 and as specified.
  - 1. Provide frames fabricated from 0.172-inch-minimum-thickness, cold-rolled steel.
- D. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention frame to comply with the following minimum thicknesses:
  - 1. Hinges and Pivots: 0.187 inch thick by 1-1/2 inches wide by 10 inches long.
  - 2. Strikes and Closers: 0.187 inch thick.
  - 3. Surface-Mounted Hardware: 0.093 inch thick.
  - 4. Lock Pockets: 0.123 inch thick at non-inmate side, welded to face sheet. Provide 0.123-inch-thick, lock protection plate for attachment to lock pocket with security fasteners.
- E. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware, interconnected with UL-approved, 1/2-inch-diameter conduit and connectors.
  - 1. Access Plates: Where indicated for wiring installation, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least four security fasteners spaced not more than 6 inches o.c.
- F. Mullions and Transom Bars: Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between detention frame members with concealed clip angles or sleeves of same metal and thickness as detention frame.
- G. Jamb Anchors: Weld jamb anchors to detention frames near hinges and directly opposite on strike jamb or as required to secure detention frames to adjacent construction.
  - 1. Number of Anchors: Provide two anchors per jamb plus the following:
    - a. Detention Door Frames: One additional anchor for each 18 inches, or fraction thereof, above 54 inches in height.
    - b. Detention Frames with Security Glazing or Detention Panels: One additional anchor for each 18 inches, or fraction thereof, above 36 inches in height.
- H. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material and thickness as detention frame, and as follows:



- I. Rubber Door Silencers: Except on weather-stripped detention doors, drill stops in strike jambs to receive three silencers on single-detention-door frames and drill head jamb stop to receive two silencers on double-detention-door frames. Keep holes clear during construction.
- J. Grout Guards: Provide factory-installed grout guards of same material as detention frame, welded to detention frame at back of hardware cutouts, silencers, and glazing-stop screw preparations to close off interior of openings and prevent mortar or other materials from obstructing hardware operation or installation.

## 2.5 DETENTION PANELS

- A. Provide fixed detention panels of same materials, construction, and finish as specified for adjoining detention door.

## 2.6 MOLDINGS AND STOPS

- A. Provide fixed moldings on inmate side of glazed openings and removable stops on non-inmate side.
  - 1. Height: As required to provide minimum 1-inch glass engagement, but not less than 1-1/4 inches.
  - 2. Fixed Moldings: Formed from same material as detention door and frame face sheets, but not less than 0.093 inch thick, and spot welded to face sheets a maximum of 5 inches on center.
- B. Coordinate rabbet width between fixed and removable stops with glass or panel type and installation type indicated.

## 2.7 MATERIALS

- A. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B.
- C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Concealed Bolts: ASTM A307, Grade A.
- E. Masonry Anchors: Same steel sheet as door face.
- F. Embedded Anchors: Hot-dip galvanized according to ASTM A153/A153M.
- G. Post-Installed Anchors: Torque-controlled expansion anchors.
- H. Welding Rods and Bare Electrodes: According to AWS specifications for metal alloy welded.
- I. Grout: Comply with ASTM C476, with a slump of not more than 4 inches as measured according to ASTM C143/C143M.
- J. Insulation: Slag-wool-fiber/rock-wool-fiber or glass-fiber blanket insulation.
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.





- L. Waterborne Asphaltic Emulsion Coating: Minimum 2.5-mil dry film thickness.

## 2.8 FABRICATION

- A. Fabricate detention doors and frames rigid, neat in appearance, and free of defects, warp, or buckle.
- B. Tolerances: Comply with NAAMM-HMMA 863.
- C. Removable Jamb Faces: Provide removable jamb faces where required for access to embedded anchors. Fabricate to allow secure reattachment of removable face with security fasteners.
- D. Fabricate multiple-opening detention frames with mullions that have closed tubular shapes and with no visible seams or joints.
- E. Exterior Detention Doors: Provide weep-hole openings in bottoms of detention doors to permit entrapped moisture to escape. Seal joints in top edges of detention doors against water penetration.
- F. Hardware Preparation: Factory prepare detention doors and frames to receive mortised hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final Door Hardware Schedule and templates provided by detention door hardware supplier.
- G. Factory cut openings in detention doors.
- H. Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

## 2.9 STEEL SHEET FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".
- B. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mil.
  - 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with SDI A250.10.

## 2.10 SEALANTS

- A. Provide type as required by project application.
- B. Polyurethane Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; DynaFlex.



- b. Sika Canada, Inc; SikaBond Construction Adhesive.
  - c. BASF; MasterSeal CR 195 (formerly Sonolastic Ultra).
- C. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; DynaPox EP-1200.
    - b. Polygem Inc.; GEMLOCK FLEX 22.
    - c. Chemtron; Epocon 850 Epoxy Paste & Security Sealant.

## 2.11 SECURITY FASTENERS

- A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific fastener type.

## 2.12 ACCESSORIES

- A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.
- B. Embedded Plate Anchors: Mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch-diameter, headed studs welded to back of plate.
- C. Welding Rods and Bare Electrodes: According to AWS specifications.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrate, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention frame connections before detention frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Inspect embedded plate installations before installing detention frames to verify that plate installations comply with requirements. Prepare inspection reports.
  - 1. Remove and replace plates where inspections indicate that they do not comply with specified requirements. Reinspect after restoration or replacement has been completed.
  - 2. Perform additional inspections to determine compliance of replaced or additional work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.3 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Before installation and with shipping spreaders removed, adjust detention frames for squareness, alignment, twist, and plumbness to the following tolerances:
  - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb and perpendicular to frame head.
  - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of face.
  - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of door rabbet.
  - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

### 3.4 INSTALLATION

- A. Before installation and with shipping spreaders removed, adjust detention frames for squareness, alignment, twist, and plumbness to the following tolerances:
  - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb and perpendicular to frame head.
  - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of face.
  - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of door rabbet.
  - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- B. Inspect embedded plate installations before installing detention frames to verify that plate installations comply with requirements. Prepare inspection reports.
- C. Anchorage: Set detention frame anchorage devices according to details on Shop Drawings and according to anchorage device manufacturer's written instructions.
- D. Where detention frames are fabricated in sections due to shipping limitations, assemble frames and install angle splices at each corner, of same material and thickness as detention frame, and extend at least 4 inches on both sides of joint.
  - 1. Field splice only at approved locations. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
  - 2. Continuously weld and finish smooth joints between faces of abutted, multiple-opening, detention frame members.
- E. Apply bituminous waterborne asphaltic emulsion coating to backs of frames before filling with grout.
- F. Placing Detention Frames: Install detention frames of sizes and profiles indicated. Set detention frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.



- G. Grout: Fully grout detention frame jambs and heads. Completely fill space between frames and adjacent substrates. Hand trowel grout and take other precautions, including bracing detention frames, to ensure that frames are not deformed or damaged by grout forces.
- H. Swinging Detention Doors: Fit non-fire-rated detention doors accurately in their frames, with the following clearances:
- I. Fire-Rated Detention Doors: Install with clearances as specified in NFPA 80.
- J. Smoke-Control Detention Doors: Install according to NFPA 105.
- K. Installation Tolerances: Comply with NAAMM-HMMA 863.
- L. Glazing: Comply with installation requirements in Section 08 88 53 "Security Glazing" unless otherwise indicated.
- M. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors and frames that are warped, bowed, or otherwise unacceptable.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Detention work will be considered defective if it does not pass inspections.
- C. Perform additional inspections to determine compliance of replaced or additional work.

### 3.6 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors and frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off detention doors and frames immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
  - 1. After finishing smooth field welds, apply air-drying primer.

**END OF SECTION 08 34 63**



## **SECTION 08 41 15**

### **INTERIOR ALUMINUM- FRAMED STOREFRONTS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Interior aluminum and glass storefronts.
  - 2. Anchorages, shims, fasteners, accessories, and supports.
- B. Related Sections:
  - 1. Section 08 80 00 "Glazing."

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirement.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's product data including construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum entrance and storefront indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include setting drawings, templates, and directions for the installation of anchor bolts and other anchorages installed as a unit of work under other Sections.
- C. Samples for Initial Selection: Demonstrating anodized aluminum finish.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12 inch lengths of full-size components and showing details of the following:
  - 1. Joinery, including concealed welds.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Glazing.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Certificates: Submit certificates showing compliance with performance and 2014 NYC Building Code requirements.
- B. Test Reports: Submit material and product test reports showing compliance with performance and Building Code requirements.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Welding Qualifications: Qualify procedures according to AWS D1.2, "Structural Welding Code - Aluminum."



- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to restore or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 5 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to restore or replace components on which finishes do not comply with requirements or that deteriorate within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide interior storefront assemblies as supplied by one of the following, as approved by the Commissioner:
1. EFCO.
  2. Kawneer; an arconic company.
  3. Vistawall.
  4. Wausau Window and Wall Systems.
  5. Or approved equal.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
- B. Steel Reinforcement: Complying with ASTM A 36 for structural shapes, plates, and bars; ASTM A 1008 for cold-rolled sheet and strip; or ASTM A 1011 for hot-rolled sheet and strip.

### 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.



1. Provide 4-1/2 inch by 2 inch frames, with 3/16 inch wall thickness.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from stainless steel.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123 or ASTM A 153.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

## 2.4 GLAZING

- A. Glazing: Provide 1/2 inch clear tempered glazing. Refer to Division 08 Section "Interior Glazing" for materials and requirements. Fabricate to sizes required with edge clearances and tolerances that comply with manufacturer's recommendations.
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

## 2.5 ACCESSORY MATERIALS

- A. Joint Sealants: Provide silicone sealants approved by the manufacturer of the system, complying with ASTM C920, and Division 7 Section "Joint Sealants."

## 2.6 FABRICATION

- A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Storefront Framing: Fabricate components for assembly using shear-block system.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.





- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Notify the Commissioner in writing of conditions unsatisfactory for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. General: Install assemblies in accordance with manufacturer's instructions and approved shop drawings, using workers specifically trained in the installation of this type of work.
- B. Set units plumb, level, and true to line, without warp or rack of framing members. Install components in proper alignment and relation to established lines and grades. Provide proper support and anchor securely in place.
- C. Metal Protection:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
- D. Glazing: Install glazing as specified in Division 08 Section "Glazing."
- E. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce airtight installation.

### 3.4 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
  - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.



2. Alignment:

- a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
- b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- c. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

**END OF SECTION 08 41 15**



**SECTION 08 41 23**

**FIRE-RATED STOREFRONTS AND CURTAIN WALLS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section includes:

1. Fire-rated storefront framing and entrances.
2. Fire-rated curtain wall systems,
3. Perimeter trims, stools, accessories, shims and anchors, and perimeter sealing wall framing.
4. Installation accessories.

B. Related Sections:

1. Section 05 12 00 "Structural Steel Framing:" Steel attachment members.
2. Section 05 50 00 "Metal Fabrications:" Steel attachment members inserts and anchors.
3. Section 07 21 00 - "Thermal Insulation."
4. Section 07 62 00 "Sheet Metal Flashing and Trim" Flashing between this work and other work.
5. Section 07 84 10 "Firestopping" for firestops between work of this section and other fire resistive assemblies.
6. Section 07 92 00 "Joint Sealants."
7. Section 08 80 00 –"Glazing" for Fire-rated glass requirements and types.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 COORDINATION**

- A. Coordinate the work of this section with others affected including but not limited to: other interior and/or exterior envelope components and door hardware beyond that provided by this section.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.7 ACTION SUBMITTALS**

- A. Product Data: Submit latest edition of manufacturer's product data providing product descriptions, technical data, Underwriters Laboratories, Inc. listings and installation instructions.
- B. Shop Drawings:
  1. Include plans, elevations and details of each product type showing component dimensions; framed opening requirements, dimensions, tolerances, and attachment to structure
- C. Engineering Services Submittal: For Fire-rated entrances, storefronts, and curtain walls, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.
- D. Samples: For following products:
  1. Each type of glass: Section 08 80 00 –"Glazing."
  2. Each type of frame.
  3. Finish: Each selected finish.
- E. Glazing Schedule: Refer to Section 08 80 00 –"Glazing."



**1.8 INFORMATIONAL SUBMITTALS**

- A. Warranties: Submit manufacturer's warranty.
- B. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
  - 1. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to the New York City Department of Buildings.
- C. Maintenance data.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Manufacturer Qualifications: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.
- C. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Commissioner, except with Commissioner's approval. If changes are proposed, submit comprehensive explanatory data to Commissioner for review.

**1.10 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store and handle under provisions in accordance with manufacturer's instructions.

**1.11 FIELD CONDITIONS**

- A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner, coordinate planned measurements with the work of other sections.

**1.12 WARRANTY**

- A. Special Assembly Warranty: Manufacturer agrees to restore or replace components of Fire-rated storefronts and curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.
- B. Glass Warranty: Refer to Section 08 80 00 –"Glazing."



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design, Products: Subject to compliance with requirements, provide the following or equal as approved by the Commissioner:
1. Fire-Rated Narrow Profile Steel Doors & Frames and Storefront System: Fireframes Heat Barrier Series fire-rated steel frame system as manufactured and supplied by Technical Glass Products (TGP) or comparable product by one of the following:
    - a. SaftiFirst, a division of O'Keeffe's Inc.
    - b. Vetrotech Saint-Gobain
    - c. Or approved equal.
  2. Curtain Wall Frame System: Fireframes Curtainwall Series Fire-rated steel frame system with aluminum cover, as manufactured and supplied by Technical Glass Products (TGP). or comparable product by one of the following:
    - a. SaftiFirst, a division of O'Keeffe's Inc.
    - b. Vetrotech Saint-Gobain
    - c. Or approved equal.
- B. Manufacturers for glass and glazing accessories: Refer to Section 08 80 00 –“Glazing.”

### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design fire- rated storefronts and curtain walls including connections.
1. Engineering Services shall include complete calculations for fire- rated storefronts and curtain walls and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. Fire-Rated Wall Assemblies: Assemblies complying with ASTM E119 that are classified and labeled by UL, for fire ratings indicated, based on testing in accordance with UL 263, ASTM E119.
1. Fire Rating Requirements: Duration for Storefronts and Curtain Walls: Capable of providing a fire rating for 120 minutes
  2. Listings and Labels - Fire Rated Assemblies: Under current follow-up service by Underwriters Laboratories maintaining a current listing or certification. Label assemblies accordance with limits of manufacturer's listing.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.



2. Other Design Loads: As indicated on Drawings.

D. Structural Performance:

1. System shall withstand structural forces placed upon it without damage or permanent set when tested in accordance with ASTM E330 using load 1.5 times the design wind loads and of 10 seconds in duration.
2. Member deflection: Limit deflection of the edge of the glass normal to the plane of the glass to 1/175 of the glass edge length or 3/ 4 inch, whichever is less of any framing member.
3. Accommodate movement between storefront and adjoining systems

- E. Air infiltration: Provide systems that allow a maximum air leakage through fixed glazed openings of 0.06 cfm/sq. ft. of area when tested per ASTM E 283 at a static air differential of 6.24 lbf/ per sq. ft.

- F. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf per sq. ft.

## 2.3 STEEL FRAMING – STOREFRONT AND DOORS

- A. Construction: Narrow-profile, roll-formed steel architectural grade.
- B. Perimeter framing face dimension: 3-1/8-inch at head, sill and jamb.
- C. Horizontal and/or vertical mullions: 4-1/8-inch on the face.
- D. Depth of perimeter and mullion: Depth varies based on rating and profile.

## 2.4 CURTAIN WALL FRAMING

- A. Steel Curtainwall Framing System 120 min

1. Framing: Profiled steel tubing permanently joined with steel bolts.
2. Insulation: Insulate framing system against effects of fire, smoke, and heat transfer from either side. Firmly pack perimeter of framing system to rough opening with mineral wool fire stop insulation or appropriately rated intumescent sealant
3. Fasteners: Type recommended by manufacturer
4. Glazing Gaskets, Compounds and tapes: Glaze with approved EPDM glazing gaskets and closed cell PVC tape, or pure silicone sealant.
5. Steel Pressure Plates: Formed stainless steel pressure plate with dimensions recommended by manufacturer to securely hold glazing material in place.
6. Cover Caps: Extruded aluminum.

- B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221



- C. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength materials with nonstaining, nonferrous shims for aligning system components.
- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
  - 2. Reinforce members as required to receive fastener threads.
- F. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- G. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

## 2.5 ACCESSORIES

- A. Exposed Fasteners: Use fasteners fabricated from Type 304 or Type 316 stainless steel.
- B. Glazing Gaskets: Refer to Section 08 80 00 –“Glazing.”
- C. Intumescent Tape: As supplied by frame manufacturer.
- D. Setting Blocks: 1/ 4 inch calcium silicate.
- E. Perimeter Anchors: Steel or 316 Stainless steel when exposed.
- F. Flashings: As recommended by manufacturer; same material and finish as cover caps.
- G. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Board Insulation: Refer to Section 07 21 00 - “Thermal Insulation.”
- H. Silicone Sealant: Refer to Section 07 92 00 “Joint Sealants.”

## 2.6 MATERIALS - GLASS

- A. Fire Rated Glazing: Refer to Section 08 80 00 –“Glazing.”
- B. Glazing Accessories: Manufacturer's standard compression gaskets, spacers, setting blocks and other accessories necessary for a complete installation.





## 2.7 FABRICATION

- A. Obtain approved Shop Drawings prior to fabrication.
- B. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.
- C. Accurately fit and secure joints and corners. Make joints flush and weatherproof.
- D. Prepare components to receive anchor devices.
- E. Provide physical and thermal isolation of glazing from framing members.
- F. Provide internal guttering to drain water from joints and condensation occurring within glazing pocket.
- G. Fabricate anchors.
- H. Arrange fasteners and attachments to be concealed from view.
- I. Frame assemblies shall be prewelded.
  - 1. When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.
  - 2. Fit with suitable fasteners.
- J. Fabrication Dimensions: Fabricate fire rated assembly to field dimensions.

## 2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish frames after assembly.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

## 2.9 STEEL POWDER COAT FINISHES

- A. Finish after fabrication.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.



C. Exterior Finishes: Manufacturer's standard products.

1. Powder-Coat Finish: Polyester Super Durable powder coating which meets AAMA 2604 for chalking and fading. Apply manufacturer's standard powder coating finish system applied to factory-assembled frames before shipping, complying with manufacturer's recommended instructions for surface preparation including pretreatment, application, and minimum dry film thickness.
2. Color and Gloss: As selected by Commissioner from manufacturer's full range.

2.10 ALUMINUM FINISHES

- A. Refer to Section 08 44 13 "Glazed Aluminum Curtain Walls" for requirements.

2.11 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 EXAMINATION

- A. Examine substrates and members to which the work of this section attaches or adjoins prior to frame installation.
- B. Notify the Commissioner of any conditions that are detrimental to the integrity of the proposed fire wall systems.
- C. Do not proceed until such conditions are corrected.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Provide framing to openings plumb, square and within allowable tolerances.
- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.



- G. Seal joints and exterior faces of pressure-plate fasteners watertight, unless otherwise indicated.
- H. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

### 3.4 RESTORATION AND TOUCH UP

- A. Limited to minor restoration of small scratches. Use only manufacturer's recommended products.
  - 1. Restoration shall match original finish for quality or material and view.
- B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged.

### 3.5 PROTECTION AND CLEANING

- A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
  - 1. Do not clean with astringent cleaners. Use a clean "grit free" cloth and a small amount of mild soap and water or mild detergent.
  - 2. Do not use any of the following:
    - a. Steam jets
    - b. Abrasives
    - c. Strong acidic or alkaline detergents, or surface-reactive agents
    - d. Detergents not recommended in writing by the manufacturer
    - e. Do not use any detergent above 77 degrees F
    - f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
    - g. Metal or hard parts of cleaning equipment must not touch the glass surface
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

**END OF SECTION 08 41 23**



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## **SECTION 08 43 33**

### **SECURITY STOREFRONTS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Ballistic and forced entry resistant aluminum storefront framing.
  - 2. Installation accessories.
- B. Related Sections:
  - 1. Section 07 92 00 "Joint Sealants" for elastomeric joint sealants and backings.
  - 2. Section 08 34 63 "Detention Doors and Frames" for security sealants.
  - 3. Section 08 88 53 "Security Glazing" for glazing requirements.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirement.

1.5 COORDINATION

- A. Coordinate the locations of conduit and wire mold to be provided within in security storefront mullions with security storefront manufacturer to ensure that reinforcement is engineered by manufacturer to accommodate their presence.
- B. Coordinate holes required in sides of security storefront mullions for electrical runs and mechanical attachments to security storefront-mounted items with manufacturer

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of framing, including manufacturer recommended installation instructions.
- B. Shop Drawings: Include plans, elevations, sections, details, attachment to other work and glazing details for field-glazed units.
- C. Engineering Services Submittal: For security storefronts, submit shop drawings and design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York .responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any contract the work.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Manufacturer Qualifications: Manufacturer providing the material used in this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- C. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- D. On-site Facade Mockup: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the furnishing elements for the on-site facade mockup.



1. Provide complete security storefront installation in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
2. Incorporate full-scale details of the architectural features, approved finishes, brackets, gasketing, sealants, and attachments to be provided at full-scale building.
3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

#### 1.10 WARRANTY

- A. Special Finish Warranty: Standard form in which manufacturer agrees to restore finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- B. Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURED UNITS

- A. Basis of Design, Product: Subject to compliance with requirements, provide USAW400A as supplied by United States Bulletproofing, Inc. or comparable product from one of the following, as approved by the Commissioner:
  1. Insulgard Security Products.
  2. Total Security Solutions.
  3. Or approved equal
- B. Architectural Aluminum Framing Systems: Factory fabricated framing constructed from either 6105-T5 or 6005-T5 aluminum with integral weep design to allow water to vent to the exterior along horizontal members.
  1. Head, Jamb, Sill, Mullion and Intermediate Members: 2-1/2 inch by 7 7/8 inches.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design security storefronts including connections.
  1. Engineering Services shall include shop drawings and complete design calculations for security storefronts and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.



- b. Design calculations shall be based on Performance Requirements and product design criteria indicated.

**B. Structural Loading:**

- 1. Wind Loading: As indicated on Drawings.
- 2. Design loads.
  - a. Positive (inward) design pressure of 45 psf.
  - b. Negative (outward) design pressure of 45 psf.
- 3. Deflection Limits:
  - a. Deflection of any framing member in a direction normal to the plane of the wall when subjected to the indicated design loads shall not exceed 1/175 of its clear span or 3/4 inch, whichever is less.
  - b. For cantilevers, the span shall be taken as two times the distance between anchor centerline and end of cantilever.
  - c. The deflection shall not exceed 50 percent of the nominal joint width at sealant joints occurring between framing members and adjacent materials, unless otherwise required by sealant manufacturer.
  - d. Upon reversal of load direction at magnitudes up to and including 1.5 times design pressures, slippage at fastened and/or clamped connections, shall not exceed 1/8 inch.
  - e. Glass deflection at full design load shall not exceed 1/100 of its span, or 3/4 inch, whichever is less.
  - f. Metal panel deflection shall not exceed 1/90 of its span or 3/4 inch, whichever is less. The span shall be taken as the lesser of the distances between the horizontal or vertical support members.

**C. Thermal Movement**

- 1. Provide for expansion and contraction of component materials as will be caused by surface temperatures ranging from 20 degrees F to a high temperature of 180 degrees F.
  - a. The expansion and contraction caused by temperature differential shall not cause buckling, undue stress on glass, failure of joint seals, undue stress on structural elements, demanding loads on fasteners, reduction of performance, or other detrimental effects.

- D. Condensation Resistance:** Provide "thermal-break" construction for storefront framing, units shall be tested for thermal performance in accordance with AAMA 1503 showing condensation resistance factor (CRF) of not less than 45.

**E. Ballistic and Forced Entry Resistance:**

- 1. Minimum HPW I-B in accordance with H. P. White Laboratory Inc. Test Procedure: "Transparent Materials for Use in Forced Entry or Containment Barriers."

**2.3 GLAZING AND ACCESSORIES**

- A. Glazing Material:** Ballistic and forced entry resistance HPW I-B. See Section 08 88 53 "Security Glazing"





- B. Gaskets:
  - 1. Interior: Closed cell neoprene (40-50 Shore "A" Durometer)
  - 2. Exterior: Solid neoprene (65-75 Shore "A" Durometer)

- C. Anchors: Fully concealed as required by project application.

## 2.4 FABRICATION

- A. Provide steel reinforcement within aluminum security storefront mullions per manufacturer's requirements to achieve ballistic and forced entry resistance rating (HPW I-B), to reinforce storefront to meet structural requirements for security storefront manufacturer's warranty and security glazing manufacturer's warranty.
- B. Provide nonconductive material isolating dissimilar mullion and reinforcement metals to prevent galvanic action
- C. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

## 2.5 FINISHES, GENERAL

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

## 2.6 ALUMINUM FINISHES

- A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
  - 1. Color and Gloss: As selected by Commissioner from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Verify field dimensions of opening prior to fabrication of framing.
- B. Coordinate structural requirements to ensure proper attachment and support.



- C. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

#### 3.4 SECURITY STOREFRONTS, GENERAL

- A. Comply with written instructions of manufacturers, unless more stringent requirements are indicated

#### 3.5 INSTALLATION

- A. Install framing in accordance with manufacturer's recommendations and approved shop drawings.
- B. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.
- C. Apply sealant in accordance with window and sealant manufacturer's recommendations as indicated in installation instructions and as indicated on drawings. Wipe off excess, and leave exposed sealant surfaces clean and smooth

#### 3.6 PROTECTION

- A. Clean and protect windows from damage during construction operations. If damage occurs, remove and replace as required to provide windows in their original, undamaged condition.

**END OF SECTION 08 43 33**

**SECTION 08 44 13****GLAZED ALUMINUM CURTAIN WALLS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section includes:

1. Glazed aluminum curtain walls.
2. GFRC sunshade fin support components.
3. Insulated glazed aluminum shadow boxes.
4. Installation accessories.

B. Related Sections:

1. Section 03 49 00 "Glass-Fiber-Reinforced Concrete (GFRC)" for sunshade fin materials.
2. Section 07 92 00 "Joint Sealants" for elastomeric joint sealants and backings.
3. Section 08 80 00 "Glazing" for glass requirements.
4. Section 08 91 19 "Fixed Louvers" for vertical mechanical louvers and insulated louver blank-off panels to be provided within curtain wall areas.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.



2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Loads of Attached Work: Coordinate with manufacturers of glazing, Glass-Fiber-Reinforced Concrete (GFRC) sunshade fins, and fixed louvers, as indicated on drawings, to confirm that curtain wall will fully support dead loads and wind loads imposed by products proposed for installation in curtain wall assembly.
- B. Coordinate curtain wall installation with flashing, trim, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- C. Coordinate installation of GFRC sunshade fins with brackets attached to curtain wall mullions.
- D. Coordinate installation of fixed louvers and insulated louver blank-off panels within curtain wall mullions.

#### 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
  1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
  2. Indicate GFRC sunshade fins and support components.
  3. Indicate locations and areas of related work to be mounted to or within curtain wall mullions, including glazing and fixed louvers.
  4. Indicate areas of insulated glazed shadow boxes and provide details including aluminum back pan and finished aluminum shadow box panel at exterior face.
- C. Samples: For each type of exposed finish required.



- D. Engineering Services Submittal: For glazed aluminum curtain walls, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York .responsible for their preparation.

- 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any contract the work.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- B. Product test reports.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample warranties.

#### 1.10 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer performing the work of this section shall, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
  - 1. Installer shall be properly trained by the manufacturer.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Commissioner, except with Commissioner's approval. If changes are proposed, submit comprehensive explanatory data to Commissioner for review.
- D. On-site Facade Mockup: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  - 1. Provide complete glazed aluminum curtain wall installation in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
  - 2. Incorporate full-scale details of the architectural features, approved finishes, brackets, gasketing, sealants, and attachments to be provided at full-scale building.



3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.
4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner..
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.12 WARRANTY

- A. Special Assembly Warranty: Manufacturer agrees to restore or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to restore finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
  1. Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 HIGH- PERFORMANCE, GLAZED ALUMINUM CURTAIN WALLS

- A. Basis of Design, Product: Subject to compliance with requirements, provide 1600UT System 1 & 2 as supplied by Kawneer, an Arconic company or comparable product, as approved by the Commissioner, from one of the following:
  1. EFCO Corporation.
  2. Oldcastle Building Envelope.
  3. Or approved equal.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Construction: Thermally broken with fiberglass pressure plates.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Front.
  4. Finish: Superior-performance organic finish.
  5. Fabrication Method: Field-fabricated stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- C. Pressure Caps: Aluminum components that conceal fiberglass pressure plates to mechanically retain glazing.
  1. Manufacturer's standard 3/ 4 inch cap, where indicated on drawings.
  2. Stepped mullion 4 1/ 2 inch cap, where indicated on drawings.
  3. Include snap- on aluminum trim that conceals fasteners.



- D. Brackets and Reinforcement: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design security storefronts including connections.
  - 1. Engineering Services shall include complete calculations for glazed aluminum curtain walls and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. General: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
    - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
  - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:



- a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch for spans of greater than 11 feet 8-1/4 inches or 1/175 times span, for spans of less than 11 feet 8-1/4 inches.
- E. Structural: Test according to ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:
1. Fixed Framing and Glass Area: Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
  2. Operable Units: Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
- G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
- H. Energy Performance: Certify and label energy performance as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed glazing and framing areas as a system shall have overall U-factor of not more than 0.25 Btu/sq. ft. x h x deg F as determined according to NFRC 100 for a system specimen size of 78-3/4 by 78-3/4 inch, when fitted with 1-3/4 inch glazing with U-factor of 0.16.
    - b. Operable (Outswing) curtain wall casement windows as a system shall have overall U-factor of not more than 0.28 Btu/sq. ft. x h x deg F as determined according to NFRC 100 for a system specimen size of 23-5/8 by 59-1/16 inch, when fitted with 1-3/4" glazing with U-factor of 0.16.
  2. Condensation Resistance:
    - a. Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 66 as determined according to NFRC 500.
    - b. Operable Units (Project-Out): With 1 inch insulating glass and aluminum spacer: Not less than 73 (frame) and 60 (glass).
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.





## 2.3 VENTING WINDOWS

- A. Basis of Design, Product: Subject to compliance with requirements, provide GLASSvent UT (Ultra Thermal) windows as supplied by Kawneer, an Arconic company, or equal as approved by the Commissioner.
- B. Aluminum Windows: AAMA/WDMA/CSA 101/I.S.2/A440, manufacturer's standard, with self-flashing mounting fins where required by project application, and as follows:
  - 1. Window Type: Project- out awning and outswing casement, as indicated on drawings.
  - 2. Minimum Performance Class: AW, unless otherwise indicated.
  - 3. Minimum Performance Grade: PG- 90- AP & PG- 90- C, unless otherwise indicated.
  - 4. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 0.064-inch thickness at any location for main frame and sash members.
    - a. Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
  - 5. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
  - 6. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
    - a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
  - 7. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following, as required by project application:
    - a. Stainless steel, 4-bar hinges.
    - b. Cast white bronze cam locking handles.
    - c. Cast white bronze access control (custodial) locks with removable handle.
    - d. Cast white bronze cam handle with pole ring on meeting rail where rail is more than 72 inches above floor.
  - 8. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:
    - a. Extruded aluminum frames, 6063-T5 or 6063-T6 alloy and temper, joined at corners.
    - b. Glass-Fiber Mesh Fabric: 18-by-16 mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh; complying with ASTM D 3656.



## 2.4 SUN CONTROL

- A. GFRC Sunshade Fin Mounting Brackets: Assemblies consisting of manufacturer's standard outrigger brackets designed for attachment to curtain wall with mechanical fasteners concealed within mullion cap.
  - 1. Orientation: Vertical.
  - 2. Projection from Wall: As indicated on Drawings.
- B. Outriggers (attachment brackets: Straight with square edges, unless otherwise indicated.
  - 1. Basis of Design, Product: Subject to compliance with requirements, provide Versoleil sunshades mounting bracket as supplied by Kawneer, an Arconic company, or equal as approved by the Commissioner.
- C. GFRC Sunshade Fin Materials: Refer to Section 03 49 00 "Glass-Fiber-Reinforced Concrete (GFRC)."
- D. Aluminum Materials: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Sheet and Plate: ASTM B 209.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
  - 4. Structural Profiles: ASTM B 308.

## 2.5 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: ASTM C509 or ASTM C864. Compression-type, replaceable EPDM.
  - 1. Color: Black.
- C. Glazing Sealants: Comply with Section 08 80 00 "Glazing."

## 2.6 INSULATED GLAZED ALUMINUM SHADOW BOXES

- A. Aluminum Back Pans: Provide formed aluminum back pan continuously sealed with gaskets to glazing pockets on four sides. Provide formed aluminum front closure plate to back pan as indicated on drawings, with exterior-facing finish matching that of adjacent mullions. Insulate shadow boxes as indicated.

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
- D. Structural Profiles: ASTM B308/B308M.
- E. Steel Reinforcement:



1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

- F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

## 2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from exterior.
  6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components to resist water penetration as follows:
1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
  2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual" recommendations for applying and designating finishes
- B. Protect finishes on exposed surfaces from damage in accordance with coating manufacturers requirements.
- C. Apply organic finishes to formed metal after fabrication unless otherwise indicated.



- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.10 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
  - 1. Color and Gloss: As selected by Commissioner from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### 3.4 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Anchor curtain wall to floor slabs, floor slab secondary framing, and cast-in-place roof curb, as indicated on drawings. Anchor to additional structure at points between floor slabs or to adjacent precast concrete wall panels is not permitted.
  - 1. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.



- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- G. Seal joints and exterior faces of pressure-plate fasteners watertight, unless otherwise indicated.
- H. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- J. Install components plumb and true in alignment with established lines and grades.
- K. Install GFRC sunshade and brackets in accordance with approved shop drawings. Refer to Section 03 49 00 "Glass-Fiber Reinforced Concrete" for requirements.
- L. Install fixed louvers and insulated blank-off panels in accordance with approved shop drawings. Refer to Section 08 91 19 "Fixed Louvers" for requirements.

### 3.5 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 08 80 00 "Glazing."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Test Area: Perform tests on one bay at least 30 feet, by one story.
- C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Commissioner shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of three tests in areas as directed by Commissioner.
- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION 08 44 13**



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**SECTION 08 70 00****FINISH HARDWARE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 WORK INCLUDED**

- A. Work of this Section includes all labor, materials, equipment and services necessary to furnish all the finish hardware as shown on the drawings and specified herein.

**1.3 RELATED WORK**

- A. Interior Architectural Woodwork - Section 06 40 23
- B. Hollow Metal Doors and Frames - Section 08 11 13
- B. Access Doors and Frames - Section 08 31 13
- C. Detention Doors and Frames – Section 08 34 63
- D. Interior Aluminum- Framed Storefronts - Section 08 41 15
- B. Security Storefronts - Section 08 43 33
- E. Painting - Section 09 91 00

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% combined pre-consumer/post-consumer recycled content (the



percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.

2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.5 LEED BUILDING SUBMITTALS

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Hardware shall be suitable and adapted for its required use and shall fit its designated location. Should any hardware as shown, specified or required fail to meet the intended requirements or require modification to suit or fit the designated location, determine the correction or modification necessary and notify the Commissioner in ample time to avoid delay in the manufacture and delivery of hardware.
- C. For fire rated openings provide hardware complying with NFPA Standard No. 80 requirements of the New York City Department of Buildings and the New York City Fire Department.
- D. Barrier Free Requirements: Local laws complying with the American Disabilities Act and ANSI A117.1 2017 shall apply.
- E. Contractor Qualifications: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.8 SUBMITTALS

- A. Before any finish hardware is ordered or purchased, submit catalog cuts and a complete Hardware Schedule of Finish Hardware. Each item listed in the Hardware Schedule shall be identifiable with respect to manufacture, brand, catalog number, material, and finish.
  1. Schedule of Finish Hardware shall be submitted in the Vertical Schedule Format per Door and Hardware Institute Sequence & Format for the Hardware Schedule.
- B. Where submission differs from Schedule given herein, use different color or other means of identification to bring change to the attention of the Commissioner.



- C. Contractor's hardware trade shall coordinate all product information, wiring diagrams, and electrical data with the Contractor's electrical trade.
- D. Samples: Submit samples as requested by Commissioner. Do not proceed with installation until samples have been approved. Approved samples may be installed in the work after substantial completion of work. Samples shall include one (1) each of the following samples:
  - 1. Hinge (each type)
  - 2. Intermediate Pivot
  - 3. Surface Closer
  - 4. Lockset (office function)
  - 5. Floor Stop
  - 6. Push-Pull Plates
  - 7. Push-Pull Bars
  - 8. Finish Sample of all other hardware

#### 1.9 PRODUCT HANDLING

- A. Pack finish hardware in approved manufacturer's containers, complete with trimmings, bolts, screws, washers, etc., as required for application and securement. Each container shall bear a suitable label which shall state the quantity and kind of contents of said container, as well as identifying marks relating to the approved Hardware Schedule and its location in the project.
- B. Knobs, handles, pulls and other items of finish hardware with easily damaged finishes shall be individually wrapped before placing in containers and with sufficient sheet cloth or cotton-backed paper which shall be adequately tied with heavy strings; all as necessary to protect the finishes.
- C. Finish hardware shall be delivered, as directed, to the building site or the factories of the various fabricators of metal work to which such hardware is to be applied. Deliver hardware in the order required and in ample time to permit application at the building, or fabricators' shops, within the time required for the completion of the building.

#### 1.10 JOB CONDITIONS

- A. Field Service: The hardware supplier shall assign a competent representative, acceptable to the Commissioner, to be at the jobsite each time a major shipment of finish hardware is received. Such representative shall assist in "checking in" these shipments and shall secure a receipt covering the contents of each shipment. In addition, such representative shall be available for immediate call to the jobsite when, in the opinion of the Commissioner, his presence is necessary.
- B. Templates: Promptly following approval of the Hardware Schedule by the Commissioner, furnish and deliver template information, to the fabricators, of items to which finish hardware is to be applied.
  - 1. Such deliveries shall be made in ample time to avoid delays in such work of said fabricators. Provide drawings, schedules and detailed information to other trades as



necessary for them to accommodate and prepare their work to receive the finish hardware.

**C. Cooperation and Coordination**

1. Cooperate and coordinate work with that of other trades supplying materials or performing work in contact with, connecting to, underlying, or overlaying the work of this Section.
2. Provide complete data of requirements for work of this Section to those other trades whose work is affected by or dependent upon the work of this Section.
3. Furnish all items to be built into other work in ample time to avoid delaying the progress of such work.
4. Examine all drawings covering the work of this Section and refer to all other drawings, including mechanical and electrical drawings, which may affect the work of this Section or require coordination by this trade.

- D. Existing Conditions:** Contractor shall verify all existing conditions in the field to ensure compatibility with hardware specified in the Hardware Sets herein. Any discrepancies between the existing field conditions and hardware specified shall be brought to the attention of the Commissioner immediately. Contractor shall not order any hardware until all discrepancies are rectified and written approval is granted by the Commissioner.

**1.11 WARRANTIES**

- A. Provide a letter from the manufacturer of overhead closers, warranting such closers for five (5) years from the date of substantial completion.
- B. Provide a letter from manufacturer of concealed floor closers, warranting such closers for twenty-five (25) years from the date of substantial completion.
- C. The hardware supplier shall provide a written one (1) year warranty from the date of substantial completion for the rest of the items furnished under this Section.
- D. All warranties shall be effective beginning with the date of substantial completion.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware are indicated herein. Products are identified by using appropriate hardware designation numbers.
- B. Manufacturers are listed for each hardware type required. Provide either the product designated, or an approved equal.
- C. **Specific Products:** References to specific specific products are used to establish minimum standards of utility and quality. Other materials may be considered by the Commissioner in accordance with the provisions of these specifications.

- D. Notwithstanding anything to the contrary in this specification or the drawings, the finish hardware shall conform to the requirements of 2014 New York City Building Code, and ANSI A117.1.
- E. Finish hardware shall conform to the applicable requirements of Underwriters Laboratories Inc. and the 2014 New York City Construction Codes, and each such item shall bear a label or mark of Underwriters Laboratories Inc. indicating its conformity with such requirements for use in connection with its specified location.
- F. Finish hardware shall be uniform in color and finish and free from imperfections affecting its appearance, function, operation and serviceability. Such hardware shall be suited and adapted to its required use and shall fit its respective location.
- G. Where the finished shape or size of members receiving finish hardware are such as to prevent or render unsuitable the use of the specific types or sizes of such hardware, suitable types or sizes shall be furnished, having as nearly as practicable the same function, operation and quality as the specified hardware.
- H. Bolts, screws and other fastenings required for the application of the finished hardware shall be of size and type to fit requirements and shall be of the same material and finish as the exposed parts of such hardware which they adjoin. Exposed screws and bolts shall have countersunk oval heads and bolts shall be provided with cap nuts. Countersunk part of screw and bolt holes shall be finished smoothly without sharp edges and form a firm seal for such screw and bolt heads. Full threaded wood screws shall be furnished for all wood applications. No thru bolts will be allowed. Hex-nuts and bolts shall be provided on push/pulls, exit devices, closers, etc. when being attached to mineral core or particle core wood fire doors without necessary blocking.

## 2.2 PRODUCTS AND MANUFACTURERS

- A. The following two-letter abbreviations are used within the Hardware Sets of this section to indicate the basis-of-design manufacturer for all hardware products. For each hardware product specified, provide either the basis-of-design product, or an equivalent product from an approved equal manufacturer.
  - 1. AD: Ademco
  - 2. AR: Adams Rite
  - 3. CO: Corbin Russwin
  - 4. EL: Elmes
  - 5. FA: Fantom
  - 6. HA: Hafele
  - 7. IV: Ives
  - 8. LC: LCN
  - 9. MC: McKinney
  - 10. RX: Rixson



- 11. RO: Rockwood
- 12. SE: Sentrol
- 13. SC: Schlage
- 14. SD: Security Door Controls
- 15. SF: Southern Folger
- 16. ST: Stanley Access Technologies
- 17. TE: Tectus by Simonswerk
- 18. TX: Tormax USA
- 19. VD: Von Duprin
- 20. ZE: Zero International

B. For all selections: Or approved equal.

## 2.3 SPECIFIC ITEMS

### A. Hinges

- 1. Minimum of three (3) hinges per door leaf up to 7'-6" high. Provide one additional hinge per 2'-6" or fraction thereof.
- 2. Hinges shall be of types, sizes and materials as required to suit door weights thickness and fire ratings.
- 3. Unless otherwise specified hinges shall be standard weight. Doors 3'-4" in width shall receive 5 x 4½ .146 gauge hinges. Doors over 3'-4" in width shall receive 5 x 4½ .190 gauge hinges.
- 4. Hinge sizes shall be detailed so that the least amount of projection shall be visible from the frame.
- 5. Unless otherwise specified hinges shall have concealed ball bearings (combination anti-friction or oil impregnated) and five (5) knuckles.
  - a. Standard doors shall have non-rising pins.
  - b. Doors exposed to the public, and other secure areas, as determined by the Commissioner, shall have non-removable pins.
- 6. Electric Hinges: Coordinate voltage and other electrical requirements with applicable portions of Division 26.
- 7. Continuous Hinges: Unless otherwisw specified in the Hardware Sets, continuous hinges shall be stainless steel, steel, or aluminum with a full length Teflon coated stainless steel pin not less than ¼" in diameter.



**B. Pivots**

1. Provide quantities and types of pivots (offset, intermediate, or center) as required to suit door sizes and weights.
2. Pivot sets (offset and center) shall consist of top and bottom pivots, unless otherwise indicated.
3. Provide a top pivot for each floor closer unless otherwise indicated.
4. Provide fire rated pivots on all rated doors in a labeled opening.

**C. Closers**

1. Unless otherwise indicated, closers shall not be visible on the public side of doors. Closers opening into public spaces shall be provided with parallel arms and brackets to suit.
2. Closers shall be sized in accordance with the accepted manufacturer's standards to suit height, width, weight of door and draft conditions.
3. Provide a top pivot for each floor closer.
4. Provide weather sealing compound for each exterior floor closer.
5. Unless specified otherwise in the Hardware Sets, all floor closers shall have a built in dead stop.

**D. Locking and Latching Devices**

1. Mechanical: Provide types, functions, as specified. Coordinate with Commissioner's keying requirements.
  - a. Unless otherwise specified in the Hardware Sets, tubular style locksets or latchsets will not be accepted in lieu of cylindrical style sets specified.
  - b. Unless otherwise specified in the Hardware Sets, ANSI Grade 3 deadlocks will not be accepted.
2. Electric Lock: Electric locks shall be fail safe and shall be deactivated by fire suppression system and devices (local and/or remote) as determined by the Commissioner.
  - a. Coordinate voltage and other electrical requirements with applicable portions of Division 26.
3. Electric Strike: Electric locks shall be fail safe and shall be deactivated by fire suppression system and devices (local and/or remote) as determined by the Commissioner.
  - a. Coordinate voltage and other electrical requirements with applicable portions of Division 26.

**E. Keys and Keying**



1. Locking devices will be equipped with Corbin Russwin cylinder with 6 Pin removable core 8000 Series Cores using Corbin Russwin D1 Keyway, or approved equal, matching that indicated by the Commissioner. Contractor shall coordinate with the Commissioner on the final keying system design and manufacturer to be used. For security while the building is under construction, locks will be equipped with temporary brass construction cores and installed by the Contractor. Following approval by the Commissioner of the final keying schedule, install permanent cores, cut, sequentially number and tag keys and deliver cores and keys directly to the Commissioner.
  2. Provide complete key control system, including key cabinet and software, with capacity to store 175% of keys furnished. Subject to compliance with requirements, provide products by one of the following:
    - a. TelKee (Basis-of-Design)
    - b. Traka
    - c. MMF Industries
    - d. or approved equal
- F. Stops: Provide stops to limit the degree of opening, helping to prevent damage to adjacent walls, columns, equipment, the door or its hardware.
1. Overhead Stops
    - a. Size overhead stops to suit door width, height, weight and draft condition.
    - b. Overhead stops shall have stainless steel tracks with built-in shock absorber with 5-7 degree compression before dead stop. The arm shall be stainless steel with finish as noted.
  2. Floor Stops: All stops to be fastened to concrete shall use expansion shields and machine screws.
- G. Pushes and Pulls: Provide concealed fasteners where practical. Where exposed fasteners are required provide flush type finished to match push or pull.
1. Provide all Pulls with Plates.
- H. Flush Bolts: Provide top and bottom extension type flush bolts, mounted twelve (12) inches and seventy-two (72) inches respectively from the bottom of each door, where scheduled. Provide each bottom flush bolt with a dustproof strike.
- I. Silencers: Provide silencers for all non-gasketed and non-weatherstripped frames. Provide three (3) for each single swing door and two (2) for each pair of doors.
- J. Automatic Door Bottoms: Unless otherwise specified in the Hardware Sets, automatic door bottoms shall be dual actuated with an operating force not to exceed one and one-half (1½) pounds.
- 2.4 FINISHES**
- A. Provide finish hardware with the finishes:
1. Hinges:
    - a. Interior: US26D
    - b. Exterior: US32D

2. Pulls; US32D
3. Locksets and Exit Devices: US32D
4. Closers:
  - a. Surface: 689
  - b. In Floor: US26D
5. Protection Plates: US32D
6. Wall Stops: US26D
7. Overhead Stops: US32D

B. Provide Surface Door Closers with SRI Finish at Exterior Doors.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

A. Refer to DDC General Conditions for execution requirements.

#### 3.2 GENERAL

- A. Make periodic checks during construction in order to ascertain that the finish hardware furnished has been installed correctly. After completion of all construction work, adjust finish hardware to work properly; test all keys and adjust as required for smooth, free operation.
- B. Provide Metal Saddles by Zero International (basis of design), or a product of equivalent configuration and design by one of the following approved manufacturers, where indicated on the Door Schedule.
  1. National Guard Products
  2. Assa Abloy
  3. Or approved equal.

#### 3.3 HARDWARE SETS

- A. Hardware sets reference basis-of-design product and manufacturer. Refer to 2.2 for full list of approved manufacturers. For each hardware product specified, provide either the basis-of-design product, or an equivalent product from an approved equal manufacturer.

#### SUBSET SCHEDULE

B# Bathroom  
E# Exterior  
G# General  
M# Mechanical  
S# Security & Detention  
T# Stair

#### HW SET B1

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Privacy Set x Indicator	ML2030-NSA-M19V	CR
1 – Ea. Surface Closer	4040XP	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV

### HW SET B2

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Institutional Privacy)	ML2069-NSA-CT6-M19V	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV

### HW SET B3

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Mortise Lockset (Institutional Privacy)	ML2069-NSA-CT6-M19V	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Set Gasketing	188S	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE

### HW SET E1

1 – Ea. ¾" Offset Floor Closer	SC-L2790N-CWF	RX
1 – Ea. ¾" Offset Pivot Set	L147	RX
2 – Ea. Intermediate Pivots	ML19	RX
2 – Sets Offset Pull & Pushbar Combo	9190HD-12" CTC-J/N Mount	IV
1 – Ea. Surface Magnetic Lock (Fail SAFE)	1512-D-B-A-L-T	SD
1 – Ea. Low Energy Power Operator	Magic Force Surface Overhead	ST
1 – Ea. Motion Sensor	MD-31D	SD
1 – Ea. Exit Switch	413MNU	SD
1 – Ea. Manual Frame Actuator	HC PTO	TX
1 – Ea. Power Supply	PS902 x 900-FA	SC

Note 1: Weather seals shall be provided and shop installed by Contractor's storefront manufacturer. Coordinate with storefront manufacturer for all hardware that shall be shop installed by the storefront manufacturer as required for security storefront's performance and warranty requirements.

Note 2: Access Control System shall be installed by the security system trade, as indicated on the drawings.

Note 3: Remote Release will be provided at the Main Desk Area by the Security System trade, as indicated on the drawings.

Note 4: Tie into Fire Alarm System for Fail SAFE operation.

Note 5: Manual Frame Actuator will release Magnetic Lock and set Power Operator into motion. Exit Switch will only release Magnetic Lock.



#### HW SET E2

1 – Ea.	Center Hung Floor Closer	SC-2890N-CWF	RX
2 – Sets	Offset Pull & Pushbar Combo	9190HD-12" CTC-J/N Mount	IV
2 – Ea.	Bottom Rail Deadlocks (Cyl. x Cyl.)	1830	AR
4 – Ea.	Mortise Cylinders	1080-CT6, to suit	CR
4 – Ea.	Permanent Cores	8000-D1	CR
1 – Ea.	Low Energy Power Operator	Magic Force Surface Overhead	ST
1 – Ea.	Manual Frame Actuator	HC PTO	TX

**Note:** Weather seals shall be provided and shop installed by Contractor's storefront manufacturer. Coordinate with storefront manufacturer for all hardware that shall be shop installed by the storefront manufacturer as required for security storefront's performance and warranty requirements.

#### HW SET E3

1 – Ea.	Continuous Hinge	A500	AB
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Set	Weather Seals	429	ZE
1 – Ea.	Surface Automatic Door Bottom	351	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE

**Note:** Local Alarm will be provided at the Main Desk Area by the Security System trade, as indicated on drawings.

#### HW SET E4

1 – Ea.	Continuous Hinge	A500	AB
1 – Ea.	Rim Exit Device (Nightlatch)	XP99NL-F	VO
1 – Ea.	Rim Cylinder	3080-114-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Set	Weather Seals	429	ZE
1 – Ea.	Surface Automatic Door Bottom	351	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE

**Note:** Local Alarm will be provided at the Main Desk Area by the Security System trade, as indicated on drawings.

#### HW SET E5

1 – Ea.	Continuous Hinge	A500	AB
1 – Ea.	Rim Exit Device (Nightlatch)	XP99NL-F	VO
1 – Ea.	Rim Cylinder	3080-114-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Set	Weather Seals	429	ZE

1 – Ea. Surface Automatic Door Bottom 351 ZE

#### HW SET E6

As req.	Mortise Cylinders	1080-CT6, to suit	CR
As req.	Permanent Cores	8000-D1	CR
As req.	Overhead Door Contacts	958	AD

Note 1: All other hardware and seals required will be furnished by the Overhead Door Manufacturer. Refer to Section 08 33 23 "Overhead Coiling Doors"

Note 2: Local Alarm will be provided at the Main Desk Area by the Security System trade, as indicated on drawings.

#### HW SET E7

1 – Ea.	Continuous Hinge x Modification	A500-PT	AB
1 – Ea.	Power Transfer	EPT-10	VO
1 – Ea.	Mortise Lockset (Fail SAFE)	ML20932 x SAF-NSA-CT6	CR
2 – Ea.	Permanent Cores	8000-D1	CR
1 – Ea.	Door Closer Bracket	770SPB	
1 – Ea.	Surface Closer-Stop	4040XP-EDA (180 Degree)	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Wall Stop	WS407CVX	IV
1 – Set	Adjustable Gasketing	170AA	ZE
1 – Ea.	Mortise Automatic Door Bottom	364AA	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE
1 – Ea.	Power Supply	PS902 x 900FA	SC

Note 1: Access Control System will be provided by the Security System Contractor..

Note 2: Remote Release will be provided at the Main Desk Area by the Security System Contractor.

Note 3: Tie into Fire Alarm System for Fail SAFE operation.

#### HW SET G1

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
3 – Ea. Silencers	SR64	IV

#### HW SET G2

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Classroom)	ML2055-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV



HW SET G3

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Entrance)	ML2067-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV

HW SET G4

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Entrance)	ML2067-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP-18TJ x ST-1630	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Concealed Overhead Stop	1020SL Series	AB
3 – Ea. Silencers	SR64	IV

HW SET G5

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Mortise Lockset (Classroom)	ML2055-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Set Gasketing	188S	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE

HW SET G6

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Entrance)	ML2067-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV

HW SET G7

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Classroom)	ML2055-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP-18TJ x ST-1630	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Concealed Overhead Stop	1020SL Series	IV
3 – Ea. Silencers	SR64	IV

HW SET G8

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Mortise Lockset (Classroom)	ML2055-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP-EDA	LC

1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Wall Stop	WS407CVX	IV
3 – Ea.	Silencers	SR64	IV

#### HW SET G9

1 – Ea.	Center Hung Floor Closer	SC-2890N-CWF	RX
1 – Set	Push/Pulls	G52-01-023-L600	EL
1 – Ea.	Applied Stop	60131	RX

Note: Weather seals shall be provided and shop installed by Contractor's storefront manufacturer. Coordinate with storefront manufacturer for all hardware that shall be shop installed by the storefront manufacturer as required for security storefront's performance and warranty requirements.

#### HW SET G10

4 – Ea.	Butt Hinges	T4B3786 4.5 x 4.5	MC
1 – Ea.	Dutch Door Bolt	1630	IV
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Wall Stop	WS407CVX (Lower Leaf)	IV
1 – Ea.	Concealed Overhead Holder/Stop	1010SL Series	AB
4 – Ea.	Silencers	SR64	IV

#### HW SET G11

Prs. Butts per Paragraph 2.3.A		T4B3786 4.5 x 4.5	MC
1 – Ea.	Mortise Lockset (Entrance)	ML2067-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Wall Stop	WS407CVX	IV
1 – Set	Gasketing	188S	ZE
1 – Ea.	Mortise Automatic Door Bottom	364AA	ZE

#### HW SET G12

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Automatic Flush Bolts	FB32 x Bottom Fire Bolt	IV
1 – Ea. Mortise Lockset (Classroom)	ML2055-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Coordinator	COR-FL Series	IV
2 – Ea. Mounting Brackets	MB Series	IV
2 – Ea. Surface Closers	P-4040XP (Parallel Arm Mount)	LC
2 – Ea. Kick Plates	8402-8" x 2" LDW-B4E-CS	IV
2 – Ea. Wall Stops	WS407CVX	IV
1 – Set Gasketing	188S	ZE
2 – Ea. Mortise Automatic Door Bottoms	364AA	
1 – Ea. Astragal	41AA	ZE



HW SET G13

1 – Ea.	¾" Offset Floor Closer	SC-L2790N-CWF	RX
1 – Ea.	Intermediate Pivot	ML19	RX
1 – Set	Offset Pull & Pushbar Combo	9190HD-12" CTC-J/N Mount	IV
1 – Ea.	Deadlock (Cylinder x Cylinder)	MS1850S	AR
2 – Ea.	Mortise Cylinders	1080-CT6, to suit	CR
2 – Ea.	Permanent Cores	8000-D1	CR

Note: Weather seals shall be provided and shop installed by Contractor's storefront manufacturer. Coordinate with storefront manufacturer for all hardware that shall be shop installed by the storefront manufacturer as required for security storefront's performance and warranty requirements.

HW SET G14

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Passage Set	ML2010-NSA	CR
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV

HW SET G15

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer x Hold Open	4040XP-H	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
3 – Ea. Silencers	SR64	IV

HW SET G16

2 – Ea.	Continuous Hinges	A500	AB
2 – Ea.	Flush Bolts	FB458	IV
1 – Ea.	Dustproof Strike	DP2	IV
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
2 – Ea.	Kick Plates	8402-8" x 2" LDW-B4E-CS	IV
2 – Ea.	Wall Stops	WS407CVX	IV
2 – Ea.	Silencers	SR64	IV
1 – Ea.	Astragal	41	ZE

HW SET G17

1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer-Stop	4040XP-CUSH x 18 Bracket	LC

Note: Hinges will be provided by the Wire Mesh Gate Fabricator.



HW SET G18

1 – Ea.	Mortise Passage Set	ML2010-NSA	CR
1 – Ea.	Surface Closer-Stop	4040XP-CUSH x 18 Bracket	LC

Note: Hinges will be provided by the Wire Mesh Gate Fabricator.

HW SET G19

Prs.	Concealed Hinges per Paragraph 2.3.A	TE 540 3D	TE
2 – Ea.	Edge Pull (Bevel Edge)	RM753	RO
2 – Ea.	Magnetic Push Latches	245.75.930	HA
2 – Ea.	Magnetic Door Stops	Standard, Flush Mounted	FA

HW SET G20

2 – Sets	1-1/2" Offset Pivots	117- 1 ½	RX
2 – Ea.	Edge Pull (Bevel Edge)	RM753	RO
2 – Ea.	Magnetic Push Latches	245.75.930	HA
2 – Ea.	Magnetic Door Stops	Standard, Flush Mounted	FA

HW SET M1

Prs.	Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Door Closer Bracket	770SPB	ZE
1 – Ea.	Surface Closer	P-4040XP (180 Degrees)	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Wall Stop	WS407CVX	IV
1 – Set	Adjustable Gasketing	170AA	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings.

HW SET M2

Prs.	Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer	4040XP	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Wall Stop	WS407CVX	IV
1 – Set	Adjustable Gasketing	170AA	ZE
1 – Ea.	Mortise Automatic Door Bottom	364AA	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings



HW SET M3

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Power Transfer	EPT-10	VO
1 – Ea. Mortise Lockset (Fail Secure)	ML20906 x SEC-NSA-CT6-M92	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
1 – Set Adjustable Gasketing	170AA	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE
1 – Ea. Recessed Door Contact	SR-1078CTN/M	SE
1 – Ea. Power Supply	PS902	SC

Note: Access Control System will be provided by the Security System trade as indicated on drawings.

HW SET M4

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Rim Exit Device (Nightlatch)	99L-NL-F	VO
1 – Ea. Rim Cylinder	3080-114-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Door Closer Bracket	770SPB	ZE
1 – Ea. Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Set Adjustable Gasketing	170AA	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE
1 – Ea. Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings.

HW SET M5

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer-Stop	4040XP-SCUSH	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
3 – Ea. Silencers	SR64	IV
1 – Ea. Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System Contractor.



HW SET M6

2 – Ea.	Continuous Hinges	A500	AB
2 – Ea.	Flush Bolts	FB458	IV
1 – Ea.	Dustproof Strike	DP2	IV
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Closer Bracket	770SPB	ZE
1 – Ea.	Surface Closer-Stop	4040XP-SCUSH (Active Leaf)	LC
2 – Ea.	Kick Plates	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Surface Overhead Stop	N9020 Series (Inactive Leaf)	AB
1 – Set	Adjustable Gasketing	170AA	ZE
2 – Ea.	Surface Automatic Door Bottoms	351	ZE
1 – Ea.	Astragal	40 (Inswinging Leaf)	ZE
1 – Ea.	Astragal	41 (Outswinging Leaf)	ZE
2 – Ea.	Recessed Door Contacts	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System Contractor.

HW SET M7

Prs. Butts per Paragraph 2.3.A		T4B3786 5.0 x 4.5	MC
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer	4040XP-18TJ x ST-1630	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Concealed Overhead Stop	1020SL Series	AB
1 – Set	Gsketing	188S	ZE
1 – Ea.	Mortise Automatic Door Bottoms	364AA	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings.

HW SET M8

Prs. Butts per Paragraph 2.3.A		T4B3786 4.5 x 4.5	MC
1 – Ea.	Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea.	Permanent Core	8000-D1	CR
1 – Ea.	Surface Closer	4040XP-18TJ x ST-1630	LC
1 – Ea.	Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea.	Concealed Overhead Stop	1020SL Series	AB
1 – Set	Gsketing	188S	ZE
1 – Ea.	Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings.





HW SET M9

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5 NRP	MC
1 – Ea. Rim Exit Device (Nightlatch)	99L-NL-F	VO
1 – Ea. Rim Cylinder	3080-114-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Closer Bracket	770SPB	ZE
1 – Ea. Surface Closer	P-4040XP (180 Degrees)	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
1 – Set Adjustable Gasketing	170AA	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE
1 – Ea. Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings.

HW SET M10

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea. Mortise Lockset (Storeroom)	ML2057-NSA-CT6	CR
1 – Ea. Permanent Core	8000-D1	CR
1 – Ea. Surface Closer	4040XP	LC
1 – Ea. Kick Plate	8402-8" x 2" LDW-B4E-CS	IV
1 – Ea. Wall Stop	WS407CVX	IV
1 – Set Adjustable Gasketing	170AA	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE
1 – Ea. Recessed Door Contact	SR-1078CTN/M	SE

Note: Local Alarm will be provided at the Main Desk Area by the Security System trade as indicated on drawings.

HW SET S1

3 – Ea. Hinges	203FS	SF
2 – Ea. Raised Door Pull	212C	SF
1 – Ea. Deadlock (Key 2 Sides)	1080ASD-2-HM-4C	SF
1 – Ea. Door Stop	420	SF
1 – Set Gasketing	188S	ZE
1 – Ea. Mortise Automatic Door Bottom	364AA	ZE

HW SET S2

3 – Ea. Hinges	203FS	SF
1 – Ea. Raised Door Pull	212C	SF
1 – Ea. Recessed Door Pull	214S	SF
1 – Ea. Deadlock (Key 1 Side)	1080ASD-1-HM-4C	SF
1 – Ea. Door Stop	420	SF



HW SET S3

3 – Ea.	Hinges	203FS	SF
2 – Ea.	Raised Door Pull	212C	SF
1 – Ea.	Deadlatch (Key 2 Sides)	1070A-2-HM-470C	SF
1 – Ea.	Door Stop	420	SF
1 – Set	Gasketing	188S	ZE
1 – Ea.	Mortise Automatic Door Bottom	364AA	ZE

HW SET S4

1 – Ea.	Deadlock (Key 2 Sides)	1080ASD-2-HM-4C	SF*
1 – Ea.	Door Threshold (Rabbeted)	566	ZE**
2 – Ea.	Cam Lift Hinges	950	ZE**
1 – Ea.	Hardware set - Head and jamb	770A	ZE**
1 – Ea.	Auto door bottom	367	ZE**

\*Note: No substitutions allowed for Deadlock.

\*\*Note: No substitutions allowed for Door Threshold, Cam Lift Hinges, Hardware Set – Head and Jambs, Auto Door Bottom, or Spring Bronze at Head and Jambs. This hardware shall be factory-installed by acoustical door and frame manufacturer, for acoustically rated door and frame, as specified under Acoustical Doors and Frames in Section 08 11 13 – “Hollow Metal Doors and Frames”.

HW SET S5

3 – Ea.	Hinges	205FS	SF
1 – Ea.	Raised Door Pull	212C	SF
1 – Ea.	Recessed Door Pull	214S	SF
1 – Ea.	Deadlock (Key 1 Side)	1080ASD-1-HM-4C	SF

HW SET T1

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea.	Rim Exit Device (Passage)	VO
1 – Ea.	Surface Closer	LC
1 – Ea.	Kick Plate	IV
1 – Ea.	Wall Stop	IV
1 – Set	Gasketing	ZE
1 – Ea.	Mortise Automatic Door Bottom	ZE

HW SET T2

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea.	Rim Exit Device (Passage)	VO
1 – Ea.	Surface Closer-Stop	LC
1 – Ea.	Kick Plate	IV
1 – Set	Gasketing	ZE
1 – Ea.	Mortise Automatic Door Bottom	ZE

HW SET T3

Prs. Butts per Paragraph 2.3.A	T4B3786 4.5 x 4.5	MC
1 – Ea.	Rim Exit Device (Passage)	VO
1 – Ea.	Surface Closer-Stop	LC



MISCELLANEOUS

- |         |                                     |  |
|---------|-------------------------------------|--|
|         | Wiring Diagrams, all wired systems. |  |
| 1 – Ea. | Key Cabinet                         | TelKee Complete System, or approved<br>equal per 2.3 E 2, to suit. |

**END OF SECTION 08 70 00**



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**SECTION 08 80 00**

**GLAZING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Glass for windows, doors and curtain walls.
  2. Fire-protection-rated glazing.
  3. Fire-resistance-rated glazing.
  4. Glazing sealants.
  5. Installation accessories.
- B. Related Sections:
1. Section 08 11 13 "Hollow Metal Doors and Frames."
  2. Section 08 41 13 "Interior Aluminum Entrances and Storefronts."
  3. Section 08 44 13 "Glazed Curtain Walls" for glazing sealants used in glazed curtain walls.
  4. Section 08 88 53 "Security Glazing."

**1.3 DEFINITIONS**

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS



- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.6 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Engineering Services Submittal: For glass, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.
- C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.9 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of glass.
- B. Product Test Reports: For coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.
  1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- C. Preconstruction adhesion and compatibility test report.



- D. Sample Warranties: For special warranties.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Install glazing in mockups specified in Section 084413 "Glazed Aluminum Curtain Walls" and other sections, to match glazing systems required for Project, including glazing methods.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.11 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.13 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.



1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

#### 1.14 WARRANTY

- A. **Manufacturer's Special Warranty for Coated-Glass Products:** Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. **Manufacturer's Special Warranty on Laminated Glass:** Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

- C. **Manufacturer's Special Warranty for Insulating Glass:** Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Source Limitations for Glass:** Obtain from single source from single manufacturer for each glass type.
- B. **Source Limitations for Glazing Accessories:** Obtain from single source from single manufacturer for each product and installation method.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. **Engineering Services:** Engage a qualified Professional Engineer licensed in the State of New York to design glass for project application.
  1. Engineering Services shall include complete design calculations for glass required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.





- b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the 2014 New York City Building Code and ASTM E1300.
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.



- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.
- F. Fire- Protection- Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to the New York City Department of Buildings. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.
- G. Fire- Resistance- Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to the 2014 New York City Building Code. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.

## 2.4 GLASS PRODUCTS

- A. Basis- of- Design, Manufacturers: Subject to compliance with requirements. provide products as indicated in other Part 2 articles or comparable product from one of the following, as approved by the Commissioner:
  - 1. Cardinal Glass Industries.
  - 2. Oldcastle BuildingEnvelope.
  - 3. Viracon, Inc.
  - 4. Vitro (formerly PPG)
  - 5. Or approved equal.
- B. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- C. Ultraclear, Low- iron Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and solar heat gain coefficient of not less than 0.87.
  - 1. Basis- of- Design, Product: Subject to compliance with requirements. provide the following or equal as approved by the Commissioner:
    - a. Guardian Glass; Ultraclear low- iron glass or an equivalent product from an approved manufacturer.
- D. High Performance Reflective- Coated Vision Glass: ASTM C 1376.
  - 1. Basis- of- Design, Product: Subject to compliance with requirements. provide the following or equal as approved by the Commissioner:
    - a. Guardian Glass; Sunguard AG 50 or an equivalent product from an approved manufacturer.
- E. Low- Emissivity (Low- e) Glass: Pyrolytically coated clear Low- e coated glass.



1. Basis- of- Design, Product: Subject to compliance with requirements. provide the following or equal as approved by the Commissioner:
  - a. Guardian Glass; Sunguard SuperNeutral 68 or an equivalent product from an approved manufacturer.
- F. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- G. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

## 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  1. Construction: Laminate glass with polyvinyl butyral interlayer, ionomeric polymer interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
  2. Interlayer Thickness: Provide thickness not less than that indicated and needed to comply with requirements.
  3. Interlayer Color: As indicated in Part 3 schedule.
- B. Basis- of- Design, Interlayer Products: Subject to compliance with requirements, provide McGrory Glass- DAT 041 or equal product from one of the following, as approved by the Commissioner:
  1. SentryGlas; Kuraray America, Inc.
  2. Eastman Chemical Company; Saflex.
  3. Or approved equal.

## 2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
  1. Sealing System: Dual seals, with manufacturer's standard primary and secondary sealants.
  2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

## 2.7 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to the New York City Department of Buildings and New York City Fire Department, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.
- B. Film- Faced Ceramic Glazing: Clear, ceramic flat glass; 3/ 16 inch thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.
  1. Products: Subject to compliance with requirements, provide the following:



- a. SAFTI FIRST Fire Rated Glazing Solutions; Pyran Platinum F.
  - b. Technical Glass Products; FireLite NT.
  - c. Vetrotech Saint-Gobain; Keralite Filmed.
  - d. Or approved equal.
- C. Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 5/ 16 inch (8-mm) total thickness; and complying with 16 CFR 1201, Category II.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. SAFTI FIRST Fire Rated Glazing Solutions; Pyran Platinum L.
    - b. Technical Glass Products; FireLite Plus.
    - c. Vetrotech Saint-Gobain; Keralite Laminated.
    - d. Or approved equal.

## 2.8 FIRE-RESISTANCE-RATED GLAZING

- A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to the New York City Department of Buildings and New York City Fire Department, for fire-resistance ratings indicated, based on testing according to ASTM E119 or UL 263.
- B. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.
  - 1. Basis- of- Design, Products: Subject to compliance with requirements, provide Pilkington Pyrostop, 120-minute or one of the following, as approved by the Commissioner:
    - a. SAFTI FIRST Fire Rated Glazing Solutions; SuperLite II-XLM.
    - b. Technical Glass Products; Pyrostop.
    - c. Vetrotech Saint-Gobain; Contraflam.
    - d. Or approved equal.

## 2.9 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Colors of Exposed Glazing Sealants: As selected by Commissioner from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

## 2.10 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  - 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.11 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:
  - 1. Neoprene with a Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended by sealant or glass manufacturer.
- C. Spacers:
  - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 2. Type recommended by sealant or glass manufacturer.
- D. Edge Blocks:
  - 1. Neoprene with a Shore A durometer hardness per manufacturer's written instructions.
  - 2. Type recommended by sealant or glass manufacturer.
- E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.4 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.5 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.



- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.6 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.7 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure.
  - 1. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.



### 3.8 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.9 GLASS SCHEDULE

- A. MG-1: 1/ 4 inch tempered glass.
  - 1. Application: Vision panels, borrowed lights.
- B. GL-1: 9/ 16 inch laminated, fully tempered glass.
  - 1. Application: Interior lightwell, sidelights.
- C. IG-1: 1 inch Insulated glazing unit.
  - 1. Application: Curtain wall shadow boxes.
    - a. U-value: 0.25
    - b. SHGC: 0.36
  - 2. 1/ 4 inch ultraclear low-iron float glass with high performance reflective film on no. 2 surface.
  - 3. 1/ 2 inch argon- filled air space.
  - 4. 1/ 4 inch ultraclear low-iron float glass with low-e coating on no. 3 surface.
- D. IG-2: 1 3/4 inch Insulated glazing unit.
  - 1. Application: Curtain wall vision glazing.
    - a. U-value: 0.16
    - b. SHGC: 0.27
  - 2. 1/ 4 inch ultraclear low-iron float glass with high performance reflective film on no. 2 surface.
  - 3. 1/ 2 inch argon- filled air space.
  - 4. 1/ 4 inch ultraclear low-iron float glass
  - 5. 1/ 2 inch argon- filled air space.
  - 6. 1/ 4 inch ultraclear low-iron float glass with low-e coating on no. 5 surface.





- E. IG-3: 1 3/4 inch Insulated glazing unit with tempered interior pane.
1. Application: Curtain wall vision glazing less than 18 inches above finished floor.
    - a. U-value: 0.16
    - b. SHGC: 0.27
  2. 1/4 inch ultraclear low-iron float glass with high performance reflective film on No. 2 surface.
  3. 1/2 inch argon- filled air space.
  4. 1/4 inch ultraclear low-iron float glass
  5. 1/2 inch argon- filled air space.
  6. 1/4 inch ultraclear low-iron, fully- tempered glass with low-e coating on no. 5 surface.
- F. IG- 4: 1 inch Insulated glazing unit with translucent, silkscreen white ceramic frit, white simulated acid-etch.
1. Application: Interior lightwell aluminum storefront at east, south, and west walls of lightwell.
  2. 1/4 inch ultraclear low-iron, fully- tempered glass with 5 percent opacity, frit on No. 2 surface.
  3. 1/2 inch argon- filled air space.
  4. 1/4 inch ultraclear low-iron, fully- tempered glass with low-e coating on no. 3 surface.
- G. IG- 5: 1 inch Insulated glazing unit with translucent, silkscreen white ceramic frit simulated acid-etch.
1. Application: interior lightwell aluminum storefront at north wall to conference room
  2. 1/4 inch ultraclear low-iron, fully- tempered glass with 10 percent opacity frit on No. 2 surface.
  3. 1/2 inch argon- filled air space.
  4. 1/4 inch ultraclear low-iron, fully- tempered glass with low-e coating on no. 3 surface.
- H. GF-1: 45- Minute fire rated ceramic glazing.
1. Application: Muster Room vision panels.
- I. GF-2: 90- Minute fire rated laminated ceramic safety glazing.
1. Application: Doors and sidelights at Stair A and Stair B.
- J. GF-3: 2 3/8 inch, 90- Minute fire resistance rated laminated intumescent insulated glazing.
1. Application: Roof monitor fire- resistant curtain wall exterior glazing.
  2. U-Value: 0.35.
- K. GF-4: 1-9/16 inch, 120- Minute fire resistance rated laminated intumescent glazing.
1. Application: Sidelights at doors between corridor and Stair A and B.

**END OF SECTION 08 80 00**



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**SECTION 08 88 53**

**SECURITY GLAZING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Laminated security glazing.
  2. Glass-clad polycarbonate and air-gap security glazing.
  3. Glazing sealants.
  4. Installation accessories.
- B. Related Sections:
1. Section 08 43 33 "Security Storefronts."
  2. Section 08 88 00 "Glazing."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Engineering Services Submittal: For security glazing, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any contract the work.
- C. Security Glazing Samples: For each type of security glazing; 12 inches square.
- D. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers.
- B. Product Certificates: For each type of product indicated, from manufacturer.
- C. Product Test Reports: For each type of glazing sealant, for tests performed by a qualified testing agency.
  - 1. Provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test reports.
- E. Sample Warranties: For special warranties.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Security Glazing Testing Agency Qualifications: Subject to compliance with requirements, testing agency shall be one of the following:
  - 1. H. P. White Laboratory, Inc.
  - 2. Underwriters Laboratories, Inc.
  - 3. Wiss, Janney, Elstner Associates, Inc.



4. Approved equal.

- C. Sealant Testing Agency Qualifications: Qualified according to ASTM C 1021 for testing indicated.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install security glazing in mockups specified in other sections to match glazing systems required for Project, including glazing methods.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.10 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Refer to Section 08 80 00 - Glazing for requirements.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.12 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

#### 1.13 WARRANTY

- A. Manufacturer's Special Warranty for Glass-Clad Polycarbonate: Manufacturer agrees to replace glass-clad polycarbonate that deteriorates within specified warranty period. Deterioration of glass-clad polycarbonate is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same types of lites, plies, interlayers, and spacers for each security glazing type indicated.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design security glazing for project application.
  - 1. Engineering Services shall include complete design calculations for security glazing and connections required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated.
  - 1. Design Procedure for Glass: ASTM E1300 and 2014 New York City Building Code.
  - 2. Design Wind Pressures: As indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

### 2.3 SECURITY GLAZING, GENERAL

- A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.



- C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to the New York City Department of Buildings. Label shall indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.
- D. Insulating Glazing Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.
- E. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on construction products indicated and on procedures indicated below:
  - 1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 2. Solar-Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.4 GLASS PRODUCTS

- A. Float Glass: ASTM C1036, Refer to Section 08 80 00 - Glazing for material and product requirement.
- B. Ultraclear, Low- iron Float Glass: Refer to Section 08 80 00 - Glazing for material and product requirements.
- C. High Performance Reflective- Coated Vision Glass: Refer to Section 08 80 00 - Glazing for material and product requirements
- D. Fully Tempered Float Glass: Refer to Section 08 80 00 - Glazing for material and product requirement.
- E. Laminated Glass: Refer to Section 08 80 00 - Glazing for material and product requirement.

## 2.5 POLYCARBONATE SECURITY GLAZING

- A. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.
- B. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C1349 for maximum allowable laminating process blemishes and haze.
- C. Glass-Clad Polycarbonate: ASTM C1349.
- D. Basis- of- Design, Product: Subject to compliance with requirements. provide the following or equal as approved by the Commissioner:
  - 1. Global Security Glazing; SP035.



## 2.6 INSULATING SECURITY GLAZING

- A. Insulating Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace, qualified according to ASTM E2190
  - 1. Sealing System: Dual seal.
- B. Basis- of- Design, Products: Subject to compliance with requirements. provide Oldcastle Building Envelope; Armorprotect Plus 121200, 11/ 16 inch, HPW Lev 1, 9mm, HPW Lev B or equal from one of the following, as approved by the Commissioner:
  - 1. Global Security Glazing – “Secur-Tem + Poly 2116” IGU.
  - 2. Saftifirst IGU.
  - 3. Or approved equal.

## 2.7 GLAZING SEALANTS

- A. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and security glazing manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.





- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.10 FABRICATION OF SECURITY GLAZING

- A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine framing for security glazing, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep system.
  - 3. Minimum required face or edge clearances.
  - 4. Minimum required bite.
  - 5. Effective sealing between joints of framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

### 3.4 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.



- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
- F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.

### 3.5 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.6 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket securely in place between glazing unit and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.



- D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.7 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to security glazing and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from security glazing.

### 3.8 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter.
  - 1. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.

### 3.9 SECURITY GLAZING SCHEDULE

- A. SG-1: Glass-clad polycarbonate; 1-1/4 inch Laminated security glazing.
  - 1. 60- minute attack WMFL Level I.
  - 2. Application: Interior security borrowed lights.
- B. SG-2: 1- 3/ 8 inch laminated security glazing with mirror pane.
  - 1. 60- minute attack WMFL Level I.
  - 2. Application: Interview room viewing windows.
- C. ISG-1: Insulated glass polycarbonate; 1-7/ 8 inch Insulated laminated security glazing.
  - 1. HPW I-B.
  - 2. Application: First floor exterior glazing.
    - a. U-value: 0.22
    - b. SHGC: 0.38



3. 1/ 4 inch fully tempered low-iron glass with high performance reflective film on no. 2 surface.
4. 1/ 2 inch argon- filled air space.
5. Glass polycarbonate security glazing with low-iron glass plies and mar-resistant coating on interior polycarbonate surface.

**END OF SECTION 08 88 53**

**SECTION 08 91 19****FIXED LOUVERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Fixed extruded-aluminum louvers.
  2. Louver screens.
  3. Insulated blank-off panels for louvers.
  4. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work, including surrounding aluminum curtain wall mullions at all sides of louver area. Show frame profiles and blade profiles, angles, and spacing.
- C. Engineering Services Submittal: For louvers and connections, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.
- D. Samples: For each type of metal finish required by project application.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Sample Warranties: For manufacturer's special warranties.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Welding Qualifications: Qualify procedures according AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- C. On-site Facade Mockup: Construct on-site facade mockup as indicated on the drawings, incorporating work specified in this section. All required submittals for the work specified in this section shall be submitted by the Contractor and accepted by the Commissioner prior to the Contractor furnishing elements for the on-site facade mockup.
  - 1. Provide complete fixed louver installation in sizes, quantities, and configuration indicated on the drawings for use in the on-site facade mockup.
  - 2. Incorporate full-scale details of the architectural features, approved finishes, brackets, and attachments to be provided at full-scale building.
  - 3. Approval of on-site facade mockup does not constitute approval of deviations from the Contract Documents contained in the on-site facade mockup unless the Commissioner specifically approves such deviations in writing.



4. Maintain the on-site facade mockup at the project site until directed to demolish and remove the on-site facade mockup by the Commissioner.

#### 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### 1.10 WARRANTY

- A. Special Finish Warranty: Manufacturer agrees to restore or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design louvers including connections.

1. Engineering Services shall include complete design calculations for louvers and connections required for this project.

- a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
- b. Design calculations shall be based on Performance Requirements and product design criteria indicated.

- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- D. Louver Performance Ratings: Louvers shall comply with requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.



## 2.3 FIXED ALUMINUM LOUVERS

### A. Vertical Extreme Weather Louvers:

1. Basis of Design, Products: Subject to compliance with requirements, provide the following or equal product, as approved by the Commissioner:
  - a. Manufacturer: Construction Specialties, Inc.
  - b. Model: RS- 5605
  - c. Depth: 5 inch
2. Other Manufacturers:
  - a. Airolite Company, LLC (The).
  - b. Architectural Louvers; Harray, LLC.
  - c. Or approved equal.

### B. Acoustical Louvers: For use at emergency generator exhaust.

1. Basis of Design, Products: Subject to compliance with requirements, provide the following or equal product, as approved by the Commissioner:
  - a. Manufacturer: IAC Acoustics
  - b. Model: Noishield Acoustic Louvers Model R
  - c. Blade type: Airfoil blade
  - d. Depth: 12 inch
2. Other Manufacturers:
  - a. Airline Louvers.
  - b. Greenheck.
  - c. Riskin.
  - d. Or approved equal.

## 2.4 LOUVER SCREENS

### A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

### B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

### C. Louver Screening for Aluminum Louvers:

1. Bird Screening: Stainless steel, 1/2-inch-square mesh, 0.047-inch wire.

## 2.5 BLANK-OFF PANELS

### A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.





1. Size: As indicated on drawings.
2. Thickness: 3 inch, unless otherwise indicated.
3. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
4. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam meeting project energy performance requirements.
5. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
6. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
7. Panel Finish: Same finish applied to louvers.

a. Color and Gloss: As indicated on drawings.

8. Attach blank-off panels with clips or sheet metal screws.

## 2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  3. For fastening stainless steel, use 300 series stainless-steel fasteners.
  4. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.7 FABRICATION

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  1. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly with bolted connections between frame members, to meet project performance requirements.
- B. Fabricate louvers to accept curtain wall construction as indicated on drawings, with positive drainage from the rear of the louver to the exterior face of the building.



## 2.8 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As indicated on drawings.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.4 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.
- F. Include louver frame and any metal backup framing and bracing required to support louvers per manufacturer instructions. Backup framing shall be minimized and located so as to not conflict with any mechanical plenums at louvers.



**3.5 ADJUSTING AND CLEANING**

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Commissioner, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION 08 91 19**



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## **SECTION 09 21 16**

### **GYPSUM BOARD SHAFT WALL ASSEMBLIES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section includes:
  - 1. Gypsum board shaft wall assemblies.
  - 2. Installation accessories.
- B. Related Sections:
  - 1. Section 09 22 16 "Non-structural Metal Framing."
  - 2. Section 09 29 00 "Gypsum Board."

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each component of gypsum board shaft wall assembly.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

**1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.



- C. Framing Performance Characteristics: Gypsum board shaft-wall assemblies shall withstand the design loads (air pressures) without failing and while maintaining an airtight and smoke-tight seal, as required by the 2014 New York City Building Code. Apply design loads transiently and cyclically under in-service conditions for maximum heights of partitions indicated. Evidence of failure includes deflections exceeding those indicated below, bending stresses causing studs to break or to distort, and end-reaction shear causing runners to bend or to shear and studs to become crippled.
1. Structural Criteria: Limiting heights of partitions are based on L/ 240 at 510 psi. Increase gage of steel framing to maintain above criteria while not increasing the thickness of partition.
  2. Lateral Design Load: As indicated, but not less than 10 psf.
  3. Deflection Limit: As indicated, but not more than 1/ 240 of partition height, unless otherwise indicated and required.
  4. Seismic Characteristics, where required: Fabricate assemblies to comply with seismic load criteria, as required by the 2014 New York City Building Code.

## 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated
- B. STC Rating: As indicated.
- C. Gypsum Shaftliner Board:
1. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) CertainTeed Corporation; ProRoc Moisture and Mold Resistant Shaftliner.
      - 2) Continental Building Products, LLC; Mold Defense Shaftliner Type X.
      - 3) Georgia-Pacific Gypsum LLC; Dens-Glass Ultra Shaftliner.
      - 4) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
      - 5) USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.
      - 6) Approved equal.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
1. Protective Coating: Refer to Section 09 22 16 "Non-Structural Metal Framing."
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
1. Depth: As indicated.
  2. Minimum Base-Metal Thickness: As indicated and required by project performance requirements.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.



1. Minimum Base-Metal Thickness: Matching steel studs.
- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  1. Refer to Section 09 29 00 "Non- structural Metal Framing."
- H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.
- I. Finish Panels: Gypsum board, refer to Section 09 29 00 "Gypsum Board."
- J. Sound Attenuation Blankets: Refer to Section 09 29 00 "Gypsum Board."

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Refer to Section 09 29 00 "Gypsum Board." Cornerbead, edge trim, and control joints of material and shapes that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
  2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency
- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).
- F. Acoustical Sealant: Refer to Section 09 29 00 "Gypsum Board."
- G. Gypsum Board Cants:
  1. Gypsum Board Panels: Refer to Section 09 29 00 "Gypsum Board."
  2. Laminating adhesive: Refer to Section 09 29 00 "Gypsum Board."
  3. Non-Load-Bearing Steel Framing: Refer to Section 09 22 16 "Non-Structural Metal Framing."



**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 PREPARATION**

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

**3.4 INSTALLATION**

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
  - 2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.



- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Commissioner while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Gypsum Board Cants: At projections into shaft exceeding 4 inches where indicated, install gypsum board cants covering tops of projections.
  - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
  - 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION 09 21 16**

**SECTION 09 22 16****NON-STRUCTURAL METAL FRAMING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Non-load-bearing steel framing systems for interior partitions.
  2. Suspension systems for interior ceilings and soffits.
  3. Grid suspension systems for gypsum board ceilings.
- B. Related Sections:
1. Section 09 21 16 "Gypsum Board Shaft Wall Assemblies."
  2. Section 09 29 00 "Gypsum Board."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For firestop tracks and post-installed anchors, from ICC-ES or other qualified testing agency acceptable to New York City Department of Buildings and New York City Fire Department.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Metal framing assemblies shall be capable of withstanding following lateral design loadings for maximum heights of partitions without failing. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end reaction shear causing track (runners) to bend or to shear and studs to become crippled. Comply with SA923 of United States Gypsum Company and as required by the 2014 New York City Building Code.
  - 1. Lateral Loading, Partition, Furring and Other Assemblies: 5.0 psf, unless otherwise indicated.
  - 2. Deflection Limits, Painted Assemblies: 1/360 of partition height.



3. Deflection Limits, Tile and Other Hard Finish Surfaces: 1/360 of partition height.

## 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
  3. Protective Coating where used at exterior walls and areas subject to high humidity, i.e., 'wet areas': ASTM A 653/A 653M, G90, hot-dip galvanized unless otherwise indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ClarkDietrich; ProSTUD Drywall Framing or Trakloc Deflection Stud Assembly.
  2. MarinoWARE; QuickFrame Rough Opening System, StudRite Drywall Framing, or ViperStud Drywall Framing.
  3. Telling Industries; Equivalent products.
  4. Approved equal.
- C. Studs and Tracks: ASTM C 645.
  1. Steel Studs and Tracks, to suit project application:
    - a. Minimum Base-Metal Thickness: As indicated and required by performance requirements for horizontal deflection.
    - b. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
  1. Single Long-Leg Track System: ASTM C 645 top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  2. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
  3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) ClarkDietrich; MaxTrak or Slotted Deflection Track.
      - 2) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
      - 3) The Steel Network, Inc.; VertiClip SLD or VertiTrack VTD.
      - 4) Approved equal.



- E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CEMCO; California Expanded Metal Products Co.; FAS Track.
    - b. ClarkDietrich; BlazeFrame.
    - c. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.
    - d. The Steel Network, Inc.; VertiTrack VT.
    - e. Approved equal.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.0179 inch.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
  - 1. Depth: 1-1/2 inches.
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.0179 inch.
  - 2. Depth: 7/8 inch.
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
  - 1. Configuration: Asymmetrical or hat shaped.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
  - 1. Depth: 3/4 inch.
  - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:



1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to New York City Department of Buildings, based on ICC-ES AC58 or AC308 as appropriate for the substrate.
  - a. Uses: Securing hangers to structure.
  - b. Type: Torque-controlled, , adhesive anchor or adhesive anchor.
  - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
  1. Depth: As indicated on Drawings.
- E. Furring Channels (Furring Members):
  1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  2. Steel Studs and Tracks: ASTM C 645.
    - a. Minimum Base-Metal Thickness: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
  3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base-Metal Thickness: As indicated on Drawings.
  4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following systems to suit project application:
    - a. Armstrong World Industries, Inc; Drywall Grid Systems.
    - b. Rockfon (Rockwool International); 640/660 Drywall Ceiling Suspension, 650/670 Fire Rated Drywall Ceiling Suspension, Radius Drywall Ceiling Suspension or.
    - c. USG Corporation; Drywall Suspension System or Wall-to-Wall Drywall Suspension System.
    - d. Approved equal.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.



1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
  2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch-thick, in width to suit steel stud size.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 PREPARATION

- A. Coordination with Sprayed Fire-Resistive Materials:
  1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

#### 3.4 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.





- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.5 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.



F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.6 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c. unless otherwise indicated.
2. Carrying Channels (Main Runners): 48 inches o.c. unless otherwise indicated.
3. Furring Channels (Furring Members): 16 inches o.c. unless otherwise indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
  - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.



7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

**END OF SECTION 09 22 16**



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**SECTION 09 29 00**

**GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Interior gypsum board.
  2. Tile backing panels.
  3. Installation accessories.
- B. Related Sections:
1. Section 09 21 16 "Gypsum Board Shaft Wall Assemblies."
  2. Section 09 22 16 "Non- structural Metal Framing."
  3. Section 09 30 13 "Ceramic Tiling."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Gypsum-containing products shall contain "synthetic" gypsum produced with a minimum of 75% post-industrial recycled content, if readily available.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 COORDINATION**

- A. Coordinate installation of gypsum board products and metal framing with security meh products.



1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

1.9 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Continental Building Products, LLC
  - 2. CertainTeed Corporation.
  - 3. Georgia-Pacific Gypsum LLC.
  - 4. National Gypsum Company
  - 5. USG Corporation.
  - 6. Approved equal.



## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

## 2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

## 2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
  - 1. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- B. Gypsum Ceiling Board: ASTM C1396/C1396M.
  - 1. Thickness: 5/ 8 inch.
  - 2. Long Edges: Tapered.
- C. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
  - 1. Core: 5/8-inch, Type X.
  - 2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
  - 3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
  - 4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
  - 5. Long Edges: Tapered.
  - 6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
  - 1. Core: 5/ 8-inch, Type X.
  - 2. Long Edges: Tapered.
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

## 2.5 TILE BACKING PANELS

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. CertainTeed Corporation; FiberCement BackerBoard.
  - 2. Custom Building Products; EasyBoard or Wonderboard.
  - 3. National Gypsum Company; PermaBase BRAND Cement Board.
  - 4. USG Corporation; DUROCK Cement Board or USG Durock Brand Cement Board.
  - 5. Approved equal.



- B. Core: 5/ 8-inch, Type X.
- C. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

## 2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes, Use the following as indicated and required to suit project application:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.7 DECORATIVE PROFILE TRIM AND REVEALS

- A. Description: Extruded aluminum profile trim and reveal, in sizes and configurations; "C"-reveal, "F"-reveal, "Z"-reveal, as indicated on drawings.
- B. Finish: Extruded aluminum, clear anodized finish.
- C. Basis-of-Design, Products: Subject to compliance with requirements, provide Fry Reglet, DRM/DRMF series or one of the following as approved by the Commissioner:
  - 1. Gordon, 200/300/400/500 Series Reveals
  - 2. Pittcon Industries, STR/SWR/SWR-U series.
  - 3. Approved equal.

## 2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
  - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.





4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.9 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

2.10 SECURITY MATERIALS

- A. Maximum Security Mesh: Expanded metal minimum 9 gage flattened, galvanized security mesh conforming to ASTM 1267 Type II (expanded and flattened) with Class 2, hot-dipped galvanized finish.
  1. Minimum weight: 1.40 lbs. per square foot.
  2. Overall Thickness: 0.70 inch.
  3. Open Area: 57 percent.
- B. Basis-of-Design, Products: Subject to compliance with requirements, provide "ASM .50 -13F" as supplied by Amico, A Gibraltar Industries Company or comparable product by one of the following, as approved by the Commissioner:
  1. Alabama Metal Industries Corporation.
  2. ClarkDietrich
  3. Niles Expanded Metals
  4. Approved equal.
- C. Fasteners: Mechanical fasteners and other means of attachment as recommended by the security mesh manufacturer.
- D. General: Provide other security materials for gypsum board work of the grade recommended by the manufacturer of the security materials.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 APPLYING AND FINISHING PANELS**

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.



- I. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- J. Attachment for Decorative Profile Trim and Reveals Screw to gypsum board panels through 7/8 inch grooved mudding ramps at each side.
  - 1. Apply tape and joint compound over mudding ramps flush with adjacent finish.
  - 2. Use projecting or flush trim edges at reveal, as indicated on drawings.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- L. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- M. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- N. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- O. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
  - 4. Level 5: Where indicated on Drawings.
- P. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

### 3.4 PROTECTION

- A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-drywall surfaces. Restore surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and restore panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
- D. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION 09 29 00**



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## **SECTION 09 30 13**

### **CERAMIC TILING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
1. Glazed wall tile.
  2. Waterproof membrane for thinset applications.
  3. Installation accessories.
- B. Related Sections:
1. Section 09 22 16 "Non- structural Metal Framing."
  2. Section 09 29 00 "Gypsum Board."

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Gypsum-containing products shall contain "synthetic" gypsum produced with a minimum of 75% post-industrial recycled content, if readily available.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
  - 1. Each type and composition of tile and for each color and finish required.

#### 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of a single 96 inch by 96 inch mockup of patterned tile accent wall composed of four (4) glazed tile colors as indicated on drawings, in a location within one Locker Room as chosen by Commissioner.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

**2.2 PRODUCTS, GENERAL**

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

**2.3 CERAMIC TILE PRODUCTS**

- A. Basis of Design, Product: Subject to compliance with requirements, provide semi- gloss, glazed ceramic tile as supplied by Daltile or comparable product, as approved by the Commissioner from one of the following:
  - 1. American Marazzi Tile, Inc.
  - 2. Crossville, Inc.
  - 3. Lone Star Ceramics; Elgin Butler.
  - 4. Or approved equal.
- B. Tile Shapes:
  - 1. Square Field: 4 1/4 by 4 1/4 inch by 5/16 inch thick.
  - 2. Bullnose: 4 1/4 by 4 1/4 inch by 5/16 inch thick runner tile at exterior corner edges of tiled surfaces.

**2.4 WATERPROOF MEMBRANE**

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
- C. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Custom Building Products; REdGard Waterproofing and Crack Prevention Membrane.
  - 2. LATICRETE SUPERCAP, LLC; Laticrete Hydro Ban.
  - 3. MAPEI Corporation; Mapelastic HPG.
  - 4. Approved equal.



## 2.5 SETTING MATERIALS

- A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

## 2.6 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

## 2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

## 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Commissioner.





- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.4 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

### 3.5 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Masonry or Concrete:
  - 1. Ceramic Tile Installation Insert designation: TCNA W222 and ANSI A108.1A; one-coat cement mortar bed (thickset) on metal lath over waterproof membrane.
    - a. Bond Coat for Wet-Set Method: Improved modified dry-set mortar.
    - b. Bond Coat for Cured-Bed Method: Improved modified dry-set mortar.
    - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Metal Studs:
  - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.
    - a. Thinset Mortar: Improved modified dry-set mortar.
    - b. Grout: Water-cleanable epoxy grout.

**END OF SECTION 09 30 13**



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**SECTION 09 51 13****ACOUSTICAL PANEL CEILINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Acoustical ceiling panels.
  2. Perforated metal ceiling panels.
  3. Exposed suspension systems for interior ceilings.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Gypsum-containing products shall contain "synthetic" gypsum produced with a minimum of 75% post-industrial recycled content, if readily available.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."



**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

**1.8 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For finishes to include in maintenance manuals.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

**1.11 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A according to ASTM E 1264.
  - 2. Smoke-Developed Index: 50 or less.

**2.3 ACOUSTICAL PANELS, GENERAL**

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4-inches away from test surface per ASTM E 795.
- B. Ceiling Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by the Commissioner from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Coating-Based Antimicrobial Treatment: Provide panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273.

**2.4 ACOUSTICAL PANELS**

- A. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. USG Interiors Inc.
  - 2. Ecophon CertainTeed, Inc.
  - 3. Hunter Douglas Architectural Products.
  - 4. Armstrong World Industries, Inc.
  - 5. Approved equal.
- B. Refer to Drawing for acoustical panel selections.

**2.5 PERFORATED METAL CEILING PANELS**

- A. Where this designation is indicated on the Drawings, provide specified products complying with the following characteristic:



1. Sheet Metal Characteristics: Form metal panels from sheet metals selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discolorations, or other imperfections.
  2. Perforations: .060-inch diameter, open area 23 percent.
- B. Basis-of-Design, Product: Subject to compliance with requirements, provide :Luxalon Model #160 as supplied by Hunter Douglas Architectural Products or an equivalent product from one of the following:
1. Armstrong World Industries, Inc.
  2. Gordon, Inc.
  3. Approved equal.

## 2.6 METAL SUSPENSION SYSTEMS

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Exposed Steel Suspension System: Main and cross-runners, roll formed from or electrolytic zinc-coated cold rolled steel sheet, with 1-1/2" high by 15/16" wide exposed faces, and slotted reveal where indicated, metal flanges; other characteristics as follows:
1. Structural Classification: Intermediate-Duty System.
  2. Cap Material and Finish: Steel sheet painted to match color indicated by reference to manufacturer's standard color designations.

## 2.7 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Armstrong World Industries, Inc.
  2. Fry Reglet Corporation.
  3. Gordon, Inc.
  4. MM Systems, Inc.
  5. USG Interiors, Inc.
  6. Approved equal.
- B. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.



## 2.8 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "In-Direct Hung," unless otherwise indicated.
- B. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- C. Angle Hangers: Angles with legs not less than 7/8-inch-wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- D. Hold-Down Clips: Where indicated, provide manufacturer's standard hold- down clips spaced 24 inches o.c. on all cross tees.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.4 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.



2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  3. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to postinstalled mechanical or adhesive anchors that extend into concrete.
  5. Do not attach hangers to steel deck tabs.
  6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. Install all ceiling systems in accordance with reflected ceiling plan.
    - b. Ceiling systems shall align with the segment of the curve they exist within, cut on angles as required to comply with building geometry.
  2. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
    - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners unless otherwise indicated.

### 3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.





- B. Remove and replace ceiling components that cannot be successfully cleaned and restored to permanently eliminate evidence of damage.

**END OF SECTION 09 51 13**



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**SECTION 09 65 00**

**RESILIENT FLOORING AND BASE**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Recycled rubber flooring for Stress Reduction Room.
  - 2. Thermoset- rubber base.
  - 3. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."



1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups for each type of flooring and base, with mockups specified in other Sections.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration and in accordance with material manufacturers requirements.
  - 1. Store tiles on flat surfaces.
  - 2. Store rolls upright.

1.9 FIELD CONDITIONS

- A. Adhesively Applied Products:
  - 1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
  - 2. After post installation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
  - 3. Close spaces to traffic during flooring installation.
  - 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.



## PART 2 - PRODUCTS

### 2.1 RUBBER SPORTS FLOORING

- A. Description: Rubber athletic flooring provided as rolled goods for adhered installation.
- B. Products: Subject to compliance with requirements, provide 'Sport-Fleck' as supplied by Amarco Products or one of the following, as approved by the Commissioner:
  - 1. Premier; TUFF Rolled Rubber.
  - 2. Roppe; Recoil Fitness Flooring.
  - 3. Or approved equal.
- C. Materials: Recycled rubber flooring flecked colored granules consisting of 0 to 90 percent EPDM virgin rubber.
- D. Sheet Size: 44 inch wide rolls by manufacturers standard length.
- E. Edges: Square.
- F. Thickness: 3/8 inch.
- G. Selected Product Physical Characteristics:
  - 1. Durometer, Shore A, per ASTM D2240: 60.
  - 2. Density, per ASTM D297: 64 lbs. per cu. ft.
  - 3. Compressibility at 100, psi ASTM F36: 12 percent.
  - 4. Flammability and Flame Spread: per DOC FFI- 70 CSPC: Pass.
  - 5. Indoor Abrasion, per ASTM C501: 0.24 percent material loss
- H. Color: Blue fleck over black background, as indicated on drawings.

### 2.2 THERMOSET-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  - 2. Johnsonite; a Tarkett company.
  - 3. Roppe Corporation, USA.
  - 4. Approved equal.
- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  - 1. Style B.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches unless otherwise indicated.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.



- G. Inside Corners: Job formed.
- H. Colors: As selected by the Commissioner from the manufacturer's full color line.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Type as recommended by product manufacturer for substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

### 3.3 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

### 3.4 RUBBER SPORTS FLOORING INSTALLATION

- A. Comply with manufacturer's installation instructions and recommendations.
- B. Glue-down Installation: Apply adhesive at a spreading in accordance with manufacturers requirements.



### 3.5 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
  - 2. Miter or cope corners to minimize open joints.

### 3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting products.
- B. Protect rubber flooring until time of Substantial Completion.

**END OF SECTION 09 65 00**



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**SECTION 09 66 21**

**RESINOUS MATRIX TERRAZZO**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:

1. Thin-set, epoxy-resin terrazzo flooring.
2. Precast, epoxy-resin terrazzo units, including base and stair treads.
3. Installation accessories.

- B. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete."
2. Section 05 51 13 "Metal Pan Stairs for installation of precast stair treads."
3. Section 06 40 23 "Interior Architectural Woodwork for installation of precast panels at main desk."
4. Section 07 92 00 "Joint Sealants for sealants installed with terrazzo."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
    - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    - b. Review and finalize construction schedule and verify availability of materials, equipment, and facilities needed to make progress and avoid delays.
    - c. Review terrazzo designs and patterns.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

**1.9 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For terrazzo to include in maintenance manuals.



**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. **Manufacturer’s Qualifications:** Manufacturer providing the material for this section shall, for the past five (5) years, have been regularly engaged in the manufacture of material similar in type to that required for this Project. Such similar material provided by the manufacturer shall have been in satisfactory service for not less than five (5) years.
- C. **Installer’s Qualifications:** Installer performing the work of this section shall, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- D. **Mockups:** Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups for terrazzo including accessories.
    - a. Size: Minimum 100 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Commissioner.
    - b. Include base and first three stair treads.
    - c. Include precast panels as part of main desk mockup.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

**1.12 FIELD CONDITIONS**

- A. **Environmental Limitations:** Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- C. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- D. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and restoration materials of type and from source recommended by manufacturer of primary materials.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

**2.2 PERFORMANCE REQUIREMENTS**

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- B. Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.

**2.3 EPOXY-RESIN TERRAZZO**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Key Resin Company.
  - 2. Master Terrazzo Technologies LLC.
  - 3. Sherwin-Williams Company, General Polymers.
  - 4. Terrazzo & Marble Supply Companies.
  - 5. Approved equal.
- B. Mix Color and Pattern: 50 percent Raven black #2 and 50 percent Raven black #0- 1 matrix with 40/ 200 filler; 200 grit diamond finish and 2 coats 804 sealer.
- C. Materials:
  - 1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lbs. of water/1000 sq. ft. in 24 hours.
  - 2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.
    - a. Reinforcement: Fiberglass scrim.
  - 3. Primer: Manufacturer's product recommended for substrate and use indicated.
  - 4. Epoxy-Resin Matrix: As required for use indicated and in color required for mix indicated.
  - 5. Finishing Grout: Resin based.



## 2.4 PRECAST EPOXY-RESIN TERRAZZO

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Precast Terrazzo Enterprises, Inc.
  - 2. Romoco Precast Terrazzo Products; a subsidiary of Roman Mosaic & Tile Company.
  - 3. Wausau Tile Inc.
  - 4. Approved equal.
- B. Precast Terrazzo Base: Minimum 3/8-inch- thick, epoxy terrazzo units cast in maximum lengths possible, but not less than 36 inches. Comply with manufacturer's written instructions for fabricating precast terrazzo base units in sizes and profiles indicated.
- C. Precast Terrazzo Units: Minimum 3/4-inch thick, epoxy terrazzo units. Comply with manufacturer's written instructions for fabricating precast units in sizes and profiles indicated.
  - 1. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer.
  - 2. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to 1/8-inch radius, unless otherwise indicated.
- D. Color, Pattern, and Finish: Match poured-in-place terrazzo flooring, unless otherwise indicated.

## 2.5 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.
  - 1. Material: White-zinc alloy.
  - 2. Top Width: As indicated.
- B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

## 2.6 MISCELLANEOUS ACCESSORIES

- A. Anchoring Devices: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
- B. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- C. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- E. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.
  - 1. Surface Friction: Not less than 0.6 according to ASTM D2047.
  - 2. Acid-Base Properties: With pH factor between 7 and 10.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

**3.3 PREPARATION**

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
  - 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Restore damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
- D. Preinstallation Moisture Testing:
  - 1. Testing Agency: Engage a qualified testing agency to perform tests.
  - 2. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours when tested according to ASTM F1869 using anhydrous calcium chloride.
    - b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F2170 using in-situ probes.
  - 3. Proceed with terrazzo installation only after concrete substrates pass moisture testing or after installation of moisture-vapor-emission-control membrane on substrate areas that fail testing.



- E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.
  - 1. Install on concrete substrates that incorporate lightweight aggregates.
  - 2. Install concrete substrates that fail preinstallation moisture testing.
- F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.
  - 1. Prepare and prefill substrate cracks with membrane material.
  - 2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
  - 3. Reinforce membrane with fiberglass scrim.
- G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
  - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.4 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Strip Materials:
  - 1. Divider and Control-Joint Strips:
    - a. Locate divider strips in locations indicated.
    - b. Install control-joint strips back to back and directly above concrete-slab control joints with elastomeric joint filler between L- angles.
    - c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
- C. Apply primer to terrazzo substrates according to manufacturer's written instructions.
- D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
  - 1. Installed Thickness: 3/8 inch nominal.
  - 2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
    - a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
    - b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
    - c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 120-grit stones or with comparable diamond abrasives until grout is removed from surface.



3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

- E. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.
- F. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.

### 3.5 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.
- C. Seal joints between units with joint sealant unless otherwise indicated.

### 3.6 RESTORATION

- A. Cut out and replace terrazzo areas that lack bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or restore panels according to NTMA's written recommendations, as approved by Commissioner.

### 3.7 CLEANING AND PROTECTION

- A. Cleaning:
  1. Remove grinding dust from installation and adjacent areas.
  2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
  1. Seal surfaces according to NTMA's written recommendations.
  2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Commissioner, that ensures that terrazzo is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 09 66 21**



**SECTION 09 67 23****RESINOUS FLOORING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Resinous flooring systems.
  2. Waterproofing membrane, cold- applied self-curing liquid rubber polymer, installed in conjunction with broadcast epoxy installation at toilet floors and rooms with shower.
  3. Installation accessories.
- B. Related Sections:
1. Section 03 30 00 "Cast-in-Place Concrete."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 COORDINATION

- A. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of exposed finish required.

1.8 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each resinous flooring component, from manufacturer.
- B. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

1.9 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Apply full-thickness mockups on 96-inch- square floor area selected by Commissioner.
    - a. Include 96-inch length of integral cove base with inside and outside corner.
  - 2. Simulate finished lighting conditions for Commissioner's review of mockups.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.



## 1.12 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D 635.

### 2.2 EPOXY FLOORING

- A. Basis of Design, Products: Subject to compliance with requirements, provide the following or equal as approved by the Commissioner:
  - 1. Mechanical Equipment Rooms (EB-2): EPO-FLEX MER II" as manufactured by General Polymers.
  - 2. Broadcast Epoxy Resinous Flooring, Other Spaces (EB-1): Ceramic Carpet No. 400 as manufactured by General Polymers.
- B. Other Manufacturers:
  - 1. Stonhard, Inc.
  - 2. Dur-A-Flex, Inc.
  - 3. Approved equal.
- C. General: Resinous flooring shall be comprised of a penetrating two-component epoxy primer, a free flowing two-component, epoxy finish coating with manufacturer's well graded proprietary aggregate.
  - 1. Seamless Flooring System: Provide seamless flooring system comprised of the following components:
    - a. Primer: Universal penetrating primer, No. 3579, by "EPO-FLEX".
    - b. Monolithic Waterproofing Membrane: One coat of 3555 EPO-FLEX HD Epoxy Coating.
    - c. Top Coat: Wear course with 5310-8 Dry Silica (30 mesh) or other Hard Aggregate.
    - d. Seal Coat: 3744P High Performance CR Epoxy as the seal coat.
  - 2. Color: As selected by the Commissioner.
- D. Products other than those specified, may be incorporated in the work, provided they meet or exceed the requirements specified herein.



## 2.3 FLOORING AND BASE PHYSICAL CHARACTERISTICS

- A. Seamless flooring systems shall comply with the following physical properties, unless otherwise indicated by selected products. Flooring system in which physical properties of finish coating including aggregate, when tested in accordance with standards or procedures referenced below, are as follows:

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| 1. Solids by volume:              | 100 percent                         |
| 2. VOC (Volatile Organic Content) | -0-                                 |
| 3. Hardness (ASTM D2240/Shore D)  | 50/ 40.                             |
| 4. Tensile Strength (ASTM D412)   | 1,700 psi.                          |
| 5. Elongation (ASTMD 412)         | 80 percent.                         |
| 6. Adhesion (ACI 503R)            | 350 psi over concrete.              |
| 7. Flammability (ASTM D635)       | Self Extinguishing over concrete.   |
| 8. Thermal Cycling (ASTM C 884)   | 24 Hours, -21C to 25C. No cracking. |

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Remove oils, grease, wax and other hydrocarbon-based materials Any material which cannot be chemically removed, must be removed mechanically.
  2. Roughen concrete substrates as follows:
    - a. Creation of surface profile: Surface profile of horizontal concrete subjected to traffic shall be not less than 5 mils.
    - b. Restore of surface irregularities: Including spalls, cracks, deteriorated joints, slopes, areas near transition zones, such as around drains and doorways, etc. shall be restored prior to the placement of the polymer system and/or the system shall be designed to off-set the thickness irregularities.
    - c. Preferred method of preparation of concrete slabs, including the removal of dirt, dust, laitance and curing compounds is vacuum-grit blasting, sand or grit blasting or mechanical scarification.
  3. Surfaces to receive the flooring system shall be inspected after the surface is prepared to ensure that the substrate is sound and structurally durable. Areas found to be unsound or non-durable must be replaced. Dust or other detritus, not removed after the initial surface preparation, must be vacuumed or "tack wiped", leaving the surface dust free and clean.
  4. Comply with ASTM C 811, unless otherwise required by manufacturer's instructions. Surface preparation shall include vacuum-grit blasting, sand or grit blasting or mechanical scarification process as recommended by the flooring system manufacturer.



- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Patch and restore substrate as required to prevent telegraphy of surface irregularities through the finished coating system. Comply with the recommendations of the manufacturer. Remove any surface material that will interfere with the bond of the seamless primer. All depressions and cracks in substrates shall be filled as recommended by the flooring manufacturer. Drains and other slab fixtures shall have been properly secured in position before flooring operations begin. Maintain areas to receive flooring at temperatures recommended by the materials manufacturer.

### 3.3 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - 2. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Waterproofing Membrane: Apply waterproofing membrane over entire substrate surface, in manufacturer's recommended thickness.
  - 1. Apply waterproofing membrane to integral cove base substrates.
- D. Cracks: Treat cracks in concrete substrates, in accordance with manufacturer instructions.
- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
  - 1. Integral Cove Base: 4 inches high unless otherwise indicated.

### 3.4 CURING, CLEANING AND PROTECTION

- A. Cure flooring system materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of the installation and prior to completion of the curing process.
- B. Protect the flooring system from damage and wear during other phases of the construction operation, using temporary coverings as recommended by the manufacturer, if required. Remove temporary covering just prior to final inspection.
- C. Clean the flooring system just prior to final inspection, using materials and procedures suitable to the system manufacturer.
- D. Test each cleaner, in a small area, utilizing proposed technique, with cleaner compatible with floor system. If no deleterious effects are observed, continue with the procedure. If deleterious effects do occur, modify the cleaning material and/or procedure.



### 3.5 ACCESSORY INSTALLATION

- A. Joints: Where substrate is interrupted by expansion or control joints, provide joint in seamless flooring to comply with details indicated, or, if not otherwise indicated, as recommended by resinous flooring manufacturer.
  - 1. Apply joint sealant materials to comply with resinous flooring manufacturer's recommendations.
  - 2. Joint sealant materials and installation are specified in a Section 07 90 00 - Joint Sealants.

### 3.6 FIELD QUALITY CONTROL

- A. General: The right is reserved to invoke following material testing procedure at any time, and any number of times during period of flooring application.
- B. The City of New York will engage service of independent testing laboratory to sample materials testing used. Samples of material will be taken, identified and sealed in presence of Contractor.
- C. Testing laboratory will perform tests for any of characteristics specified, using applicable testing procedures referenced herein, or if not referenced, in manufacturer's product data.
- D. If test results show materials being used do not comply with specified requirements, Contractor may be directed by City to stop work, and remove non-complying materials; pay for testing; and reapply flooring materials to surfaces coated with rejected materials.

**END OF SECTION 09 67 23**

**SECTION 09 69 00**

**ACCESS FLOORING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Cementitious- core steel panel access flooring.
  2. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 COORDINATION**

- A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access flooring.
- B. Mark pedestal locations on subfloor to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals installed after mechanical and electrical work.

**1.6 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review connections between access flooring and mechanical and electrical systems.
  - 2. Review requirements related to sealing the plenum.
  - 3. Review procedures for keeping underfloor space clean.

**1.7 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.8 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for access flooring.
  - 2. Include loading capacities.
- B. Shop Drawings: For access flooring:
  - 1. Include layout of access flooring and relationship to adjoining Work based on field-verified dimensions.
  - 2. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.
- C. Samples: For the following products:
  - 1. Floor Coverings: Full-size units for each color and texture specified.
  - 2. Exposed Metal Accessories: Approximately 10 inches in length.
  - 3. One full-size floor panel, pedestal, and understructure unit for each type of access flooring required.
- D. Engineering Services Submittal: For seismic design of access flooring, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York, responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.





**1.9 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of access flooring.
- C. Product Test Reports: For each type of access-flooring material and floor covering, performed by a qualified testing agency.
- D. Seismic Design Calculations: For seismic design of access flooring, including analysis data signed and sealed by the qualified Professional Engineer licensed in the State of New York, responsible for their preparation.
- E. Preconstruction Test Reports: For preconstruction adhesive field test.

**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical access flooring, as shown on Drawings. Size to be an area no fewer than five floor panels in length by five floor panels in width.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.11 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.
  - 1. Use materials and methods of construction that will be used at Project site.
  - 2. Notify Commissioner seven days in advance of the dates and times when laboratory mockups will be tested.
- B. Preconstruction Adhesive Field Test: Before installing pedestals, field test their adhesion to subfloor surfaces by doing the following:
  - 1. In areas representative of each subfloor surface, set typical pedestal assemblies in same adhesive, and use methods required for the completed Work.
  - 2. Allow test installation to cure for manufacturer's recommended cure time, with a pressure of 25 lbf applied vertically to pedestals during this period.
  - 3. After curing, apply lateral load against a straight steel bar inserted 2 inches into pedestal stems. Measure the force needed to cause adhesive failure of pedestal base.
  - 4. Remove and discard failed pedestals and clean pedestals of adhered residue.



5. Proceed with installation only after tests show compliance with performance requirement for pedestals' capability to resist overturning moment.

## 1.12 FIELD CONDITIONS

- A. Environmental Limitations: Do not install access flooring until spaces are enclosed, subfloor has been sealed, ambient temperature is between 50 and 90 deg F, and relative humidity is not less than 20 and not more than 70 percent.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design access flooring.
  1. Engineering Services shall include complete design calculations for access flooring for seismic performance, including loads imposed on the access flooring by items and equipment installed on the access flooring required for this project.
    - a. Indicate required design loads, including live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated.
- B. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7, including loads imposed on the access flooring by items and equipment installed on the access flooring.
- C. Structural Performance, as required by project application unless otherwise indicated: Provide access flooring capable of complying with the following performance requirements according to testing procedures in CISC's "Recommended Test Procedures for Access Floors":
  1. Concentrated Loads: 900 lbf with the following deflection and permanent set:
    - a. Top-Surface Deflection: 0.10 inch.
    - b. Permanent Set: 0.010 inch.
  2. Ultimate Loads: 1800 lbf.
  3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch.
    - a. CISC Wheel 1: 10 passes at 400 lbf.
  4. Stringer Load Test: 75 lbf at center of span with a permanent set not to exceed 0.010 inch.
  5. Pedestal Axial Load Test: 5000 lbf.
  6. Pedestal-Overturning-Moment Test: 1000 lbf x inches.
  7. Uniform Load Test: 200 lbf/sq. ft. with a maximum top-surface deflection not to exceed 0.040 inch and a permanent set not to exceed 0.010 inch.
  8. Drop Impact Load Test: 75 lb.



D. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 25 or less.
  - b. Smoke-Developed Index: 50 or less.

2.2 CEMENTITIOUS-CORE STEEL PANEL ACCESS FLOORING

- A. Fabricate panels from cold-rolled steel sheet, with die-cut flat top sheet and die-formed and stiffened bottom pan welded together. Protect metal surfaces against corrosion using manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.
- B. Basis-of-Design, Product: Subject to compliance with requirements, provide the following or equivalent acceptable to the Commissioner:
  1. Tec-Crete 1250 as supplied by Haworth, Inc.
- C. Other Manufacturers:
  1. ASM Modular Systems, Inc.
  2. Bergvik North America, Inc.
  3. Tate Access Floors, Inc.
  4. Or approved equal.
- D. Configuration: Provide modular panels with nominal size of 24 by 24 inches, interchangeable with other field panels without disturbing adjacent panels or understructure.
- E. Attachment to Understructure: Bolted.
- F. Pedestal System Understructure: System consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
  1. Base: Square or circular base with not less than 16 sq. in. of bearing area, unless otherwise required by structural performance requirements.
  2. Column: Of height required to bring finished floor to elevations indicated. Weld column to base plate.
  3. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
  4. Head: Designed to support the floor panel indicated.
    - a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
    - b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.
- G. Stringer System Understructure: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.



1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.
- H. Finish: Factory-applied to cover entire panel face.
  1. Selected manufacturers standard polyurethane sealer.

## 2.3 FABRICATION

- A. Fabrication Tolerances:
  1. Size: Plus or minus 0.020 inch of required size.
  2. Squareness: Plus or minus 0.015 inch between diagonal measurements across top of panel.
  3. Flatness: Plus or minus 0.035 inch, measured on a diagonal on top of panel.
- B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.
- C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.
  1. Captive Fasteners: Provide fasteners held captive to panels.
- D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.
  1. Number, Size, Shape, and Location: As indicated.
  2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.
  3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

## 2.4 ACCESSORIES

- A. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide post-installed expansion anchors or threaded concrete screws, as required by project structural requirements, made from carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to 1.5 times the loads imposed by pedestal-overturning moment on fasteners, as determined by testing according to ASTM E 488/E 488, conducted by a qualified independent testing agency.
- B. Service Outlets: UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
  1. Refer to Division 26 Electrical for requirements.
- C. Occupant Adjustable Diffusers: Refer to Division 23 - Heating, Ventilating, and Air Conditioning (HVAC) for requirements.



- D. Floor Grilles: Standard load-bearing grilles formed from aluminum to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field panels, with adjustable/removable or without dampers as indicated and complying with the following requirements:
- E. Plenum-Wall Brush Grommets, where indicated and required by project application: Self-sealing cable brush grommet with usable area for passage of power and signal cables through plenum walls. Provide Aluminum frame with passageway of interwoven nylon filaments and intermediate layer of EPDM.
- F. Cavity Dividers, where indicated and required by project application: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.
- G. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish.
- H. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.
- I. Steps, where indicated and required by project application: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads unless otherwise indicated.
- J. Railings, where indicated and required by project application: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.
- K. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required. Comply with NFPA 75 for computer rooms.
- L. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of conditions and deleterious substances that might interfere with attachment of pedestals.



2. Verify that concrete floor sealer and finish have been applied and cured.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches.

B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

### 3.4 INSTALLATION

A. Install access flooring and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors as required to meet seismic design requirements.

C. Adjust pedestals so installed panels are flat, level, and at the proper height.

D. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

E. Install flooring panels securely in place, leaving them properly seated with panel edges flush. Do not force panels into place.

F. Scribe perimeter panels to provide a close fit, with adjoining construction having no voids greater than 1/8 inch where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.

G. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under installed access flooring.

H. Grounded Access Flooring: Ground access flooring as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.

1. Panel-to-Understructure Resistance: Unless otherwise indicated, not more than 10 ohms as measured without floor coverings.

I. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.

J. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.

K. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.



- L. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.
- M. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
  - 1. Plus or minus 1/16 inch in any 10-foot distance.
  - 2. Plus or minus 1/8 inch from a level plane over entire access flooring area.

### 3.5 PROTECTION

- A. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

**END OF SECTION 09 69 00**



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**SECTION 09 77 23****FABRIC-WRAPPED PANELS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Shop- fabricated, fabric-wrapped wall panels.
  - 2. Installation accessories.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.5 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For fabric-wrapped wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.
  - 1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.
- C. Samples: For each type of fabric facing from fabric-wrapped, wall panel manufacturer's full range.
  - 1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch-square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets, switches, and thermostats.
  - 2. Items penetrating or covered by fabric-wrapped wall panels
  - 3. Show operation of hinged and sliding components covered by or adjacent to fabric-wrapped wall panels.
- B. Product Certificates: For each type of fabric-wrapped wall panel, from manufacturer.
- C. Warranty: Sample of special warranty.



**1.9 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For fabric-wrapped wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
  - 1. Build mockup of typical wall area as directed by Commissioner. Include intersection of wall and ceiling, corners, and perimeters.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with fabric and fabric-wrapped, wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

**1.12 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install fabric-wrapped wall panels until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect fabric-wrapped wall panels from exposure to airborne odors such as tobacco smoke and install panels under conditions free from odor contamination of ambient air.
- C. Field Measurements: Verify locations of fabric-wrapped wall panels and actual dimensions of openings and penetrations by field measurements before fabrication.

**1.13 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fabric-wrapped panels that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to the following:



- a. Fabric sagging, distorting, or releasing from panel edge.
  - b. Warping of core.
2. Warranty Period: Two (2) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fabric-wrapped wall panels from single source and manufacturer.
- B. Basis-Of-Design, Product: Subject to compliance with requirements, provide Soundsoak 85 as supplied by Armstrong World Industries, Inc or one of the following equivalent products, as approved by the Commissioner:
  1. Fabritrak; FabriTACK.
  2. Novawall Systems, Inc.; Novawall.
  3. Or approved equal.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide fabric-wrapped wall panels meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Surface-Burning Characteristics: As determined by testing per ASTM E 84, Class A.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 or NFPA 286.
- B. Acoustical Requirement: NRC of 0.80, as determined in accordance with ASTM C423

### 2.3 FABRIC-WRAPPED WALL PANELS

- A. Fabric-Wrapped Wall Panel: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.
  1. Facing Material: Woven fabric, product as indicated on Finish Schedule or selected by Commissioner.
  2. Mounting: Use one of the following to suit project application, as approved by the Commissioner.
    - a. Edge mounted with splines secured to substrate. Color at exposed edges shall be as selected by Commissioner from manufacturer's full range.
    - b. Back mounted with manufacturer's standard adhesive, secured to substrate.



3. Core: Fiberglass.
4. Core Overlay: Polyester batting manufacturer's standard thickness.
5. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
6. Edge Profile: Square.
7. Corner Detail in Elevation: Square with continuous edge profile indicated.
8. Reveals between Panels, if any: Flush.
9. Nominal Overall Panel Thickness: 1 inch.
10. Panel Width: As indicated on Drawings.
11. Panel Height: As indicated on Drawings.

## 2.4 MATERIALS

- A. Core Materials: Glass-Fiber Board, ASTM C 612; Type standard with manufacturer; nominal density of 6 to 7 lbs. per cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- B. Mounting Devices: Concealed on back of panel, recommended by manufacturer to support weight of panel, and as follows:
  1. Splines: Manufacturer's standard concealed metal or plastic splines that engage the kerfed edges of the panel, with other moldings and trim for interior corners, exterior corners, and exposed edges, with factory-applied finish on exposed items.
  2. Adhesives: As recommended by fabric-wrapped, wall panel manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Glass-Fiber Board and Mineral-Fiber Board Cores: Chemically harden core edges and areas of core where mounting devices are attached.
- C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- D. Facing Material: Apply fabric fully covering visible surfaces of panel; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
  1. Square Corners: Tailor corners.
- E. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch for the following:
  1. Thickness.
  2. Edge straightness.
  3. Overall length and width.
  4. Squareness from corner to corner.
  5. Chords, radii, and diameters.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine fabric, fabricated panels, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of fabric-wrapped wall panels.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install fabric-wrapped wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with fabric-wrapped, wall panel manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.
- C. Align and level fabric pattern and grain among adjacent panels.

**3.3 INSTALLATION TOLERANCES**

- A. Variation from Plumb and Level: Plus or minus 1/16 inch.
- B. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

**3.4 CLEANING**

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

**END OF SECTION 09 77 23**



## **SECTION 09 91 00**

### **PAINTING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section includes:

1. Painting of the following interior and exterior items surfaces, unless otherwise indicated.
  - a. Floor paint systems for exposed concrete floors, not finished with another material.
  - b. Walls, ceilings, doors, frames, wood trim, railings, handrails, stairs, ladders and other exposed elements.
  - c. Exposed pipes.
  - d. Ducts.
  - e. Conduit.
  - f. Hangers.
  - g. Exposed steel.
  - h. Primed metal equipment.
  - i. For items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas.
2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

- B. Labels: Do not paint over code required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Gypsum-containing products shall contain “synthetic” gypsum produced with a minimum of 75% post-industrial recycled content, if readily available.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 “INDOOR AIR QUALITY MANAGEMENT”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements

**1.5 COORDINATION**

- A. Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
  1. Notify the Commissioner about anticipated problems using the materials specified over substrate primed by others.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures.”

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and each color and gloss of topcoat.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements.”
- B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Commissioner will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
    - b. Other Items: Commissioner will designate items or areas required.
  2. Final approval of color selections will be based on mockups.





- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Commissioner at no added expense to City of New York.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.10 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

### PART 2 - PRODUCTS

#### 2.1 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.
  2. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

#### 2.2 MANUFACTURERS

- A. Exterior Paint Products:
  1. Manufacturers: Subject to compliance with requirements, provide products for substrate indicated or equal product from one of the following:
    - a. PPG Paints.
    - b. Sherwin-Williams Company (The).
    - c. Valspar Corporation (The).
    - d. Approved equal.



2. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
  3. Galvanized Metal:
    - a. Primer (1) Coat; Tnemec 66; 4.0 to 6.0 dry mil thickness or approved equal.
    - b. Finish (2) Coat; Tnemec 70 or 71 as selected; 1.5 to 2.5 dry mil thickness or equivalent product from approved manufacturers listed.
  4. Metal, Ferrous:
    - a. High Gloss Alkyd Enamel
      - 1) Prime Coat: Benjamin Moore & Co, IronClad Retardo Rust Inhibitive Paint, 163 or equivalent product from approved manufacturers listed.
      - 2) Two Coats: Benjamin Moore & Co, Impervo Enamel, 133 or equivalent product from approved manufacturers listed.
  5. Mechanical Dunnage:
    - a. Semi-Gloss Aliphatic Acrylic Polyurethane
      - 1) Surface Preparation: SSPC-SP 6 for ferrous metal; omit surface preparation and shop primer on galvanized metal.
      - 2) Primer Coat: Tnemec 90-97; 2.5 to 4.0 mils d.f.t or equivalent product from approved manufacturers listed.
      - 3) Coat: Tnemec Series 66 Epoxoline; 3.0 to 5.0 mils d.f.t or equivalent product from approved manufacturers listed.
      - 4) Finish Coat: Tnemec Series 73 Endura-Shield; 2.0 to 3.0 mils d.f.t or equivalent product from approved manufacturers listed.
  6. Metal, Rooftop Mechanical Units:
    - a. Semi-Gloss Modified Polyamidoamine Epoxy
      - 1) Surface preparation: SSPC-SP3.
      - 2) Prime Coat: Tnemec Series 10-99; 2.5 to 3.5 mils d.f.t. or equivalent product from approved manufacturers listed.
      - 3) Finish Coat: Tnemec Series 135 Chembuild; minimum 4.0 mils d.f.t. or equivalent product from approved manufacturers listed.
- B. Interior Paint Products:
1. Manufacturers: Subject to compliance with requirements, provide products for substrate indicated or equal product from one of the following:
    - a. Behr Paint Company.
    - b. Benjamin Moore & Co.
    - c. PPG Paints (PPG).
    - d. Sherwin-Williams Company (The).
    - e. Approved equal.



2. Cast-In-Place Concrete:
    - a. Low Sheen Acrylic Epoxy Finish: 2 coats.
      - 1) Undercoat: Tnemec Series 27WB Typoxy (4.0-14.0 mils DFT) or equivalent product from approved manufacturers listed.
      - 2) Finish Coat: Tnemec Series 297 Enviro-Glaze (2.0 - 3.0 mils DFT) or equivalent product from approved manufacturers listed.
  3. Concrete Masonry Units, except surfaces of glazed CMU:
    - a. Low Sheen Acrylic Epoxy Finish: 2 coats over filled surface.
      - 1) Block Filler: Tnemec 130 modified epoxy filler. Provide Uniform Finish for varying CMU surfaces or equivalent product from approved manufacturers listed.
      - 2) Undercoat: Tnemec Series 27WB Typoxy (4.0-14.0 mils DFT) or equivalent product from approved manufacturers listed.
      - 3) Finish Coat: Tnemec Series 297 Enviro-Glaze (2.0 - 3.0 mils DFT) or equivalent product from approved manufacturers listed.
  4. Gypsum Board:
    - a. Low Sheen Acrylic Epoxy Finish: 2 coats.
      - 1) Primer: Tnemec Series 151 Elasto-Grip FC (0.7 - 1.5 mils DFT) or equivalent product from approved manufacturers listed.
      - 2) Undercoat: Tnemec 287 Enviropox (2.0 to 3.0 mils DFT) or equivalent product from approved manufacturers listed.
      - 3) Finish Coat: Tnemec Series 297 Enviro-Glaze (2.0 - 3.0 mils DFT) or equivalent product from approved manufacturers listed.
  5. Ferrous, Metal:
    - a. Semigloss Enamel Finish: 2 coats.
      - 1) Primer: Tnemec Series 115 Uni-Bond DF (2.0 - 4.0 mils DFT) or equivalent product from approved manufacturers listed.
      - 1) Finish: Tnemec Series 1029 Enduratone (2.0 - 3.0 mils DFT)
  6. Zinc-Coated Metal:
    - a. Semigloss Finish: 2 coats.
      - 1) Primer: Tnemec Series 115 Uni-Bond DF (2.0 - 4.0 mils DFT) or equivalent product from approved manufacturers listed.
      - 2) Finish: Tnemec Series 1029 Enduratone (2.0 - 3.0 mils DFT) or equivalent product from approved manufacturers listed.
- C. Colors/ Gloss: Refer to Paint Color/ Finish Schedule as indicated on the drawings.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter, substrate shall be in accordance with coating material manufacturers requirements.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

**3.3 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations applicable to substrate and paint systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- C. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
  - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each substrate condition and as specified.
  - 1. Provide barrier coats over incompatible primers or remove and reprime.
  - 2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
    - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.



- c. When transparent finish is required, back prime with spar varnish.
  - d. Back prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
  - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
- 3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
  - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
  - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- 4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- 5. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and other surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
  - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
  - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
  - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner, unless otherwise indicated. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- E. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.



### 3.4 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
  2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  3. Provide finish coats that are compatible with primers used.
  4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
  10. Sand lightly between each succeeding enamel or varnish coat.
  11. Where facias, soffits and housings that are to be painted are exposed to exterior viewing, allow for second color selection by Commissioner, and for painting of viewable surfaces different color from adjacent surfaces, match approved samples.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. Omit primer on metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.



- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
  - 1. Piping, pipe hangers, and supports.
  - 2. Heat exchangers.
  - 3. Tanks.
  - 4. Ductwork.
  - 5. Insulation.
  - 6. Motors and mechanical equipment.
  - 7. Accessory items.
- G. Electrical items to be painted include, but are not limited to, the following:
  - 1. Conduit and fittings.
  - 2. Switchgear.
  - 3. Panelboards.
- H. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.5 CLEANING AND PROTECTION

- A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- C. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, restoring or replacing, and repainting, as approved by the Commissioner.
- D. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.



- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

**END OF SECTION 09 91 00**



**SECTION 10 11 00****VISUAL DISPLAY UNITS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Visual display board assemblies.
  2. Bulletin board assemblies.
  3. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures.”

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints
- C. Samples: For each type of visual display unit indicated.
- D. Product Schedule: For visual display units.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Sample Warranties: For special warranties.

**1.8 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For visual display units to include in maintenance manuals.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements.”
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical visual display unit as directed by the Commissioner. Include accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Commissioner specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.



1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to restore or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
  2. Warranty Period: 50 years from date of Substantial Completion or Life of the building, as is standard with product manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Multi- Media Markerboards: Subject to compliance with requirements, provide the following or equal as approved by the Commissioner:
1. Claridge Products and Equipment Inc.; Series 1, LCS Markerboard with Aluminum Trim.
  2. Size, unless otherwise indicated: 4 by 4 feet.
  3. Other Manufacturers:
    - a. Ghent Manufacturing, Inc.
    - b. Marsh Industries, Inc.
    - c. MooreCo, Inc.
    - d. Approved equal.
- B. Bulletin Board Assemblies, Case with Sliding Doors: Subject to compliance with requirements, provide the following or equal as approved by the Commissioner:
1. Poblocki; Model G6063- T poster case.
  2. Product Description: Recessed unit made from aluminum alloy and 1/ 4 inch clear, laminated glass sliding doors, with grooved finger pulls and 'H' shoe rollers. Provide tumbler type locks keyed alike, with 4 keys each unit,
  3. Other Manufacturers:
    - a. Claridge Products and Equipment, Inc.
    - b. Ghent Manufacturing Inc.
    - c. Marsh Industries, Inc.
    - d. MooreCo, Inc.
    - e. Approved equal.



## 2.2 MATERIALS

- A. Board Description: 24-gage steel sheet with porcelain enamel coating, compressed fiber board core with .002 aluminum foil backing.

## 2.3 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.
  - 1. Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Commissioner from the manufacturer's standard structural support accessories to suit the condition indicated.
  - 2. Field-Applied Trim: Unless otherwise indicated, provide the manufacturer's standard snap-on trim, with no visible screws or exposed joints.
  - 3. Marker tray: Unless otherwise indicated, furnish the manufacturer's standard continuous, solid extrusion-type aluminum tray with ribbed section and smoothly curved exposed ends, for each board.
  - 4. Holder Bar: Unless otherwise indicated, provide the manufacturer's standard holder bars.
  - 5. Map Hooks and Clips: Two map hooks with flexible metal clips for each board.

## 2.4 FABRICATION

- A. Construction shall include the following layers: 24-gage steel with porcelain enamel coat face sheet 3/8-inch-thick fiberboard core material and manufacturer's standard .002-inch-thick aluminum foil backing sheet.
  - 1. Assembly: Provide factory-assembled markerboard units, except where field-assembled units are required.
  - 2. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Commissioner.
  - 3. Provide the manufacturer's standard vertical joint system between abutting sections of board.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.



## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work
- B. Do not proceed until unsatisfactory conditions have been corrected to the satisfaction of the Commissioner.

### 3.3 PREPARATION

- A. Prior to installation of visual display items, clean substrate to remove dust, debris, and loose particles.
- B. Verify required grounds, blocking and any miscellaneous required concealed framing, brackets and supports are installed prior to installing visual display items.

### 3.4 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrate of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

### 3.5 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.



- B. Deliver factory-built units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Commissioner. When overall dimensions require delivery in separate units, prefabricate components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- C. Prior to installation verify infield locations to be mounted with the Commissioner and NYPD.
- D. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.
- E. Coordinate job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.
- F. Exposed surfaces of units shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.

### 3.6 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

**END OF SECTION 10 11 00**



## **SECTION 10 14 00**

### **SIGNAGE**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.02 SUMMARY**

- A. Signage under this section is intended to include items for identification, direction, control and information of building, and to be installed as a complete integrated system. Signs include, but are not limited to:

1. Adhesive vinyl Entrance IDs
2. Exterior metal panel Entrance IDs
3. Flat cut metal letterforms with painted finish Entrance IDs
4. Tactile Room IDs
5. Elevator and Stair IDs
6. Custom sized lockable directory
7. Magnetic panel board bulletin boards
8. Custom sized homasote panel with metal frame

- B. Related Sections:

1. Section 09 91 00 "Painting"
2. Section 08 80 00 "Glazing"
3. Section 08 88 53 "Security Glazing"

##### **1.03 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.04 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.05 REFERENCES

- A. Comply with the following codes and standards:
  1. American National Standards Institute (ANSI)
  2. 2014 NYCBC – 2014 New York City Building Code.
  3. ASTM B 209/209M – Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  4. ASTM B 221/221M – Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  5. American Concrete Institute ACI 301 – Specifications for Structural Concrete.
  6. American Concrete Institute ACI 347 – Guide to Formwork for Concrete.
  7. CC/ANSI A117.1 – Accessible and Useable Buildings and Facilities; 2017.
  8. USATBCB – Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).

1.06 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.07 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation methods.
- B. Shop Drawings: Showing sign styles, lettering, locations and dimensions of each sign. Submit shop drawings as follows:
  1. For each sign number, indicate size, material and method of attachment to door and/or wall or suspension method.
  2. Each sign number shall be drawn to a measurable scale, fully dimensioned and detailed to clearly call out all materials, finishes and coatings.
  3. Indicate component details including, framing, anchorage, design loading, and location of fasteners, and accessories or items required of related Work.





4. Engineering Services: Submit calculations for loadings and stresses of all framing and anchorage for exterior signage under a Professional Engineer's seal from an Engineer that is licensed in the State of New York, for review by Commissioner.
5. Scaled graphic layouts for all signs shall be created by Fabricator.
6. All letter and character styles shall be accurately reproduced.
7. Shop Drawings and graphic layouts are to be submitted for review to Commissioner for approval.
8. Shop Drawings shall be submitted as a complete, unified, cross-referenced set.

C. Material and Finish Samples:

1. Formed Concrete: Submit (1) sample of form material with submittal of shop drawings of formed concrete which will be exposed in the finished work to the public view.
2. Flat-Cut Painted Metal Letterform: Submit (1) sample of a painted metal letterform illustrating font, metal thickness, and select color.
3. Flat-Cut Metal ADA: Submit (1) sample of a metal ADA illustrating font, metal thickness, and select color.
4. Color Samples: Submit (4) four 4"x4" color samples of each color used on the select material and finish as specified in the Contract Drawings.

D. Manufacturer's Installation Instructions: Submit substrate requirements, installation methods, and material analysis.

E. Schedule: A schedule of completion and sequence of delivery of the work to be furnished and installed under this Section. This schedule shall include at least:

1. Preparation of Shop Drawings and review schedule for approval.
2. Material and color sample review, final approval.
3. Construction and sequence of delivery.
4. Timetable of installation indicating start date and each phase until completion of Work.
5. Date for final inspection.

F. Submit maintenance and cleaning recommendations based on manufacturer Instructions for all sign types.

G. Furnish one (1) quart of each paint and finish color for touch-up purposes.

1.08 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Pre-installation conference: Closely coordinate tolerances required in this section for completely coordinated and smooth installation.
- C. Regulatory Requirements: Comply with requirements of ICC/ANSI A117.1 and ADAAG.

1.09 DELIVERY, STORAGE, AND HANDLING



- A. Deliver all signs packed and protected for timely installation, minimizing damage and on-site storage time.
- B. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Individually mark each sign to match-up with sign location number.
- E. Store all signs in a secure area, protected from the weather during installation.
- F. Sign design builder shall be responsible for supplying replacement parts, on a one-for-one no charge basis, and for installation for any defective components that fail.
- G. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of New York City Department of Environmental Protection.

#### 1.10 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.
- B. Do not install products under environmental conditions outside manufacturer's absolute limits.

### PART 2 – PRODUCTS

#### 2.01 SIGNAGE

##### A. MANUFACTURERS

- 1. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. Coyle & Company
    - i) 60 Plant Avenue, Suite 5, Hauppauge, New York 11788, (631) 780-7045
  - b. Design Communications LTD
    - i) 153 West 27<sup>th</sup> Street, Suite 707 New York, New York 10001, (212) 255-3226
  - c. I & M Architectural Signs
    - i) 20 Montesano Road, Fairfield, New Jersey 07004, (973) 575-7665
  - d. Or approved equal.

#### 2.02 GENERAL

##### A. Structural Design:

- 1. Details on the Contract Drawings indicate a design approach for sign structure, but do not necessarily include all fabricating details required for the complete structural integrity of the signs, including consideration for static and erection loads during handling, erecting, and service at the installed locations, nor do they necessarily consider the preferred shop



practices of the individual sign fabricators. Design must comply with 2014 New York City Building Code requirements, as well as testing laboratory listings where required.

**B. Loads:**

1. Interior signs shall sustain wind loads of a minimum of 10-psf.
2. Exterior signs shall sustain wind load, in any directions, or 30-psf.
3. All signs shall sustain a vertical live load of 300-pounds at any point on the sign. The vertical load is not simultaneous with the wind loads.
4. All signs shall sustain their own dead load.

**2.03 TYPOGRAPHY**

- A. Typography shown on the Drawings is intended as guidelines for layouts and type size only and is based on scale calculations of the message lengths within estimated sign areas. Should conflicts arise in the final graphic layouts, notify the Commissioner before proceeding.
- B. All typography shall be straight and true to the proportions and visual characteristics of the actual typeface(s) used for the sign inscriptions.
- C. Contractor is required to purchase all typefaces required for project.
- D. Use the following typefaces, as indicated on drawings, unless otherwise indicated.
  1. Avenir Black
  2. Futura Demi

**2.04 ARTWORK**

- A. Representative digital artwork and templates for sign inscriptions and graphics will be provided by the Commissioner in Adobe Illustrator CC 2017 (13.1.0) or higher files.
- B. Generate all scaled and full size graphic layouts in Adobe Illustrator CC 2017 (13.1.0) or higher, using Commissioner-provided digital artwork. Provide graphic layouts with indicated scale as PDF for review by Commissioner.
- C. Except as may be indicated otherwise on the Contract Drawings, position all sign graphics and inscriptions straight and true on sign units and architectural surfaces, and maintaining accurate dimensions, including margins spaces and gutters, per approved graphic layouts.
- D. Do not, under any circumstances, use signage Contract Drawings as artwork.

**2.05 TACTILE AND BRAILLE COPY**

- A. Signage requiring tactile graphics:
  1. Wall-mounted signs designating permanent rooms and spaces, such as room numbers, restrooms, electrical closets, and mechanical rooms.
  2. Individually applied characters are prohibited.
- B. Signage not requiring tactile graphics but requiring compliance to other ADA requirements: All other signs providing direction to or information about function of space, such as directional signs (signs with arrow), informational signs (operating hours, policies, etc.), regulatory signs (no smoking, do not enter) and ceiling and projected wall-mounted signs.



- C. Tactile graphics sign mounting requirements:
  - 1. Openings: Mount 60" to sign centerline above finished floor adjacent to opening.
  - 2. No wall space adjacent to latch side of door, opening or double doors: Mount 60" to centerline above finished floor on nearest adjacent wall.
  - 3. An interior sign plaque shall be installed adjacent to each new door. The final room description on each sign shall be determined prior to fabrication.
- D. Tactile and Braille Copy Requirements: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
  - 1. Panel Material: Clear acrylic sheet with opaque color coating, subsurface applied.
  - 2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).

## 2.06 CAST-IN-PLACE CONCRETE

- A. Formwork Shop Drawings: Submit drawings that indicate the following:
  - 1. Forming system and method of erection with associated details, including bracing as required ensuring stability of formwork.
  - 2. Design calculations for the forming system.
  - 3. Concrete placement rates and ambient temperature requirements at time of concrete placement.
- B. Product Data: Provide manufacturers' data and installation requirements on form materials, form coatings, form ties, and other accessories.
- C. Lumber:
  - 1. Boards: Use dressed side of lumber for surface in contact with the concrete and use dressed or tongue-and-groove edges.
  - 2. Framing Lumber: Structural grade dressed or rough.
- D. Installation:
  - 1. Erect formwork, shoring and bracing to achieve design requirements and to maintain allowable tolerances in accordance with the requirements of ACI 301.
  - 2. Locate and set in place items that will be cast directly into concrete.
  - 3. Coordinate with related work of other Sections in forming and placing letterforms and other potential openings, slots, recesses, chases, sleeves, bolts, anchors, ties, inserts, and similar embedded items.
  - 4. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over-stressing by construction loads.
  - 5. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping, and permit removal of remaining principal shores.



6. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place during concrete placement.
7. Verify locations, lines, and levels before proceeding with formwork. Ensure that dimensions agree with shop drawings.
8. Loosen forms carefully, and remove without hammering or prying against finished concrete surfaces.
9. Form Release Agent: Commercial formulation, silicone-free form-release agent, designed for use on all types of forms, which will not bond with, stain, nor adversely affect concrete surfaces, and which will not impair subsequent treatment of concrete surfaces requiring bond or adhesion nor impede wetting of surfaces which will be cured with water, steam, or curing compounds. Form release agent for use on steel forms shall be non- staining and rust-preventive.
10. Protect concrete surface from damage. Store removed forms for re-use, as appropriate, and dispose of damaged forms from the site.
11. As soon as the forms have been stripped and the concrete surfaces exposed, commence finishing and restoration such as removal of fins and other projections, filling recesses left by the removal of form ties, and repair defects.
12. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.

**E. Field Quality Control:**

1. Inspect erected formwork, shoring, and bracing to ensure that the work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
2. While placing concrete, provide quality control to assure that formwork and related supports have not been displaced, that loss of cement paste through joints is prevented and that completed work will be within specified tolerances.
3. Ensure letterforms are level and flush to front surface of formed cement. Remove any excess cement and make surface smooth.
4. During removal, verify that architectural features meet the form and texture requirements of the samples approved by the Commissioner.
5. Check movement using methods, such as plumb lines, tell tales and survey equipment, as approved by the Commissioner, to detect movement of formwork during concrete placement.

**2.07 ALUMINUM**

- A. Aluminum plate and sheet shall be specified thickness and finish.
- B. Metal Thickness: Provide metal thickness indicated on Drawings. When metal thickness is not indicated on Drawings, provide thickness most appropriate for the fabrication condition to prevent warping, oil canning, or distortion. All corners and sides shall be eased and free from sharp or rough edges.

**2.08 HOMASOTE WITH ALUMINUM FRAME**

- A. Homasote sheet shall be specified thickness and finish.



- B. Thickness: Provide thickness indicated on Drawings. When thickness is not indicated on Drawings, provide thickness most appropriate for the fabrication condition to prevent warping, oil canning, or distortion.
- C. Aluminum frame to painted white as specified, fit securely around Homasote
- D. Secured to wall not visible from the front.

#### 2.09 LOCKABLE DIRECTORY

- A. Basis-of-Design Product: Subject to compliance with requirements provide Aarco Product Number DCC4836R, or comparable product by one of the following:
  - 1. Balt
  - 2. Claridge
  - 3. Or approved equal.
- B. Size: Custom, as indicated of Drawings
- C. Accessories: Removable letter board, lockable front door, with set of two keys furnished to Commissioner.
- D. Mount within prepared cabinet space for front of directory to be flush with wall.
- E. Fabricated Metal box and applied letters and to match finish and mounted to top of directory.
- F. Secured to wall not visible from the front.

#### 2.10 MAGNETIC PANEL BOARD

- A. Description: Finished stainless steel magnetic bulletin board. ¼" corner radius at all exposed corner, all edges ground smooth. Factory-drilled holes for fasteners. Cut out voids in bulletin board panel for other wall mounted items and grind void edges smooth in locations and sizes indicated on drawings.
- B. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. DiamondLife / Magpanel (Basis-of-Design)
  - 2. MMF Industries / STEELMASTER Soho Collection
  - 3. MURO / Magnetic Bulletin Board
  - 4. Or approved equal.
- C. Finish: Brushed stainless steel.
- D. Attachment: Provide double-sided foam tape at backside of panel at 6" OC and fasten to wall surface along all four sides of bulletin board using pan-head stainless steel wall anchors matching finish of bulletin board panel.
- E. Panel thickness: 0.030"
- F. Sizes: As indicated on drawings.

#### 2.11 FLAT CUT LETTERFORMS



- A. Form individual letters and numbers by laser or water-jet cutting. Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, and other defects. Drill to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.

- 1. Material: Aluminum.

#### 2.12 ACRYLIC

- A. Use virgin cast acrylic sheet made with methylmethacrylate polymers, premium quality, as manufactured by Acrylite; ICI Acrylics, Rohm and Hass; or approved equal.
- B. Provide solid sheet cast acrylic in size, thickness, clarity, opacity, texture, and color required for Work indicated on the Contract Drawings.

#### 2.13 ADA COMPLIANT SOLID SURFACE SIGN PLAQUES

- A. Custom cast solid acrylic of thickness indicated, monolithic thermally formed and bonded tactile plaque constructed utilizing a high-pressure thermoforming process, which provides a fully homogeneous plaque sign. The sign body, face, raised text and Braille are compression molded to form a single dimensional component creating a sign surface, body, and graphic elements that exhibit toughness to scratching, cracking, gouging and graffiti.

#### 2.14 ADHESIVES, FASTENERS, INKS AND PAINTS

- A. All adhesives and fasteners shall be adequate for producing structurally sound joints between similar and dissimilar materials without causing undue stress, discoloration, or deformation of surfaces or joints.
- B. Joining methods shall be in accordance with best practices and recommendations made by the manufacturer of the materials to be joined, using fasteners and adhesives that will not fade, discolor, or de-laminate as a result of continued exposure to sunlight, heat, cold, or moisture. Adhesives and fasteners shall not deteriorate the materials to which they are applied.
- C. No adhesives, which will fade, discolor, or de-laminate as a result of ultra violet light or heat shall be used.
- D. All mechanical fasteners shall be of stainless steel.
- E. Mechanical fasteners shall be concealed, unless specified otherwise in Contract Drawings, and of proper type and quantity to securely attach signage components to each other and to mounting surfaces.
- F. All painted lettering and silkscreening to be custom color matched in context with all other paint and material sign finishes.
- G. All paints, inks, coatings, and finishes, including primers and other surface preparations, shall be of the highest quality manufactured specifically for the surface materials to which they are to be applied, and shall be compatible with each other and with the materials to which they are applied.
- H. All paints, inks, and coatings shall be heavy-duty exterior grade to withstand chalking, fading, discoloring, chipping, cracking, and peeling, and warranted for a minimum of 10 years.
- I. All paints, inks, and coatings shall have a satin, eggshell, or non-glare finish per ADA requirements unless otherwise specified in the Contract Drawings or Graphic Layouts.
- J. Inks for etched-and-filled and/or silkscreened message copy shall be heavy-duty, scratchproof, and epoxy-based. Inks shall not fade, bubble, or peel as a result of exposure to sunlight, heat,

cold, or moisture, nor shall inks change the color of or deteriorate the materials to which they are applied.

- K. All exterior and interior sign faces with silkscreened, direct print and/or frisket paint shall have a non-glare, matte, UV and graffiti resistant clear protective coating.

#### 2.15 VINYL

- A. All vinyl shall be as specified in the Contract Drawings.
- B. All colored/painted vinyl shall be of the highest quality.
- C. Vinyl shall not fade, bubble, or peel as a result of exposure to sunlight, heat, cold or moisture, nor vinyl change the color of or deteriorate the materials to which they are applied.

### PART 3 – EXECUTION

#### 3.01 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.02 EXAMINATION

- A. All materials and products shall be new and free from defects, which impair strength or appearance.
- B. Construct all Work to eliminate burrs, dents, cutting edges, and sharp corners.
- C. Finish welds on exposed surfaces. Any damage by welding must be restored by grinding, polishing, or buffing.
- D. Finish all surfaces smooth, except as indicated or directed otherwise. Eliminate distortions of flat surfaces to be imperceptible in the finished work. At exposed connections, all flux, oxides, slag, and discoloration shall be removed so that these areas match the finish of adjacent areas.
- E. Surfaces that are intended to be flat shall be without dents, bulges, oil canning, gaps, or other physical deformities.
- F. Except where directed otherwise by the Commissioner, conceal all fasteners. If fasteners are exposed, paint them to match adjacent surface.
- G. Where actual conditions encountered require modifications to said manufacturer's instructions, they shall be accepted by manufacturer and Contractor prior to proceeding with the Work.
- H. If substrate preparation is the responsibility of another trade, notify Commissioner of unsatisfactory preparation before proceeding.

#### 3.03 PREPARATION

- A. Clean mounting surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### 3.04 INSPECTION





- A. Inspect installation locations for conditions that will adversely affect execution, permanence and quality of Work, and do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Exercise care to ensure that polished, plated, or finished surfaces are unblemished in the finished work.
- C. Conceal all identification labels and code compliance labels to comply with 2014 New York City Building Code.
- D. Carefully follow manufacturer's recommended fabricating procedures regarding expansion/contraction, fastening, and restraining of acrylic plastic.

### 3.05 FINISHES

- A. Protect finishes on exposed surfaces from damage by application of strippable temporary protective covering prior to shipment.
- B. Corrosion Protection: Coat concealed surfaces, which will be in contact with concrete, stone, masonry, wood, or dissimilar metals with a heavy or double coat of bituminous material.
- C. Graphics painted or silkscreened on-site on interior architectural surfaces shall be smooth and of uniform density, and shall not bubble, blister, peel or bleed beyond graphic edges or into stone or metal joints and seams.
- D. Graffiti resistant, scratch resistant, and UV matte clear coat required for exterior and/or interior sign faces as indicated in the Contract Drawings.

### 3.06 INSTALLATION

- A. Fabricator shall establish a timetable in conjunction with Commissioner for completion of installation by deadline date and final inspection.
- B. Install in accordance with manufacturer's instructions.
- C. Locate signs in accordance with approved shop drawings and ADA requirements.
- D. Do not begin installation until surfaces to receive signs have been finished and finishes are dry and correctly cured.
- E. Prior to installation, examine areas, surfaces, and conditions under which Work is to be installed. Inspect installation locations for conditions, which will adversely affect execution, permanence, and quality of Work, and shall not proceed with installation until unsatisfactory conditions have been corrected. Notify the Commissioner in writing of these conditions.
- F. Verify the location for all signs, which are not specifically dimensioned on the Contract Drawings. Sign location plans represent general sign location only. The indicator representing the sign is not to scale, nor does it show exact placement. Field-verify all sign locations.
- G. Except as may be indicated otherwise on the Contract Drawings, install prefabricated work plumb, level, square, and true to line.
- H. Securely anchor work in proper location using anchors, fasteners, or other methods. All anchors/fasteners shall be appropriate for the anchorage condition and be of non-corrosive type.
- I. Locate signs in a straight and aligned manner using manufactured adhesive and/or fastening methods.



- J. Surfaces under adhesive-applied signs shall be smooth, clean, and free of dust, oil, fingerprints, or other foreign matter. All adhesives required shall be used in accordance with the manufacturer's specifications. The sign shall be permanently installed and not removable unless indicated on the Contract Drawings.
- K. Contact the Commissioner if there are any questions as to suitability of the installation location or installation surface.
- L. Conform to ADA requirements for tactile graphics signage.

### 3.07 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, restore or replace damaged products before Substantial Completion.

### 3.08 CLEANING

- A. Clean-up the Work Site during and after installation to ensure the premises, adjacent and public properties is maintained free from accumulation of materials and construction debris.
- B. Final Clean-Up: All evidence of installation work or damages incurred on other surfaces shall be cleaned or restored prior to completion of Work. Protect all Work from damage.
  - 1. Remove protective materials and dispose of properly.
  - 2. Broom clean paved or concrete surfaces.
- C. Cleaning of Signs: Clean all completed and installed signs to remove fingerprints, residue, adhesives, etc. prior to Final Acceptance.

### 3.09 QUALITY CONTROL

- A. Touch-up all scratched, marred, abraded, or otherwise damaged surfaces to match original finishes.

### 3.10 WASTE MANAGEMENT

- A. Remove and dispose of all waste prior to Work completion.

**END OF SECTION 10 14 00**



## **SECTION 10 21 13**

### **TOILET COMPARTMENTS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section includes:
  - 1. Solid- plastic toilet compartments configured as toilet enclosure partitions, urinal screens and shower cubicles.
  - 2. Installation accessories.
- B. Related Sections:
  - 1. Section 05 50 00 "Metal Fabrications" for attachments.
  - 2. Section 06 10 00 "Rough Carpentry" for blocking.
  - 3. Section 09 30 13 "Ceramic Tiling."
  - 4. Section 10 28 00 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, shower seats, and similar accessories mounted on toilet compartments.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.



2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.6 COORDINATION

- A. Coordinate requirements for blocking, reinforcing, and other supports concealed within wall.
- B. Coordinate requirements for Toilet and Bath Accessories mounted on partitions.

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, and attachment details.
- C. Samples for each type of toilet compartment material indicated.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

#### 1.9 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

#### 1.11 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 and the New York City Department of Buildings, for toilet compartments designated as accessible.

**2.2 MANUFACTURERS**

- A. Basis of Design, Product: Subject to compliance with requirements, provide products as supplied by Scranton Products, Inc., Hiney Hiders, as fabricated by Santana Toilet Partitions or comparable product from one of the following, as approved by the Commissioner:
  - 1. Accurate Partitions Corporation.
  - 2. Bobrick Washroom Equipment, Inc.
  - 3. Approved equal.

**2.3 MATERIALS**

- A. Door, Panel, Seat and Pilaster Construction: Solid, high- density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
  - 1. Colors and Finish: Charcoal, with orange peel as supplied by Santana Products, Inc. or equivalent product.
- B. Pilasters: Minimum of 1 inch thick, same construction and material as panels.
- C. Brackets (Fittings): Provide full length (of juncture) continuous brackets (single ear, double ear, tee, or corner as required for condition), anodized aluminum (6463-T5 alloy) for panel-to-pilaster, panel-to-panel, and pilaster-to-pilaster connections.
  - 1. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
  - 2. Panel-to-wall connection (at top): Provide 1-1/2 by 1-1/2 by 1/8 inch anodized aluminum angle, 6463-T5 alloy.
- D. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
- E. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

**2.4 HARDWARE AND ACCESSORIES**

- A. Hardware: Provide each toilet compartment with all vandal resistant hardware, door hinges, latch stop and keeper, and all necessary fittings and fasteners for a complete installation.
  - 1. Accessible doors shall comply with Regulatory Requirements, as per Article 2.1.



2. Hinges: Full height continuous piano type, adjustable to hold door open at any angle up to 90 degrees. Provide gravity type, spring-action cam type, or concealed torsion rod type to suit manufacturer's standards.
  - a. For Accessible doors, provide heavy duty outswing wrap-around hinges. Provide 1/ 2 inch clearance between door and pilaster, in closed position.
3. Latch and Keeper: Surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper.
  - a. Door strike and keeper shall be aluminum extrusion, 6463-T5 alloy, with bright dipped anodized finish with wrap around flanges, surface mounted and through-bolted to door with one-way sex- bolts. Provide full length (of juncture) continuous wall brackets per linear foot, for all panels-to- pilasters, pilasters-to-wall and panel-to-wall connection.
    - 1) Predrill wall brackets, with holes spaced a maximum of 13 inches along full length of each leg of bracket, with a hole 3 inch maximum from each end. Stagger holes in bracket legs, so that vertical spacing between holes is not more than 6 1/ 2 inches.
    - 2) Wall brackets shall be through-bolted to panels and pilasters with one-way sex- bolts.
  - b. Slide bolt and button: heavy aluminum with "tough-coat black" finish unless otherwise indicated.
    - 1) For Accessible doors, provide latch easily- operable.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance screen doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors. Provide units on both sides of doors at compartments indicated to be accessible.
7. Shower Hooks: Stainless steel with self- lubricating nylon 6/6 slides, unless otherwise as recommended by manufacturer.
- B. Headrail (Overhead Bracing): Aluminum extrusion, 6463-T5 Alloy, with bright dipped anodized finish in anti-grip configuration weighing minimum 1.188 lbs. per linear foot. Fasten Headrail to tops of pilasters and headrail brackets by thru-bolting with star-head security pin, stainless steel barrel bolts.
  1. Headrail Brackets: 18 gauge stainless steel.
- C. Anchorages and Fasteners: Manufacturer's Standard exposed fasteners.
  1. Reinforcement: Minimum 12 gauge galvanized steel sheet.
- D. Tapping Reinforcement: Minimum 14 gauge galvanized steel sheet.



## 2.5 FABRICATION

- A. Fabrication, General: Fabricate compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide galvanized steel supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Wall-Hung Screens: Provide panel units 55 inch deep by 55 inch high of same construction and finish as compartment panels. Mount bottom at 14" above floor unless otherwise indicated.
- D. Doors: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments indicated to be accessible to people with disabilities.
- E. Shower Compartment Dividers: 76 inch high above shower base, unless otherwise shown on the Drawings.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.



2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
  - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
  - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.
- D. Shower Seats mounted to Partitions: Secure to vertical panels with stainless steel 18 inch "L" brackets and tamper-proof sex- bolts.
  1. Seat to be secured to sustain a force of 300 lbs. at any point and from any direction, except sustain a downward force of 350 lbs.

#### 3.4 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

**END OF SECTION 10 21 13**





## **SECTION 10 22 13**

### **WIRE MESH PARTITIONS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

A. Section Includes:

1. Heavy-duty wire mesh partitions.
2. Framing, supports and doors.
3. Installation accessories.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for attachments not provided under this section.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Indicate clearances required for operation of service windows and doors.
- C. Samples: 12-by-12-inch panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.
- D. Engineering Services Submittal: For wire mesh partitions and supports, submit design calculations sealed and signed by the qualified Contractor's Professional Engineer, licensed in the State of New York responsible for their preparation.
  - 1. Engineering services documentation shall be submitted to Commissioner for review and approval prior to any incorporation into the work.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wire mesh partition hardware to include in maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.
- C. Welding Qualifications: Qualify procedures according to the following:
  - 1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."



**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver wire mesh items with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.
- B. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.
  - 1. Tag each item or package separately with identification and include basic installation instructions with each item or package.
- C. Deliver keys to Commissioner at Substantial Completion.

**1.11 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh partitions by field measurements before fabrication.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Stainless Steel Wire Mesh Products: Subject to compliance with requirements, provide Delta 16 as supplied by GKD Metal Fabrics or comparable product from one of the following, as approved by the Commissioner:
  - 1. McNichols Co.
  - 2. Darby Wire Mesh.
  - 3. Or approved equal.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Engineering Services: Engage a qualified Professional Engineer licensed in the State of New York to design wire mesh partitions and supports for project application.
  - 1. Engineering Services shall include complete design calculations for wire mesh partitions and supports required for this project.
    - a. Indicate required design loads, including applicable live loads, wind loads, seismic loads, and dead loads and handling stresses during shipment and erection including loads from construction procedures.
    - b. Design calculations shall be based on Performance Requirements and product design criteria indicated
- B. Structural Performance: Wire mesh partitions and supports shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, unless otherwise required by project and 2014 New York City Building Code.
  - 1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.



2. Total load of 200 lbf applied uniformly over each panel.
  3. Concentrated load and total load need not be assumed to act concurrently.
- C. Seismic Performance: Wire mesh partitions and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.0.

## 2.3 MATERIALS

- A. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316/ 316L.
- B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316, stretcher-leveled standard of flatness.
- C. Stainless Steel Castings: ASTM A743/A743M.
- D. Panel-to-Panel Fasteners: Stainless steel bolts, nuts, and washers.
- E. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
1. Material Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- F. Power-Driven Fasteners: ICC-ES AC70.
- G. Seismic Bracing: Angles with legs not less than 1-1/4 inch wide, formed from 0.040-inch-thick, stainless steel sheet; with bolted connections and 1/4-inch-diameter bolts.

## 2.4 HEAVY-DUTY WIRE MESH PARTITIONS

- A. Wire Mesh Panels: Stainless steel angle frames with stainless steel wire mesh secured in frame; frame joints coped at corner and securely welded and pre-drilled holes for fasteners.
- B. Rigid Mesh: 0.105 inch (12 gage), Type 316 stainless steel wire, woven into 2 by 2 inch pattern, unless otherwise indicated.
1. Weight: 2.08 lbs. per sq. ft.
  2. Open Area: 64 percent.
  3. Frame Configuration: As indicated on drawings.
- C. Vertical and Horizontal Panel Framing: 1-1/2-by-3/4-by-1/8-inch, stainless steel channels; with holes for 3/8-inch-diameter bolts not more than 12 inches o.c.
- D. Horizontal Panel Stiffeners: Two stainless steel channels, 1 by 1/2 by 1/8 inch, bolted or riveted toe to toe through mesh.
- E. Top Capping Bars: 3-by-1-inch stainless steel channels.



- F. Posts for 90-Degree Corners: 1-1/2-by-1-1/2-by-1/8-inch, stainless steel angles or 2-by-2-by-0.075-inch stainless steel tubes, with holes for 3/8-inch-diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch stainless steel base plates.
- G. Posts for Other-Than-90-Degree Corners: 2-inch-OD by 1/8-inch stainless steel pipe or round tube, with holes for 3/8-inch-diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch stainless steel base plates.
- H. Adjustable Corner Posts: Two 1-1/2-by-3/4-by-1/8-inch stainless steel channels or 2-by-2-by-0.075-inch stainless steel tubes connected by stainless steel hinges at 36 inches o.c. attached to posts; with 1/4-inch-diameter bolt holes aligning with bolt holes in vertical framing; with 1/4-inch stainless steel base plates.
- I. Line Posts: 3-inch-by-4.1-lb or 3-1/2-by-1-1/4-by-1/8-inch stainless steel channels; with 1/4-inch stainless steel base plates.
- J. Three- and Four-Way Intersection Posts: 2-by-2-by-0.075-inch stainless steel tubes, with holes for 3/8-inch-diameter bolts aligned for bolting to adjacent panels; with 1/4-inch stainless steel base plates.
- K. Floor Shoes: Metal, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
- L. Swinging Doors: Fabricated from same stainless steel mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch stainless steel channels or 1-1/4-by-5/8-by-0.080-inch stainless steel channels, banded with 1-1/4-by-1/8-inch flat stainless steel bar cover plates on four sides, and with 1/8-inch-thick angle strike bar and cover on strike jamb.
  - 1. Hardware: Refer to Section 08 70 00 "Finish Hardware."
  - 2. Inactive Leaf Hardware: Cane bolt at bottom and chain bolt at top.
- M. Accessories:
  - 1. Adjustable Filler Panels: 0.060-inch-thick stainless steel sheet, capable of filling openings from 2 to 12 inches.
  - 2. Wall Clips/ Brackets: Stainless steel sheet; allowing minimum 1 inch of adjustment.

## 2.5 FABRICATION

- A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
  - 1. Fabricate wire mesh items to be readily disassembled.
  - 2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.
- B. Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
  - 1. Mesh: Securely clinch or weld mesh to framing.



2. Framing: Fabricate framing with mortise and tenon corner construction.
  - a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height.
  - b. Weld horizontal stiffeners to vertical framing.
3. Fabricate three- and four-way intersections using connecting clips and fasteners.
4. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
5. Fabricate wire mesh partitions with 3 to 4 inches of clear space between finished floor and bottom horizontal framing, unless otherwise indicated.
6. Doors: Align bottom of door with bottom of adjacent panels.
  - a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
7. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

## 2.6 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.
- D. Finish: Directional Satin No. 4 or Dull Satin No. 6, as selected by the Commissioner.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.3 INSTALLATION

- A. Anchor wire mesh partitions to floor with 3/8-inch-diameter postinstalled expansion anchors at 12 inches o.c. through anchor clip or floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
- B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:
  - 1. For concrete and solid masonry anchorage, use expansion anchors.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For steel-framed gypsum board assemblies, fasten brackets directly to framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.
- C. Secure top capping bars to top framing channels with 1/4-inch-diameter "U" bolts spaced not more than 28 inches o.c.
- D. Provide line posts at locations indicated or, if not indicated, as follows:
  - 1. On each side of sliding-door openings.
  - 2. For partitions that are 7 to 9 feet high, spaced at 15 to 20 feet o.c.
  - 3. For partitions that are 10 to 12 feet high, located between every other panel.
  - 4. For partitions that are more than 12 feet high, located between each panel.
- E. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.
- F. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
- G. Install doors complete with door hardware.
- H. Install service windows complete with window hardware.
- I. Weld or bolt sheet metal bases to wire mesh partitions and doors where indicated.
- J. Bolt accessories to wire mesh partition framing.

### 3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.



- C. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- D. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- E. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and restore galvanizing to comply with ASTM A 780/A 780M.
- F. Protect finishes of from damage during construction period with material approved by partition fabricator. Remove protective covering at time of Substantial Completion.
- G. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish items or provide new.

**END OF SECTION 10 22 13**



**SECTION 10 26 00**

**WALL AND DOOR PROTECTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Corner guards.
  2. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Material certificates.
- C. Sample warranty.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to restore or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

#### 2.2 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or custom angled corner as indicated on drawings.



1. Basis- of Design, Product: Subject to compliance with requirements, provide Model CO- 8 as supplied by C/S Acrovyn or comparable product from one of the following, as approved by the Commissioner:
    - a. Inpro Corporation.
    - b. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - c. Approved equal.
  2. Material: Stainless-steel sheet, Type 304 or 430.
    - a. Thickness: Minimum 0.0625 inch (16 gage).
    - b. Finish: Directional satin, No. 4.
  3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
  4. Corner Radius: 1/8 inch.
  5. Height: Top of base to 88 inches above finished floor.
  6. Surface- Mounting: Torx pin- head, security screws through factory-drilled mounting holes at 12 inches on center.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened.

### **PART 3 - EXECUTION**

#### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

#### **3.2 INSTALLATION**

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
1. Provide anchoring devices and suitable locations to withstand imposed loads.
  2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
  3. Adjust end and top caps as required to ensure tight seams.

**END OF SECTION 10 26 00**



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**SECTION 10 28 00**

**TOILET AND BATH ACCESSORIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Warm-air dryers.
4. Childcare accessories.
5. Underlavatory guards.
6. Custodial accessories.

- B. Related Sections:

1. Section 10 21 13 "Toilet Compartments" for shower seats and similar accessories mounted on toilet partitions.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.



2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 COORDINATION

- A. Coordinate requirements for blocking, reinforcing, and other supports concealed within walls.

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full size, for each exposed product and for each finish specified.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

#### 1.9 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

#### 1.11 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to restore or replace mirrors that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, visible silver spoilage defects.
  2. Warranty Period: 15 years from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 MANUFACTURERS

- A. Basis- of Design, Toilet and Bath Accessory Products: Subject to compliance with requirements, provide products as indicated or comparable product from one of the following, as approved by the Commissioner:

- 1. American Specialties, Inc.
- 2. Bradley Corp
- 3. Approved equal.

- B. Toilet and Bath Accessories for Public-Use:

- 1. Toilet Tissue Holder (BA- 4):

- a. Basis-of-Design, Product: B-4288 by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
- b. Material and Finish: Stainless steel, No. 4 finish (satin).

- 2. Paper Towel Dispenser and Waste Receptible (BA- 5):

- a. Basis-of-Design ,Product: B-3949, 18 gallon by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.

- 3. Warm-Air Dryers (BA- 9):

- a. Basis-of-Design, Product: Model DXM5- 973 by AirMax Series or equivalent product from approved manufacturers listed.
- b. Surface mounted, stainless steel cover, push button activated, 115-volt, 20 amp, 2300 watts.

- 4. Grab Bar (BA- 1):

- a. Basis-of-Design, Product: "B-6806 Series" Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.

- 5. Sanitary Napkin Disposal Unit (BA- 6):

- a. Basis-of-Design, Product: Provide "B-270" Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.
- b. Material and Finish: Stainless steel, No. 4 finish (satin).

- 6. Mirror Unit (BA- 2):

- a. Basis-of-Design, Product: Series B-290- 2436, mirror with angle frame by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.



7. Mirror Unit ADA (BA- 2):
  - a. Basis-of-Design, Product: Series B-293- 2436, mirror with angle frame by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
8. Childcare Accessories (BA-13):
  - a. Basis-of-Design, Product: Provide “KB110- SSWM by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
  - b. Baby- changing Station: Horizontal type, stainless steel.
  - c. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Toilet and Bath Accessories for Private-Use:
  1. Paper Towel Dispenser and Waste Receptible (BA- 5):
    - a. Basis-of-Design, Product: B-3949, 18 gallon by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
  2. Medicine Cabinet (BA-8):
    - a. Basis-of-Design, Product: B-398, recessed” by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
  3. Soap Dispenser (BA-7):
    - a. Basis-of-Design, Product: B-2111 by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
  4. Mirror Unit and Shelf (BA-3):
    - a. Basis-of-Design, Product: Series B-292- 1836; mirror with angle frame by Bobrick Washroom Equipment, Inc. or equivalent product from approved manufacturers listed.
  5. Sanitary Napkin Disposal Unit (BA-6):
    - a. Basis-of-Design, Product: B-270; Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.
    - b. Material and Finish: Stainless steel, No. 4 finish (satin).
  6. Shower Rod Extra Heavy Duty and Accessories (BA-12):
    - a. Basis-of-Design, Product: B-6047; Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.
    - b. Shower Curtain Hooks: Provide “B-204-1 1” and 1-1/4” dia.” Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.
    - c. Shower Curtain: Provide “6 Gauge parquet, 48” wide x 84” long” Gary Manufacturing or equivalent product from approved manufacturers listed.





7. Shower Seat (BA- 11):
  - a. Basis-of-Design, Product: 956-30- left hand; Bradley Corporation or equivalent product from approved manufacturers listed.
8. Coat Hook (mounted on rear wall of toilet stall) (BA-10):
  - a. Basis-of-Design Product: Provide “B-211 wall mounted Coat Hook” Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.
  - b. Description: Single-prong and neoprene bumper unit.
  - c. Material and Finish: Polished chrome-plated brass.
9. Shelf with Mop and Broom Holder:
  - a. Basis-of-Design, Product: Provide “B-239-34” Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.
  - b. Provide one in each custodial closet.
10. Locker Room Dressing Mirror:
  - a. Basis-of-Design, Product: 290- 18 by 60 inch; wall mounted Mirror Bobrick Washroom Equipment, Inc or equivalent product from approved manufacturers listed.

## 2.3 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- D. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- F. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

## 2.4 UNDERLAVATORY GUARDS

- A. Manufacturers: Subject to compliance with requirements, provide the following or equal as approved by the Commissioner by one of the following:
  1. LavShiel as supplied by Truebro, Inc.
- B. Other Manufacturers:
  1. TCI Products.
  2. Plumberex Specialty Products, Inc.
  3. Approved equal.



- C. Description: Rigid high-impact, stain resistant PVC guard, that prevent direct contact with and burns from piping, and allow service access by removing coverings.
- D. Color and Finish: China white, fine haircell.

## 2.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to the Commissioner.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

### 3.3 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

**END OF SECTION 10 28 00**

**SECTION 10 28 13****DETENTION TOILET ACCESSORIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Grab bars.
  2. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 COORDINATION

- A. Coordinate installation of anchorages for detention toilet accessories. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjoining construction. Deliver such items to Project site in time for installation.
- B. Coordinate size and location of recesses in wall construction to receive recessed detention toilet accessories.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Samples: For each detention toilet accessory indicated.

1.8 INFORMATIONAL SUBMITTALS

- A. Examination reports documenting inspection of substrates, areas, and conditions.
- B. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- C. Field quality-control certification signed by Contractor.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to restore or replace detention toilet accessories that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including deflection exceeding 1/4 inch.
    - b. Faulty operation of hardware.
    - c. Deterioration of metals, metal finishes, and other materials.
  - 2. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide products as supplied by Bobrick Washroom Equipment, Inc or comparable product from one of the following, as approved by the Commissioner:
1. American Specialties, Inc.
  2. Bradley Corp
  3. PSI LLC.
  4. Approved equal.

**2.2 DETENTION GRAB BARS**

- A. Grab Bars: 1-1/2 inches in diameter; formed from 0.038-inch-thick, stainless-steel tubing, with 3-inch-diameter flanges formed from 0.125-inch-thick, stainless steel. Closure plates formed from 0.125-inch-thick, stainless steel. All-welded construction.
1. Length: As indicated on Drawings.
  2. Mounting: Front mounting with security fasteners.
- B. Materials:
1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.
  2. Stainless-Steel Tubing: ASTM A1016/A1016M, austenitic stainless steel, Type 304, seamless.
- C. Stainless-Steel Finish: Directional Satin Finish: No. 4.

**2.3 STAINLESS-STEEL FINISHES**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. Run grain of directional finishes with long dimension of each piece.
  2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

**2.4 FABRICATION**

- A. Coordinate dimensions and attachment methods of detention toilet accessories with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Form edges and corners to be free of sharp edges and rough areas. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.



- D. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Weld corners and seams continuously to comply with referenced AWS standard.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention toilet accessories rigidly in place and to support expected loads.
- G. Cut, reinforce, drill, and tap detention toilet accessories to receive hardware, security fasteners, and similar items.
- H. Form exposed work true to line and level with accurate angles and surfaces. Grind off and ease edges unless otherwise indicated.
- I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

## 2.5 SECURITY FASTENERS

- A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.

## 2.6 SECURITY SEALANTS

- A. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. BASF Corp. - Construction Chemicals.
  - 2. Euclid Chemical Company (The); an RPM company.
  - 3. Pecora Corporation.
  - 4. Approved equal.

## 2.7 ACCESSORIES

- A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

## 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of detention toilet accessories.



- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention toilet accessory connections before detention toilet accessory installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention toilet accessories.
- D. Inspect built-in and cast-in anchor installations before installing detention toilet accessories to verify that anchor installations comply with requirements. Prepare inspection reports.
  - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after restoration or replacements are made.
  - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- E. Verify locations of detention toilet accessories.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention toilet accessories to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
- B. Provide temporary bracing or anchors in formwork for items that are to be built into construction.
- C. Apply epoxy security sealant around perimeter in a continuous ribbon on back of detention toilet accessories before installation.
- D. Security Fasteners: Install detention toilet accessories using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials.
- E. Grab Bars: Install to withstand a downward load of not less than 250 lbf per ASTM F446.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Remove and replace detention work where inspections indicate that work does not comply with specified requirements.
- C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- D. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

### 3.5 ADJUSTING AND CLEANING

- A. Remove temporary labels and protective coatings.



- B. Touchup Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

**END OF SECTION 10 28 13**



**SECTION 10 44 13**

**FIRE PROTECTION CABINETS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Fire-protection cabinets for portable fire extinguishers.
  2. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

#### 1.6 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.
- C. Samples: For each type of exposed finish required.

#### 1.9 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
  - 1. Comply with the 2014 New York City Building Code.
- B. Accessibility Standard: Comply with applicable provisions of ICC A117.1.

#### 2.2 FIRE-PROTECTION CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, as approved by the Commissioner:
  - 1. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - 2. Larsens Manufacturing Company.
  - 3. Potter Roemer LLC.



4. Approved equal.
- B. Cabinet Type: Suitable for fire extinguisher as approved by the Commissioner.
- C. Cabinet Construction: Nonrated, unless required by partition fire- resistance rating.
  1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
- D. Cabinet Material: Cold-rolled steel sheet.
- E. Recessed Cabinet:
  1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.
  2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
  3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- F. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
  2. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- G. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- H. Cabinet Trim Material: Same material and finish as door.
- I. Door Material: Stainless- steel sheet.
- J. Door Style: Vertical or horizontal duo panel with frame.
- K. Door Glazing: Tempered float glass (clear).
- L. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- M. Accessories:
  1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
  3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.



4. Identification: Lettering complying with the Regulatory Requirements for letter style, size, spacing, and location. Locate as directed by Commissioner.
  - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
    - 1) Location: Applied to cabinet door or glazing, as indicated on Drawings.
    - 2) Application Process: Silk-screened.
    - 3) Lettering Color: Red.
    - 4) Orientation: Vertical, unless otherwise indicated on Drawings.
5. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by low voltage, complete with transformer.

**N. Materials:**

1. Stainless Steel: ASTM A 666, Type 304.
  - a. Finish: No. 4 directional satin finish, unless otherwise indicated.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

**2.3 FABRICATION**

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

**PART 3 - EXECUTION**

**3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 PREPARATION**

- A. Prepare recesses for fire-protection cabinets as required by type and size of cabinet and trim style.

**3.4 INSTALLATION**

- A. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights in compliance with the 2014 New York City Building Code.



- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- C. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

### 3.5 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful restoration by finish touchup or similar minor restoration procedures.

**END OF SECTION 10 44 13**



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**SECTION 10 51 13****METAL LOCKERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Welded lockers.
  2. Locker benches.
  3. Installation accessories.
- B. Related Sections:
1. Division 26 – Electrical sections for connection to duplex outlets that are part of lockers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 COORDINATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

**1.6 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.7 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.8 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal lockers.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include locker identification system and numbering sequence.
- C. Samples: For each color specified.

**1.9 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

**1.10 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For adjusting, restoring and replacing locker doors and latching mechanisms to include in maintenance manuals.

**1.11 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."





**1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

**1.13 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

**1.14 WARRANTY**

- A. Special Warranty: Manufacturer agrees to restore or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of latches and other door hardware.
  - 2. Damage from deliberate destruction and vandalism is excluded.
  - 3. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single locker manufacturer.
- B. Products: Subject to compliance with requirements, provide products by one of the following.
  - 1. Spacesaver. Inc.
  - 1. Penco Products, Inc.
  - 2. Lyon Workspace Products.
  - 3. Republic Storage Systems Company.
  - 4. Approved equal.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions ICC A117.1 and the 2014 New York City Building Code.

**2.3 MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.



- B. Extruded Aluminum: ASTM B 221, alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
- C. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- D. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.
  - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
  - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

## 2.4 ALL- WELDED METAL LOCKERS

- A. Wardrobe Lockers (L-1): 8-inch high by 24-inch deep sloped top on 64-inch high by 24-inch deep on 18-inch high by 36-inch deep locking drawer base with benchtop. Total height 92 inches to high point of slope top. Configuration as indicated on drawings.
  - 1. Body Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
    - a. Tops: 16 gauge.
    - b. Bottoms: 16 gauge.
      - 1) Provide two 16 gauge box braces across the entire length of the bottom panel spaced evenly apart welded to the underside of the bottom panel.
    - c. Backs and Sides: 22 gauge.
    - d. Shelves: 22 gauge, with double bend at front and single bend at sides and back.
      - 2) Provide two 22 gauge box braces across the entire length of the shelf panel spaced evenly apart welded to the underside of the shelf panel.
    - e. Base Closure: 18 gauge.
  - 2. Frames: Channel formed; fabricated from 16 gauge, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
    - a. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
  - 3. Doors: Door of one-piece; fabricated from 16 gauge with 24 gauge reinforcing panel, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
  - 4. Door Frames: Formed angle, 1 inch by 1 inch, 11 gauge.
  - 5. Door Style: Vented panel with Louvered Vents: Not less than six louver openings at top and bottom for single-tier.
  - 6. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
    - a. Continuous Hinges: Manufacturer's standard, steel continuous hinge.



7. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant, eye for padlock.
    - a. Multipoint Latching: Finger-lift latch control designed for use padlocks, minimum three point latching.
      - 1) Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
  8. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
    - a. Uniform Lockers: Hat shelf, coat rod, 6 single prong wall hooks (2 on each wall), 8'x10" mirror.
    - b. Wood bench with drawer.
    - c. Sloped top.
    - d. Boot tray.
    - e. Document holder.
    - f. Duplex outlet.
  9. Accessories:
    - a. Filler Panels: Fabricated from 16 gauge, cold-rolled steel sheet.
  10. Finish: Baked enamel.
    - b. Color(s): As indicated on drawings.
- B. Single Tier Lockers (L-2): Single tier locker 72 inch high on 6 inch closed base. Sizes and configuration as indicated on drawings
1. Body Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
    - a. Tops: 16 gauge.
    - b. Bottoms: 14 gauge
    - c. Backs and Sides: 16 gauge.
    - d. Shelves: 18 gauge, with double bend at front and single bend at sides and back.
    - e. Base Closure: 16 gauge.
  2. Frames: Channel formed; fabricated from 16 gauge, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
  3. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
  4. Base: 6 inches high; fabricated from 11 gauge steel sheet; welded to bottom of locker. Included reinforcement and support required for locker.
  5. Doors: Door of one-piece; fabricated from 14 gauge with 24 gauge reinforcing panel, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.



6. Door Frames: Formed angle, 1 inch by 1 inch, 11 gauge.
  7. Door Style: Vented panel as follows:
    - a. Louvered Vents: Not less than six louver openings at top and bottom for single-tier.
  8. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
    - a. Continuous Hinges: Manufacturer's standard, steel continuous hinge.
  9. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant, eye for padlock.
    - a. Multipoint Latching: Finger-lift latch control designed for use padlocks.
    - b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
  2. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
    - a. Uniform Lockers: Hat shelf, coat rod, 6 single prong wall hooks (2 on each wall), 8"x10" mirror.
  3. Accessories:
    - a. Filler Panels: Fabricated from 16 gauge, cold-rolled steel sheet.
  4. Finish: Baked enamel.
    - a. Color: As indicated on drawings.
  10. Refer to diagram at the end of this section.
- C. Double Tier Lockers (L3): Double tier locker 72 inch high on 6 inch closed base.
1. Body: Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
    - a. Tops and Sides: 16 gauge.
    - b. Bottoms: 14 gauge.
    - c. Backs: 16 gauge.
    - d. Shelves: 18 gauge, with double bend at front and single bend at sides and back.
    - e. Base Closure: 16 gauge.
  2. Frames: Channel formed; fabricated from 16 gauge cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
    - a. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.



3. Base: 6 inches high; fabricated from 11 gauge steel sheet; welded to bottom of locker. Included reinforcement and support required for locker.
4. Doors: One-piece; fabricated from 14 gauge, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
  - a. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
5. Door Frames: Formed angle, 1 inch by 1 inch, 11 gauge.
6. Door Style: Vented panel as follows:
  - a. Louvered Vents: Not less than three louver openings at top for double-tier lockers.
7. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
  - a. Hinges: Manufacturer's standard, steel continuous or knuckle type.
8. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant eye for padlock.
  - a. Multipoint Latching: Finger-lift latch control designed for use padlocks.
    - 1) Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
9. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
  - a. Double-Tier Units for Civilian Lockers: One coat rod in each tier.
10. Accessories:
  - a. Closures: Vertical-end type.
11. Filler Panels: Fabricated from 16 gauge, cold-rolled steel sheet.
12. Finish: Baked enamel.
  - a. Color: As indicated on drawings.

## **2.5 LOCKER ROOM BENCHES**

- A. Bench Tops: Manufacturer's standard 1-piece units 9 inch wide by 2 inch thick, with rounded corners and edges, fabricated from laminated maple with one coat of clear sealer on all surfaces, and two coats of clear lacquer on top and sides.
- B. Freestanding Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners and anchorage, and as follows



1. Freestanding Isosceles Trapezoid Base: 1/4-inch-thick by 3-inch-wide anodized aluminum bar stock, shaped into isosceles trapezoidal form; with nonskid rubber pads at bottom. Provide minimum two pedestals for each bench. Maximum spacing 6 feet.
  2. Size: 14 inches wide and 16-1/2 inches high.
- C. Custom Bench Sizes: Length and width as indicated on the Drawings.
1. Stain Color: As selected by the Commissioner.

## 2.6 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
  2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.
- B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections, with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- E. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch high.
- F. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.
1. Sloped top corner fillers, mitered.
- G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

## 2.7 STEEL SHEET FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- D. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
  - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
  - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
  - 3. Anchor back-to-back metal lockers to floor.
- B. All-Welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
  - 1. Attach hooks with at least two fasteners.
  - 2. Attach door locks on doors using security-type fasteners.
  - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
    - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
  - 4. Attach filler panels with concealed fasteners. Locate fillers panels where indicated on Drawings.
  - 5. Attach sloping top units to metal lockers, with closures at exposed ends.
- D. Freestanding Locker Benches: Place benches in locations indicated on the Drawings.

**3.4 ADJUSTING, CLEANING, AND PROTECTION**

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers and benches from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.



- C. Touch up marred finishes or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

**END OF SECTION 10 51 13**



**SECTION 10 75 00****FLAGPOLES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Aluminum flagpoles as shown on drawings and specified with components as needed for complete installation.

B. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete"
2. Section 26 56 00 "Exterior Lighting"
3. Section 32 05 16 "Aggregate Materials"
4. Section 32 14 13 "Precast Concrete Unit Pavers"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.6 PERFORMANCE

- A. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to NAAMM FP 1001-07, "Guide Specifications for Design of Metal Flagpoles" for the site's region.

## 1.7 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and standard installation instructions.
- B. Shop Drawings: Show general layout, jointing, anchorage, support systems, and accessories.
- C. Samples: Finish samples for each finished metal used on flagpoles, as may be required.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Obtain each flagpole as a complete unit from manufacturer including fittings, accessories, bases, and anchorage devices.
- D. Drawings and installation plans to be reviewed by Commissioner.

## 1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Spiral wrap flagpoles with a heavy Kraft paper or other lightweight wrapping and enclose in a hard fiber tube or other protective means. Store bare flagpoles in a dry location, protected from the weather and moisture.
- B. Ship to project site in one piece. If more than one piece is necessary, provide snug fitting precision joints with self-aligning, internal splicing sleeve arrangements for weather tight, hairline field joints.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum flagpole with concealed internal halyard system and vandal proof lockable door, with components as needed for complete installation. Fabricated from seamless, extruded tubing complying with ASTM B 221, Alloy 6063-T6, having a tensile strength not less than 30,000 psi with a yield point of 25,000 psi. Heat treat after fabrication to comply with ASTM B 597, Temper T6.
- B. Dimensions:

1. Flagpole mounting height – 35'-0"
  2. Butt diameter – 8"
  3. Top Diameter – 4"
  4. Wall thickness – 0.188"
  5. Set depth – 4'-0"
- C. Max wind load with flag - 115 Mph or determined according to NAAM FP 1001-07, "Guide Specifications for Design of Metal Flagpoles, whichever is more stringent.
- D. Internal Halyard Winch System: Provide one (1) complete internal halyard 1/8" stainless steel wire cable assembly with plastic coated counterweight and beaded sling assembly.
- E. Halyard Flag Snaps: Provide two (2) stainless steel swivel snap hooks with neoprene covers.
- F. Light Fixtures: One (1) Triple upright/downlight fixture mount welded to pole, one per flagpole, as specified in Section 26 56 00 and indicated in the lighting drawings.
- G. Metal Finish: Natural Satin Finish – Provide directional-sanded satin finish (AA-M33): buff complying with AA-M20.
- H. Manufacturer
1. Basis-of-Design Product: Subject to Compliance with requirements provided; American Flagpole, 26252 Hillman Highway, Abingdon, VA 24210 (855) 530-4078.
    - a. Flagpoles Etc. 407 Hadley St., Holly, MI 48442, 1888-648-1804
    - b. Johnson Bros. Metal Forming CO., 5744 McDermott Drive, Berkeley, IL 60163-1102, 708-449-7050
    - c. Or approved equal
- I. Mounting: Ground sleeve will be set in foundation utilizing 3000 psi concrete, per manufacturer's instructions.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 INSTALLATION

- A. General: Install flagpoles where shown and according to shop drawings and manufacturer's written instruction.
- B. Do not begin installation until final grades and elevations have been established.
- C. Flagpole shall be plumbed with 1/4" for every 10 feet of pole height.
- D. Ground Sleeve Installation: Insert flagpole into ground sleeve, plumb flagpole with wooden wedges. Fill space between ground sleeve and flagpole with tamped dry sand. Fill ground sleeve 6" to 8" at a time and tamp while filling. Fill ground sleeve with sand to approx.. 2" from top. Cap off with waterproof cement.

3.3 QUALITY CONTROL

- A. After flagpole is mounted, raise and lower halyard with winch handle.

3.4 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 10 75 00**

**SECTION 11 30 13****RESIDENTIAL APPLIANCES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pantry appliances as schedules on drawings.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures.”

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.
- C. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of appliance.
- B. Field quality-control reports.
- C. Sample Warranties: For manufacturers' special warranties.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of residential appliance from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

## 2.3 APPLIANCES

- A. Manufacturers: Subject to compliance with requirements, provide products by General Electric or equal from one of the following:
1. Maytag
  2. Kenmore
  3. Or approved equal.
- B. Basis-of-Design, Product- Refrigerators: Subject to compliance with requirements, provide General Electric GTE21GSHSS. or an equivalent product from an approved manufacturer listed.
1. Description: 21.1 Cu. Ft. Top-Freezer Refrigerator, Energy-Star Listed.
  2. Finish: Stainless Steel.
  3. Dimensions: 66 3/4" high x 34" deep x 32 7/8" wide.
  4. Features: Leveling legs, 3 clear-front drawers in refrigerator compartment, adjustable glass shelves in refrigerator, wire shelf in freezer.
- C. Basis-of-Design Product- Electric Convection Ranges: Subject to compliance with requirements, provide General Electric JS760SLSS or an equivalent product from an approved manufacturer listed.
1. Description: 30" Slide-In Electric Convection Range
  2. Finish: Stainless Steel.
  3. Dimensions: 37 1/4" high x 25 7/8" deep x 29 7/8" wide.
  4. Features: Storage drawer at bottom, oven with full-front door, control surface at front, five total heating elements on cooktop.
- D. Basis-of-Design Product- Under-the-Cabinet Range Hood: Subject to compliance with requirements, provide General Electric PVX7360SJSS. or an equivalent product from an approved manufacturer listed above.
1. Description: Recirculating under-the-cabinet range hood with metal grease filters and charcoal recirculating filter.
  2. Finish: Stainless Steel.
  3. Dimensions: 5 1/2" high x 20" deep x 35 7/8" wide.
  4. Features: Four-speed selectable fan setting. LED lighting for cooktop surfaces below. Fully enclosed bottom.
- E. Basis-of-Design Product- Microwave Ovens: Subject to compliance with requirements, provide General Electric PES7227SLSS or an equivalent product from an approved manufacturer listed.
1. Description: 2.2 Cu. Ft. 1100-Watt Microwave Oven.
  2. Finish: Stainless Steel.
  3. Dimensions: 13 1/2" high x 18 1/2" deep x 24" wide.
  4. Features: 16 1/2" recessed glass turntable.



## 2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods and microwave ovens with vented exhaust fans will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.





### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Restore areas and items with leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct The City of New York's service staff to adjust, operate, and service residential appliances.

**END OF SECTION 11 30 13**



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**SECTION 11 82 26****FACILITY WASTE COMPACTOR****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Facility waste compactor.
  2. Odor neutralizer.
- B. Related sections:
1. Section 03 30 00 – “Cast-in-Place Concrete”.
  2. Division 26 – Electrical.

**1.3 SYSTEM DESCRIPTION**

- A. Provide facility waste compactor operationally suitable for use with the Roll-on Roll-off container type vehicles used by the New York City Department of Sanitation. Container design shall permit complete discharge by gravity without jogging the container by using the operating controls of the truck and without manual assistance of any kind. The maximum container size permitted to be used with this system is 35 cubic yard minimum.
1. Containers are to be built to (ANSI-Z 245.30) waste container safety requirements.
  2. Containers are to be built to OSHA standards.
  3. Container to have 3 inch taper for entire length of container.
  4. Container to have ram forward option.

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
- 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications, performance data sheets, and installation instructions for each principal component of waste handling equipment, and include certified test reports on operation of units.
- B. Shop Drawings: Submit plans, elevations and details for work not fully shown by published product data; include rough-in dimensions and service connection details.
- C. Submit statement written by the manufacturer that their products are compatible with this specification and with requirements of the New York City Department of Sanitation.
- D. Submitting a certificate to DSNY Collection & Containerization Office stating that the facility waste compactor complies with DSNY specifications. Submit copy of this certificate to the Commissioner for review and approval. The certificate shall contain the following information:
  - 1. Container size and tare weight.
  - 2. Site name and address.
- E. Maintenance Manuals: Submit bound maintenance manuals for each major operational unit of equipment, including operating and maintenance instructions, parts listing, parts inventory listing, purchase source listing for operational/maintenance materials, emergency instructions and similar information.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Waste Compactor Standards: Comply with Federal, State and local regulations; and comply with other standards as indicated.
  - 1. Comply with ANSI Z245.1, "Safety Requirements for Refuse Collection and Compaction Equipment".
- C. Electrical Component Standards: Provide components complying with NFPA 70, "National Electrical Code"; and bearing UL labels where available.



- D. **Installer Qualifications:** Engage an experienced installer who is properly trained by the manufacturer.
- E. **New York City Requirements:** Comply with the requirements of the New York City Department of Sanitation, and with the applicable requirements of the New York City Building Code Subchapter 14, Article 18 - Refuse and Disposal Systems, including New York City Environmental Protection Administration criteria referenced therein.

#### 1.9 GUARANTEE SERVICE AND MANUFACTURER WARRANTY

- A. **Warranty Maintenance:** For a period of 12 months following the date of Substantial Completion, provide warranty maintenance service and full maintenance of compactor equipment on a periodic basis. Correct operational faults and restore/replace defective/deteriorated components and finishes. Check oil for proper level and water entrainment, clean strainers, check pressure switch and relief valves settings. At end of warranty maintenance period drain, flush and refill hydraulic system with clean oil and make final inspection of hoses, fittings, wiring and controls for drainage an undue wear.
- B. **Manufacturer's Warranty:** Provide special project warranty, signed by Manufacturer, and countersigned by Contractor, agreeing to replace/repair/restore defective materials and workmanship during warranty period, for Facility Waste Compactor and Odor Neutralizer.
  - 1. The manufacturer's warranty period is 12 months starting form date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide Waste Equipment Specialties Model #265C35/NY (Basis-of-Design) or an equivalent product by one of the following:
  - 1. All Boro, Brooklyn, NY.
  - 2. Cooper Tank & Welding Corp., Brooklyn, NY.
  - 3. Enviro Equipment Sales Ltd., Rhine Beck, NY.
  - 4. Hillside Recycling Equip Corp., Woodside, NY.
  - 5. J.C. Industries Inc., West Babylon, NY.
  - 6. Wilkinson Hirise, Greenwich, CT.
  - 7. Vasso Waste Equip Sales Inc., Brooklyn, NY.
  - 8. Direct Environmental Corp., Bronx, NY.
  - 9. Nu-Way Compactor, Brooklyn, NY.
  - 10. Or approved equal.

## 2.2 WASTE COMPACTOR

- A. Waste Compactor: Manufacturer's standard roll on/roll off compactor-container-type stationary compactor, complying with requirements, and with components, options, and accessories needed to provide a complete, functional system.
1. Waste-Compactor Standards: ANSI Z245.21, ANSI Z245.30, and NFPA 82.
  2. Container floor and walls shall be continuously welded inside and outside. Roof shall be welded continuously outside, and stitch welded inside. All welds and edges shall be grounded smoothly, suitably reinforced with steel structural members welded in place and shall meet minimum Department of Sanitation structural standards as shown on Department of Sanitation reference drawing and as detailed below.
    - a. Overall Width: Shall not exceed 96 inches.
    - b. Overall Height: Shall not exceed 96 inches (as measured from the bottom of the rails).
    - c. Overall Chassis Length: Shall be 23 feet (not including container nose rollers).
  3. Cycle Time: Maximum 60 seconds.
  4. Electrical Characteristics:
    - a. Voltage: 460 V AC, three phase, 60 hertz.
    - b. Finish: Manufacturer's standard.
- B. Fabrication:
1. General:
    - a. Fabricate waste compactors with smooth, eased, exposed edges to prevent injury to persons in vicinity of the equipment.
    - b. Fabricate containers, hoppers, compaction chambers, unit bodies, and similar components of steel with welded joints. Reinforce with steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent deformation.
    - c. Fabricate equipment with replaceable parts at points of normal wear.
  2. Head Sheet Panels: Upper side, top, and head sheet panels shall be of high tensile sheet steel (45,000 P.S.I., tensile strength) 10 gauge or heavier.
  3. Lower Side Sheet Panel: (45,000 P.S.I) to be 7 gauge or heavier.
  4. Floor: Seven (7) gauge minimum steel plate, full length of container, two piece maximum, floor to be leak proof.
  5. Cross Members: Under the floor shall be 3 inch channels 3.5 lb. Minimum, C-channels on 16 inch centers.



6. Front and Rear Rollers: Shall be constructed from standard black pipe, minimum schedule 40 and shall be a 8 inches in diameter with grease fittings.
7. Long Rails: Shall be 6 inches x 2 inches steel tubing, minimum VA inch wall thickness, one piece construction.
8. Front Nose Rollers: Shall be 4 inch O.D. x 6 inch long with grease fittings. Hollow cast rollers not acceptable.
9. Tailgate Door: Shall be 10 gauge high tensile steel reinforced, with two V" x 6" vertical plate stiffeners for full height of door with 1A inch steel plate hinges with 1 1/16" inch pins and grease fittings. Pin to be removable with cotton pin.
10. Framing: Tailgate to be surrounded with 3 inches x 6 inches x 3/16 inch rectangular tube.
11. Safety Chain: Shall be included to secure the door in the open or closed position, 3/8" minimum. Safety chain to be part of pin and sleeve assembly, attached to the container body side to provide positive door attachment in open position and also provide additional door closed safety lock in case of tailgate latch failure.
12. Tailgate Latch/ Gasket: Shall ensure a tight fit in conjunction with appropriate full door seal that shall prevent liquid leakage from the container. Gasket must be replaceable type.
  - a. Manually operated ratchet style latches shall be located on both sides of the container tailgate.
13. Tailgate Openings: Shall be full height and width of container above the sump.
  - a. Design of the hinges shall permit clean dumping of the container. Door must be provided with automatic door latch.
14. Container Hook: Shall be 1-1/2" steel plate.
15. Hook Plate: Shall be 1" steel plate with hook welded to both sides of plate.
16. Push Plate: Shall be 7/16 inch steel plate, 18 inches x 66 inches minimum, hinged and pinned to provide access and protection for compacting head. Locking pin and clip to be tethered.
17. Sides of Roof and Head Braces: Shall be (45,000 psi) 10 gauge minimum, high tensile strength at 24 inch on center.
18. Sides of Body: Containers shall have no less than two horizontal V crimps in the metal equally spaced running the full length of the container. Horizontal structural stiffeners may be used in lieu of V crimps.
19. Paint: Container shall be scraped, all sharp edges, prepped, primed and painted Green, single stage manufacturer's standard enamel, to prevent corrosion.
20. Stencil: Comply with DSNY requirements for providing painted stenciled signage.
  - a. Site Stencil: Provide site name "NYPD 116" stenciled on each side in 8"-high white stenciled letters.



- b. Safety Stencils:
  - 1) "WARNING" on all four sides in 3"-high white stenciled letters.
  - 2) "STAND CLEAR WHEN CONTAINER IS OFF GROUND", on all four sides, in 1-1/2"-high white letters, located under "WARNING".
- 21. Conspicuity Tape: Red/White alternating color self-adhesive reflective tape. Install conspicuity tape around entire upper rim of the container and the entire circumference of the tailgate. All corners to have angled 12" x 12' White tape. Subject to compliance with requirements, provide 3m #980-32 (Basis-of-Design), or an equivalent product from one of the following:
  - a. Grote industries
  - b. Heskins
  - c. Or approved equal.
- 22. Identification Plate: Each container shall be affixed with a stamped metal plate bearing the name and address of the manufacturer, the net internal capacity (cubic yards), unladen weight (can be a separate plate), and a unique serial number. The serial number is also to be welded on the main rails.

## 2.3 ODOR NEUTRALIZER

- A. Basis-of-Design: Subject to compliance with requirements, Sonozaire Odor Neutralizer Model 630 A (Basis-of-Design), or an equivalent product by one of the following:
  - 1. Envirostat Inc.
  - 2. Airscent
  - 3. Or approved equal.
- B. Description: Electric blower odor neutralizer in weather-proof enclosure. Install in accordance with manufacturer's instructions and connect to electrical power. Connect air hoses to facility waste compactor with quick-connect/disconnect hoses.
- C. Blower air volume: 100 CFM @ 60hz, 141 CFM @ 50hz.
- D. Electrical requirements: 260 watts, 115 volt, 50/60 hz, 1 ph, or 220-240 volt, 50/60 hz, 1 ph.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Set each component of work securely and accurately in place; plumb, level and properly aligned with other components and other work. Anchor as required for secure operation.





- B. Complete field assembly with joints as recommended by manufacturer. Grind welds smooth and restore finish. Comply with NECA Standards for electrical.

### 3.3 TESTING AND DEMONSTRATION

- A. Test each item of operational equipment including safety devices and fire protection equipment. Instruct Commissioner's operational personnel in proper use and maintenance of equipment, and demonstrate capacity ratings, safety features, cleaning procedures, and proper storage/handling of raw and processed waste materials. Provide raw material and bags for demonstration.
  - 1. Perform tests required by DSNY and NYCDOB. File documentation and assist in obtaining operating permits, as required.

### 3.4 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 11 82 26**



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**SECTION 12 24 13****ROLLER WINDOW SHADES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Manually operated roller shades with single rollers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."



1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified.

1.7 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Installer Qualifications: Installer shall be properly trained by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES

- A. Basis- of Design, Manufacturers: Subject to compliance with requirements, provide products as supplied by Draper Inc. or comparable product from one of the following, as approved by the Commissioner:
  - 1. DFB Sales Inc.
  - 2. MechoShade Systems, Inc.
  - 3. Or approved equal
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - 1. Chain-Retainer Type: Chain tensioner, jamb or sill mounted.
  - 2. Spring Lift-Assist Mechanisms, where required by project application: Provide for shadebands that weigh more than 10 lbs. or for shades as recommended by manufacturer, whichever criterion is more stringent.



- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  - 1. Roller Drive-End Location: As indicated on Drawings.
  - 2. Direction of Shadeband Roll: Reverse, from front (interior face) of roller.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
  - 1. Shadeband Material: Light-filtering fabric or Light-blocking fabric, as indicated.
  - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material.
    - b. Color and Finish: As selected by Commissioner from manufacturer's full range.

## 2.3 INSTALLATION ACCESSORIES

- A. Provide the following as required by project application:
  - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
  - 2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
  - 3. Endcap Covers: To cover exposed endcaps.
  - 4. Recessed Shade Pocket, where required: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
  - 5. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
  - 6. Side Channels for Light- blocking Fabric: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
  - 7. Bottom (Sill) Channel or Angle for Light-blocking Fabric: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
- B. Color and Finish: As selected from manufacturer's full range.

## 2.4 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer.



2. Type: PVC-coated fiberglass and PVC-coated polyester.
3. Weave: Mesh.
4. Thickness: As indicated by selected product designation
5. Weight: As indicated by selected product designation.
6. Roll Width: As indicated by selected product designation
7. Orientation on Shadeband: As indicated on Drawings.
8. Openness Factor: 3 percent unless otherwise indicated.
9. Color: As selected by Commissioner from manufacturer's full range.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Fiberglass textile with PVC film bonded to both sides.
3. Thickness: As indicated by selected product designation
4. Weight: As indicated by selected product designation
5. Roll Width: As indicated by selected product designation
6. Orientation on Shadeband: As indicated on Drawings.
7. Features: Washable.
8. Color: As selected by Commissioner from manufacturer's full range.

## 2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

A. Refer to DDC General Conditions for execution requirements.



### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Locate so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### 3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be restored, in a manner approved by Commissioner, before time of Substantial Completion.

**END OF SECTION 12 24 13**



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**SECTION 12 48 16****ENTRANCE FLOOR GRILLES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Recessed floor grilles and frames.
  2. Installation accessories.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section or trade and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 COORDINATION

- A. Coordinate top of floor-grille surfaces with doors that swing across grilles to provide clearance under door.

## 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

## 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Items penetrating floor grilles and frames, including door control devices.
  - 2. Divisions between grille sections.
  - 3. Perimeter floor moldings.
- C. Samples: For each exposed product and for each color and texture specified.

## 1.8 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

## 1.10 FIELD CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products as supplied by C/S Group or comparable product from one of the following, as approved by the Commissioner:
  - 1. Babcock-Davis.
  - 2. Kadee Industries, Inc.
  - 3. Mats Incorporated.
  - 4. Or approved equal.

## 2.2 ENTRANCE FLOOR GRILLES, GENERAL

- A. Accessibility Standard: Comply with applicable provisions ICC A117.1 and the 2014 New York City Building Code.



## 2.3 FLOOR GRILLES

### A. Stainless-Steel Floor Grille: Type 304.

1. Surface Treads: 0.093-by-0.156-inch wire with 0.125-inch- wide openings between wires.
2. Support Rods: Spaced 1 inch o.c., welded to each wire.
3. Mat Grating: 5/8 inch deep.
4. Stainless-Steel Finish: No. 4.
5. Grille Size: As indicated on drawings.

### B. Lockdown: Hidden.

## 2.4 FRAMES

### A. Provide manufacturer's standard frames of size and style for grille type.

## 2.5 SUPPORT SYSTEM

### A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.

## 2.6 MATERIALS

### A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304.

### B. Stainless-Steel Angles: ASTM A276 or ASTM A479/A479M, Type 304.

## 2.7 FABRICATION

### A. Shop fabricate floor grilles to greatest extent possible in sizes as indicated.

### B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible.

## 2.8 STAINLESS-STEEL FINISHES

### A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

### B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

#### A. Refer to DDC General Conditions for execution requirements.



**3.2 EXAMINATION**

- A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of floor grilles and frames.
- B. Examine roughing-in for drainage piping systems to verify actual locations of piping connections before floor grille and frame and drain pan installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

- A. Install recessed floor grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of floor grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer.
- B. Set floor-grille tops at height for most effective cleaning action.

**3.4 PROTECTION**

- A. After completing frame installations, provide temporary filler of plywood or fiberboard in floor-grille recesses and cover frames with plywood protective flooring.
- B. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

**END OF SECTION 12 48 16**

**SECTION 12 93 00****SITE FURNISHINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. RPL Backless Bench "A" and "C" on precast concrete base.
2. RPL Raised Planter Bench "B" on precast concrete base.
3. RPL Bleacher on precast concrete base.
4. Bottle Filling Station
5. Bicycle Rack
6. Removable Bollard Cover
7. Litter and Recycling Receptacles
8. Stainless Steel Panel Enclosure Box Housing

B. Related Sections

1. Section 32 05 16 "Aggregate Materials"
2. Section 03 30 00 "Cast-in-Place Concrete"
3. Section 03 33 00 "Architectural Concrete"
4. Section 03 45 00 "Precast Architectural Concrete"
5. Section 03 48 00 "Precast Concrete Specialties"
6. Section 05 50 00 "Metal Fabrications"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based

on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 SUBMITTALS

- A. Shop Drawing:
  - 1. Provide detailed shop drawings showing assembly methods, dimensions, and integration with adjacent materials for all furnishings prior to the start of fabrication.
- B. Samples:
  - 1. Provide samples of finish materials for all site furnishings listed in this section.
  - 2. Provide color chips of all specified colors of furnishings listed in this section.

#### 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Every effort shall be made to maximize post-industrial/post-consumer recycled content. Certification of recycled content shall be in accordance with the Submittal Requirements herein.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Benches and Bleachers shall be recycled plastic lumber composed of 50% recycled LDPE plastic combined with 50% recycled textile fibers, with steel "C" channel support beams and steel flat bar cover plates in-between RPL members.
  - 1. Basis-of-design Product: Subject to compliance with requirements provided: STREETLIFE Rough&Ready Crosswise Topseat, as manufactured by STREETLIFE America LLC, Philadelphia PA, (215) 247-0148, or comparable product by one of the following:
    - a. Landscape Forms, Inc. 7800 E. Michigan Ave. Kalamazoo, MI 49048, USA, (269) 381-0396
    - b. Columbia Cascade Co., TimberForm Site Furnishings, 1300 S.W. Sixth Avenue, Suite 310 Portland, Oregon 97201-3464, USA, (503) 223-4530
    - c. Or approved equal



2. Bench Components

a. Recycled Plastic Lumber Bench Toppers:

- 1) Bench "A" and "C" RPL Members 2'-0" L x 2.8" H x 2.8" W
- 2) Bench "B" RPL Members: 1'-6" L x 2.8" H x 2.8" W
- 3) Bleacher RPL Members: 3'-4" L x 2.8" H x 2.8" W
- 4) Seat Height: As indicated on drawings
- 5) Seat Surface: Flat
- 6) Arms: None
- 7) Seating Configuration: Straight
- 8) RPL Finish: Solid Series Cloudy Gray, or similar color as selected by Commissioner from manufacturer's standard range of colors.

b. Steel Mounting Rail:

- 1) Mounting Rail: Powder-coated steel "C" channels notched at regular intervals to hold RPL members.
- 2) Gauge: 9 gauge
- 3) Recessed Notch: 1" deep x 2.8" wide notches spaced 3.8" on center, to hold individual RPL members.
- 4) Fasteners: Powder Coated Steel Expansion Anchor Bolts. All holes pre-drilled
- 5) Support Option: Metal Frame Mounted to Precast Concrete Base.
- 6) Metal Finish: Polyester Powder Coating over Zinc Rich Primer:
  - a) Blasted to white metal,
  - b) Processed through a 5-stage wash system,
  - c) Coated with Zinc-rich primer.
  - d) Finished with a top coat of TGIC-polyester powder.
  - e) Cured for approximately 20 minutes.
- 7) Color: Satin Black, or similar color as selected by Commissioner from manufacturer's standard range of colors.
- 8) Location: Every RPL Seat as indicated on plans and details.

c. Metal Cover Plates Between Slats

- 1) Material: Steel Flat bar welded in place to Metal Support Frame
- 2) Bench "A" and "C" Dimensions: 1'-10 3/4" L x 1" W x 1/4" H
- 3) Bench "B" Dimensions: 1'-5 3/8" L x 1" W x 1/4" H
- 4) Bleacher Dimension: 3'-3 3/16" L x 1" W x 1/4" H
- 5) Metal Finish: Polyester Powder Coating over Zinc Rich Primer:
  - a) Blasted to white metal,
  - b) Processed through a 5-stage wash system,
  - c) Coated with Zinc-rich primer.
  - d) Finished with a top coat of TGIC-polyester powder.
  - e) Cured for approximately 20 minutes.
- 6) Color: Satin Black.
- 7) Location: Either side of support frame rail notches; in-between RPL members.

**B. Bottle filling station and Water Fountain**

1. Basis-of-design Product: Subject to compliance with requirements provided: Elkay Outdoor ezH20 Bottle Filling Station Bi-Level Pedestal Freeze Resistant, by Elkay Headquarters 2222 Camden Court, Oak Brook, IL 60523, (630) 574-8484, or comparable product by one of the following:
  - a. Halsey Taylor, 2222 Camden Court, Oak Brook, IL 60523, (630) 572-3192
  - b. Haws Co., 1455 Kleppe Lane, Sparks, NV 8943, 1-800-766-5612
  - c. Or approved equal
2. Finish
  - a. Finish: Powder coated and 316 stainless steel
  - b. Color: Gray
  - c. Bubbler Style
  - d. Mount: Surface Mounted
  - e. Dimensions: 14" x 31" x 64"

**C. Bicycle Racks**

1. Basis-of-design Product: Subject to compliance with requirements provided: Landscape Forms Loop Bike Rack, Landscape Forms, Inc. 7800 E. Michigan Ave. Kalamazoo, MI 49048, USA, (269) 381-0396, or comparable product by one of the following:
  - a. Reliance Foundry, Unit 207, 6450-148<sup>th</sup> Street, Surrey, British Columbia, Canada V3S-7G7, 1-877-789-3245
  - b. NYC DOT Standard Bike Rack
  - c. Or approved equal
2. Frame: Aluminum Casting
3. Embedded Hardware Pack: (4) 5/16-18 UNC-2A fully threaded rods, 4" Length
4. Style: Double-side parking
5. Dimensions:
6. Finish: Rust inhibitor primer; Thermosetting TGIC polyester powder coat Topcoat
7. Color: "Panguard II" Silver, or similar color as selected by Commissioner from manufacturer's standard range of colors.

**D. Removable Bollard Cover**

1. Basis-of-design Product: Subject to compliance with requirements provide: Reliance Foundry R-7315, or comparable product by one of the following:
  - a. Granger
  - b. SecureUSA, Inc.
  - c. Or approved equal
2. Locations: Type B1 and B2 M50/K12 fixed and removable bollards. Refer to structural drawings and Section 05 50 00 "Metal Fabrications".
3. Finish: 316 stainless steel.
4. Attachment: 3 hex socket set screws near bottom of bollard, in addition to adhesive foam strips near top portion of bollard.
5. Design: Flat cap, cylindrical, with no routed profiles or striping on any face.
6. Dimensions: 42" high, 10 3/4" interior diameter, 11" outside diameter.



E. Litter and Recycling Receptacles

1. Basis-of-design Product: Subject to compliance with requirements provided: "Select Recycling System" Triple Unit, Landscape Forms, Inc. 7800 E. Michigan Ave. Kalamazoo, MI 49048, USA, (269) 381-0396, or comparable product by one of the following:
  - a. DuMor, P.O. Box 142 Mifflintown, PA 17059, Phone: (800) 598-4018
  - b. mmicité, 2905 Westinghouse Blvd, Suite 300 Charlotte, NC 28273, Phone: (704) 995-1942
  - c. Or approved equal
2. Style: Triple Unit
3. Dimensions: 42" H x 17" D x 50-3/8" W
4. Locations: As indicated on Plan Drawings
5. Body Panel Style : Perforated back and side panels, top panel is solid
6. Door #1
  - a. Panel Style: Perforated panel, with lock
  - b. Opening Style: Multi-use opening, 8" x 8"
  - c. Sign #: 14 – "trash only"
7. Door #2
  - a. Panel Style: Perforated panel, with lock
  - b. Opening Style: Hole Opening, 5" diameter
  - c. Sign #: 06 – "aluminum, glass, plastic"
8. Door #3
  - a. Panel Style: Perforated panel, with lock
  - b. Opening Style: Slot opening, 10" x 4" oval shaped slot
  - c. Sign #:01 - "paper"
9. Mounting: Surface Mounted to concrete slab
10. Accessories: Locks
11. Materials
  - a. Base: Welded carbon Steel. Base bolted to unit body with stainless steel 1/4-20 hex head screws.
  - b. Unit Body: 14-gauge carbon steel sheet
  - c. Door Panel: 14-gauge carbon steel sheet
  - d. Liner: Rotomolded low density polyethylene
  - e. Door opening trim and sign medallion: Cast 319 or A413 aluminum. Secured to door panel with black nylon cup washers and carbon steel #8-32 x 1/4" socket button head cap screws with magni-coat. Vinyl graphics factory-applied to medallion.
  - f. Adjustable glides: Black nylon base, 2-3/16" diameter, with 3/8-16 thread on stainless steel stem
  - g. Hinge: Stainless steel hinges (2) per door, attached to door and unit body with stainless steel screws.
  - h. Cross braces, bin dividers: Carbon steel sheet. Bin dividers on double and triple units only.

12. Finish on Carbon Steel:

- a. Primer: Rust inhibitor
- b. Topcoat: Thermosetting polyester powdercoat. UV, chip, and flake resistant.
- c. Color: Panguard II Silver, or similar color as selected by Commissioner from manufacturer's standard range of colors.

F. Stainless Steel Panel Enclosure Box Housing

- 1. Basis-of-design Product: Subject to compliance with requirements provide: Pedestal PRO Lando-SS-10x8-E, or comparable product by one of the following:
  - a. Hoffman
  - b. APX Enclosures
  - c. Or approved equal
- 2. Dimensions: 3.15" deep back box, 3.5" deep hood (overhang), 10" wide x 8" high front face (landscape).
- 3. Description: Front face continuously hinged at its bottom edge with cam lock at top edge, allowing controlled access to interior contents from the front. EPDM rubber seals at all openings to provide a weathertight enclosure. Two keys for cam lock.
- 4. Enclosure rating: NEMA 4x
- 5. Installation: Mount to vertical face as indicated on drawings using mechanical fasteners. Seal at all rear face penetrations following wiring of enclosed devices.
- 6. Material: 14 gauge 304 stainless steel, brushed #4 finish.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 JOB CONDITIONS

- A. Verify that surfaces on which furnishings are to be installed are level, smooth, clean, and otherwise ready to receive the work of this section. Do not proceed until unsatisfactory conditions are corrected.

3.3 INSTALLATION

- A. Install benches, bottle filling station, bicycle racks and removable bollards where indicated on the plans and as per manufacturer's instructions.
  - 1. Install in accordance with manufacturer's instructions at locations indicated on the drawings.
  - 2. Unless otherwise indicated, install sit furnishings after landscaping and paving have been completed.
  - 3. Install site furnishings level, plumb, true and securely anchored at locations indicated on drawings.

3.4 QUALITY CONTROL

- A. Protect all site furnishings from damage during construction. Restore or replace damaged site furnishings at no additional expense to the City of New York.

3.5 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 12 93 00**

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## **SECTION 13 10 00**

### **VEHICLE OPERABLE BARRIERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

##### **1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS:**

- A. Footings Section 31 61 00
- B. Cast-in-Place Concrete Section 03 30 00
- C. Structural Steel Section 05 12 00

##### **1.3 SUMMARY**

- A. Section includes:
  - 1. Operable beam barrier system.

##### **1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.5 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.
- B. Product Data:
  - 1. Submit crash test data from independent testing agency.
  - 2. Engineering calculations shall be performed and submitted for all conditions where test data is not applicable. This includes, but is not limited to, utilities, vaults, and the soil bearing capacity.
  - 3. Submit manufacturer's product data and installation instructions for each type of equipment required.
- C. Shop Drawings:
  - 1. Submit Shop Drawings showing all components for proper installation, including anchoring, supporting systems, and details.
  - 2. Include wiring diagrams.
- D. Operation and Maintenance Data:
  - 1. Submit three (3) copies of manufacturer's operation and maintenance manual.
  - 2. Include parts list and other information needed for continued use for inclusion in Project Operation and Maintenance Manual.
  - 3. Include copy of submittal in Project Operation and Maintenance Manual.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”
- B. Testing: Upon completion, mechanically operable barrier will be fully tested in the manufacturer's shop. In addition to complete cycle testing to verify function and operating speeds, the following checks shall be made:
  - 1. Identification. A nameplate with manufacturer's name, model number, serial number and year built shall be located within the maintenance access area.
  - 2. Workmanship. The Gate and subsystems shall have a neat and workmanlike appearance.
  - 3. Dimensions. Principal dimensions shall be checked against contract documents and field measurements.
  - 4. Finish. Finishes shall conform to Architectural Drawings.
- C. The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- D. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.

**PART 2 - PRODUCTS****2.1 RISING BEAM BARRIER**

- A. Basis of Design Product: Subject to compliance with requirements, provide Patriot Beam Barrier by Ameristar (Basis-of-Design) or comparable product by one of the following:
  - 1. ATG Access,
  - 2. Ross Technology,
  - 3. Or approved equal.
- B. Rising beam barrier, foundation assembly, and subgrade conditions shall be in accordance with the independently verified crash test data or engineering calculations per Section 1.6-B of this specification. The operable barrier and foundation assembly are subject to the performance requirements listed in Section 2.2 herein.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Barrier design shall have successfully passed actual full-scale crash tests conducted by a qualified independent agency in accordance with ASTM F2656. Alternatively, barrier design shall be based on finite element analytical methods pre-approved by the Commissioner.
- B. Stopping Capacity
  - 1. Normal Operation. Barrier(s) shall provide security and positive control of normal traffic by providing an almost insurmountable obstacle to the average passenger vehicle.
  - 2. The Barrier system shall be designed to stop a vehicle attacking from the priority direction such that the leading edge of the cargo bed does not penetrate the beam more than 3.25 feet when the vehicle is within the weight and velocity characteristics defined in paragraph 2.2.C.3. See Barrier Drawings and Civil Drawings for Barrier location.
  - 3. The Barrier shall be capable of stopping a vehicle(s) weighing 15,000 pounds traveling at 50 mph (66.7 KN at 80.5 kph), consistent M50/P1 per ASTM standards.
- C. Operation
  - 1. Environmental Data: Barricade shall operate satisfactorily under the full range and extremes of temperature, humidity, rainfall, and other environmental conditions characteristic for New York City.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**END OF SECTION 13 10 00**



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## SECTION 14 21 23

### TRACTION ELEVATOR

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### B. RELATED SECTIONS

- |     |                        |   |
|-----|------------------------|---|
| 1.  | DDC General Conditions | Protecting hoistway during installation of equipment, LEED Reporting Form, Construction Waste Management, Sustainable Design Requirements, Indoor Air Quality Management, Volatile Organic Compound Limits. |
| 2.  | Section 03 30 00:      | Concrete pits and slabs.  |
| 3.  | Section 04 20 00:      | Shaft and control room walls.   |
| 4.  | Section 05 12 00:      | Structural steel hoistway frame, hoist beam in overhead.  |
| 5.  | Section 05 50 00:      | Access Ladders, smoke hole grating, railing and inspection platforms, intermediate support members, sump pit covers.  |
| 6.  | Division 07:           | Elevator pit waterproofing.   |
| 7.  | Section 09 67 23:      | Finished flooring.  |
| 8.  | Division 23:           | Ventilation of hoistway and control room.   |
| 9.  | Division 26:           | Power feeders to starter panels through fused main line switches  |
| 10. | Division 26:           | Branch circuits through fused disconnects for car lights.   |
| 11. | Division 26:           | Lights and GFI receptacles in control room, overhead and pit.   |
| 12. | Division 26:           | Signal wiring to initiate emergency power operation.  |
| 13. | Division 26:           | Signal wiring from smoke detectors to a junction box in the machine room.   |
| 14. | Division 26:           | Empty conduit runs for wiring required to monitor elevators from a central location.  |
| 15. | Division 26:           | Shunt trip devices to automatically disconnect the main power supply to the elevators prior to the activation of sprinkler system.  |
| 16. | Section 27 00 00       | Telephone communications wiring terminated in a junction box located next to the controller.  |
| 17. | Section 27 00 00       | Ethernet port in each elevator machine, in top end of each escalator, fire command center and building engineer's office.   |
| 18. | Section 28 31 11       | Life safety system speakers and telephone communication wiring to a junction box in the control room for each elevator.   |
| 19. | Section 28 00 00       | Card reader and CCTV Systems, device and their interface with the elevator system.  |

##### 1.2 SUMMARY

- A. Work Included: The extent of the work is indicated on the drawings.
- B. Work of this Section includes labor, materials, tools, equipment, appliances and services required to manufacture, deliver and install the units complete as shown on the drawings, as specified herein, and/or as required by job conditions.

- C. The work and /or requirements specified in all sections is described in singular with the understanding that identical work shall be performed on all units or associated systems unless otherwise specified herein.
- D. The work shall include, but is not limited to the following:
  - 1. One (1) 3,500-lb. capacity machine room-less traction passenger elevator operating at 200 fpm. (PE1)

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 2. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### 1.5 Abbreviations and Symbols

- A. The following abbreviations, Associations, Institutions, and Societies may appear in the Project Manual or Contract Documents:

AIA	American Institute of Architects
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers

ASTM	American Society for Testing and Materials
AWS	American Welding Society
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
OSHA	Occupational Safety and Health Act

#### 1.6 Codes and Ordinances / Regulatory Agencies

- A. Regulations of New York City Department of Buildings and the New York City Fire Department shall be fulfilled by the Contractor. The entire installation, when completed, shall conform with all regulations set forth in the latest editions of:
  - 1. 2014 New York City Construction Codes
  - 2. Safety Code for Elevators and Escalators, ASME A17.1 and all supplements as modified and adopted by the 2014 New York City Construction Codes
  - 3. Safety Code for Elevators and Escalators, A17.1S supplement to A17.1 as modified and adopted by the 2014 New York City Construction Codes for Machine Room Less installations (MRL).
  - 4. Guide for Inspection of Elevators, Escalators, and Moving Walks, ASME A17.2.
  - 5. Safety Code for Existing Elevators and Escalators, ASME A17.3 as modified and adopted by the 2014 New York City Construction Codes.
  - 6. Guide for emergency evacuation of passengers from elevators, ASME A17.4.
  - 7. National Electrical Code (ANSI/NFPA 70).
  - 8. Americans with Disabilities Act - Accessibility Guidelines for Building and Facilities and/or A117.1 Accessibility as may be applicable to the 2014 New York City Construction Codes.
  - 9. ASME A17.5/CSA-B44.1 - Elevator and escalator electrical equipment.
- B. Advise the Commissioner of pending code changes that could be applicable to this project.

#### 1.7 REFERENCE STANDARDS

- A. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
- B. ANSI/AWS D1.1 - Structural Welding Code, Steel.
- C. ANSI/NFPA 80 - Fire Doors and Windows.
- D. ANSI/UL 10B - Fire Tests of Door Assemblies.

#### 1.8 DEFINITIONS

- A. Definitions in ASME A17.1 as amended or modified by the 2014 New York City Construction Codes apply to work of this Section.

1.9 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

1.10 PERMITS AND SUBMITTALS

A. Permits

1. Comply with the requirements of the DDC General Conditions.
2. Prior to commencing work specified by the Contract Documents, the Contractor shall, at its own expense, obtain all permits or variances as may be required by the Commissioner of the New York City Department of Buildings and provide satisfactory evidence of having obtained said permits and variances to the Commissioner.
3. File necessary drawings for approval of New York City Department of Buildings.
4. The Contractor shall undertake the necessary review and search procedure to identify open applications and/or outstanding violations for this property; and, close-out such applications and/or expunge such violations relative to the project scope as required for final acceptance by the New York City Department of Buildings and the New York City Fire Department.
  - a. Outstanding applications and violations must be indicated on the request for permit filing for this procedure to ensure such applications and/or violations are dismissed accordingly.

B. Submittals

1. Comply with the requirements of DDC General Conditions.
2. Submit the following
  - a. Samples

Item No.	Quantity	Size	Description
S1	3	12" x 12"	Exposed finishes as requested by Commissioner
S2	1	Actual	Each fixture as requested by the Commissioner
S3	1	Actual	Mitered, corner construction of entrance frame

b. The samples shall be:

- 1) Held on site after inspection and used as a standard for acceptance or rejection of subsequent production units.
- 2) Labeled to identify their intended use and relation to the documents, e.g., car finishes, control panel, etc.
- 3) Returned to the contractor at the completion of the project.



Subject to approval, where an item of equipment is a standard item, copies of the manufacturer's catalogue or brochure may be accepted provided that all dimensions and relevant information are shown in the catalogue or brochure.

- c. Shop Drawings - Submit computer generated layout drawings for approval. Include the following:
- 1) A listing of all components, devices and sub-systems including:
    - a) Manufacturer and location of plant
    - b) Size and model number
  - 2) Machine space plan indicating:
    - a) Location of equipment
    - b) Reactions
  - 3) Control Room Plan indicating:
    - a) Location of equipment and 2014 A17.1-Appendix K clearances
    - b) Service connections and disconnect switches
    - c) Passenger rescue and brake release
    - d) CCTV provisions
  - 4) Fully dimensioned hoistway plan, pit plan and section of each unit indicating:
    - a) Platform (with cab), hoistway and entrance dimensions
    - b) All running clearances
    - c) Location of fixtures
    - d) Buffers, service ladders and pit reactions
    - e) Location of inserts
    - f) Rail Reactions
  - 5) Entrance details
  - 6) Sill support detail
  - 7) Fixture details including hall lanterns, hall pushbutton stations, car operating panel, etc.
  - 8) Wiring diagrams
  - 9) Insert diagrams
  - 10) Cab details including wall, ceiling, base, handrail, lighting, fixtures, front return and transom plans and sections
  - 11) MRL criteria including:
    - a) Location of machine and governor
    - b) Structural requirements and reactions
    - c) Clearances
    - d) Access requirements
3. Calculations
- a. Rail loads
  - b. Pit and machine room reactions
  - c. Heat emissions in machine room



- d. Electrical loads including, accelerating and running currents. Include all auxiliary loads.
- e. Submit design calculations identifying seismic design forces and support capacities. Calculations shall be certified by the Contractor's professional engineer licensed in the state of New York. All work products, load diagrams, calculations, and shop drawings generated by the Contractor's engineer shall be submitted to the Commissioner for review and approval.

**C. Keys**

1. Upon substantial completion of work, deliver to the Commissioner, six (6) keys for each general key-operated device that is provided under these specifications in accordance with ASME A17.1, Part 8 standards as may be adopted and modified by the 2014 New York City Construction Codes.
2. All other keying of access or operation of equipment shall be provided in accordance with ASME A17.1 Part 8 as may be adopted and modified by the 2014 New York City Construction Codes.

**D. Diagnostic Tools**

1. Prior to seeking final acceptance of the project, deliver to the Commissioner any specialized tools required to perform diagnostic evaluations, adjustments, and/or programming changes on any microprocessor-based control equipment installed. All such tools shall become the property of The City of New York.
  - a. Commissioner's diagnostic tools shall be configured to perform all levels of diagnostics, systems adjustment and software program changes which are available to the Contractor.
  - b. Commissioner's diagnostic tools that require periodic re-calibration and/or re-initiation shall be performed by the Contractor at no additional expense to The City of New York for a period equal to the term of the maintenance agreement from the date of final acceptance of the project.
  - c. Provide a temporary replacement, at no additional expense to The City of New York, during those intervals in which the Commissioner might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation or restoration of function.
2. Deliver to the Commissioner printed instructions, access codes, passwords or other information necessary to interface with the microprocessor-control equipment.

**E. Wiring Diagrams, Operating Manuals and Maintenance Data**

1. Comply with the requirements of the DDC General Conditions.
2. Deliver to the Commissioner, four (4) identical volumes of printed information organized into neatly bound manuals prior to seeking final acceptance of the project.
3. The manuals shall also be submitted in electronic format on non-volatile media, incorporating raw 'CAD' and/or Acrobat 'PDF' file formats.
4. Manuals, as well as electronic copies, shall contain the following:
  - a. Step-by-step adjusting, programming and troubleshooting procedures that pertain to the solid-state microprocessor-control and motor drive equipment.
  - b. Passwords or identification codes required to gain access to each software program in order to perform diagnostics or program changes.
  - c. A composite listing of the individual settings chosen for variable software parameters stored in the software programs of both the motion and dispatch controllers.



- d. Method of control and operation.
  - e. All the elevator components, technical assistance, operating manuals, hardware and software, etc. shall be immediately provided to the Commissioner, regardless whether the elevator maintenance contractor is the original installing contractor or manufacture.
5. Provide four (4) sets of "AS INSTALLED" straight-line wiring diagrams in both hard and electronic format in accordance with the following requirements:
- a. Displaying name and symbol of each relay, switch or other electrical component utilized including identification of each wiring terminal.
  - b. Electrical circuits depicted shall include all those which are hard wired in both the machine room and hoistway.
  - c. Supplemental wiring changes performed in the field shall be incorporated into the diagrams in order to accurately replicate the completed installation.
6. Furnish four (4) bound instructions and recommendations for maintenance, with special reference to lubrication and lubricants.
7. Manuals or photographs showing controller replacement parts with part numbers listed.

**F. Instruction**

- 1. Prior to seeking final acceptance of the project, conduct an eight-hour instruction program on-site with building service staff selected by the Commissioner.
- 2. The focus of the session shall include:
  - a. Instructions on proper safety procedures to utilize in assisting passengers that may become entrapped inside an elevator car.
  - b. Explain each control feature and its correct sequence of operation.
- 3. Control features covered shall include but, not be limited to:
  - a. Independent Service Operation.
  - b. Attendant Service Operation.
  - c. Emergency Fire Recall Operation - Phase I
  - d. Emergency In-car Operation - Phase II.
  - e. Emergency Power Operation.
  - f. Emergency Communications Equipment.
  - g. Security Operating Features.
  - h. Interactive Systems Management.
  - i. Remote Monitoring/Controls.
  - j. Emergency Hoistway Access and Rescue Features.

**1.11 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- C. The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar



in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.

**D. Structural, Mechanical and Electrical Design Parameters**

1. The mechanical and electrical systems and the building structure have been designed for the following design loads:
  - a. Structural Loads:
    - 1) The pit, machine room and rail loads are shown on the drawings.
2. Power supply: 208V - 3Ph - 60 Hz (EE to verify)
3. Electrical Loads: PE1 20 HP
  - 59 A. FLR (Full Load Running)
  - 148 A. FLA (Full Load Acceleration)
4. Heat Release: PE1 9,000 BTU/HR/UNIT
5. Submit a written statement that the above design loads and the clearance requirements shown on the Architectural drawings are acceptable for the proposed equipment. If not, specifically state the design variances.
6. If the type of equipment provided requires structure, mechanical and electrical system changes and/or revisions, the Contractor shall be responsible for all additional engineering and construction expenses.
7. Electrical equipment, motors, controllers, etc., installed under this contract shall have necessary CSA/US or UL listing as may be required by the 2014 New York City Construction Codes. Equipment shall be labeled or tagged accordingly.

**1.12 DELIVERY / STORAGE / HANDLING / COORDINATION**

**A. Delivery and Storage of Material and Tools**

1. Comply with the requirements of the DDC General Conditions.
2. Delivery, Storage and Handling:
  - a. Deliver materials to the site ready for use in the accepted manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name and manufacturer's name. Delivered materials shall be identical to accepted samples.
  - b. Store materials under cover in a dry and clean location, off the ground.
  - c. Remove delivered materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials.
3. The Commissioner shall bear no responsibility for the materials, equipment or tools of the Contractor and shall not be liable for any loss thereof or damage thereto.
4. Confine storage of materials on the job site to the limits and locations designated by the Commissioner and do not unnecessarily encumber the premises or overload any portion with materials to a greater extent than the structural design load of the Facility.

**B. Coordination**





1. Coordinate installation of sleeves, block outs, equipment with integral anchors, and other items that are embedded in concrete or masonry for the applicable equipment. Furnish templates, sleeves, equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
2. Coordinate sequence of installation with other work to avoid delaying the Work.
3. Coordinate locations and dimensions of other work relating to the equipment scheduled for installation including pit ladders, sumps, and floor drains in pits; entrance subsills; machine beams; and electrical service, electrical outlets, lights, and switches in pits and machine rooms, secondary levels, overhead sheave rooms and hoistways as it relates to the specific equipment.

#### 1.13 WARRANTY

##### A. Manufacturer's Warranty

1. Comply with the requirements of the DDC General Conditions.
2. Warranty:
  - a. Manufacturer shall warrant the equipment installed under these specifications against defects in material and quality of installation and correct any defects not due to ordinary wear and tear or improper use of car which may develop within one year from the date of substantial completion.

### PART 2 - PRODUCTS

#### 2.1 GENERAL DESCRIPTION

##### A. Elevator - PE1

1.	Quantity	One (1)
2.	Type	Machine-room-less/Passenger
3.	Capacity (lbs)	3,500
4.	Speed (fpm)	200
5.	Travel in Feet	28' - 6"
6.	Number of Landings	Three (3) at C, 1, 2
7.	Number of Openings	(3) at C, 1, 2
8.	Front Opening	All
9.	Rear Opening	None
10.	Operation	Simplex selective collective
11.	Control	Variable voltage variable frequency
12.	Fireman's Control	Phase I and II

13.	Number of Push Button Risers	One
14.	Cab Size	6' - 8" wide x 5' - 4" deep
15.	Guide Rails	Steel tees, provide rail backing as required
16.	Buffers	Spring
17.	Cab	As further specified.
18.	Entrance Size	3' - 6" wide x 7' - 0" high
19.	Door Operation	Single speed side opening
20.	Machine Type	Gearless traction
21.	Machine Location	Within overhead space
22.	Counterweight Safety	Not Required
23.	Power Supply	208V - 3Ph - 60 Hz (EE to verify)

## 2.2 MANUFACTURERS

### A. Equipment Manufacturers

1. Subject to compliance with requirements, provide products manufactured one of the listed manufacturers, for each product type listed, as follows:
  - a. Controller
    - 1) GAL (GALaxy),
    - 2) Motion Control Engineering,
    - 3) Elevator Controls Corporation,
    - 4) Elevator Systems, Inc.,
    - 5) Smartrise,
    - 6) Or approved equal.
  - b. Tracks, Hangers, Interlocks and Door Operators
    - 1) G.A.L.,
    - 2) ECI,
    - 3) Moline Accessories Corporation
    - 4) Or approved equal.



c. Fixtures

- 1) G.A.L.,
- 2) Adams,
- 3) EPCO,
- 4) Monitor,
- 5) E-Motive USA,
- 6) C.E. Electronics,
- 7) Innovation,
- 8) MAD,
- 9) National,
- 10) Or approved equal.

d. Door Protective Device

- 1) Janus,
- 2) Adams,
- 3) G.A.L.,
- 4) T.L. Jones,
- 5) Tri-Tronics,
- 6) Or approved equal.

e. Cabs and Entrances

- 1) CEC Elevator Cab,
- 2) EDI/ECI,
- 3) Elite Elevator Cab,
- 4) National Cab & Door,
- 5) Tyler,
- 6) Velis,
- 7) Gunderlin,
- 8) Eklund,



- 9) EMCO,
- 10) Columbia Elevator Products,
- 11) Or approved equal.
- f. Machines
  - 1) Hollister-Whitney,
  - 2) Titan,
  - 3) Imperial,
  - 4) Torin,
  - 5) Or approved equal.
- g. VVVF Power Drives
  - 1) Mitsubishi,
  - 2) MagneTek,
  - 3) Yaskawa,
  - 4) TorqMax,
  - 5) Or approved equal.
- h. VVVF Emergency Power Systems
  - 1) MCE,
  - 2) Reynolds & Reynolds Electronics,
  - 3) G.A.L
  - 4) Or approved equal.
- i. Guide Rails
  - 1) Savera,
  - 2) Monteferro,
  - 3) AFD
  - 4) or approved equal.
- j. Electrical Traveling Cables
  - 1) Draka,



- 2) James Monroe,
- 3) Prysmian
- 4) or approved equal.
- k. Guide Shoes/Rollers
  - 1) ELSCO,
  - 2) G.A.L. ,
  - 3) ELPRO
  - 4) Or approved equal.
- l. Wire Ropes
  - 1) Paulsen,
  - 2) Bethlehem,
  - 3) Wayland,
  - 4) Draka,
  - 5) Or approved equal.
- m. Intercommunications/Telephones
  - 1) Webb Electronics,
  - 2) K-Tec,
  - 3) Ring,
  - 4) Wurtec,
  - 5) Janus,
  - 6) Or approved equal.
- n. All specialized tools, equipment, software, and passwords, required to maintain, restore to working order, adjust the operation, and perform 2014 NYCBC/A17.1-Appendix K mandated inspections shall provided to the Commissioner as part of the base installation.
- o. Technical support of the product(s) shall be available to the Commissioner.

## 2.3 CONTROL FEATURES / OPERATION

### A. Motion Control

- 1. Smooth stepless acceleration and deceleration of the elevator car shall be provided in either direction of travel during both single and multiple floor runs.



2. Use digital logic to calculate optimum acceleration and deceleration patterns during each run.
  - a. The amplitude of acceleration and deceleration shall not exceed 2.6 - 2.8 ft./sec<sup>2</sup> for geared and MRL traction, and 3.5 - 4 ft./sec<sup>2</sup> for gearless traction elevators.
  - b. The maximum jerk rate shall be 1.5 to 2.0 times the acceleration and deceleration.
  - c. The maximum velocity which the elevator achieves in either direction of travel while operating under load conditions that vary between empty car and full rated load shall be within  $\pm 3\%$  of the rated speed.
3. Floor leveling accuracy of  $\pm 1/4"$  as measured between the car entrance threshold and the landing sill on any given floor shall be provided.
  - a. This accuracy standard shall be maintained under varying load conditions and without need for releveling corrections caused by overshooting or stopping short of the floor.
4. Elapsed flight time during a typical elevator one floor run shall not exceed values as further specified.
  - a. Timing, as measured between the moment door closing operations begin and when the doors are 3/4 open at the next adjacent floor, shall remain consistent under varying load conditions in either direction of travel.

**B. Simplex Selective Collective Operation**

1. Provide simplex selective collective operation from a riser of hall push button stations.
2. The registration of one or more car calls shall dispatch the car to the selected floors.
  - a. The car shall also respond to registered hall calls in the same direction of travel.
  - b. Car and hall calls shall be canceled when answered.
3. Stops in response to calls that are registered in either the car or hall push button stations shall occur in the natural order of progression in which the floors are encountered, depending on the direction of car travel, and irrespective of the order in which calls are registered.
4. When the car has responded to the highest or lowest call, and calls are registered for the opposite direction, the car shall reverse direction automatically and respond to those registered calls.
5. When the car arrives at its last stop and reverses direction of travel, all previously registered car calls shall be automatically cancelled.
6. When the car arrives at a landing where both up and down hall calls are registered, it will answer the call in the direction of travel.
  - a. After a pre-determined delay, if no car call is registered, the car shall respond to calls registered for the opposite direction. Car doors shall close immediately, re-open and respond to the call for the opposite direction.
  - b. Hall lantern operation shall always correspond to direction of service.
7. When an empty car reverses direction at a landing with no hall calls, the doors shall not open and the hall lantern shall not operate.
8. If the car has no car calls registered and arrives at a floor where both up and down hall calls have been registered, the car shall respond to the hall call corresponding to the last direction of car travel. If, after making its stop, a car call is not registered and no other hall



calls exist ahead of the car corresponding to its original direction of travel, the doors shall close and immediately reopen in response to the hall call for the opposite direction.

9. The car shall maintain its original direction at each stop until the doors are fully closed to permit a passenger to register a car call before the car reverses its direction of travel.

**C. Attendant Service Operation**

1. Arrange the elevator for operation with or without an attendant.
2. The transfer from automatic to attendant operation shall be by means of a key operated switch in the car operating panel.
  - a. Locate this switch behind a locked cover in the car station, which shall also contain an "up" and a "down" direction button and a "pass" button.
    - 1) A service demand buzzer and up and down signal lights shall also be included in the car station.
3. When the transfer switch is in the attendant position, the car shall answer calls normally except that the attendant, operating either the "Up" or the "Down" button, shall establish the direction of travel, close the doors and start the car after each stop.
4. The car and landing door opening shall be completely automatic.
  - a. The doors shall remain open until a direction is initiated by the attendant.
  - b. If the button is released before the doors are fully closed the doors shall reopen.
  - c. Continuous pressure on one of the direction buttons or the "pass" button shall cause the car to bypass hall calls and respond only to pre-registered car calls in the direction of travel.
  - d. The bypassed calls shall remain registered to be answered by another car or by the same car on another trip.
5. The up and down signal lights shall indicate that an unanswered corridor call is above or below the car and shall remain illuminated until all calls for that direction are answered.
6. Operation of an "Up" or "Down" hall push button shall momentarily sound the service demand buzzer in the car if it is stopped at a floor with its doors open.
7. Announced calls by entering passengers shall be registered by the attendant.
8. Provide an annunciator panel that shall be activated only when the elevator is in attendant operation.
  - a. Provide green LED's for "up" and red LED's for "down" hall call identifications.
  - b. An electronic buzzer shall sound momentarily when a hall call is registered.
  - c. Cancel annunciator signals as the calls are answered.
  - d. Incorporate the annunciator LED's in the car push button panel either above the car call push buttons or adjacent to the car call push buttons.

**D. Independent Service Operation**

1. The car operating station shall be equipped with a key-operated switch labeled "IND SER".
2. Locate the switch in the locked access compartment.
3. When placed in the "on" position the following shall occur:
  - a. Group elevator - the elevator shall bypass corridor calls and travel directly to any floor chosen by registration of a car call. Hall calls shall remain registered for service by another elevator in the group.



- b. Simplex elevator - existing hall call registrations shall extinguish and hall buttons shall remain inoperative as an indication to passengers that there is no elevator service.
  4. During Independent Service Operation, the elevator doors shall remain open at any landing until the door close or a car call push button is pressed and maintained until the doors are fully closed.
  5. If more than one (1) car call is registered, all registered car calls shall extinguish when the elevator stops in response to the first call.
  6. Fire Emergency Recall shall automatically override Independent Service Operation and engage Phase I - Fire Emergency Recall Operation following a period of approximately forty-five (45) seconds.
- E. Inspection Service Operation
  1. Provide a key operated switch in the main car operating panel that, when turned to the 'ON' position, shall cause the elevator to be removed from service and placed in Inspection Service Operation.
  2. Limited operation of the car shall be provided through pressing the Attendant Service up and down push buttons (if provided) or the highest or lowest car call push buttons (if up and down buttons are not provided) in the main car operating panel only.
  3. The car shall move at a speed not to exceed 150 feet per minute (0.75 meters per second) as per 2014 A17.1-Appendix K with both the hall and car door panels in the closed and locked position.
  4. The Inspection Service switch shall be keyed differently than other typical keys used in the operation of the elevator. Keying shall be in accordance with Security Group Classifications as required by 2014 A17.1-Appendix K.
  5. The top of the elevator car shall be equipped with a control for limited operation of the car during restorations, maintenance and inspection conducted in the hoistway. The transfer of control to the top of car operating device shall cause that device to be the sole means of control for the elevator.
    - a. Visual and audible indication shall be provided on the top of the car when Firefighters' Emergency Operation is initiated.
  6. Power door operating equipment shall be rendered inoperative while the car is being operated in the Inspection Service mode with the exception of power closing of the door. The control system shall maintain closing power on the door while the elevator is moving under Inspection Service Operation.
  7. The in-car Inspection Service switch shall be rendered ineffective when the top of car inspection control is activated.
  8. Machine Room Inspection Operation and Inspection Operation with open door circuits shall be provided in accordance with A17.1 Safety Code, as modified and adopted, where required or allowed by New York City Department of Buildings.
- F. Hoistway Access Operation
  1. Provisions shall be made to allow access to the hoistway through the use of hoistway access switches.
  2. Operating the access switch shall permit the car to move at a speed not to exceed 150 feet per minute (0.75 meters per second) as per 2014 A17.1-Appendix K with the hall and car doors in the open position to obtain access to the top of the car or climb-in pit.
  3. The car shall automatically stop motion when the car top is level with the hoistway door sill for access to top of car.





4. The access key switch(es) shall be keyed differently than other typical keys used in the operation of the elevator. Keying shall be in accordance with Security Group Classifications as required by 2014 A17.1-Appendix K.
5. Access operation shall be disabled when top of car inspection operation is in effect.

**G. Load Weighing Operation**

1. A positive means shall be provided to continuously monitor the amount of load being transported by the elevator car.
2. The system shall be used to;
  - a. Preload static motor drives
  - b. Activate control features that include:
    - 1) anti-nuisance operation
    - 2) load dispatch operation
    - 3) load dependent non-stop operation where applicable.
3. The anti-nuisance feature shall operate at loads not exceeding 200 lbs., whereas load dispatch and load non-stop shall be set to function at 65% of the rated loading capacity for the initial set up and adjustment procedure.

**H. Anti-Nuisance Operation**

1. In the event car loading is not commensurate with the number of car calls registered, all car calls shall be canceled.
  - a. The system shall monitor the door protection device to determine if passenger transfer has occurred.
  - b. If after the third stop a passenger transfer has not occurred, the system shall cancel all remaining registered car calls and respond to assigned hall call demand.
  - c. The number of calls registered with no passenger transfer that will trigger anti-nuisance shall be adjustable and initially set to 3 calls.

**I. Firefighters' Emergency Operation / NYC**

1. Phase I Emergency Recall Operation shall be provided in accordance with ASME A17.1 code as modified under the 2014 New York City Building Code Appendix "K".
  - a. The fire emergency operation shall include a smoke detector at the top of each hoistway in buildings classified in occupancy group R-2 for automatic recall.
2. The car operating station shall be provided with an indicator light and audible signal, each of which shall become activated when Phase I Operation is engaged.
  - a. The warning buzzer shall cease to function once the car has completed the recall sequence and is positioned at the designated recall landing.
  - b. The indicator light shall remain illuminated as long as Phase I Operation is activated.
3. A two-position key-operated switch shall be provided on the designated recall landing per local law to manually activate Phase I operation.



- a. When activated, Phase I operation shall be arranged so that in order to restore normal service, the car must first be returned to the designated recall landing, after which the Phase I key-switch must be turned to the 'OFF' position.
    - b. All fire recall switches shall be provided with an illuminated visual signal to indicate when Phase I Emergency Recall Operation is in effect.
  4. Phase II Emergency Recall In-Car Operation shall be provided in accordance with applicable ASME A17.1 code as modified under the 2014 New York City Building Code Appendix "K".
  5. The car operating panel shall be equipped with a three-position, key-operated switch to engage Phase II Operation subsequent to completing the Phase I recall sequence and parking at the designated recall landing.
  6. The car operating panel shall be provided with a 'CALL CANCEL' push button that functions only under Phase II Operating mode.
    - a. When operated, the button shall cause any previously registered car calls to cancel.
  7. The car operating panel shall be engraved with required fire control identifications per the 2014 New York City Building Code Appendix "K".
  8. The "City Wide Standard Key" (Yale #2642) and the "Fire Department Standard Key", shall be used for all Fire Emergency operating devices including car button locked access panels in Destination Dispatch elevators.
  9. Firefighters' Emergency Operation, Phase I and Phase II, shall override all car call lockout features as well as special operating features as outlined by the applicable rules defined in 2014 New York City Building Code Appendix "K".
- J. Firefighters' Emergency Operation
1. Firefighters Service Operation and devices shall meet requirements of New York City Department of Buildings and the New York City Fire Department.
  2. Comply with all aspects of Firefighters Service including, but not limited to the mode of operation, initiation of operation, operating control and signaling devices as well as fixture engraving including operating instructions applicable to and where required by New York City Department of Buildings and the New York City Fire Department.
- K. Emergency Power Operation / All Elevators Operational
1. Upon loss of normal power, and establishing of emergency power, all elevators shall automatically resume normal operation.
    - a. Elevators shall start sequentially so as to prevent overloading of the emergency power system.
    - b. Sequential transformer connection operation shall be employed where necessary to reduce half-cycle inrush currents.
  2. An illuminated signal marked "ELEVATOR EMERGENCY POWER" shall be provided in the elevator lobby at the designated level to indicate that the normal power supply has failed and the emergency power is in effect.
  3. Prior to return to normal power, the building ATS shall provide a "pre-transfer" signal to the elevator equipment that will initiate the landing of elevators prior to transfer from emergency power to normal power.
    - a. Timer of the pre-transfer signal shall be adjustable from 15 to 30 seconds.



4. The following additional requirements apply:
  - a. Firefighters' Service Operation, if in effect, will remain active at all times during emergency power operation.
  - b. Car lighting will remain active with car lighting on separate emergency power feeders in addition to battery back-up.
  - c. Communications will remain active at all times on emergency power feeders in addition to battery back-up.
  - d. Remote monitoring, where provided, will be active from each group dispatcher for selected elevators using an uninterrupted power supply (UPS) to maintain the central processing unit during power transfers.
  - e. Position indicator for each elevator will be active in the selected elevator and security room (where applicable), as well as lobby display panels.
5. Testing of elevators under emergency power shall be accomplished with the building ATS providing necessary "pre-transfer" signals to the elevator control apparatus.
  - a. Prior to testing, the building ATS shall provide a "pre-transfer" signal to initiate the landing of the elevators prior to the transfer from normal to emergency power.
  - b. After testing, the building ATS shall provide a "pre-transfer" signal to initiate the landing of the elevators prior to the transfer from emergency to normal power.

**L. Elevator Safety Requirements for Seismic Zone 2**

1. Guarding of equipment, machine supports, guide rail systems, the design of counterweight car frame and platform, safeties and signaling devices shall meet the requirements of ASME A17.1 as may be modified by the New York City Department of Buildings.
2. Guide rails, guide rail supports and their fastenings shall meet requirements for the seismic zone.

**M. Floor Lockout Feature / Keyed Security Control / Car and Hall**

1. Provide a two (2) position "on-off" key switch located in the car station adjacent to each floor call button except the primary egress floor.
  - a. Turning the key switch to the "off" (locked out) position shall prevent the registration of a call when the corresponding car call button is pressed.
2. Provide a two (2) position "on-off" key switch located in each hall call push button station at each floor as directed by the Commissioner.
  - a. Turning the key switch to the "off" (locked out) position shall prevent the registration of a hall call when the hall call button is pressed.
3. The key switches shall be individually keyed with a master as directed by the Commissioner.
4. The lockout key switches shall be of a material and finish to match the hall push button stations.
5. Firefighters' Service Operation shall override the Floor Lockout Feature.
6. Provide a label on the door of the individual car controller cabinet identifying that the control system utilizes Floor Lockout Feature.
  - a. Firefighters' Emergency Operation override of Floor Lockout Feature shall be tested in accordance with applicable requirements.



**N. Floor Lockout Feature / Keyless Security System / Car Only**

1. Provide a complete car call push button security access system for all landings, except the main floor egress, interfaced with primary dispatch signaling for automatic home landing at a designated floor.
2. The system shall utilize a programmable, card reader to enable a corresponding car station push button that would allow a passenger to register a specific call.
3. The security system shall be activated via a keyed switch located in the car operating panel and/or a controller timing device that would initiate the security function(s) during selected or predetermined hours as directed by the Commissioner.
4. The system shall allow programming by Contractor (i.e., code changes, deletion of individual access codes per landing, additional codes, etc.).
5. Locate the card reader in accordance with applicable ADA or handicapped regulations in the car operating panel fixture.
6. Design and interface security control with primary control signaling for Firefighters' Service or other emergency control override features per local law.
7. Provide a label on the door of the individual car controller cabinet identifying that the control system utilizes Floor Lockout Feature.
  - a. Firefighters' Emergency Operation override of Floor Lockout Feature shall be tested in accordance with applicable requirements.

**O. Floor Lockout Feature / Keyless - Card Reader Control / Wiring Provisions**

1. Wiring: Provide six (6) pair of 20 gauge two (2) flexible conductor low voltage cables with an overall braided shield in the traveling cable of all elevators for card reader interface.
  - a. The cables shall extend from the security interface terminal cabinet in the elevator machine room to behind the elevator return panel above the space allotted for the card reader.
  - b. Terminate the cable to dual screw barrier terminal strips on each end.
2. Card Reader Space: Allocate card reader space in each main car station as directed by the Commissioner.
3. Interface: For floor programmable card access control in all elevators, provide a pair of terminals for all floors such that application of a momentary dry (no voltage present) contact closure across those terminals by the security system shall enable the selection of the corresponding floor from the floor selector button in the elevator cab.
  - a. Locate the terminals inside an interface terminal cabinet in the elevator machine room.
  - b. Provide all relays required to interface the elevator control system to the momentary dry contact closures provided for under another section of these specifications.
  - c. If applicable, the card reader shall be operable and compatible with the issued card keys used building wide.
  - d. Coordinate system requirements with the manufacturer of the issued card key system.
4. Card Reader "Secure/Bypass" Switch: Provide separate card reader control bypass key switches for each elevator.
  - a. The bypass key switches shall be located in the Director's Control Panel.
  - b. The bypass key switches shall be a maintained contact type key switch with the key removable in the secure or bypass position.



- 1) When the key switch is in the secure position, the card reader control mode shall be initiated.
  - 2) When in the bypass position, the card reader control mode shall be bypassed and the elevator shall return to normal operation, permitting free access to any floor.
5. The card reader operation shall bypass floor cut-out switches.
  6. Firefighters' Service Operation shall override Floor Lockout Feature.
  7. Provide a label on the door of the individual car controller cabinet identifying that the control system utilizes Floor Lockout Feature.
    - a. Firefighters' Emergency Operation override of Floor Lockout Feature shall be tested in accordance with applicable requirements.

**P. Car to Lobby Operation**

1. Provide a key-operated Car-to-Lobby feature.
  - a. Provide a 3-position key-operated switch for each elevator in the lobby control panel or at a location as directed by the Commissioner to activate the Car-to-Lobby operating feature.
2. When engaged, this feature shall:
  - a. Cause the affected elevator to return non-stop to the lobby after it has discharged all registered car calls.
  - b. Open the door upon arriving at the lobby for approximately ten (10) seconds, after which the elevator shall park out of service with the door closed.
  - c. Maintain door open button function during the interval in which the car is out of service.
3. Returning the key-operated switch in the lobby panel to the "on" position shall restore the car to normal operation.
4. Override the Priority Service feature with Firefighters' Service in accordance with FDNY guidelines and 2014 NYCBC/ A17.1-Appendix K.
5. Provide a label on the door of the individual car controller cabinet identifying that the control system utilizes Executive Priority Service Operation.
  - a. Firefighters' Emergency Operation override of Car-to-Lobby shall be tested in accordance with applicable requirements.

**Q. Passenger Rescue Feature**

1. Provide a device in the control room to move the elevator car to a floor landing in the event of controller or power failure.
  - a. This device must be speed controlled to prevent an overspeed condition.
  - b. A line of sight must be provided between the Passenger Rescue Feature device and the elevator car.
    - 1) Coordinate line of sight requirements with the control room requirements.
2. Provide a manual brake release lever attached to the control cabinet for rescue of passengers.



- a. A visual display shall be provided with the control cabinet, which indicates car position, speed and directions.

**R. Door Operation**

1. Car and hoistway doors shall be arranged to operate in unison without excessive noise or slamming in either direction of travel.
  - a. Door opening speeds of two (2) feet per second shall be provided in conjunction with closing speeds of 1.0 feet per second in accordance with 2014 New York City Building Code.
  - b. Door operation shall commence as the car stops level at the floor and the machine brake is applied. Pre-door opening shall not be permitted.
2. Where the hoistway door and the car door are mechanically coupled, the kinetic energy of the closing door system shall be based upon the sum of the hoistway and the car door weights, as well as all parts rigidly connected thereto, including the rotational inertia effects of the door operator and the connecting transmission to the door panels.
3. The force necessary to prevent closing of the car and hoistway door from rest shall not exceed 30 lbf. This force shall be measured on the leading edge of the door with the door at any point between one third and two thirds of its travel.
4. Door open and door close time shall be measured between the moment car door operation in either direction begins and the instant at which that cycle is completed.
5. When responding to either a car or corridor call, the amount of time that the elevator door remains stationary in the open position shall be adjustable up to sixty (60) seconds.
  - a. Door open dwell time for a corridor call shall be separate of that for a car call, and in both cases, dwell time shall be canceled whenever the car door protection device is momentarily interrupted by passenger transfers, followed by a reduced door open dwell time of approximately one (1) second (adjustable) after the door protection device is cleared of obstructions.
6. The operation of the door protective device by physical contact (mechanical safety-edge) or the interruption of one or more infrared light beams (dual or multi-beam non-contact) during the close cycle shall cause the immediate reversing of the doors to the full open position.
7. The door closing cycle shall be arranged so that, in the event the door protective devices become continually obstructed after the normal door open dwell time has expired, and following a time interval of approximately thirty (30) seconds (adjustable), a warning tone shall sound and the door closing cycle shall commence at reduced speed and torque per 2014 NYCBC requirements.
8. Each car operating station shall be provided with a “door open” and “door close” push button.
  - a. Pressure on the “door open” button shall cause doors in the full open position to remain so and doors engaged in the close cycle to reverse direction and assume the full open position so long as pressure remains applied to the button.
  - b. The “door open” buttons shall also control the open cycle during Phase II - Emergency In-car Operation.
  - c. The “door close” push button shall function on Independent Service, Attendant Service and Phase II - Emergency In-car Operation as well as during normal automatic operations.



9. Repeated attempts by the power door operator to open or close the door at any landing shall be monitored by the control system.
  - a. In the event the door fails to cycle properly after a preset (adjustable) number of attempts, the car shall either travel to the next stop or remove itself from service, depending upon whether the malfunction is in the open or close cycle.
10. Each hoistway door shall be provided with an automatic self-closing mechanism arranged so that the door shall close and lock if the car should leave the landing while the hoistway door is unlocked.
11. Car doors shall be arranged to prevent their being manually opened from inside the car unless the elevator is positioned within a floor landing zone.

## 2.4 MACHINE ROOM / SECONDARY EQUIPMENT

### A. Controller

1. The elevator shall have a microprocessor-based controller.
2. Digital logic shall calculate optimum acceleration, deceleration and velocity patterns for the car to follow during each run.
3. Closed-loop distance and velocity feedback shall monitor the actual performance of the elevator car with the desired speed profile.
4. System operating software shall be stored in non-volatile memory.
5. Elevator control relays, contactors, switches, capacitors, resistors, fuses, circuit breakers, overload relays, power supplies, electronic circuit boards, microprocessors, static motor drive units, wiring terminal blocks and related components shall be totally enclosed inside a free-standing metal cabinet with hinged access doors.
  - a. Provide natural or mechanical ventilation for the controller cabinets.
  - b. Equip the vent openings and exhaust fans with filters.
6. Mount equipment to moisture-resistant, noncombustible panels supported from the steel frame.
7. Provide "noise filter" between hoistway wiring and controller/dispatchers to eliminate interference.
8. Optically isolate communication cables between components.
9. Wiring: Wiring on the units, whether factory or field wiring, shall be done in neat order, and all connections shall be made to studs and/or terminals by means of grommets, solderless lugs or similar connections. All wiring shall be copper.
10. Terminal Blocks: Provide terminal blocks with identifying studs on units for connection of board wiring and external wiring.
11. Marking: Identifying symbols or letters shall be permanently marked on or adjacent to each device on the unit, and the marking shall be identical with marking used on the wiring diagrams. In addition to the identifying marks, the ampere rating shall be marked adjacent to all fuse holders.
12. The manufacturer's standard on-board "LCD" display shall be incorporated on the main processor board and/or otherwise incorporated in the controller cabinet. The "LCD" shall be capable of providing alpha-numeric characters to view the operational status of the elevator and/or group functions depending on the application. The display shall provide the user with necessary information for troubleshooting and reprogramming of the basic system parameters.
  - a. Where the "LCD" is not an integral part of the controller and troubleshooting/reprogramming requires the use of a separate tool, the tool shall be



- maintained in the machine room and accessible to service installer. This tool, along with all technical documentation for the correct use of the tool, shall remain the property of the The City of New York.
- b. Password protection of critical programming features is required to prevent accidental changes to life-safety and other non-typical control settings.
  - c. Where a separate dispatch or group control panel is provided, a separate “LCD” display shall be provided to view group functions.
13. In the event diagnostics and monitoring is accomplished via Field Service Tools, provide the required Field Service Tools with related control system appurtenances for diagnostic evaluations, system monitoring and field adjustments.
- a. Provide instructions for proper use of such diagnostic tools and/or equipment with all coding and other operational requirements.
14. Microprocessor Documentation
- a. Provide and/or obtain complete information on systems' design, component parts, installation and/or modification procedures, adjusting procedures and associated computer conceptual logic circuitry and field connection.
  - b. Provide microprocessor upgrading and/or modifications to programs that have been assigned to enhance the operation of the equipment for a period of 1 year after date of substantial completion.
- B. Machine Beams
- 1. Provide support beams, angles, plates, bearing plates, blocking steel members to support machine, governors, dead end hitches, deflector and overhead sheaves.
  - 2. Provide support beams, angles, plates, rails, bearing plates, blocking steel members to support machines, governors, deflector and overhead sheaves. The machinery and deflector sheaves shall be located within the hoistway as shown on the drawings. Coordinate attachments of the machine beams to the building structure with the structural drawings.
  - 3. Mounting of the hoist machine and deflector sheaves shall incorporate isolation to minimize the transmission of noise and/or vibration to the building structure.
- C. Gearless Elevator Hoisting Machine
- 1. Provide a permanent magnet synchronous motor (PMSM) gearless traction machine, specially designed and manufactured for elevator service. The machine shall have high starting torque and low starting current, rated for 50° C (90° F) continuous operation, and a minimum of 240 starts per hour.
    - a. The traction driving sheave and brake drum shall be cast integral and bolted securely to the main armature shaft.
    - b. Securely mount the machine frame, including motor fields, bearing stands and brake on a heavy steel bedplate.
    - c. The armature shaft shall be supported in ball or roller type bearings.
    - d. The driving sheave shall be cast from the best grade of metal with a Brinell hardness of 215 to 230 and shall be machined with grooves, providing maximum traction with a minimum of rope and sheave wear.





- 1) Roping requirements and type of steel rope used as suspension means shall be engineered by the contractor and manufacturer of the equipment for maximum life of ropes and sheave.
- e. Ensure that adequate ventilation of internal stator windings and rotating element is provided to prevent overheating with thermal overload protection. (Constant velocity fan for constant cooling.)
- f. Equip housing with eyebolt(s) for lifting.
- g. Provide a spring applied and electrically released electro-mechanical brake.
- h. Swivel type brake shoes shall be applied to the braking surface simultaneously and with equal pressure by means of helical compression springs.
- i. Design the brake for quick release to provide smooth and gradual application of the brake shoes.
- 1) An emergency brake shall be an integral part of the machine design.
- j. Provide 14-gauge hoist cable guards at the car-drop and counterweight-drop side of the machine sheave.
  - 1) Guards shall cover cables from the point of slab penetration to the point where the hoist cables contact the sheave.
  - 2) Guards shall prevent access to cables at pinch points.
  - 3) Guards shall have no sharp edges.
  - 4) Guards shall be properly mounted to prevent vibration.
- k. Design and construct the hoisting machine based on passenger elevator cab enclosure weight as specified and as shown on the architectural drawings.

**D. VVVF AC Drive**

1. Provide a solid-state, variable voltage, variable frequency (VVVF), 3-phase AC hoist motor drive system as part of the microprocessor-based equipment.
  - a. VVVF drive system shall be a low-noise, flux-vector inverter device.
  - b. Include a digital LED readout and touch-key pad to facilitate software parameter adjustments, monitor system operation and display fault codes.
2. The drive shall utilize a 3-phase, full wave rectifier and capacitor bank to provide direct current power for solid-state inversion.
3. The inverter shall utilize IGBT power semiconductors and duty cycle modulation fundamental frequency of not less than one kilohertz to synthesize 3-phase, variable voltage variable frequency output.
4. The system shall be designed and configured with the following countermeasures for noise generated by the pulse-width modulated (PWM) inverters.
  - a. Control of radiated noise via inverter and/or motor cables.
  - b. Conducted noise through power lines.
  - c. Induction noise and ground noise.
5. Inverter shall be encased in metal and independently grounded.
6. A noise filter for the input power line shall be provided to prevent penetration into radios, wireless equipment and smoke detectors.
7. A 3% three-phase line reactor shall be provided on the power system rated at the utility voltage input to the drive and sized for the rated drive current.



8. The drive shall:
  - a. Be configured as a complete digital drive system.
  - b. Be totally software configurable.
  - c. Interface with external equipment/signals via either discrete local I/O connections or high speed Local Area Network (LAN).
  - d. Be located within the limits of the control cabinet (where system size allows) or separately mounted in an appropriate chassis with hinged swing-out doors with clearances equal to the cabinet width dimensions.
  - e. Provide programmable linear or S-curve acceleration.
  - f. Provide free run or programmable linear or S-curve deceleration.
  - g. Have controlled reversing.
9. Operating and Environmental Conditions:
  - a. Have a service factor of 1.0.
  - b. Rated for continuous duty.
  - c. Humidity - 90% rated humidity non condensing.
  - d. Cooling - forced air when required.
  - e. Digital display for:
    - 1) Running - output frequency, motor RPM, output current, voltage.
    - 2) Setting - Parameters values for setup and review.
    - 3) Trip - separate message for each trip, last 30 trips to be retained in memory.
10. Protective Features:
  - a. Motor overspeed.
  - b. Adjustable current limit.
  - c. Isolated control circuitry.
  - d. Digital display for fault conditions.
  - e. Selectable automatic restart at momentary power loss.
  - f. Manual restart.
  - g. Over/Under Voltage.
  - h. Line to line and line to ground faults.
  - i. Over-temperature.

**E. Overspeed Governor**

1. Provide a speed governor, located overhead, to operate the car safety.
  - a. Maintain the proper tension in the governor rope with a weighted tension sheave located in the pit.
    - 1) Springs used to develop the tension are not acceptable.
  - b. Provide rope grip jaws, designed to clamp the governor rope to actuate the car safety upon a predetermined overspeed downward.
    - 1) The centrifugal type governor shall trip and set rope jaws within 60 degrees of governor sheave rotation after reaching rated tripping speed.



- c. Design the governor rope tripping device so that no appreciable damage to or deformation of the governor rope shall result from the stopping action of the device in operating the car safety.
- d. Provide an electrical governor overspeed protective device which shall remove power from the driving machine motor and brake before or at the application of the safety.
  - 1) The setting for the overspeed switch shall be as prescribed in the ASME A17.1 Safety Code.
  - 2) Locate and enclose the switch to ensure that excess lubrication will not enter the switch enclosure.
  - 3) Overspeed switch shall operate in both direction of travel on systems employing a static power drive unit.
- e. Seal and tag the governor with the running speed, tripping speed and date last tested.
- f. Design the governor to prevent false tripping due to conditions caused by rope dynamics.
- g. Governor shall be mounted to the guide rail system or machine beam supports in the hoistway overhead.
  - 1) Coordinate access requirements and testing procedures with the New York City Department of Buildings.
  - 2) Where governor access is not required by New York City Department of Buildings, governor shall be capable of being manually reset from outside the hoistway.

**F. Equipment Isolation**

- 1. Provide effective sound isolation between machines, secondary deflector sheaves, solid state motor drive units and filters, from building structure to reduce noise transmission to occupied spaces and elevators and elevator cabs.
- 2. When operating per plans and specifications, the elevator equipment shall not generate noise levels in excess of NC-40 in occupied tenant spaces and shall be free of pure tones. For the purposes of this specification, a pure tone shall be defined as a sound level in any one-third octave band which is greater than 5 dB above both adjacent one-third octave bands, in the range 45 to 11,200 Hz.
- 3. Provide the following as a minimum:
  - a. Resiliently isolate the entire elevator/secondary deflector integral unitized base from the elevator machine room floor slab by means of effective neoprene-in-shear isolators having a minimum static deflection of 3/8".
  - b. Isolate the transformers and reactance units from the building structure by means of approved neoprene-in-shear isolators having a minimum static deflection of 3/8".
  - c. Solid state rectification units shall be mounted on 3/4" thick minimum, neoprene-in-shear pad isolators and an effective electrical filter/reactance limiting electrical noise shall be provided.
  - d. Use flexible conduit with ground wire for motor, machine, drive, governor and position/velocity transducer connections.

**G. Overhead / and Governor Stop Switches**

- 1. Provide a positive action stop switch at the following locations as required by 2014 A17.1-Appendix K:



- a. Overhead governor access panel as mandated by New York City Department of Buildings.
  2. The switch shall be arranged to prevent the application of power to the hoist motor and machine brake when placed in the “OFF” position.
    - a. Clearly identify the switch with permanent marking on the switch cover that indicates “RUN” and “STOP” positions.
- H. Ascending Car Overspeed Protection Device
  1. Provide a device designed to prevent an ascending elevator from striking the hoistway overhead structure.
  2. The device shall decelerate the car with any load up to the rated capacity by applying an emergency brake.
    - a. The device shall detect an ascending car overspeed condition of not greater than 10% higher than the speed that the car governor is set to trip.
    - b. The device, when activated, shall prevent operation of the car until the device is manually reset.
    - c. The device shall meet the requirements of the ASME A17.1 Safety Code as may be modified by New York City Department of Buildings.
- I. Unintended Car Movement Protection Device
  1. Provide a device to prevent unintended car movement away from the landing when the car and hoistway doors are not closed and locked.
    - a. The device shall prevent such movement in the event of failure of:
      - 1) The electric driving machine motor.
      - 2) The brake.
      - 3) The machine shaft or shaft coupling.
      - 4) Machine gearing.
      - 5) Control system.
      - 6) Any component upon which the speed of the car depends.
      - 7) Suspension ropes and the drive sheave of the traction machine are excluded.
    - b. The device shall prevent operation of the car until the device is manually reset.
    - c. The device shall meet the requirements of the ASME A17.1 Safety Code as may be modified by New York City Department of Buildings.
- J. Emergency Brake
  1. Provide a mechanical device, independent of the normal braking system, that will stop the elevator should it overspeed or move in an unintended manner.
  2. The device used may be arranged to apply force to the car or counterweight rails, suspension or compensation ropes, drive sheave or brake drum.
  3. The emergency brake shall be provided with a marking plate indicating the range of total masses (car with attachments and its load) for:
    - a. The range of speeds at which it is set to operate.
    - b. The criteria such as rail lubrication requirements that may be critical to the performance.



## 2.5 HOISTWAY EQUIPMENT

### A. Guide Rails / Inserts / Brackets

1. Provide machined, standard size steel "T" section guide rails with tongue and grooved joints for the car and counterweight. Use not less than 15.0-pound car rails.
2. The car guide rails shall be as follows:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Saveria Super Line,
    - 2) Monteferro S
    - 3) AFD
    - 4) Or approved equal
3. Use not less than 3/4" thick machined steel fishplates to form rail joints. Connect rails to fishplate with four (4) bolts.
4. The section modulus and moment of inertia of the fishplates shall not be less than that of the rail. Connect rails to fishplate with four (4) bolts.
5. For concrete and concrete block hoistways furnish rail brackets and provide inserts and an insert location drawing to Commissioner.
6. Brackets shall be used to support the rails from the hoistway framing and/or inserts.
  - a. The rails shall be attached to the brackets by heavy clamps or clips.
  - b. Bolting or welding rails to brackets shall only be allowed in certain instances.
  - c. Do not attach brackets to the top flange of hoistway framing steel.
7. Provide rail backing where the vertical distance between support framing is greater than 14'-0" and no intermediate support framing is shown on the drawing.
8. All guide rails shall be erected plumb and parallel to a maximum deviation of 1/8 inch (plus or minus 1/16 inch).
9. Provide oversized steel members and brackets for the rails where the distances exceed the manufacturer's standard dimensions.

### B. Counterweight Assembly / Frame

1. Counterweight shall consist of a steel frame welded or bolted together and necessary steel sub-weights.
  - a. Sub-weights shall be held within the frame by not less than 2 tie-rods passing through holes in all weights with rods equipped with locknuts, secured by washers and cotter pins at each end.
  - b. The counterweight shall be equal to the weight of the elevator car and approximately 40% of the contract (specified) capacity.
  - c. Provide the required pit counterweight guard where no compensation is used.
  - d. The bottom of the counterweight shall have a buffer striking plate and means to attach knock-off blocks to compensate for varying rope length.
  - e. Where a counterweight is located between elevators, provide a guard between the counterweight and the adjacent elevator extending the full height of the shaft as required by 2014 A17.1-Appendix K.

### C. Roller Guides

1. Provide roller guide shoes with adjustable mounting base, rigidly bolted to the top and bottom of each side of the car and counterweight frame.



- a. Roller guides shall consist of a set of sound reducing neoprene wheels in precision bearings held in contact with the three finished rail surfaces by adjustable stabilizing springs.
  - b. The bearings shall be sealed or provided with grease fittings for lubrication.
  - c. Equip roller guides with adjustable stops to control postwise float.
  - d. Fit the top car roller guides with galvanized, painted or powder coated steel guards.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ELSCO Model B for car roller guides and ELSCO Model D for counterweight guides
  - b. ELPRO
  - c. Hollister Whitney
  - d. Or approved equal.

**D. Hoist Ropes**

1. Pre-formed traction steel wire rope, specifically constructed for elevator applications, shall be provided for suspension of the elevator car and counterweight assembly.
  - a. Fastenings shall be accomplished by use of individual tapered rope sockets with adjustable shackles.
  - b. General design requirements for rope shackles and the method of securing wire rope shall conform with ASME A17.1 elevator safety code and 2014 New York City Construction Codes.
  - c. Provide machine-room-less elevators with hoist ropes having steel core.
  - d. Properly select rope for the application and compatibility with the machine drive sheave hardness and groove profile. Design shall provide for a minimum service life of ten years and shall be substantiated by calculations during the submittal phase.
2. Provide anti-spinout as required by 2014 A17.1-Appendix K at all shackles where applicable.
3. Coated steel belts with steel cords embedded in polyurethane case may be used in lieu of conventional steel hoist ropes subject to approval of the Commissioner of the New York City Department of Buildings.

**E. Governor Rope**

1. Pre-formed wire rope specifically constructed for elevator applications, shall be provided for governor ropes.
  - a. Rope shall be traction steel or iron in accordance with manufacturer requirements.
  - b. Rope diameter and method of fastening shall be in accordance with ASME A17.1 Safety Code as adopted and/or otherwise modified by 2014 New York City Construction Codes.

**F. Electrical Conduit / Wiring / Traveling Cable**

1. Electrical wiring shall be provided.
  - a. All wiring shall be stranded copper conductors, manufactured in compliance with ANSI/ASTM B174-71 and UL 62 requirements, and polyvinyl chloride insulation



- complying with ETT requirements of UL 62 and Article 400 of the National Electric Code.
- b. Electrical wiring provided for hoistway interlock shall be of a flame retardant type, capable of withstanding temperatures of at least 392 degrees Fahrenheit. Conductors shall be Type SF or equivalent.
  - c. Each run of electrical conduit or duct shall contain no less than 10% spare wires and, in any case, no fewer than two (2) spare wires.
  - d. Crimp-on type wire terminals shall be used where possible.
2. Traveling cable shall be provided.
- a. Each traveling cable shall be provided with a flame and water resistant polyvinyl chloride jacket.
  - b. Electrical wiring shall consist of stranded copper conductors, manufactured in compliance with ANSI/ASTM B174-71 and UL 62 requirements, and polyvinyl chloride insulation complying with ETT requirements of UL 62 and Article 400 of the National Electric Code.
  - c. Each traveling cable shall contain no less than 10% spare wires.
  - d. Traveling cable exceeding 100' in length shall be provided with a steel wire rope support strand from which the cable shall be suspended.
  - e. Traveling cable must be contained within an approved electrical conduit to within 6' of the final suspension point in the hoistway.
  - f. Each traveling cable shall be arranged to provide no fewer than six (6) individually shielded pairs of 20 gauge wire and arranged to contain no less than one (1) CAT5e cable for CCTV remote monitoring, one (1) CAT5e for phone and all the necessary cables for security card readers as required/identified by the Commissioner.
  - g. Traveling cable conductors that terminate at a hoistway center box shall be connected to stud blocks provided for that purpose.
    - 1) Each wiring terminal shall be clearly identified by its nomenclature as shown on the "as built" wiring diagrams and solderless, crimp-on type wire terminals shall be used where possible.
  - h. The attachment of a traveling cable to the underside of the elevator car shall be performed so that a minimum loop diameter of 30x the cable diameter is provided.
  - i. Pre-hang the cables for at least 24 hours with ends suitably weighted to eliminate twisting during operation.
3. Rigidly supported EMT conduit, flexible metal conduit and galvanized steel trough shall be utilized throughout the hoistway.
- a. Both EMT and flexible conduit shall be connected on either end by use of compression fittings and secured in place with metal clamps sized in accordance with the diameter of conduit utilized.
    - 1) Wire or plastic wire ty-raps shall not constitute an acceptable means of fastening.
  - b. The use of flexible metal conduit shall be limited to runs not greater than 3' in length.

**G. Normal and Final Terminal Stopping Devices**



1. Provide normal terminal stopping devices to stop the car automatically from any speed obtained under normal operation within the top and bottom overtravel, independent of the operating devices, final terminal stopping device and the buffers.
2. Provide final terminal stopping devices to stop the car and counterweight automatically from the speed specified within the top clearance and bottom overtravel.
3. The terminal stopping devices shall have rollers with rubber or other approved composition tread to provide silent operation when actuated by the cam fixed to the top of the car.
  - a. Terminal stopping devices that are not mechanically operated (i.e.: magnetic proximity) shall be provided by the manufacturer of the control equipment, intended for use as a terminal limit, and designed for reliable operation in the hoistway environment.
4. Final terminal limits shall be pinned so as to prevent movement after final adjustment where required by New York City Department of Buildings.

## 2.6 PIT EQUIPMENT

### A. Car and Counterweight Buffers

1. Provide buffer with necessary blocking and horizontal steel braces under the car and counterweight.
2. Provide spring type buffers for elevators with operating speeds of up to and including 200 fpm. Use oil buffers for elevators with operating speeds over 200 fpm.
3. The buffer shall be tested and approved by a qualified testing laboratory.
4. Provide a permanent buffer marking plate which indicates the manufacturer's name, identification number, rated impact speed and stroke.
5. Provide a permanent data plate in the vicinity of the counterweight buffer indicating the maximum designed counterweight runby.
6. Support buffers from the pit floor level with all required blocking and bracing steel members.
7. Coordinate the installation of the buffer inspection platform and ladder with the Commissioner.

### B. Governor Rope Tension Assembly

1. Provide a governor rope tension assembly.
  - a. Maintain the proper tension in the governor rope with a weighted tension sheave located in the pit.
    - 1) Springs used to develop the tension are not acceptable.
  - b. The sheave shall be of proper diameter and set directly plumb with the governor rope drop to prevent the rope from pulling off of the sheave at an angle.
  - c. Lubrication fittings shall be provided on the assembly.
  - d. The assembly shall have necessary rope guards to prevent accidental contact of the rope/sheave by service installer and to prevent the governor rope from jumping off of the sheave.

### C. Pit Stop Switch

1. Where pit depth does not exceed 67", each elevator pit shall be provided with a push/pull or toggle switch that is conspicuously designated "EMERGENCY STOP" and located so





as to be readily accessible from the hoistway entrance on the lowest landing served at a height of approximately 18" above the floor.

- a. This switch shall be arranged to prevent the application of power to the hoist motor and machine brake when placed in the "OFF" position.
2. Where climb-in pit depth exceeds 67", each pit shall be provided with two (2) push/pull or toggle switches conspicuously designated "EMERGENCY STOP".
  - a. Both of these stop switches shall be located immediately adjacent to the pit access ladder.
    - 1) Place one stop switch approximately 47" above the pit floor.
    - 2) Place the second stop switch 18" above the hoistway entrance sill on the lowest landing served.
    - 3) These switches shall be arranged so as to prevent the application of power to the hoist motor or machine brake when either one is placed in the "OFF" position.
3. Where a walk-in pit exists, each elevator shall be provided with a push/pull or toggle switch that is conspicuously numbered and designated "EMERGENCY STOP".
  - a. The location of this stop switch shall be approximately 47" above the pit floor at the nearest point of pit entry from the access door.
  - b. This switch shall be arranged so as to prevent the application of power to the hoist motor and machine brake when placed in the "OFF" position.
4. Provide an electric contact safety switch for the pit access door if any equipment attached to the car extends within the space of the hoistway pit when the car is level at the bottom terminal landing.
  - a. Opening the pit access door shall cause the electric contact switch stop the elevator by interrupting electric power to the driving machine and brake.
  - b. Provide a sign on the pit door "WARNING – OPENING OF PIT DOOR WILL STOP ELEVATOR" using lettering a minimum of 2 inches high.

## 2.7 HOISTWAY ENTRANCES

### A. Hoistway Entrance Structure

1. Frames - The frames shall be constructed of 14-gauge sheet steel.
  - a. Passenger Elevators - Provide stainless steel with No. 4 finish unit frame with welded and mitered corners ground smooth, 2" wide square profile at all floors.
2. Doors - The doors shall be constructed of 16-gauge sheet steel, not less than 1-1/4" thick, reinforced to accept hangers, interlocks or door closers.
3. Equip all hoistway landing doors with one-piece full height non-vision wings of material and finish to match hall side of door panels. The doors shall be as follows:
  - a. Passenger Elevators - At all Floors: Stainless steel with No. 4 finish.
4. Entrances shall bear 1 ½ hour label of Underwriters Laboratories, Inc.



5. Provide each door panel with two removable laminated plastic composition guides, arranged to run in sill grooves with a minimum clearance, replaceable without removing the door from the hangers and incorporating a steel fire stop.
6. In multi-speed door arrangements, provisions shall be made to interlock the individual panels so all panels close should the normal door panel relating means fail.
7. Provide rubber bumpers at the top and bottom of the door to stop them at their limit of travel in opening direction.
8. Sills - Provide narrow-type, extruded sills with the nosing approximately one (1) inch deep and running the full length of door travel.
  - a. The sills shall be at least 3/8 inch thick.
  - b. The wearing surface shall be of a non-slip type.
  - c. Rigidly secure the sills to the building construction by means of steel sill support brackets or blocking with necessary metal shimming or adjustments.
    - 1) Passenger Elevators – At all Floors: Extruded stainless steel.
  - d. Provide and rigidly secure sill support members to the building structure after blocking and leveling them with necessary metal shimming.
    - 1) Use 4" x 4" x 1/4" angle for single speed entrances and 5" x 5" x 3/8" angle for two speed entrances.
    - 2) If formed sheet steel sill support members are used, the structural properties of these members shall match or exceed the structural properties of 4" x 4" x 1/4" angle for single speed entrances, and 5"x 5" x 3/8" angle for two speed entrances.
9. Struts - Provide 3" x 3" x 1/4" hot rolled steel angle struts.
  - a. If formed sheet steel struts are used, the structural properties of formed struts shall match or exceed the structural properties of 3" x 3"x 1/4" steel angle.
  - b. Extend the struts from top of sill to either the bottom of floor beam or intermediate framing above.
  - c. Bolt struts in place with not less than two (2) bolts at each end.
  - d. Strut clip angles or brackets shall have a thickness not less than the thickness of the supported strut.
10. Track Support - 3/16-inch-thick steel track support plate shall extend between and be bolted to the vertical steel struts with no less than two (2) bolts at each end.
11. Track Covers – 14 gauge steel cover plates shall extend the full travel of the doors.
  - a. Covers shall be made in sections for service access to hangers, sheaves, tracks and interlocks.
  - b. The sections above the door opening shall be movable from within the elevator car.
  - c. Cover fastening devices shall be non-removable from the cover.
12. Fascias – 14 gauge steel fascia plates shall extend at least the full width of the door and be secured at hanger support and sill with oval head machine screws.
  - a. Provide fascia plates where the clearance between the edge of the loading side of the platform and the inside face of the hoistway enclosure exceeds the allowed clearance per 2014 New York City Construction Code.



13. Toe Guards - Provide 14 gauge steel toe guards to extend 12 inches below any sill not protected by fascia.
  - a. The toe guards shall extend the full width of the door and shall return to the hoistway wall at a 15-degree angle and be firmly fastened.
14. Dust Covers - Provide 14 gauge steel dust covers to extend 6 inches above any header not protected by fascia.
  - a. The dust covers shall extend to a full width of travel of the doors, return to the hoistway wall at a 15-degree angle and be firmly fastened.
15. The bottom of each horizontally sliding hoistway door panel shall be equipped with guiding members and safety retainers in accordance with A17.1 Safety Code as adopted and/or modified by New York City Department of Buildings.
  - a. The bottom hoistway door panel safety retainers shall be of stainless steel "Z" bar design, or shall be otherwise designed to prevent displacement of the door panel.
  - b. Contractor must submit proof to the Commissioner, in the form of a statement certified by an engineer licensed in the State of New York, that the engineering and design of the safety retainers comply with the performance standard defined in 2014 New York City Building Code Appendix "K".

**B. Tracks / Hangers / Closers / Related Equipment**

1. Formed or extruded steel landing door hanger tracks shall be provided.
2. Each landing door panel shall be suspended from a pair of door hanger assemblies that are compatible with the hanger tracks.
  - a. Hanger assemblies shall be directly mounted to the door panel using 3/8" diameter or better hardware.
  - b. Solid steel blocks shall be used where job-site conditions dictate the use of spacers between hanger assemblies and the landing door panel.
  - c. Hanger assemblies shall be adjusted or shimmed so that door panels are suspended in a plumb manner with no more than 3/8" vertical clearance to the cab entrance threshold.
  - d. Upthrust rollers shall be adjusted for minimal operating clearance against the bottom edge of the hanger track.
  - e. Means shall be provided to prevent hangers from jumping the track.
  - f. Blocks shall be provided to prevent rollers from overrunning the end of the track.
3. Each set of multi-speed center opening or side slide landing doors shall be provided with a sill-mounted spring closing mechanism with necessary door panel relating hardware.
4. Each set of single speed side slide landing doors shall be provided with a sill-mounted spring closing mechanism.
  - a. Spirator-type spring closers shall be acceptable should prevailing sill depth or runby clearance conditions require their use.

**C. Interlocks / Unlocking Devices**

1. Each set of landing doors shall be provided with a complete electromechanical interlock assembly.



- a. Each interlock assembly shall consist of:
    - 1) A switch housing with contacts
    - 2) Lock keeper
    - 3) Clutch engagement/release subassembly
    - 4) Associated linkages
  - b. Arrange the lock so that individual leading door panels (side slide or center opening) are locked when in the closed position.
2. Non-typical mounting arrangements for interlocks and/or related mechanisms must receive prior approval from the Commissioner.
  3. Each hoistway door interlock assembly shall be provided with an emergency release mechanism utilizing a drop-leaf type access key at all landings served.
    - a. Each hoistway door shall accommodate manufacturers standard lock release key with escutcheon.
      - 1) The key hole shall be fitted with a metal ferrule that matches the door finish.
      - 2) Drilling key holes in the field will not be accepted.

## 2.8 CAR EQUIPMENT / FRAME

### A. Car Frame and Platform

1. The car frame shall be made of steel members, with the required factor of safety.
2. The car platform shall consist of a steel frame with necessary steel stringers, all securely welded together.
3. The frame and platform shall be so braced and reinforced that no strain will be transmitted to the elevator car.
  - a. Provide platform with two (2) layers of 3/4" thick marine grade plywood.
  - b. Cover the underside of the car platform with sheet steel.
4. The support frame shall carry rubber pads on which the platform shall rest without any connection to the steel frame for sound and vibration isolation.
5. Provide extruded stainless steel thresholds having non-slip surface, guide grooves.
6. Sound isolate all passenger elevator platforms with vibration isolation pads. The support frame shall carry rubber pads on which the platform shall rest without any connection to the steel frame.
7. Recess the passenger elevator platforms to receive finished flooring as selected by the Commissioner and specified under another section of their specification.
8. The car frame shall be sized for an 8' - 0" overall cab height.
9. Design the elevator frames and platforms for elevator PE1 for a Class A freight loading.

### B. Car Safety

1. Provide a governor actuated mechanical safety device mounted under the car platform and securely bolted to the car sling.
2. The car safety shall be sized for the capacity and speed noted herein.
  - a. When tripped, the safety mechanism shall engage the rails with sufficient force to stop a fully loaded car with an average rate of retardation within the limits given in



A17.1 Safety Code as adopted and/or otherwise modified by the 2014 New York City Construction Codes.

3. Install a car safety marking plate of corrosion resistant metal and, in addition to the data required by 2014 A17.1-Appendix K, indicate the manufacturer's name and manufacturer's catalog designation number for safety.
4. Make provisions to release the car safety. In no event shall the safety be released by downward motion of the car. Raising the car to reset the safety shall be allowed.
5. Provide an electrical safety plank switch that will interrupt the power to the hoist machine and apply the machine brakes when the safety is set.

**C. Automatic Leveling / Releveling / Positioning Device**

1. Equip the elevator with a floor leveling device which shall automatically bring the car to a stop within 1/4" of any floor for which a stop has been initiated regardless of load or direction of travel.
2. This device shall also provide for releveling which shall be arranged to automatically return the elevator to the floor in the event the elevator should move below or above floor level in excess of 1/4".
3. This device shall be operative at all floors served and whether the hoistway or car door is open or closed provided there is no interruption of power to the elevator.
4. A positioning device shall be part of the controller microprocessor systems.
  - a. Position determination in the hoistway may be through fixed tape in the hoistway or by sensors fitted on each driving machine to encode and store car movement.
  - b. Design the mechanical features and electrical circuits to permit accurate control and rapid acceleration and retardation without discomfort.

**D. Top-of-Car Inspection Operating Station**

1. An inspection operating station shall be provided on top of the elevator car.
2. This station shall be installed so that the controls are plainly visible and readily accessible from the hoistway entrance without stepping on the car.
3. When the station is operational, all operating devices in the car shall be inoperative.
4. Provide the following control devices and features:
  - a. A push/pull or toggle switch designated "EMERGENCY STOP" shall be arranged so as to prevent the application of power to the hoist motor or machine brake when in the "off" position.
  - b. A toggle switch designated "INSPECTION" and "NORMAL" to activate the top of car Inspection Service Operation.
  - c. Push button designated "Up", "Down" and "Enable" to operate the elevator on Inspection Service (the "Enable" button shall be arranged to operate in conjunction with either the "Up" or "Down" button).
  - d. An indicator light and warning buzzer that are subject to activation under Phase I - Fire Emergency Recall Operation.

**E. Load Weighing Device**

1. Provide means to measure the load in the car within an accuracy of  $\pm 4\%$  of the elevator capacity.
2. Provide one of the following types of devices:



- a. A device consisting of four strain gauge load cells located at each corner of the car platform and supporting a free floating car platform and cab with summing circuits to calculate the actual load under varying conditions of eccentric loading.
    - b. A strain gauge device located on the crosshead, arranged to measure the deflection of the crosshead and thus determine the load in the car.
    - c. A device consisting of four strain gauge load cells, supporting the weight of the elevator machine with summing circuits to calculate the actual load under varying conditions of load.
    - d. A device to measure the tension in the elevator hoist ropes and thus determine the load in the car.
  3. Arrange that the output signal from the load weighing device be connected as an input to the signal and motor control systems to pre-torque of the hoisting machine motors where applicable.
  4. Provide audible and visual signals in connection with the load weighing device when used as an “overload” device.
- F. Car Enclosure Work Light / Receptacle
1. The top and bottom of each car shall be provided with a permanent lighting fixture and 110 volt GFI receptacle.
  2. Light control switches shall be located for easy accessibility from the hoistway entrance.
  3. Where sufficient overhead clearance exists, the car top lighting fixture shall be extended no less than 24” above the crosshead member of the car frame.
  4. Light bulbs shall be guarded so as to prevent breakage or accidental contact.
- G. Master Door Power Operator System – VVVF/AC
1. Provide a heavy-duty master door operator on top of the elevator car enclosure for power opening and closing of the cab and hoistway entrance door panels.
  2. Operator shall utilize an alternating current motor, controlled by a variable voltage, variable frequency (VVVF) drive and a closed-loop control with programmable operating parameters.
    - a. System may incorporate an encoder feedback to monitor positions with a separate speed sensing device or an encoderless closed-loop VVVF-AC control to monitor motor parameters and vary power applied to compensate for load changes.
  3. The type of system shall be designated as a high speed operator, designed for door panel opening at an average speed of 2.0 feet per second and closing at approximately 1.0 foot per second.
    - a. Reduce the closing speed as required to limit kinetic energy of closing doors to within values permitted by ASME A17.1 as may be adopted and/or modified by the 2014 New York City Construction Codes.
  4. The door shall operate smoothly without a slam or abrupt motion in both the opening and closing cycle directions.
    - a. Provide controls to automatically compensate for load changes such as:
      - 1) Wind conditions (stack effect)
      - 2) Use of different weight door panels on multiple landings



- 3) Other unique prevailing conditions that could cause variations in operational speeds.
- b. Provide nudging to limit speed and torque in conjunction with door close signaling/closing and timing devices as permitted by ASME A17.1 as may be adopted and/or modified by the 2014 New York City Construction Codes. Nudging shall be initiated by the signal control system and not from the door protective device.
5. In case of interruption or failure of electric power from any cause, the door operating mechanism shall be so designed that it shall permit emergency manual operation of both the car and corridor doors only when the elevator is located in the floor landing unlocking zone.
  - a. The hoistway door shall continue to be self-locking and self-closing during emergency operation.
  - b. The door operator and/or car door panel shall be equipped with safety switches and electrical controls to prevent operation of the elevator with the door in the open position as per ASME A17.1 Code Standards.
  - c. Provide zone-lock devices as required by ASME A17.1 as may be adopted and/or otherwise modified by the New York City Department of Buildings
6. Construct all door operating levers of heavy steel or reinforced extruded aluminum members, designed for stress and forces imposed on the related parts, linkages and fixed components during normal and emergency operation functions.
  - a. All pivot points shall have either ball or roller-type bearings, iolite bronze bushings or other non-metallic bushings of ample size.
7. Provide operating data / data tag permanently attached to the operator as required by 2014 A17.1-Appendix K.

**H. Door Reopening Device**

1. Provide an infrared curtain door protection system.
2. The door shall be prevented from closing and reopen when closing if a person interrupts any one of the light rays.
3. The door shall start to close when the protection system is free of any obstruction.
4. The infrared curtain protective system shall provide:
  - a. Protective field not less than 71" above the sill.
  - b. Where a horizontal infrared light beam system is used:
    - 1) A minimum of 47 light beams.
    - 2) Accurately positioned infrared lights to conform to the requirements of ANSI a117.1, section 407.3.3, "Reopening Device".
  - c. Modular design to permit on board test operation and replacement of all circuit boards without removing the complete unit.
  - d. Controls to shut down the elevator when the unit fails to operate properly.

**2.9 FINISH / MATERIALS / SIGNAGE**

**A. Material, Finishes and Painting**



1. General

- a. Cold-rolled Sheet Steel Sections: ASTM A366, commercial steel, Type B
- b. Rolled Steel Floor Plate: ASTM A786
- c. Steel Supports and Reinforcement: ASTM A36
- d. Aluminum-alloy Rolled Tread Plate: ASTM B632
- e. Aluminum Plate: ASTM B209
- f. Stainless Steel: ASTM A167 Type 302, 304 or 316
- g. Stainless Steel Bars and Shapes: ASTM A276
- h. Stainless Steel Tubes: ASTM A269
- i. Aluminum Extrusions: ASTM B221
- j. Nickel Silver Extrusions: ASTM B155
- k. Bronze Sheet: ASTM B36(36M) alloy UNS No. C2800 (Muntz Metal)
- l. Structural Tubing: ASTM A500
- m. Bolts, Nuts and Washers: ASTM A325 and A490
- n. Laminated / Safety Tempered Glass: ANSI Z97.1

2. Finishes

- a. Stainless Steel
  - 1) Satin Finish: No. 4 satin, long grain
  - 2) Mirror Finish: No. 8 non-directional mirror polished
- b. Sheet Steel:
  - 1) Shop Prime: Factory-applied baked on coat of mineral filler and primer
  - 2) Finish Paint: Two (2) coats of low sheen baked enamel, color as selected by the Commissioner.
  - 3) Steel Equipment: Two (2) coats of manufacturer's standard rust-inhibiting paint to exposed ferrous metal surfaces in both the hoistway and pit that do not have galvanized, anodized, baked enamel, or special architectural finishes.

3. Painting

- a. Apply two (2) coats of paint to the machine room floor.
- b. Apply two (2) coats of clear lacquer to bronze or similar non-ferrous materials to prevent tarnishing during a period of not less than twelve (12) months after substantial completion.
- c. Identify all equipment including buffers, crosshead, safety plank, machine, controller, drive, governor, disconnect switch, etc., by 4" high numerals which shall contrast with the background to which it is applied. The identification shall be either decalcomania or stencil type.
- d. Paint or provide decal-type floor designation not less than six (6) inches high on hoistway doors (hoistway side), fascias and/or walls as required by A17.1 as may be adopted and/or modified by the 2014 New York City Construction Codes. The color of paint used shall contrast with the color of the surface to which it is applied.

B. Designation and Data Plates, Labeling and Signage.

- 1. Provide an elevator identification plate on or adjacent to each entrance frame where required by the New York City Department of Buildings.





2. Provide an elevator identification plate on or adjacent to each entrance frame at the designated landing only as required by 2014 A17.1-Appendix K.
3. Elevators shall be identified by "number" only. Where a "letter" is used to identify the elevator, the letter shall indicate the Bank the elevator is in.
  - a. The designation numeral shall be a minimum of 3" in height.
4. For MRL elevators; provide permanent signage indicating the location of the main line disconnect switch(es) for the elevator or bank of elevators.
  - a. The sign shall be located on or adjacent to the Firefighters' Emergency Phase I key switch located at the designated landing.
  - b. Lettering must be a minimum of 6 mm (0.25 in) high in red or a color contrasting with a red background.
5. Provide floor designation plates at each elevator entrance, on both sides of the jamb at a height of 60 inches to center line of plate.
  - a. Floor number designations and Braille shall be 2" high, 0.03" raised and stud mounted.
6. For Destination Based Dispatch systems, provide an elevator designation plate immediately below the floor designation plate in accordance with ANSI A117.1, A17.1-Appendix K and 2014 NYCBC.
  - a. Elevator number designations and Braille shall be 2" high, 0.03" raised and stud mounted.
7. Identify the designated medical emergency services elevator with 3" high international symbol at each elevator entrance on both sides of the jamb.
8. Provide raised designations and Braille markings to the left of the car call and control buttons of the car operating panel(s).
  - a. Designations shall be a minimum of 5/8" high, 0.03" raised and stud mounted.
9. Provide elevators with data and marking plates, labels, signages and refuge space markings complying with A17.1 Elevator Safety Code as may be adopted and/or otherwise modified by the 2014 New York City Construction Codes.
10. Commissioner shall select the designation and data plates from manufacturer's premium line of plates.

## 2.10 FIXTURES / SIGNAL EQUIPMENT

### A. General - Design and Finish

1. The design and location of the hall and car operating and signaling fixtures shall comply with the ADAAG.
2. The operating fixtures shall be selected from the manufacturer's premium line of fixtures.
3. Custom designed operating and signaling fixtures shall be as shown on the drawings or as approved by the Commissioner.
4. The layout of the fixtures including all associated signage and engraving shall be as approved by the Commissioner.
5. Where no special design is shown on the drawings, the buttons shall be as follows:



- a. Stainless steel convex type as selected by the Commissioner from the manufacturer's premium line of push buttons.
    - b. The button shall have a collar & small square indicator on the button with LED call registered light.
  6. Where no special design is shown on the drawings, the faceplates shall be as follows:
    - a. Passenger Elevator
      - 1) At all Floors: Stainless steel faceplate with No.4 finish.
  7. Mount passenger elevator fixtures with concealed fasteners. The screw and key switch cylinder finishes shall match faceplate finish.
  8. Where key-operated switch and or key operated cylinder locks are furnished in conjunction with any component of the installation, four keys for each individual switch or lock shall be furnished, stamped or permanently tagged to indicate function.
  9. All caution signs, pictographs, 2014 NYCBC/ A17.1-Appendix K mandated instructions and directives shall be engraved and filled with epoxy.
- B. Main Car Operating Panel**
1. Provide a main car operating push button panel on the inside front return panel of the car.
  2. Car operating panel shall be incorporated in the swing-front return of the elevator cab.
    - a. Coordination with car front manufacturer shall be the responsibility of the Contractor.
  3. The push buttons shall become individually illuminated as they are pressed and shall extinguish as the calls are answered.
  4. The operating panel shall include:
    - a. A call button for each floor served, located not more than 48" above the cab floor.
    - b. "Door open" / "Door close" buttons.
    - c. "Alarm" button, interfaced with emergency alarm. The alarm button shall illuminate when pressed.
    - d. "Emergency Stop" switch per local law located at 35" above the cab floor.
    - e. Self-dialing intercom with call acknowledging feature and A.D.A. design provisions.
    - f. Three (3) position firefighter key operated switch, call cancel button and illuminated visual/audible signal system with mandated signage engraved per ASME A 17.1 Standards as modified by the 2014 New York City Construction Codes.
      - 1) The "City-Wide Standard Key" (#2642) as well as the "Fire Department Standard Key" (#1620), shall be used for all Fire Emergency operating devices.
  5. Provide a locked service cabinet flush mounted and containing the key switches required to operate and maintain the elevator, including, but not limited to:
    - a. Independent service switch.
    - b. Light switch.
    - c. Fan switch.
    - d. G. F. I. duplex receptacle.
    - e. Emergency light test button and indicator.
    - f. Inspection Service Operation key switch.
    - g. Port for hand-held service tool where applicable.

- h. Dimmer for cab interior lighting.
6. Car operating panel shall incorporate:
- a. An integral (no separate faceplate) digital L.E.D. floor position indicator
  - b. Emergency light fixture (without a separate faceplate) and black-filled engraved unit I.D. number or other nomenclature, as approved by Commissioner
  - c. A "No Smoking" advisory and the rated passenger load capacity.
7. Equip the car operating panel with security car call keyed switches & proximity card reader to disconnect the corresponding floor push button.
- a. Security system shall be overridden by Phase II Firefighter's Emergency Operations in accordance with 2014 NYCBC/ A17.1-Appendix K.
8. Where posting of an advisory is permitted by the New York City Department of Buildings in lieu of the inspection certificate, engrave the following advisory on the hinged cover of the service cabinet, or where otherwise directed by the Commissioner.
- a. Inspection Certificate is On File in the Building Management Office Located on the (indicate floor).
- C. Auxiliary Car Operating Panel
1. Provide an auxiliary car operating panel that contains the following:
- a. Car call registration buttons.
  - b. Door open and close buttons.
  - c. Illuminated alarm button.
2. Operating devices shall be of the same design, material and finish as the main operating panel.
3. Design this station so as to duplicate the layout of the main operating panel.
4. Provide a digital position indicator, ID engraving to match the main car operating panel.
5. Provide auxiliary car operating panels shall be provided as indicated on the architectural drawings or as directed by the Commissioner.
- D. Car Position Indicator
1. The position of the car in the hoistway shall be indicated by the illumination of the position indicator numeral corresponding to the floor at which the car has stopped or is passing.
- a. Provide 2" high, 10-segment LED type position indicator with direction arrows, integral with the car operating panel.
  - b. Provide Lexan cover lens with hidden support frame behind fixture plate to protect the indicator readout.
  - c. Provide audible floor passing signal per ADA standards where not provided by the elevator signal control.
  - d. Flush mount fixture with cover to match selected car front or car operating panel finish as directed by the Commissioner.
- E. Voice Annunciator
1. Provide a voice annunciator in each elevator.



2. The device features shall comply with the requirements of ADAAG and A117.1 where applicable.
3. Coordinate size, shape and design with Commissioner and other trades.
4. The system shall include, but not limited to:
  - a. Solid state digital speech annunciator
  - b. A recording feature for customized messages
  - c. Playback option
  - d. Built-in voice amplifier
  - e. Master volume control
  - f. Audible indication for selected floor, floor status or position, direction of travel, floor stop and nudging.
5. Locate all associated equipment in a single, clearly labeled enclosure located either in the machine room and/or on car top.

**F. Corridor Push Button Stations / Riser**

1. A riser of push button signal fixtures shall be provided on all floors.
2. Each signal fixture shall consist of the following:
  - a. A flush-mounted faceplate.
  - b. Illuminating tamper-resistant push buttons measuring 3/4" at their smallest dimension as selected by the Commissioner.
  - c. A recessed mounting box, electrical conduit and wiring.
3. Intermediate landings shall be provided with fixtures containing two (2) push buttons while terminal landings shall be provided with fixtures containing a single push button.
4. Include firefighter key switch in the main lobby level station or other designated recall landing.
5. Push button signal fixtures shall be installed at a centerline height of 42" above the floor and shall be installed both plumb and flush to the finished wall.
  - a. Standardize the final distance on all floors.
6. Fixture faceplates shall be installed adjacent to the entrance frame on front wall.

**G. Lobby Call Fixture Cover Engraving/MRL**

1. For MRL elevators; engrave the location of the main line disconnect switch for the elevator or bank of elevators on the cover of the fixture that contains the Firefighters' Emergency Phase I key switch at the designated landing.
  - a. Lettering must be a minimum of 6 mm (0.25 in) high in red or a color contrasting with a red background.

**H. Floor Position Indicator**

1. Provide a digital LED type floor position indicator at each landing.
2. Indicator shall include 2" high numerals with integral direction arrows that will indicate the direction in which the elevator is traveling.
3. Indicator shall be integrated with hall directional lanterns located adjacent to the hoistway entrance frames.



**I. Hall Direction Lanterns**

1. Provide a visual and audible signal at each entrance to indicate the direction of travel and, where applicable, which car shall stop in response to the hall call.
  - a. Design the lantern with up and down indication at intermediate landings and a single indication at terminal landings.
  - b. Lanterns shall sound once for the up direction and twice for the down direction.
    - 1) Provide an electronic chime with adjustable sound volume.
  - c. Provide adjustable signal time (3 to 10 seconds, with 1 second increments) to notify passengers which car shall answer the hall call and preset per ADAAG distance standards.
2. Incorporate a 2" high LED floor position indicator in the hall lantern fixture with direction arrows located on both sides of the indicator.
3. Locate the lantern adjacent to the corridor entrance.

**J. Car Arrival Advanced Hall Notification Device**

1. Provide a "car here" or approved equal signal in the hall call fixture which will illuminate only where the car is about to stop or has stopped at the specified landing.
2. The signal shall remain illuminated while the car remains at the landing and shall extinguish at the beginning of the door close cycle.

**K. Hoistway Access Switch**

1. Install a cylindrical type keyed switch at top terminal in order to permit the car to be moved at slow speed with the doors open to allow authorized persons to obtain access to the top of the car.
2. Where there is no separate pit access door, a similar switch shall be installed at the lowest landing in order to permit the car to be moved away from the landing with the doors open in order to gain access to the pit.
3. Locate the switch in the terminal floor entrance jambs without faceplate at a height of 78" above the finished floor.
4. This switch is to be of the continuous pressure spring-return type and shall be operated by a cylinder type lock having not less than a five (5) pin or five (5) disc combination with the key removable only in the "OFF" position.
  - a. The lock shall not be operable by any key which operates locks or devices used for other purposes in the building and shall be available to and used only by inspectors, maintenance men and repairmen in accordance with A17.1 applicable Security Group.

**L. Lobby Control Panel/Remote Lobby Security System**

1. Provide a Lobby Control Panel, including a Remote Lobby Security System for the elevator in the main lobby as directed by the Commissioner.
2. Provide stainless steel finish faceplate with tamperproof screws.
3. Coordinate panel location with the Commissioner.
4. The panel shall include:
  - a. 2" high LED position and direction indicators



- b. Car On / Car to Lobby /Car Off three (3) position keyed switch with pilot light.
- c. Security On / Off keyed switch and card reader provision.

**M. Emergency Power Control Panel**

- 1. Provide the lobby console or other designated location with a control panel for emergency power operation as further specified.
  - a. An emergency power control panel provided at the designated location.
  - b. The panel shall contain:
    - 1) An indicator light that illuminates when a transfer to emergency power takes place.
    - 2) Indication that the elevators have arrived at the designated landing and have parked with the doors maintained in the open position.
    - 3) Key-operated override switch(es) and a manual selector switch(es) identified with positions for each elevator.
- 2. The control panel shall be engraved so as to identify the function of each control feature and device provided.
- 3. Provide all necessary electrical conduit and wiring between the elevator machine room(s), and the Emergency Power Control Panel.

**2.11 CAR ENCLOSURES**

**A. Passenger Elevator (PE1)**

- 1. Wall Panels:
  - a. 3/4" thick fire-retardant plywood or particleboard with all surfaces faced with stainless steel as directed by the Commissioner. The panels shall be constructed as the removable type.
- 2. Canopy: Paint canopy with a coat of primer and one coat of low sheen enamel paint.
- 3. Front Return Panels and Transom: Stainless steel swing type front return panel.
  - a. Provide stainless steel entrance posts having mitered, welded and ground smooth corners.
- 4. Cab Doors: Stainless steel with No. 4 finish.
- 5. Ceiling:
  - a. Suspended 3/4" thick fire-retardant plywood or particleboard with all surfaces finished in the selected stainless steel.
- 6. Handrails:
  - a. 1½" inch diameter/flat 1/4" x 4" stainless steel handrail at all walls.
- 7. Lighting:
  - a. Fully recessed LED down light fixtures with aluminum Alzak reflector. Unless otherwise shown on the drawings, provide a light fixture in each ceiling panel.



8. Base: Provide a 4" high base in the material and finish selected by the Commissioner at the sides and rear of the cab enclosure.

**B. Elevator Cab / General Design Requirements**

1. The design, materials and finishes of the cab enclosures shall be as shown on the Architectural Drawings.
2. Materials:
  - a. Particleboard: Premium grade, AWI, Section 200, fire retardant treated, equal to Duraflake FR
  - b. Plastic Laminate: Comply with NEMA LD3, 0.05" thick, color, texture and finish as selected by the Commissioner
  - c. Wood Panels: AWI Premium Grade, quarter sliced wood veneer.
  - d. Trims: AWI Premium Grade quarter sawn wood.
3. Steel Shell: 14-gauge furniture steel reinforced and designed to accept finished wall panels. Finish shell panels with one coat of rust inhibitive primer and two coats of enamel paint in accordance with Section 09 91 00 - "Painting". Apply 1/8" thick, rubberized sound deadening material to the hoistway side of the shell.
  - a. All panels shall have minimum radii. Apply sealant beads to panel joints before bolting together with lock washers.
  - b. Side emergency exit shall be of inconspicuous flush design, fitted with concealed hinges and an approved locking arrangement. Provide a three point locking system; at top, bottom and side.
4. Wood Shell: 3/4" thick particleboard with backing laminate at both sides designed to accept finished wall panels. Apply 26-gauge sheet steel or fire proofing compound to the hoistway side of the shell.
5. Canopy: Canopy construction methods shall match the shell walls. Use 12-gauge furniture sheet steel and adequately support canopy to comply with the loading requirements of 2014 NYCBC.
  - a. Provide necessary cutouts for the installation of fan and top emergency exit. Arrange exit panel to swing up using a heavy duty piano hinge.
  - b. The exit panel shall have dual locks, necessary stops and a handle.
  - c. When in the locked position, the panel shall be flush with the interior face of the canopy with hairline joints.
6. Base: Where finished base provided under another section of these specifications, recess and prepare the shell to accept the base.
  - a. Provide concealed vent slots above side and rear wall base for proper ventilation. Arrange and size vent slots for quiet operation without any whistling. Use 16 gauge baffles to protect the hoistway side of the vent slots.
  - b. The elevator cab shop drawings shall include elevator vent calculations and number, location and size of top and bottom vent holes.
7. Flooring: Where finished flooring is provided under another section of these specifications, recess and prepare sub-flooring to accept the finished flooring.



- a. Service and Freight Elevators: Provide steel or aluminum diamond plate flooring in sections of not more than 24" x 48". Install each section using flat head stainless steel screws.
8. Front Return Panels, Entrance Posts and Transom: Use 14-gauge furniture sheet steel with proper reinforcing to prevent oil canning.
  - a. Fixed type return panel shall have required cutouts for car operating and signaling fixtures.
  - b. Swing front return panels shall have required cutouts for the car call buttons, keyed switches, indicators, emergency light fixture, cabinets and the specified special control and signaling devices.
    - 1) Provide concealed full height stainless steel piano hinges of sufficient strength to support the panel, without sagging, in the open position.
    - 2) The concealed locks shall secure the panel at two points with linkage that shall be free of vibration and noise when in the locked position.
    - 3) When locked in the closed position, the front return panel shall be in true alignment with the transom and base.
    - 4) Lock release holes shall be not more than 1/4" diameter and be located at the return side jamb of the panel.
    - 5) Engrave the elevator identification number and capacity, no smoking sign, firefighter instructions, and other 2014 NYCBC mandated instructions and caution signs directly in the front return panel. Applied panels are unacceptable.
  - c. Transom shall be 14 gauge, and be reinforced and constructed the same as the front return panels.
  - d. Construct entrance posts for the passenger elevators from 12-gauge sheet steel and reinforce to maintain vertical alignment with the adjacent panels.
  - e. Provide channel post entrance jambs for the service elevators. Clad channels with 14-gauge sheet steel and through bolt channels to the floor and to the reinforced header section.
9. Cab Doors: Standard 1" thick, 14-gauge hollow metal flush construction, reinforced for power operation and insulated for sound deadening. Paint hatch side of doors black and face cab side with 16-gauge sheet steel in selected material and finish.
  - a. The door panels shall have no binder angles. All welds shall be continuous, ground smooth and invisible.
  - b. Drill and reinforce doors for installation of door operator hardware, door protective device, door gibs, etc.
10. Ceiling: Construction techniques for wall panels shall apply to ceiling panel construction. Locate top emergency exit inconspicuously. Construct and mount the exit panel to prevent light leakage around the perimeter of panel.
11. Ventilation: The ventilation system of the exhaust type shall be provided in each elevator.
  - a. The system shall include a blower driven by a direct connected motor and mounted on top of car with isolation to effectively prevent transmission of vibration to the car structure. The blower shall have not less than two operating speeds. The ventilation system shall be sized to provide one air change per minute at low speed and 1.5 air





changes per minute at high speed. The unit design and installation shall be such that the maximum noise level, when operating at high speed, shall not exceed 55 dBA approximately three feet above the car floor. A three-position switch to control the blower shall be provided in the car station.

- b. The cab ventilation fan shall be designed so that it does not consume more than .33 watts per CFM while operating at maximum speed.
  - c. The fan or blower shall start upon the pressing of a car or landing call button and shall stop a predetermined time (approximately 2 minutes) after the car has answered the last registered call.
12. Lighting: Arrange lighting fixtures and ceiling assembly to provide even illumination without hot spots and shadows. Overlap fluorescent lamps where cove lighting is specified.
- a. Design and configure lighting system to facilitate maintenance of the fixtures.
  - b. Cab lighting source shall be designed to provide a minimum output of 35 lumens per watt.
  - c. When an unoccupied elevator has remained stationary for 15 minutes, the cab lighting shall become de-energized. The control system shall automatically re-energize the lighting system upon opening of the cab door.
13. Handrails: All attachment hardware shall match the selected handrail and shall permit handrail removal from within the cab.
- a. Provide a minimum of 10-gauge plate at the hatch side of the shell, aligned with the handrail attachment points, to assure secure handrail mounting.
  - b. Design handrail attachment system to support the weight of a person (250 pounds) sitting on it without any deflection and damage to the handrail, cab panel and the shell.
14. Protective Pads and Pad Hooks: Provide pad hooks at locations as directed by the Commissioner. Protective pads shall cover the front return panels, and the side and rear walls. Provide cutouts in pads for access to the cab operating and signaling devices. Pads shall be fire-resistant canvas with two (2) layers of cotton batting padding.
- a. Identify each pad by elevator number and wall location.
15. Accessories: Construct elevator cab to accommodate the door operator, hangers, interlocks and all accessory equipment provided under other sections of these specifications, including firefighter phones, card readers and CCTV.
16. All cab materials shall conform to the 2014 NYCBC/ A17.1-Appendix K prescribed flame spread rating and smoke development requirements.

**C. Cab Fabrication and Installation**

- 1. Maintain accurate relation of planes and angles with hairline fit of contacting panels and/or surfaces.
- 2. Any shadow gaps (reveals) between panels shall be consistent and uniform.



3. Unless otherwise specified or shown on the drawings, for work exposed to view use concealed fasteners.
4. Maximum exposed edge radius at corner bends shall be 1/16". There shall be no visible grain difference at the bends.
5. Form the work to the required shapes and sizes with smooth and even curves, lines and angles. Provide necessary brackets, spacers and blocking material for assembly of the cab.
6. Interior cab surfaces shall be flat and free of bow or oil canning. The maximum overall deviation between the low and high points of 24" x 24" panel section shall not exceed 1/32".
7. Make weights of connections and accessories adequate to safely sustain and withstand stresses to which they will be subjected.
8. All steel work except stainless steel and bronze materials shall be painted with an approved coat of primer and one (1) coat of baked enamel paint.
9. Cab Finish Warranty Enhancement
  - a. Contractor shall be responsible for engineering and installing interior cab finishes in a manner that will withstand all 2014 NYCBC/ A17.1-Appendix K mandated inspections and test procedures. Failure of finishes during testing shall be restored by the contractor without expense to The City of New York. Any objections or qualifications to material selection or design shall be identified for review by the Commissioner.

## 2.12 EMERGENCY LIGHTING / COMMUNICATIONS / SIGNALING

### A. Battery Back Up Emergency Lighting Fixture and Alarm

1. Provide a self-powered emergency light unit.
  - a. Arrange all the light fixtures of the cab to operate as the emergency light system.
2. Provide a car-mounted battery unit including solid-state charger and testing means enclosed in common metal container.
  - a. The battery shall be rechargeable nickel cadmium with a 10-year minimum life expectancy. Mount the power pack on the top of the car.
  - b. Provide a 6" diameter alarm bell mounted directly to the battery/charger unit and connected to sound when any alarm push button or stop switch in the car enclosure is operated.
  - c. The bell shall be configured to operate from power supplied by the building emergency power generator. The bell shall produce a sound output of between 80-90 dBa (measured from a distance of 10') mounted on top of the elevator car.
    - 1) Activation of this bell shall be controlled by the stop switch and alarm button in the car operating station
    - 2) The alarm button shall illuminate when pressed.
3. Where required by 2014 NYCBC/ A17.1-Appendix K for the specific application, the unit shall provide mechanical ventilation for at least one (1) hour.
4. The operation shall be completely automatic upon failure of normal power supply.
5. Unit shall be connected to normal power supply for car lights and arranged to be energized at all times so it automatically recharges battery after use.

### B. Central Exchange Communication System / Intercom



1. Provide an ADA compatible, hands-free intercommunication system for all elevators for two-way, multi-path communication between the elevator car stations and master stations using a central exchange design system.
2. The communication system shall include:
  - a. A car station in the elevator.
  - b. A master station in the elevator control room to communicate with the central and satellite monitor panel, and with the elevator car.
  - c. A master station at the Main Desk area.
  - d. A master station where selected by the Commissioner.
3. The car station shall have a loudspeaker and a microphone to provide hands-free communication. The station shall be installed behind the car operating panel.
4. Master stations shall include:
  - a. Selector push buttons
  - b. Annunciator lights for each connected station
  - c. Speaker/microphone
  - d. Volume control and function buttons.
5. The master stations shall communicate with other master stations and any elevator in that group.
6. A call shall be placed from the elevator car station by pressing the emergency call or alarm button.
  - a. This action shall cause the lamp in the corresponding button of all the designated master stations to flash and an intermittent tone to be heard.
  - b. When the incoming call is answered, the flashing light shall go to a steady condition.
  - c. Disconnection of a call is simply done by depressing the designated car button once.
  - d. If a call request is placed during a conversation, it shall be indicated by a flashing light and short tone of every designated master station.
  - e. When the original conversation is completed, the normal intermittent tone shall resume.
7. A master station shall be connected to any of its designated car stations by depressing the corresponding call button.
  - a. The lamp in the button shall be illuminated while the button is depressed.
  - b. In the car station an audible tone shall be emitted and immediate communication is established.
  - c. The call shall be ended by depressing the button a second time, disconnecting the circuit.
  - d. The master stations shall call any other master station by depressing the corresponding call button.
  - e. The button shall lock in its down position and the lamp shall be lit with a steady light.
  - f. At the called master station, a short tone shall be sent out and the lamp in the button corresponding to the "calling" party shall be lit.
  - g. After the tone, immediate communication is established.
8. On all non-called master stations, the lamps corresponding to the calling and called stations shall be illuminated as an indication that those stations are busy.
9. Provide all power supplies, wire, conduit, fittings, etc., for both systems.
10. Location of the stations, in the specified rooms or areas, shall be directed by the Commissioner.



11. The intercom system shall include the following features:
  - a. Test button to verify audio circuit path.
  - b. All call buttons to initiate a call to all cars in the systems.
  - c. Priority button in the remote monitoring panel stations.
  - d. Visual acknowledgment for the hearing impaired.
12. Provide a battery backup power supply for the intercom capable of providing sufficient power to operate the complete system for a minimum of four (4) hours.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Inspection
  1. Study the Contract Documents with regard to the work as specified and required so as to ensure its completeness.
  2. Examine surface and conditions to which this work is to be attached or applied and notify the Commissioner in writing if conditions or surfaces are detrimental to the proper and expeditious installation of the work. Starting the work shall imply acceptance of the surfaces and conditions to perform the work as specified.
  3. Verify, by measurements at the job site, dimensions affecting the work. Bring field dimensions which are at variance with those on the accepted shop drawings to the attention of the Commissioner. Obtain the decision regarding corrective measures before the start of fabrication of items affected.
  4. Cooperate in the coordination and scheduling of the work of this section with the work of other sections so as not to delay job progress.

#### 3.3 INSTALLATION / PROJECT PHASING

- A. Installation
  1. Install the elevators, using skilled installers in strict accordance with the final accepted shop drawings and other submittals.
  2. Comply with 2014 NYCBC/ A17.1-Appendix K, manufacturer's instructions and recommendations.
  3. Coordinate work with the work of other building functions for proper time and sequence to avoid delays and to ensure right-of-way of system. Use lines and levels to ensure dimensional coordination of the work.
  4. Accurately and rigidly secure supporting elements within the shaftways to the encountered construction within the tolerance established.
  5. Provide and install motor, switch, control, safety and maintenance and operating devices in strict accordance with the submitted wiring diagrams and 2014 New York City Construction Codes.
  6. Ensure sill-to-sill running clearances do not exceed 1 ¼" at all landings served.
  7. Erect guide rails plumb and parallel with a tolerance of 1/8" (plus or minus 1/16")
  8. Install rails so joints do not interfere with brackets.
  9. Set entrance plumb in hoistway and in alignment with guide rails prior to erection of the front walls.



10. Arrange door tracks and sheaves so that no metal-to-metal contact exists.
11. Reinforce hoistway fascias to allow not more than 1/2" of deflection.
12. Install elevator cab enclosure on platform plumb and align cab entrance with hoistway entrances.
13. Sound isolate cab enclosure from car structure. Allow no direct rigid connections between enclosure and car structure and between platform and car structure.
14. Isolate cab fan from canopy to minimize vibration and noise.
15. Remove oil, dirt and impurities and give a factory coat of rust inhibitive paint to all exposed surfaces of struts, hanger supports, covers, fascias, toe guards, dust covers and other ferrous metal.
16. Prehang traveling cables for at least 24 hours with ends suitably weighted to eliminate twisting after installation.
17. After installation, touch up in the field, surfaces of shop primed elements which have become scratched or damaged.
18. Lubricate operating parts of system as recommended by the manufacturer.

### 3.4 FIELD QUALITY CONTROL

#### A. Inspection and Testing

1. Upon completion of each work phase or individual elevator specified herein, the Contractor shall, at its own expense, arrange and assist with inspection and testing as required by the NYC Department of Buildings in order to secure a Certificate of Operation.

### 3.5 PROTECTION / CLEANING

#### A. Protection and Cleaning

1. Adequately protect surfaces against accumulation of paint, mortar, mastic and disfiguration or discoloration and damage during shipment and installation.
2. Upon completion, remove protection from finished surfaces and thoroughly clean and polish surfaces with due regard to the type of material. Work shall be free from discoloration, scratches, dents and other surface defects.
3. The finished installation shall be free of defects.
4. Before final completion and acceptance, restore and/or replace defective work, to the satisfaction of the Commissioner, at no additional expense.
5. Remove tools, equipment and surplus materials from the site.

### 3.6 DEMONSTRATION

#### A. Performance and Operating Requirements

1. Passenger elevators shall be adjusted to meet the following performance requirements:
  - a. Speed: within 3% of rated speed under any loading condition.
  - b. Leveling: within 1/4" under any loading condition.
  - c. Typical Floor-to-Floor Time: (Recorded from the doors start to close on one floor until they are 3/4 open at the next floor.)  
  
Passenger Elevator PE1                      13 seconds.
  - d. Door Operating Times



Door Type	Opening	Closing
3' - 6" single side opening	2.4 sec.	4.9 sec.

- e. Door dwell time for hall calls: 4.0 sec with Advance lantern signals
- f. Door dwell time for hall calls: 5.0 sec without Advance lantern signals
- g. Door dwell time for car calls: 3.0 seconds
- h. Reduced non-interference dwell time: 1.0 seconds.

2. Maintain the following ride quality requirements for the passenger elevators:

- a. For speeds up to 1400 fpm, the speed of the car roller guides shall not exceed 500 rpm.
- b. Where pit permits, extend bottom roller guides by not less than one half the distance from the centerline of the upper roller guides to the platform.
- c. Noise levels inside the car shall not exceed the following:
  - 1) Car at rest with doors closed and fan off - 40 dba.
  - 2) Car at rest with doors closed, fan running - 55 dba.
  - 3) Car running at high speed, fan off - 50 dba.
  - 4) Door in operation - 60 dba.
- d. Vertical accelerations shall not exceed 14 milli-g.
  - 1) The accelerometer used for this testing shall be capable of measuring and recording acceleration to nearest 0.01 m/s<sup>2</sup> (1 milli-g) in the range of 0-2 m/s<sup>2</sup> over a frequency range from 0-80 Hz with ISO 8041 filter weights applied. Accelerometer should provide contact with the floor similar to foot pressure, 60 kPA (8.7psi).
- e. Amplitude of acceleration and deceleration shall not exceed 4.0 ft/sec<sup>2</sup>.
- f. A sustained jerk shall not be more than twice the acceleration.
- g. The rate of change in the acceleration/deceleration rate shall not be greater than 8.0 ft/sec<sup>3</sup>.

B. Acceptance Testing

- 1. Comply with the requirements of the DDC General Conditions.
- 2. Provide at least five (5) days prior written notice to the Commissioner regarding the exact date on which work specified in the Contract Documents will reach completion on any single unit of vertical transportation equipment.
- 3. In addition to conducting whatever testing procedures may be required by NYC Department of Buildings in order to gain approval of the completed work, and before seeking approval of said work by the Commissioner, perform certain other tests in the presence of the Commissioner.
- 4. Provide test instruments, test weights, and qualified field labor as required to safely operate the unit under load conditions that vary from empty to full rated load and, in so doing, successfully demonstrate compliance with applicable performance standards set forth in the project specifications with regard to:
  - a. Operation of safety devices.
  - b. Sustained high-speed velocity of the elevator in either direction of travel.
  - c. Brake-to-brake running time and floor-to-floor time between adjacent floors.



- d. Floor leveling accuracy.
  - e. Door opening/closing and dwell times.
  - f. Ride quality inside the elevator car.
  - g. Communication system.
  - h. Load settings at which anti-nuisance, load dispatch, and load non-stop features are activated.
5. Upon completion of work specified in the Contract Documents, and in conjunction with the aforementioned testing procedures, carry out additional testing of group dispatch/supervisory control features in the presence of the Commissioner.
6. Provide test instruments and qualified field labor as required to successfully demonstrate:
- a. The back-up operating mode for group dispatch failure
  - b. Simulated and actual emergency power operation
  - c. Firefighter, attendant and independent service operations
  - d. Restricted access security features and card reader controls
  - e. Zoning operations and floor parking assignments
  - f. Up/down peak operation
7. After hour tests of systems such as emergency generators, fire service, and security systems shall be conducted at no extra expense to The City of New York.

**END OF SECTION 14 21 23**

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**SECTION 21 00 00****COMMON WORK RESULTS FOR FIRE PROTECTION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 21 08 00 "Commissioning of Fire Suppression"

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.4 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.5 DEFINITIONS**

- A. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.

- B. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.
- C. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow operation of equipment.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- H. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- I. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. NP: Nylon plastic.
  - 4. PE: Polyethylene plastic.
  - 5. PVC: Polyvinyl chloride plastic.
- J. The following are industry abbreviations for rubber materials:
  - 1. CR: Chlorosulfonated polyethylene synthetic rubber.
  - 2. EPDM: Ethylene propylene diene terpolymer rubber.

## 1.6 WORK INCLUDED

- A. The work covered by this section includes, but is not limited to the following:
  - 1. Sprinkler Systems and Equipment.
  - 2. Fire Standpipe System and Equipment.
  - 3. Piping, Valves and Fittings.
  - 4. Identification System.
  - 5. Hydraulic Calculations.
  - 6. Cutting, Patching and Equipment Painting.
  - 7. Hangers, Supports and Guides.
  - 8. Fire Pumps and Controllers.
  - 9. Electric Motors.
  - 10. Electric Motor Controllers.
  - 11. Internal Wiring of Factory-Assembled Prewired Equipment.
  - 12. Alarm Wiring, except for Fire Alarm.
  - 13. Rigging of Equipment.
  - 14. Furnishing access Doors and Frames to be installed under another section.
  - 15. Fire Stopping for Pipe Penetration.



16. Pipe Penetration.
17. Concrete Pads for Equipment.
18. Alarm Initiating Devices.

B. Related Work not Included in this Division but Specified Elsewhere:

1. Fire Alarm Wiring.
2. Finish painting, except for pre-finished equipment or as otherwise specified.
3. Concrete work, except equipment inertia and floating bases.
4. Base flashing for piping.
5. Waterproofing.
6. Power wiring for motors and motor controllers.
7. Installation of access doors and frames.

1.7 COORDINATION OF WORK

- A. The fire protection drawings show the general arrangement of piping and appurtenances. Follow these drawings as closely as the actual construction will permit. Conform the fire protection work to the requirements shown on the drawings. Provide offsets, fittings, and accessories, which may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions.
- B. Carefully check space requirements with other trades to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings.
- C. Wherever work interconnects with work of other trades, coordinate to ensure that necessary information is presented so all the necessary connections and equipment may be properly installed. Identify all items (valves, piping, equipment, etc.) in order that other trades will know where to install access doors and panels.
- D. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.
- E. Furnish and set all sleeves for passage of pipes and conduits through structural masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.
- F. Provide required supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.
- G. Examine and compare the contract drawings and specifications with the drawings and specifications of other disciplines and report any discrepancies between them to the Commissioner. Install and coordinate the work of this section in cooperation with the trades installing interrelated work. Before installation, take proper provisions to avoid interferences. All changes required in the work of the contractor, caused by his neglect to do so, are to be made by him at his own expense.
- H. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship and report any conditions, which prevent performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.
- I. Provide required anchor bolts, sleeves, inserts and supports. Direct location of anchor bolts, sleeves, inserts and supports to insure that they are properly installed. Any expense resulting



from the improper location or installation of anchor bolts, sleeves, inserts and supports to be paid for by the contractor.

- J. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. Properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.
- K. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.
  - 1. Right-of-Way: Lines that pitch have the right-of-way over those that do not pitch, i.e., plumbing drains. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
  - 2. Make offsets, transitions and changes in direction in pipes as required to maintain proper head room and pitch on sloping lines whether or not indicated on the drawings. Furnish and install all air vents, drains, etc., as required to affect these offsets, transitions and changes in direction.
- L. Install all fire protection work to permit removal (without damage to other parts) of all other parts requiring periodic replacement or maintenance. Arrange pipes and equipment to permit access to valves, cocks, starters, motors, and control components, and to clear the openings of swinging doors and access panels.
- M. Provide access panels in equipment as required for inspection and maintenance of internal parts, etc.
- N. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.

#### 1.8 USE OF SITE AND LOAD LIMITATIONS

- A. The contractor shall review all available data on the location and types of pipelines and other underground utilities. The contractor shall not operate equipment over the facilities and shall take care not to damage them or otherwise impair their use. The contractor shall make investigation to verify the location of these facilities before proceeding with construction and/or operations in their vicinity.

#### 1.9 CONTRACTOR'S RESPONSIBILITY FOR EVALUATION

- A. The City of New York and the Commissioner make no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground or other subsurface conditions which may be encountered during the Work. The contractor must make his own evaluation of existing conditions, which may affect methods or expense of performing the Work, based on his own examination of the facility or other information. Failure to examine the drawings or other information shall not relieve the contractor of his responsibility for satisfactory accomplishment of the Work.
- B. The locations of existing services are believed to be as indicated on the drawings. The contractor shall verify the actual location of these services and notify the Commissioner of any discrepancies prior to commencing work.

#### 1.10 ACCESS TO FIRE PROTECTION EQUIPMENT

- A. The contractor shall not interfere with access to hydrants, fire exits, fire hose stations, fire extinguishers, and fire alarm pull stations. In no case shall the contractor's material or equipment be within twenty-five (25) feet of a hydrant or fire alarm pull station.

#### 1.11 EQUIPMENT AND MATERIALS

- A. If products and materials are specified or indicated on the drawings for a specific item or system, the contractor shall use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, in accordance with shop drawings.
- B. All products and materials shall be new, clean, free of defects and free of damage and corrosion.
- C. No permanent equipment shall be used to provide temporary services during construction.
- D. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair.
- E. Make certain that all materials selected directly, or by suppliers, conform to the requirements of the contract drawings and specification. Transmittal of such specifications and drawings, information to persons manufacturing and supplying materials to the project, and rigid adherence thereto, is the contractor's responsibility. Acceptance of a manufacturer's name by the Commissioner does not release the contractor of the responsibility for providing materials, which comply in all respects with the requirements in the Contract Documents.
- F. Applicable equipment and materials to be listed by Underwriters' Laboratories and Manufactured in accordance with ASME, AWWA, NFPA or ANSI standards, and as approved by the local New York City Department of Buildings.
- G. Fully lubricate all equipment when installed and prior to final acceptance.
- H. Locate valves, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified herein.
- I. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Commissioner before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special valves, piping, wiring and accessories.

#### 1.12 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Codes Standards and Fees:
  - 1. Codes and Standards:
    - a. Comply with the requirements of the 2014 New York City Construction Codes, NFPA and other agencies or New York City Department of Buildings over any part of the Work and secure all necessary permits.
    - b. Where codes or standards are listed herein, the applicable portions apply.



- c. The codes and standards listed in the Specifications can be obtained from the organizations listed as follows:
- 1) OSHA Occupational Safety and Health Act
  - 2) ANSI American National Standard Institute, Inc.
  - 3) ASME American Society of Mechanical Engineers
  - 4) ASTM American Society for Testing and Materials
  - 5) AWWA American Water Works Association
  - 6) UL Underwriters Laboratories, Inc.
  - 7) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
  - 8) NFPA National Fire Protection Association
  - 9) NEMA National Electrical Manufacturers Association
  - 10) AIA American Insurance Association
  - 11) AWS American Welding Society
  - 12) ASA American Standards Association
  - 13) IEEE Institute of Electrical and Electronics Engineers
  - 14) NEC National Electrical Code
- d. The particular specification will be identified by appropriate prefix and number only with the latest revision being applicable unless otherwise noted.
2. Furnish all materials and equipment new, free from defects and with listings or labels of Underwriter's Laboratories, Inc. or other nationally approved testing laboratory.
  3. All items of a given type shall be the product of the same manufacturer.
  4. All materials and equipment shall be the product of manufacturers regularly engaged in their manufacture.

#### 1.13 PERMITS AND FEES

- A. Refer to the DDC General Conditions for requirements related to permits and permitting fees.
- B. The Contractor shall be responsible for all required testing and inspections except for Special Inspections. Where required, the City of New York will engage a qualified testing agency to perform Special Inspections.
- C. This contractor shall prepare and file all plans, calculation, forms, etc. required for filing with all agencies required for this work including but not limited to The DEP (Department of Environmental Protection ), DEC (Department of Environmental Conservation, Bureau of Air Resources, EPA Environmental protection Agency, and FDNY.

#### 1.14 SPECIAL / CONTROLLED INSPECTION- NYC

- A. Special inspection shall be provided by the City of New York. The contractor shall coordinate with the Commissioner to accomplish all special inspections and provide any access necessary.

#### 1.15 INSPECTIONS / TESTING

- A. Independent testing and progress inspections shall be provided by the contractor.

#### 1.16 SHOP DRAWINGS

- A. Prepare and submit detailed shop drawings for piping work and other distribution services, including locations and sizes of all openings in floor walls and roofs.



- B. The work described in any shop drawing submission to be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.
- C. If submittals differ from the Contract Document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.
- D. Submit shop drawings and manufacturer's data for the following items in accordance with the Contract Documents:
  - 1. Coordinated, detailed shop layout drawings of all mechanical rooms, services and distribution systems, including plans, profiles and sections.
  - 2. Details of piping supports, elbows, anchors and miscellaneous appurtenances.
  - 3. Hangers, supports, inserts, anchors, guides and foundations.
  - 4. Valves.
  - 5. Pressure gauges.
  - 6. Corrosion protective coatings.
  - 7. Equipment and piping layouts at 3/8 in. scale for the building.
  - 8. Location and size of sleeves for openings in floors and walls.
  - 9. Certified equipment performance curves for pumps.
  - 10. Schedule of pipe and fittings, materials and application, valves, escutcheons, air vents, valve tags and schedules, strainers, and water specialties.
  - 11. Pumps and controllers.
  - 12. Pressure-reducing valves, relief valves.
  - 13. Access doors.
  - 14. Sound insulation, thermal insulation and vibration isolation.
  - 15. Motors, motor controllers and wiring diagram.
  - 16. Building automation systems including descriptions, instruments, and alarms.
  - 17. Flashing.
  - 18. Equipment identification and certificates.
  - 19. Sprinkler heads and accessories.
  - 20. Other shop drawings and submittals as requested within the specification.

#### 1.17 SAMPLES

- A. Submit samples of all items with exposed finishes for review.
- B. Allow sufficient time for consideration without interfering with job schedule.
- C. Duplicate quality and finish to type to be supplied under contract.

#### 1.18 AS-BUILTS AND EQUIPMENT OPERATION INSTRUCTIONS

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing requirements.

#### 1.19 START-UP

- A. Properly lubricate all pieces of equipment.
- B. Check and clean all pipes of dirt and debris.
- C. Prepare each piece of equipment in accordance with manufacturer's installation instructions and have a copy at the equipment.



- D. Check rotation on each motor.
- E. Have representatives of each manufacturer present when hereinafter specified, so that equipment will be started up by manufacturer.

**1.20 ACCESS DOORS IN FINISHED CONSTRUCTION**

- A. Furnish access doors as required for operation and maintenance of concealed equipment and coordinate their delivery with the installing trade.
- B. Coordinate and prepare a location, size and function schedule of access doors required and deliver to the Commissioner for review.
- C. Refer to Section 08 31 13 "ACCESS DOORS AND FRAMES" for access door requirements.
- D. Unless otherwise indicated, minimum size to be 18" x 18".
- E. Furnish color coded buttons or tabs to indicate location of valves or other equipment located above removable type ceilings where access doors are not required.
- F. Access doors shall have a fire rating compatible with the wall construction in which they are located.

**1.21 SYSTEMS IDENTIFICATION**

- A. Piping:
  - 1. All exposed fire protection piping shall be finish painted red in color unless otherwise directed.
  - 2. All piping, exposed or concealed, shall be identified as to its service in accordance with OSHA and ANSI Standards by one of the following methods:
    - a. For installation of manufactured adhesive band type identification markers, provide "Quick-Label" by W.H. Brady Company (Basis of Design), or an equivalent system by one of the following approved manufacturers:
      - 1) Seton
      - 2) BradyID
      - 3) Or approved equal.
  - 3. Piping identification markings shall be installed as follows:
    - a. In each room.
    - b. All valve locations.
    - c. At shaft walls.
    - d. Every 40 feet on continuous runs.
- B. Valves:
  - 1. Valves shall be identified by tag system utilizing brass tags at 2-inch minimum diameter and attached to the valves using brass chain.
    - a. The new valve tag identification numbers shall be permanently added to all existing valve tag charts.





2. The service and function of all fire protection valves shall be identified at the valve by signs, similar to Potter Roemer Series 6300, attached to the valves by brass chains.

C. Equipment:

1. Identify all controls such as motor starters not in motor control centers, float switches, and alarms.

1.22 OPERATING & MAINTENANCE INSTRUCTION

A. Prepare an operating and maintenance instruction manual which includes the following:

1. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
2. Operating instructions for complete system, including:
  - a. Normal starting, operating, and shut-down.
  - b. Emergency procedures for fire or failure of major equipment.
  - c. Summer and winter special procedures.
  - d. Day and night special procedures.
3. Maintenance instructions, including:
  - a. Valve tag list and equipment tag list.
  - b. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated.
  - c. Required cleaning, replacement and/or adjustment schedule.
4. Manufacturer's data on each piece of equipment, including:
  - a. Installation instructions.
  - b. Drawings and specifications.
  - c. Parts list, including recommended items to be stocked.
  - d. Complete wiring and temperature control diagrams.
  - e. Marked or revised prints locating all concealed parts and all variations from the original system design.
  - f. Test and inspection certificates.
5. Specific equipment data including, but not limited to, the following:
  - a. For Fire Protection System:
    - b. Pumps.
    - c. Piping.
    - d. Valves.
    - e. Accessories.
    - f. Pressure reducing valves.
    - g. Sprinkler heads.
    - h. Tamper switches.
    - i. Flow switches.
    - j. Flow measuring devices.
    - k. Electric wiring.
    - l. Controllers.
6. For Automatic Control System



- a. Drawings and description of system controlled.
    - b. Sequence of operation for each system.
    - c. Data on components.
    - d. Wiring and piping, schematic any layout, for panels and panelboards.
    - e. System operating manual, including set points.
  - B. Provide instruction of operating personnel.
    1. Instruct the City of New York's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.
    2. Instruction to be by instructors skilled in operation of equipment. Instructions for major equipment to be by equipment manufacturers' representatives.
    3. Make arrangements to give instructions by system and not by building areas.
    4. Provide five (5) instruction sessions not to exceed six (6) hours each.
    5. Instructions on automatic controls to be by manufacturer's representative.
  - C. Submittals.
    1. Shop Drawings: Submit three copies for review prior to final issuance.
    2. Provide 6 copies of each operation and maintenance manual.
      - a. Manuals to be 8-1/2" x 11" size in hard-back, 3-ring loose-leaf binders. Use more than one volume if required. Do not overfill binders.
      - b. Manuals to be completed and delivered to the Commissioner for approval at least 20 days prior to instruction of operating personnel.
    3. Prepare separate manuals for the fire protection systems.
- 1.23 TOOLS FOR OPERATION, ADJUSTMENT AND SERVICE
- A. Deliver to Commissioner all special tools needed for proper operation, adjustment and service of equipment.
- 1.24 RECORD DRAWINGS
- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing requirements.

PART 2 - PRODUCTS  
NOT USED.

PART 3 - EXECUTION  
NOT USED.

**END OF SECTION 21 00 00**

**SECTION 21 05 13****COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

**PART 2 - PRODUCTS****2.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

**2.2 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

**2.3 POLYPHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## 2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

Permanent-split capacitor.

1. Split phase.
2. Capacitor start, inductor run.
3. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## PART 3 - EXECUTION

### 3.1 NOT USED

### END OF SECTION 21 05 13



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**SECTION 21 05 17****SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

**PART 2 - PRODUCTS****2.1 SLEEVES**

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

**2.2 STACK-SLEEVE FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Smith, Jay R. Mfg. Co.
  - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
  - 3. Wade Inc.
  - 4. Or approved equal.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

**2.3 SLEEVE-SEAL SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
  - 5. Proco Products, Inc.
  - 6. Or approved equal.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.





1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

#### 2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Presealed Systems.
  2. Advance Products & Systems, Inc.
  3. CALPICO, Inc.
  4. Or approved equal.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

#### 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.



3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 10 "Firestopping".

### 3.3 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
  2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
  4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 10 "Firestopping."

### 3.4 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.5 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.



- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel wall sleeves, Galvanized-steel-pipe sleeves, Sleeve-seal fittings.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel wall sleeves, Galvanized-steel-pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, Sleeve-seal fittings.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves.
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves, Stack-sleeve fittings.



5. Interior Partitions:
  - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
  - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION 21 05 17**

**SECTION 21 05 18****ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. Escutcheons.
2. Floor plates.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

**PART 2 - PRODUCTS****2.1 ESCUTCHEONS**

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- D. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

**2.2 FLOOR PLATES**

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: split-plate, stamped-steel type with concealed hinge.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: split-plate, stamped-steel type with concealed hinge.



- f. Bare Piping in Unfinished Service Spaces: split-plate, stamped-steel type with concealed hinge.
    - g. Bare Piping in Equipment Rooms: split-plate, stamped-steel type with concealed hinge.
  - C. Install floor plates for piping penetrations of equipment-room floors.
  - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - E. New Piping: One-piece, floor-plate type.
- 3.3 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION 21 05 18**



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**SECTION 21 05 48****VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 21 08 00 "Commissioning of Fire Suppression"

**1.2 SUMMARY**

- A. This section includes the following:
  - 1. All equipment and piping as noted on the drawing's schedule or in the specification shall be seismically braced if the building is so classified as listed herein. Vibration control shall apply as described in all cases herein.
  - 2. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, 2014 NYCBC. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.
  - 3. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.
  - 4. Seismic bracing, wind, flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
  - 5. It is the intent of the seismic and wind load portion of this specification to keep all plumbing building system components in place during a seismic or high wind event and additionally operational where the occupancy category of the building so requires as listed herein.
  - 6. All such systems must be installed in strict accordance with seismic/wind codes, component manufacturer's and building construction standards.
  - 7. This specification is considered to be minimum requirements for seismic, wind, flood and vibration control considerations.
  - 8. Any variation, which results in non-compliance with the specification requirements, shall be corrected by the contractor in an approved manner.
- B. The work in this section includes, but is not limited to, the following:
  - 1. Vibration isolation for piping and equipment, all referred to as components.
  - 2. Component isolation bases.
  - 3. Seismic restraints for isolated components.
  - 4. Seismic restraints for non-isolated components.
  - 5. Wind restraints for isolated components.



6. Wind restraints for non-isolated components.
  7. Flood restraints for isolated components.
  8. Flood restraints for non-isolated components.
  9. Certification of seismic, wind or flood restraint designs.
  10. Installation supervision.
  11. Design of attachment of housekeeping pads.
  12. All components requiring 2014 NYCBC compliance.
  13. All inspection and test procedures for components requiring 2014 NYCBC compliance.
- C. All fire suppression equipment and piping within, on or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
- D. Components referred to below are typical. (Components not listed are still included in this specification.) All systems that are part of the building in any way are referred to as components, including:
1. Air Separators
  2. Equipment Supports
  3. Pipe
  4. Pumps (all types)
  5. Risers
  6. Supports
  7. Tanks (all types)
  8. Vibration Isolators

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
1. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

## 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.7 DEFINITIONS (building and components, 2014 New York City Building Code)

- A. ESSENTIAL FACILITIES, (Occupancy Category IV, 2014 NYCBC)
  - 1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.
- B. LIFE SAFETY AND HIGH HAZARD
  - 1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels. (Life Safety)
  - 2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers. (Life Safety)
  - 3. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells. (High Hazard)
  - 4. Heating systems in any facility in Occupancy Category IV, 2014 NYCBC where the ambient temperature can fall below 32 degrees Fahrenheit. (Life Safety)
- C. General
  - 1. Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.
  - 2. Approved Agency: An established and recognized agency, or other qualified person, regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the AHJ as being qualified for such purposes.
  - 3. Attachment: See Positive Attachment below.
  - 4. Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per 2014 NYCBC. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed. See Section 16 09 .3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.
  - 5. Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also Longitudinal Bracing and Transverse Bracing. Together, they resist environmental loads from any direction.
  - 6. Certificate of Compliance: A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents, provided by an approved agency. (Certificate to be supplied by equipment component



- manufacturer.)
7. Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.
  8. Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor is 1.5.
  9. Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.
  10. Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.
  11. Consequential Damage: The functional and physical interrelationship of components, their supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.
  12. Equipment: Systems associated with ducts, pipes and conduits also called components.
  13. Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:
    - a. The overflow of inland or tidal waters.
    - b. The unusual and rapid accumulation of runoff of surface waters from any source.
  14. Flood Hazard Area: The greater of the following of two areas:
    - a. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
    - b. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.
  15. Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as zone V, VO, VE or VI-30.
  16. Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.
  17. Gas pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel, gas, fuel oil, medical gas, or compressed air.
  18. Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.
  19. Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.
  20. Importance Factor, G: A factor that accounts for the degree of hazard to human life and damage to property.
  21. Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 17 03 .5 and "Label" and "Manufacturer's Designation" and "Mark").
  22. Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (see Section 17 03 .5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark").
  23. Lateral forces: A force acting on a component in the horizontal plane. This force can be in any direction.



24. Longitudinal bracing: Bracing that prevents a component from moving in the direction of its run.
25. Longitudinal force: An applied force that happens to be in the same direction as the duct or pipe run.
26. Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate," "Label" and "Manufacturer's Designation").
27. Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection Certificate," "Label" and "Mark".)
28. Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow and seismic based on occupancy of the structure.
29. Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double-sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.
30. Seismic: Related to an earthquake. Seismic loads on a structure are caused by wave movements in the earth during an earthquake.
31. Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group or Occupancy Category and the severity of the design earthquake ground motion at the site.
32. Seismic Forces: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used in the design of the structure and its components.
33. Seismic Use Group, Occupancy Category: A classification assigned to a building based on its use as defined in Section 16 04 .516.2.
34. Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2.
35. Story Drift Ratio: The story drift (Lateral displacement) divided by the story height.
36. Transverse bracing: Bracing that prevents a component from moving from side to side.
37. Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater.

## 1.8 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

### A. General Design Requirements.

1. SEISMIC CONSIDERATIONS: This project has seismic design requirements as follows:
  - a. Occupancy Category, III (Seismic Design Category C) essential facility.
    - 1) All Components, with the additional requirement of a manufacturer's Certificate of Compliance to prove 'on line' capability ( $I_p = 1.5$ )
2. WIND CONSIDERATIONS: This project has wind design requirements as follows:
  - a. Wind load in hurricane, tornado and/or wind-borne debris regions (90 plus mph) having a building height greater than 60 feet. Rooftop structures; Section 6.5.15.1 of ASCE 7-05 design requirements apply.

B. General Design Performance Requirements

1. Seismic and Wind Load Certification and Analysis:
  - a. Attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the mounting system, seismic or wind restraints, fasteners or ICC Certified Concrete Anchors shall be submitted for approval along with the shop drawings. Seismic loads shall have their calculations based on seismic loads as established in Specification Section 1.8, Paragraph A Design Seismic Loads. Wind loads shall have their calculations based on Section 1.8, Paragraph 2, Design Wind Loads. A registered professional engineer licensed in the State of New York shall stamp all analysis, or as required by 2014 NYC Construction Codes.
  - b. Unless otherwise specified, all equipment and piping shall be restrained to resist seismic forces. Restraints shall maintain components in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:
    - 1) 2014 New York City Building Code, and ASCE.
    - 2) NFPA (fire protection only)
2. Importance Factor,  $I_p = 1.5$  Components:
  - a. In addition to all of the above provisions, for components having an  $I_p$  greater than 1.0, all trades shall comply with Sections 16 and 17 of the NYC Building Code.
3. All component manufacturers shall submit for approval the following as required below:
  - a. For all life safety system components noted in this specification: the Approved Agency's Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include anchorage, structural and on-line capability. Use of seismic experience data shall be permitted if evidence confirms that the historical based component has the same construction and weight and accompanying center of gravity as submitted unit and basis of experience claim conforms to loads derived in testing with accompanying accelerations based on AC-156. Seismic qualification by seismic experience data based upon nationally recognized procedures acceptable to the NYC Department of Buildings and 2014 NYC Construction Codes shall be deemed to satisfy the design and evaluation requirements provided that the substantiated seismic capacities equal or exceed the seismic demands determined in accordance with Sections 13.3.1 and 13.3.2 of ASCE 7-05.
  - b. In addition, all components needed for the continued operation of the facility in the above stated categories will have the manufacturer of that component submit the Approved Agency's Certificate of Compliance for their equipment when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include on line capability. This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Use Group. Where components do not affect the facility's functional operation but could affect the performance of other components should they dislodge, only anchorage of that component requires compliance. Components needed for continued operation of the building require Analytical or Shaker Test certification through the total component's load path to structure calculated at its center of gravity. Certification



- shall prove anchorage, structural and on line capability. For use of seismic experience data, see (a) above.
- c. All components containing hazardous or flammable materials will have the manufacturer of the component submit the Approved Agency's Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of C through F. Testing shall be conducted by Analytical or Shaker Test through the total component's load path to structure at its center of gravity and shall prove anchorage, structural capability and hazardous material containment. Testing shall prove that no internal component will rupture to insure against loss of hazardous or flammable (explosive) material that could support combustion, ignite or contaminate.
  - d. All components requiring anchorage compliance only, not listed in the above categories, shall have the manufacturer of each component submit a PE stamped calculation package stating that their project specific equipment will accept anchorage by calculating its reactions through the component's load path to structure at its center of gravity at the designated anchorage locations. This requirement is for all projects having a Seismic Design Category of C through F.
4. Occupancy Category II & III Structures, NYCBC 2014, Ip 1.0, Seismic Design Category C:
- a. Projects in these categories require seismic bracing for all life safety and high hazard components, Paragraph 1.7B sub-paragraphs 1, 2, 5 and 6. In addition, any un-braced component that could adversely affect the performance of a component that must remain functional, Ip 1.5, or could cause the failure or release of hazardous materials (gas or liquid fuel), must be braced or anchored to avoid such failure. This includes any component that could fall or move laterally. (Consequential Damage, ASCE 7-05, Section 16 .2 .3.)
5. Design Seismic Loads:
- a. Project has a minimum design load of 0.4g for statically mounted components and 0.5g for resiliently mounted components. Actual loads for both internal and external isolation and/or anchorage of components shall be as above or as calculated for the specific project location but in no event shall it be less than the above.
  - b. Exclusions for seismic restraint of piping and duct shall be according to 2014 New York City Construction Codes and as stated herein. The minimum horizontal restraint capability shall be 0.4g horizontal and 0.27g vertical (in addition to the gravity load). Life safety equipment defined above shall be designed to withstand a horizontal load of 0.9g and a vertical load of 0.6g.
  - c. Analysis for anchorage must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment depth and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in this section, acting through the equipment center of gravity.
  - d. Vertical load shall be calculated at 1/3 the horizontal load as a minimum, or, as prescribed by the code as 0.2 times Sds.
  - e. Internally isolated equipment in lieu of specified isolation and restraint systems must meet all of the requirements of this section, all articles.
  - f. A Seismic Design Errors and Omissions Insurance Certificate MUST accompany the seismic restraint equipment manufacturer's calculation. Product liability insurance certificates are not acceptable.
  - g. Whether the equipment is internally or externally isolated and restrained, the entire



unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic or wind attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section. Sheet metal screw attachment is acceptable provided that the following five conditions are met and verified.

- 1) Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.
- 2) Shear and tension allowables are obtained from an accredited third-party source, such as ICC or NDS, not from the screw manufacturer.
- 3) Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure.
- 4) Attachment points of the roof-mounted unit to curb and the curb to structure demonstrates structural load path.
- 5) The method of attachment does not violate the NRCA rating of the curb by violating the roof member's waterproofing.

- h. Failure is defined as the discontinuance of any attachment point or load path between component and structure. Permanent deformation of the component is acceptable as long as the component continues to operate without failure and, if permanent, it is within acceptable manufacturing or structural tolerances.

6. Design Wind Loads:

- a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
  - 1) If component is curb mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base type B-3 if isolated, Base type B-4 if non-isolated.
  - 2) If component is support mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base type B-5 if isolated, Base type B-6 if non-isolated.
  - 3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.
- b. Loads and calculations shall be based on 2014 NYCBC, figure 1609 and related sections in ASCE 7-05.
- c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), the force on roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.
- d. Equivalent basic wind speed shall be based on 2014 NYCBC, Table 1609.3.1.
- e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

7. Design Flood Loads:

- a. When a building or structure is located in a flood hazard area, anchorage for all components subjected to those locations shall follow Section 1.8 B 3d. for their proper fastening to structure.
- b. Components used for anchorage purposes shall be hot dipped galvanized,



cadmium-plated or powder-coated for the purpose of anti-corrosion.

1.9 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.10 SUBMITTALS

- A. Refer to Part 1, General.
- B. Product Data: The manufacturer of vibration isolation, seismic, wind and flood restraints shall provide submittals for products as follows:

- 1. Descriptive Data:

- a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
- b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and restraints by referencing numbered descriptive drawings.

- 2. Shop Drawings:

- a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
- b. Provide all details of suspension and support for ceiling hung equipment.
- c. Where walls, floors, slabs or supplementary steel work are used for restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturer's submittals must include spacing and maximum seismic/wind loads at the restraint points.
- d. Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third-party certification.
- e. Calculations shall be submitted as required in Section 1.8, General Design and Performance Requirements.
- f. Contractor to submit all calculations, drawings, design and signed by New York State Professional Engineer.

1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Manufacturer of vibration isolation, seismic and wind load control equipment or manufacturer's approved representative shall have the following responsibilities:

- 1. Determine vibration isolation and restraint sizes and locations.
- 2. Provide vibration isolation and restraints as scheduled or specified.
- 3. Provide calculations and materials, if required, for restraint of non-isolated equipment.
- 4. Provide installation instructions in writing, drawings and trained field supervision, where necessary, to insure proper installation and performance.
- 5. Certify correctness of installation upon completion, in writing.
- 6. All provisions of Section 1.8, General Design and Performance Requirements.

- C. All manufacturers of any type of equipment including OEM are responsible for Section 1.8.



- D. Equipment manufacturer's substitution of internally or externally isolated and/or restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their engineering department, PE stamped and certified by an engineer licensed in the State of New York per the section on the Seismic Restraint Design (See Section 1.8B, article 1a), stating that the seismic restraints are in full compliance with these specifications. Manufacturer's certification proving on line capability shall be required in addition to all requirements stated in Section 1.8B.
- E. All expenses for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable for:
  - 1. Indoor or outdoor mounted equipment over or adjacent to:
    - a. Office locations
    - b. Assembly areas

**F. RELATED WORK**

- 1. Housekeeping pad structural design, including its attachment to building structure, shall be as shown on the contract drawings. Attachment of all components and restraints to the pad and size of the pad shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor, or by the contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad.
- 2. Roof steel supporting roof-mounted equipment shall be designed for all seismic and wind forces including, but not limited to, tension, compression and moment loads.
- 3. Chimneys, stacks and boiler breeching passing through floors are to be attached at each floor level with a riser guide.
- 4. Where ceilings are not braced, lay-in lighting fixtures, weighing more than 20 lbs, shall have at least 2 independent corner diagonal wire ties to structure.
- 5. Lay-in ceilings in compliance with seismic code requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as panel lights and diffusers less than 40 lbs to T-bar structures. 2014 NYCBC dictates fixture support requirements.

**1.12 CODE AND STANDARDS REQUIREMENTS**

**A. Codes and Standards**

- 1. 2014 New York City Construction Codes.
- 2. SMACNA Guidelines for Seismic Restraint of Mechanical Systems, Second Edition (Standard reference, to be used for design purposes only, not code).
- 3. American Society for Testing and Materials (ASTM) (Standard).
- 4. International Conference of Building Officials (ICBO) (Standard).
- 5. ASHRAE (Standard reference, to be used for design purposes only, not code).
- 6. VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard reference, to be used for design purposes only, not code).

- B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

## PART 2 - PRODUCTS

### 2.1 DESCRIPTION

- A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association). Subject to compliance with requirements, provide products manufactured by The VMC Group, including Vibration Mountings & Controls, Amber/Booth or Korfund Dynamics (Basis-of-Design), or a similar product by an approved manufacturer listed below:

1. Senior Flexonics
2. Mason Industries
3. Or approved equal.

### 2.2 VIBRATION ISOLATION TYPES

- A. Type A: Spring Isolator – Free Standing

A\*

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or ¼" elastomeric acoustical friction pad between the bottom of isolator and the support.
2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.
3. Spring diameters shall be no less than 0.8" of the compressed height of the spring at rated load.
4. Springs shall have a minimum additional travel to solid equal to 50% of the operating deflection.

- B. Type B: Seismically and Wind Restrained Spring Isolator

1. MS, MSS, AEQM, ASCM, AMSR
2. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric deceleration bushings. Limit stops shall be out of contact during normal operation. If housings are to be bolted or welded in position, there must be an internal isolation pad or elastomeric cup. Housing shall be designed to resist all seismic forces.

- C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type)

HRSA

1. Hangers shall consist of rigid steel frames containing minimum 1 ¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type A. The elastomeric element shall have resilient bushings projecting through the steel box.
2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short-circuiting the spring.
3. Submittals shall include a hanger drawing showing the 30° capability.
4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.

D. Type D: Elastomer Double Deflection Hanger Isolator

HR

1. Molded (minimum 1 ¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35."
2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.

E. Type E: Combination Spring/Elastomer Hanger Isolator

HRS

1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.
2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
3. 30° angularity feature is not required.

F. Type F: Seismically Restrained Elastomer Floor Isolator

RSM, MB, RUD

1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing specifications.

G. Type G: Pad Type Elastomer Isolator (Standard)

Maxiflex

1. One layer of ¾" thick elastomeric pad consisting of 2" square modules for size required.
2. Load distribution plates shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

H. Type H: Pad Type Elastomer Isolator (High Density)

Fabri-Flex, NDB, NRC

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.
2. Load distribution plate shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

I. Type I: Thrust Restraints

RSHTR, TRK

1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting



movement of air handling equipment to ¼" due to thrust forces. Contractor shall supply hardware.

2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.

J. Type J: Pipe Anchors

MDPA, AG

1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum ½" thick 60 durometer elastomer.
2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.
3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

K. Type K: Pipe Guides

PG/AG/SWP/SWX

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum ½" thickness of 60 durometer elastomer.
2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and replaceable to allow for selection of pipe movement.
3. Guides shall be capable of ± 1 5/8" motion, or to meet location requirements.

L. Type L: Isolated Pipe Hanger System

CIH, CIR, TIH, PIH

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
5. Systems shall be pre-compressed to allow for rod insertion and standard leveling.

## 2.3 SEISMIC RESTRAINT TYPES

A. Type I: Spring Isolator, Restrained

B. MS, MSS, AEQM, ASCM, AMRS

1. Refer to vibration isolation Type B.

C. Type II: Seismically Restrained Elastomer Floor Isolator

MB, RUD



1. Refer to vibration isolation Type F.

D. Type III: All-Directional Seismic Snubber

SR, ER

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of ¼" thick. Applied loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.

E. Type IV: Floor or Roof Anchorage

Cast-In Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

F. Type V: Seismic Cable Restraints

1. SB, LRC
2. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges.

G. Type VI: Rigid Arm Brace

SAB

1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.

H. Type VII: Internal Clevis Cross Brace

ICB

1. Internal clevis cross braces at seismic locations shall be pre-cut pipe or other approved device sized for internal dimensions.

I. Type VIII: Seismic Waterproof Foundation Wall Sleeve

SWFWS

1. Seismic waterproof foundation wall sleeves shall consist of two elastomeric sleeves that shall be mounted both inside and out of the vertical foundation wall. The conical design shall have a suitably waterproof means of fastening to both concrete and to its concentric



utility pipe. Allowable vertical drift shall be  $\pm 2"$  from the installed neutral point along the vertical "y" axis. All fittings shall be stainless steel or galvanized.

## 2.4 EQUIPMENT BASES

### A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

### B. Base Types

1. Type B-1: Integral Structural Steel Base  
WFB, SFB, WSB
  - a. Rectangular bases are preferred for all equipment.
  - b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
  - c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.
  - d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
  - e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2."
2. Type B-2: Concrete Inertia Base  
MPF, WPF, CPF
  - a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
  - b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
  - c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6."
  - d. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
  - e. Forms shall include a minimum concrete reinforcing consisting of 3/8" bars welded in place a maximum of 16" on centers running both ways in a layer 1 to 1½" above the bottom.
  - f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
  - g. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum operational clearance below the base.
3. Type B-5: Isolated Equipment Supports  
R7200/R7300
  - a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. The lower frame must accept point



support for both seismic attachment and leveling. The upper frame must be furnished with positive fastening provisions, (welding or bolting), to anchor the component to the equipment support so as not to violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.8, Article B, paragraph 7, Design Seismic Loads, are met. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.

- b. All-directional elastomeric snubber bushings shall be minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick elastomeric acoustical pads or cups.
  - c. Hardware must be plated and the springs shall be powder-coated or cadmium-plated.
  - d. All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
  - e. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design wind/seismic loads.
4. Type B-6: Non-Isolated Equipment Supports  
R7000
- a. This shall have the same provisions as Type B-5 without the spring isolation.
5. Type B-8: Plumbing Components Structural Base Frames
- a. Where roof mounted plumbing components are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit's base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on type "B" wind /seismic restrained isolation system.
  - b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A". Structural Base Frame shall be type RTSBF as manufactured by The VMC Group.

## 2.5 FLEXIBLE CONNECTORS

### A. Type FC-2: Flexible Stainless Steel Hose

1. SS-FP, SS-FW, SS-PM, SS-WE
2. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples.

### B. Type BC-2 connector shall be braided bronze for Freon connections.

1. Minimum lengths shall be as tabulated:

a. Flanged		Male Nipples	
3 x 14	10 x 26	½ x 9	1 ½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14



5 x 19	14 x 30	1 x 11	2 ½ x 18
6 x 20	16 x 32	1 ¼ x 12	
8 x 22			

2. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. All areas that will receive components requiring vibration control, seismic or wind load bracing shall be thoroughly examined for deficiencies that will affect their installation or performance. Such deficiencies shall be corrected prior to the installation of any such system.
- B. Examine all “rough ins” including anchors and reinforcing prior to placement.

### 3.3 APPLICATIONS

- A. All vibration isolators and seismic, wind restraint systems must be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic, wind restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system specified herein.
- D. The contractor shall not install any isolated components in a manner that makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Overstressing of the building structure must not occur due to overhead support of equipment. Contractor must submit loads to the Commissioner for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.
- G. Seismic cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment or piping.
- H. Seismic cable assemblies are installed taut on non-isolated systems. Seismic rigid braces may be used in place of cables on rigidly attached systems.
- I. At locations where seismic cable restraints or seismic single arm braces are located, the support rods must be braced when necessary to accept compressive loads. See Table “E.”



- J. At all locations where seismic cable braces and seismic cable restraints are attached to the pipe clevis, the clevis bolt must be reinforced with pipe clevis cross bolt braces or double inside nuts if required by seismic acceleration levels.
- K. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.
- L. Special and Periodic Inspections for items listed in Section 1.8, Article B shall be conducted and submitted on a timely basis.

### 3.4 EQUIPMENT INSTALLATION

- A. Equipment shall be isolated and/or restrained as per Tables B-E at the end of this section.
- B. Place floor mounted equipment on 4" actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck to meet acceleration criteria (see Section 1.8). Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under that section of the contract documents.
- C. Additional Requirements:
  - 1. The minimum operating clearance under all isolated components bases shall be 2."
  - 2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
  - 3. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions, within the limits of the restraints.
  - 4. Ceilings containing diffusers or lighting fixtures must meet seismic requirements by using earthquake clips or other approved means of positive attachment to secure diffuser and fixtures to T-bar structure.
  - 5. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

### 3.5 PIPE

- A. Vibration Isolation of Piping:
  - 1. Plumbing Water Piping (Excludes Sanitary and Drainage Lines): All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Type E hangers shall isolate horizontal pressurized runs in all other locations of the building. Floor supported piping shall rest on Type B isolators. Expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment shall have at least the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" nominal deflection or greater for pipe sizes up to and including 3," 1 3/8" nominal deflection or greater for pipe sizes greater than 3." Where column spacing exceeds 35', isolation hanger deflection shall be 2½" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.
  - 2. Condensate Piping: All ceiling suspended piping in the mechanical equipment room shall



- be isolated with Type D hangers except where anchor or guided if connected to isolated equipment. All floor supported piping shall be supported with Type F isolators.
3. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B.) Isolator type shall be as listed in Article 1, above.
  4. Riser Location: All risers shall be supported on Type J or K anchors or guide restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
  5. Control Air Piping: Where control air piping is connected to isolated components, all piping shall be isolated and equipment shall be flexibly connected in horizontal and vertical plane with Type FC-2 flexible connectors.
  6. Gas lines shall not be isolated.
  7. Fire protection lines shall not be isolated.

**B. Seismic Restraint of Piping.**

1. All high hazard and life safety pipe regardless of size such as fuel oil piping, fire protection mains, gas piping, medical gas piping and compressed air piping and piping with an  $I_p=1.5$  shall be seismically restrained or braced. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping. There are no exclusions for size or distance in this category.
2. Seismically restrain piping, with an  $I_p = 1.0$ , located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is  $1\frac{1}{4}$ " I.D. and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping.
3. Seismically restrain all other piping  $2\frac{1}{2}$ " diameter and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type VI seismic cable restraints or single arm braces may be used on non-isolated piping.
4. See Table D for maximum seismic bracing distances.
5. Multiple runs of pipe on the same support shall have distance determined by calculation.
6. Rod braces shall be used for all rod lengths as listed in Table E.
7. Clevis hangers shall have braces placed inside of hanger at seismic brace locations.
8. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
9. For fuel oil and all gas piping, transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
10. Transverse restraint for one pipe section may also act as longitudinal restraint for a pipe section of the same or smaller size connected perpendicular to it if the restraint is installed within 24" of the centerline of the smaller pipe or combined stresses are within allowable limits at longer distances.
11. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints. Use Type V or VI restraint, if trapeze is smaller than 48" long.
12. Branch lines may not be used to restrain main lines or cross-mains.
13. Where pipe passes through a fire-rated, seismic gypsum wall, the wall can act as a lateral/transverse brace for pipe sizes up to and including 6," provided fire stopping material is tight to the pipe.
14. Where pipe passes through a seismic block or concrete wall, the wall can act as a lateral/transverse brace.
15. Where horizontal pipe crosses a building's drift expansion joint, allowance shall be part of the design to accommodate differential motion.
16. Vertical pipe rises between floors shall have their differential movement part of the seismic design for building drift.



17. For horizontal passage of all underground utilities through building's foundation wall, all pipes shall pass freely through an oversized opening and waterproofed accordingly to accommodate maximum allowable building drift. (Seismic Restraint Type VIII).

### 3.6 EXEMPTIONS

#### A. EQUIPMENT:

1. Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.
2. Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor,  $I_p = 1.0$  and there is no possibility of consequential damage.
3. Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an  $I_p = 1.0$  and where flexible connections exist between the component and associated piping.

#### B. PIPING and CONDUIT

1. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where  $I_p = 1.0$ .
2. High deformability pipe in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where  $I_p = 1.5$ .
3. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where  $I_p = 1.5$ .
4. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
5. Piping systems, including their supports, designed and constructed in accordance with ASME B31.

#### C. EXEMPTIONS DO NOT APPLY FOR:

##### 1. LIFE SAFETY or HIGH HAZARD COMPONENTS

- a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, 2014 NYCBC. High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

##### 2. ELECTRICAL

- a. Includes critical, standby or emergency power components including conduit (1" nominal diameter and larger) cable tray or bus duct, lighting, panels, communication lines involving 911, etc.

##### 3. PIPING

- a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.

4. DUCT

- a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

5. EQUIPMENT

- a. Previously excluded non-life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

3.7 FIELD QUALITY CONTROL, INSPECTION

- A. All Independent Special and Periodic Inspections must be performed and submitted by the Contractor on components as outlined in Section 1.8 B, Article 3. Note: Special Inspection services are to be supplied by the The City of New York.
- B. Upon completion of installation of all vibration isolation devices, the manufacturer's chosen representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or list any that require correction. Shall submit a report to the Commissioner, including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

3.8 Selection Guide for Vibration Isolation and Seismic Restraint

TABLE "B" PLUMBING EQUIPMENT										
	On Grade, Basement or Slab on Grade						Above Grade			
Equipment (See Notes)	HP	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Rest r
Air Compressors & Vacuum Pumps	Up to 10	Floor	B	0.75	---	IV	B	1.50	---	IV
	Over 10	Floor	B	0.75	B-2	IV	B	1.50	B-2	IV
Base Mounted Pumps	Up to 15	Floor	B	0.75	B-2	IV	B	0.75	B-2	IV
	Over 15	Floor	B	0.75	B-2	IV	B	0.75	B-2	IV

1. Roof Mounted Components use Spec Type B-5, if over occupied areas, Defl, 1.5".
2. Roof Mounted Components use Spec Type B-6 if over unoccupied areas.
3. Minimum Deflection Guide for Equipment with Low RPM

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5"
401 thru 600	2.5"

601 thru 900	1.5"
Greater than 900	0.75"

B. General Notes for All Tables:

1. Abbreviations:

- a. Mtg = Mounting
- b. ol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
- c. Defl = Minimum Deflection of Vibration Isolator
- d. Base = Base Type per Section 2.4, Equipment Bases
- e. Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types

- 2. All deflections indicated are in inches.
- 3. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.
- 4. For roof applications, use base Type B-5, and/or B-8 where applicable.
- 5. Static deflection shall be determined based on the deflection guide for Table "A."
- 6. Deflections indicated are minimums at actual load and shall be selected for manufacturer's nominal 5," 4," 3," 2" and 1" deflection spring series; RPM is defined as the lowest operating speed of the equipment.
- 7. Single stroke compressors may require inertia bases with thicknesses greater than 14" maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8."

3.9 Spacing Chart for Suspended Components

Table "D" Seismic Bracing			
(Maximum Allowable Spacing Shown – Actual Spacing to Be Determined by Calculation)			
Equipment	On center Transverse	On Center Longitudinal	Change of Direction
Pipe Threaded, Welded, Soldered or Grooved; Conduit and Conduit Racks			
16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
2.5" & Larger	10 Feet	20 Feet	4 Feet
Boiler Breeching	30 Feet	60 Feet	4 Feet
Chimneys & Stacks	30 Feet	60 Feet	4 Feet



3.10 Vertical Hanger Rod Bracing Schedule

Table "E" Hanger Rod Bracing Schedule (Stiffener to be maximum 6" from end of rod)					
Rod Dia.	Clamp Size	Maximum Un-braced Rod Length	Steel Angle Size	Clamp Spacing	Min # of Clamps per Stiffener
3/8"	SRBC-1-1/4	19"	1 x 1 x 1/4"	16"	2
1/2"	SRBC-1-1/4	25"	1 x 1 x 1/4"	20"	2
5/8"	SRBC-1-1/4	31"	1 x 1 x 1/4"	24"	2
3/4"	SRBC-1-1/2	37"	1 1/2 x 1 1/2 x 1/4"	28"	2
7/8"	SRBC-1-1/2	43"	1 1/2 x 1 1/2 x 1/4"	33"	2
1"	SRBC-1-1/2	50"	1 1/2 x 1 1/2 x 1/4"	40"	2
1 1/8"	SRBC-1-1/2	62"	1 1/2 x 1 1/2 x 1/4"	50"	2

**END OF SECTION 21 05 48**



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**SECTION 21 05 53****IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.
  4. Stencils.
  5. Valve tags.
  6. Warning tags.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve Schedules: Valve numbering scheme.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each piping system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: stainless steel, 0.025 inch (0.64 mm) thick, with predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: Yellow.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  - 5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 6. Fasteners: Stainless-steel self-tapping screws.
  - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.
- D. Pipe-Label Colors:
  - 1. Background Color: Red.
  - 2. Letter Color: White.

## 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.
  - 1. Tag Material: stainless steel, 0.025 inch (0.64 mm) thick, with predrilled holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain.
  - 3. Valve-Tag Color: Red.



4. Letter Color: White.

- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.3 LABEL INSTALLATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.
- E. Piping Color-Coding: Painting of piping is specified in Section 09 91 00 "Painting".
- F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

#### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.



- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
- C. Valve-Tag Size and Shape:
  - a. Fire-Suppression Standpipe: 2 inches (50 mm), square.
  - b. Wet-Pipe Sprinkler System: 2 inches (50 mm), square.
  - c. Dry-Pipe Sprinkler Preaction System: 2 inches (50 mm), square.
  - d. Foam-Water System: 2 inches (50 mm), square.

**END OF SECTION 21 05 53**



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## **SECTION 21 08 00**

### **COMMISSIONING OF FIRE SUPPRESSION**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

##### **1.2 SUMMARY**

- A. This section includes commissioning process requirements for Fire Suppression systems, assemblies, and equipment.
- B. Related Sections:
  - 1. DDC General Conditions Section "General Commissioning Requirements" for general commissioning process requirements.

##### **1.3 DESCRIPTION**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for the description of commissioning.

##### **1.4 DEFINITIONS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for definitions.

##### **1.5 SUBMITTALS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for CxA's role.
- B. Refer to DDC General Conditions Section "Submittals" for specific requirements. In addition, provide the following:
- C. Certificates of readiness
- D. Certificates of completion of installation, prestart, and startup activities.
- E. O&M manuals
- F. Test reports



## **1.6 QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

## **1.7 COORDINATION**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the contractor for the equipment being tested. For example, the Contractor shall ultimately be responsible for all standard testing equipment for the plumbing system in Division 21. A sufficient quantity of two-way radios shall be provided by the Contractor.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be provided by the Contractor and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the The City of New York upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of The City of New York.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems





- B. Red-lined Drawings: The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the contractor.
- D. Demonstration and Instruction: Contractor will provide demonstration and instruction as required by the specifications. A complete instruction plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any instruction. An instruction agenda for each instruction session must be submitted to the CxA one (1) week prior to the instruction session

### **3.2 CONTRACTOR'S RESPONSIBILITIES**

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase coordination meetings.
- C. Participate in Fire Suppression systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and instruction in each purchase order or sub-contract written.
- F. Prepare preliminary schedule for Fire Suppression system orientations and inspections, operation and maintenance manual submissions, instruction sessions, flushing and cleaning, equipment start-up, and task completion for The City of New York. Distribute preliminary schedule to commissioning team members.
- G. Update schedule as required throughout the construction period.
- H. Assist the CxA in all verification and functional performance tests.
- I. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- J. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- K. Coordinate with the CxA to provide 48-hour advanced notice so that the witnessing of equipment and system start-up and testing can begin.
- L. Participate in, and schedule vendors and contractors to participate in the instruction sessions.



- M. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
  - 1. Fire Suppression equipment including pumps, piping, and all other equipment furnished under this Division.
  - 2. Automatic sprinkler system.
  - 3. Fire stopping in fire rated construction, including caulking, gasketing and sealing of smoke barriers.
- N. The equipment supplier shall document the performance of his equipment.
- O. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- P. Equipment Suppliers
  - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of The City of New York, to keep warranties in force.
  - 2. Assist in equipment testing per agreements with contractors.
  - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- Q. Refer to DDC General Conditions Section “General Commissioning Requirements” for additional contractor responsibilities.

### **3.3 CxA'S RESPONSIBILITIES**

- A. Refer to DDC General Conditions Section “General Commissioning Requirements” for CxA’s Responsibilities.
- B. Cx Team Meetings
  - 1. Commissioning during construction will begin with a ‘Commissioning Kick-Off Meeting – for Construction Team’ conducted by the CxA where the commissioning process is reviewed with all of the commissioning team members.
  - 2. Additional meetings will be required throughout construction, and will be scheduled by the CxA on a weekly basis with necessary parties of the commissioning team attending, in order to plan, scope, coordinate, and schedule future activities and resolve problems.
- C. Coordination and Scheduling
  - 1. Coordinate and direct commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications, and consultations with all necessary parties.
  - 2. Coordinate commissioning work with the Commissioner to ensure that commissioning activities are being scheduled into the master project schedule.
  - 3. Coordinate with the Commissioner to witness tests, inspections, and systems startup.
- D. Commissioning Progress
  - 1. Perform site visits to observe component and system installations.
  - 2. Report deficiencies to the Commissioner including but not limited to issues related to adequate accessibility required for component maintenance replacement and repair.
  - 3. Attend selected planning and jobsite meetings to obtain information on construction progress.
  - 4. Review construction meeting minutes for revisions/substitutions relating to the commissioning process.



**E. Pre-Functional Checks**

1. Verify proper installation of components, equipment, systems and assemblies. Sampling procedures may NOT be employed on systems and equipment.

**F. Equipment and System Startup and Verification**

1. Review and approve component, equipment, system, and assembly startup plan developed and submitted by the Contractor.
2. Approve system startup by reviewing startup reports, if contracted; and by selected site observation.
3. Review the Testing, Adjusting and Balancing execution plan for the project, which shall be submitted by the Contractor.
4. Verify and document the accuracy of the air and water systems balancing by spot testing the air and water reported field values with Contractor and by reviewing completed reports.

**G. Functional Performance Testing**

1. With assistance from the Contractor, write Functional Performance Testing procedures for all components, equipment or systems to be commissioned.
2. With the assistance of the Contractors, coordinate Functional Performance Testing. Witness and approve Functional Performance Testing performed by the Contractors.
3. With the assistance of the Contractors, coordinate retesting as necessary until satisfactory performance is achieved.
4. Witness seasonal or deferred Functional Performance Testing as necessary.

**H. Issue/Deficiency Logs**

1. The CxA shall prepare a formal, ongoing, online record of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process.
2. Issues will be recorded on an online Commissioning Issues Log for the contractors to resolve to the satisfaction of the Commissioner. Issues will be added by the CxA. Team members are required to post their own responses to issues pertaining to their work. Team members are required to respond to issues added to the list within five (5) working days of being added by the CxA.
3. Issues will be revisited one (1) time to verify that the proper corrections have been made.
4. When issues are resolved, they will be closed on the Issues Log by the CxA

**I. Operation and Maintenance Data**

1. The CxA shall review of the documentation submitted by the Contractor as required by the Specifications for completeness and accuracy. This commissioning review supplements, but does not replace, the Commissioner's review.
2. Review equipment warranties.

**J. Instruction**

1. The Contractor will provide all documentation and qualified instruction personnel for instruction.
2. The CxA will verify through the Contractor's plan and schedule, instruction agendas, and select observations that proper instruction procedures were followed on all commissioned systems.
3. The CxA will verify that Instruction Video Recordings are executed, collected, and provided to the Commissioner.
4. See appropriate section below pertaining to instruction.



**K. Systems Manual Requirements**

1. Index of Systems Manual with notation as to content storage location if not in actual manual.
2. Executive Summary
3. A list of recommended operational record keeping procedures at the facility level, including sample forms, trend logs, or others, and a rationale for each.
4. Maintenance procedures, schedules and recommendations.
5. Ongoing Optimization
6. Other Attachments

**L. Post Occupancy Review**

1. The CxA will return to the site within the 12-month warranty period to address the following: review current building operations with facility staff and address outstanding issues related to the The City of New York's Project Requirements; Interview facility staff and identify problems or concerns with operating the building; Identify problems covered under warranty or under the original construction contract.
2. The CxA will make suggestions for improvements in the content of the O&M Manuals. Any required changes shall be made by the contractor responsible for that section.
3. The CxA shall assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

**M. Commissioning Final Report**

1. The CxA shall provide a final report following the completion of all Functional Performance Testing. The report is to outline compliance and non-compliance to the construction documents, as well as identify concerns relative to future performance.

**3.4 TESTING PREPARATION**

- A. Certify in writing to the CxA that Fire Suppression systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Fire Suppression instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

**3.5 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.



- B. Scope of Fire Protection testing shall include entire Fire Suppression installation. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions.
- D. The CxA along with the Fire Suppression contractor shall prepare detailed testing plans, procedures, and checklists for Fire Suppression systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Fire Suppression system, document the deficiency and report it to The City of New York. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.6 FIRE SUPPRESSION SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 21 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. Fire Suppression Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of sprinkler distribution systems.
- C. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:
  - 1. Fire Protection Piping
  - 2. Fire Pump
  - 3. Jockey Pump

### **3.7 DEFICIENCIES/NON-CONFORMANCE, RETESTING, FAILURE DUE TO MANUFACTURER DEFECT**

- A. Deficiencies/Non-Conformance
  - 1. The CxA will record the results of the functional test on the test form. All deficiencies or non-conformance items shall be noted and reported to the Commissioner and Contractors on a standardized form.



2. The Contractor shall respond to new deficiencies within five (5) business days. The response shall either indicate the issue will be corrected with anticipated date of completion indicated or the response should clearly indicate why the Contractor disputes the claim while referencing the contract document in dispute or request further information to clarify the concern.
3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA.
4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
5. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing Contractor.
6. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it, the CxA documents the deficiency and the Contractor's response and intentions or corrections. The CxA and Contractor then proceed to another test or sequence. Once the Contractor corrects the deficiency, the test is rescheduled and repeated in the anticipation of correct operation or function.
7. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the CxA documents the deficiency and the Contractor's response. The deficiency is then forwarded to parties assumed to be responsible for the deficiency. Resolutions are made at the lowest management level possible. Other parties are brought into the discussion as needed. Final interpretive authority is with the Commissioner. Final acceptance authority is with the Commissioner and CxA. The CxA will then document the resolution process. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency. The CxA then reschedules the test as stated in the section above.

**B. Failure due to Manufacturer Defect**

1. If 10% or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable only by the Commissioner. In such case, the Contractor shall provide the Commissioner with the following.
  - i. Within one week of notification from the Contractor the manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Commissioner within two weeks of the original notice.
  - ii. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
  - iii. The Commissioner will determine whether a replacement of all identical units or a repair is acceptable.
  - iv. Two examples of the proposed solution will be installed by the Contractor and the Contractor will be allowed to test the installations for up to one week, upon which the Commissioner will decide whether to accept the solution.
  - v. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

**3.8 APPROVAL**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for approval procedures.



**3.9 DEFERRED TESTING**

- A. Refer to DDC General Conditions Section “General Commissioning Requirements” for requirements pertaining to deferred testing.

**3.10 MANUFACTURER’S MANUALS**

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in DDC General Conditions.
- B. Refer to DDC General Conditions Section “General Commissioning Requirements” for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

**3.11 INSTRUCTION OF NEW YORK CITY PERSONNEL**

- A. Refer to DDC General Conditions Section “General Commissioning Requirements” for requirements pertaining to instruction.

**3.12 FUNCTIONAL BUILDING SYSTEMS DEMONSTRATION TEST (72 HOURS)**

- A. Refer to Addendum to the General Conditions Section “General Commissioning Requirements” for requirements pertaining to 72-Hour Functional Building Systems Demonstration Testing.

**END OF SECTION 21 08 00**



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**SECTION 21 11 00****FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through wall into the building.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C. Related Sections:
  - 1. Section 21 12 00 "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
  - 2. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.
  - 3. Section 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and controllers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.6 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control reports.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:



1. Ensure that valves are dry and internally protected against rust and corrosion.
  2. Protect valves against damage to threaded ends and flange faces.
  3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- H. Coordinate connection to water main with utility company.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- B. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, drawn temper.
- C. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- D. Copper, Pressure-Seal Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Viega; Plumbing & Heating Systems.
    - b. Or approved equal.
  2. Standard: UL 213.
  3. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
  4. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.



- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- F. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## 2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
- C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.
- D. Grooved-End, Ductile-Iron Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. Star Pipe Products.
    - c. Victaulic Company
    - d. Or approved equal.
  - 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
  - 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
  - 1. Gaskets: AWWA C111, rubber.
- G. Flanges: ASME B16.1, Class 125, cast iron.

## 2.3 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Flexible Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. EBAA Iron, Inc.



- b. ROMAC Industries Inc.
  - c. Star Pipe Products.
  - d. Or approved equal.
- 2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- 3. Pressure Rating: 250 psig minimum.

**B. Ductile-Iron Deflection Fittings:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. EBAA Iron, Inc.
  - b. Or approved equal.
- 2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- 3. Pressure Rating: 250 psig minimum.

**2.4 ENCASEMENT FOR PIPING**

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black.

**2.5 JOINING MATERIALS**

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

**2.6 PIPING SPECIALTIES**

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cascade Waterworks Manufacturing.
  - b. Dresser, Inc.; Dresser Piping Specialties.
  - c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
  - d. JCM Industries.
  - e. ROMAC Industries Inc.
  - f. Smith-Blair, Inc.; a Sensus company.
  - g. Viking Johnson.
  - h. Or approved equal.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
3. Standard: AWWA C219.
4. Center-Sleeve Material: Manufacturer's standard.
5. Gasket Material: Natural or synthetic rubber.
6. Pressure Rating: 200 psig minimum.
7. Metal Component Finish: Corrosion-resistant coating or material.

## 2.7 CORPORATION VALVES AND CURB VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Amcast Industrial Corporation.
  2. Ford Meter Box Company, Inc. (The); Pipe Products Division.
  3. Jones, James Company.
  4. Master Meter, Inc.
  5. McDonald, A. Y. Mfg. Co.
  6. Mueller Co.; Water Products Division.
  7. Red Hed Manufacturing & Supply.
  8. Or approved equal.
- B. Corporation Valves: Comply with AWWA C800. Include saddle and valve compatible with tapping machine and manifold.
  1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
  2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
  3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800 for high-pressure service-line valves. Valve has bronze body, ground-key plug or ball, wide tee head, and inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.



1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- E. Meter Valves: Comply with AWWA C800 for high-pressure service-line valves. Include angle- or straight-through-pattern bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

## 2.8 GATE VALVES

### A. AWWA Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. American Cast Iron Pipe Company; American Flow Control Division.
  - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - d. American R/D.
  - e. Clow Valve Company; a division of McWane, Inc.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. East Jordan Iron Works, Inc.
  - h. Kennedy Valve; a division of McWane, Inc.
  - i. M&H Valve Company; a division of McWane, Inc.
  - j. Mueller Co.; Water Products Division.
  - k. NIBCO INC.
  - l. Tyler Pipe; a division of McWane, Inc.; Utilities Division.
  - m. U.S. Pipe.
  - n. Or approved equal.
2. 200-psig, AWWA, Iron, Nonrising-Stem, Metal-Seated Gate Valves:
  - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
  - b. Standard: AWWA C500.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Mechanical joint.
  - e. Interior Coating: Complying with AWWA C550.
3. 200-psig, AWWA, Iron, Nonrising-Stem, Resilient-Seated Gate Valves:
  - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Mechanical or push-on joint.
  - e. Interior Coating: Complying with AWWA C550.
4. 250-psig, AWWA, Iron, Nonrising-Stem, Resilient-Seated Gate Valves:
  - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - b. Standard: AWWA C509.



- c. Pressure Rating: 250 psig.
  - d. End Connections: Mechanical or push-on joint.
  - e. Interior Coating: Complying with AWWA C550.
- 5. 200-psig, AWWA, Iron, OS&Y, Metal-Seated Gate Valves:
  - a. Description: Cast- or ductile-iron body and bonnet; with cast-iron double disc, bronze disc and seat rings, and bronze stem.
  - b. Standard: AWWA C500.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Flanged or grooved.
- 6. 200-psig, AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:
  - a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Flanged or grooved.
- 7. 250-psig, AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:
  - a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.
  - b. Standard: AWWA C509.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Flanged or grooved.
- 8. Class 125, Bronze, Nonrising-Stem Gate Valves:
  - a. Description: Class 125, Type 1; bronze with solid wedge and malleable-iron handwheel.
  - b. Standard: MSS SP-80.
  - c. Pressure Rating: 200 psig.
  - d. End Connections: Solder joint or threaded.
- B. UL-Listed or FM-Approved Gate Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American AVK Company; Valve & Fittings Division.
    - b. American Cast Iron Pipe Company; American Flow Control Division.
    - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - d. Clow Valve Company; a division of McWane, Inc.
    - e. Crane Co.; Crane Valve Group; Jenkins Valves.
    - f. Crane Co.; Crane Valve Group; Stockham Division.
    - g. East Jordan Iron Works, Inc.
    - h. Hammond Valve.
    - i. Kennedy Valve; a division of McWane, Inc.
    - j. M&H Valve Company; a division of McWane, Inc.
    - k. Milwaukee Valve Company.
    - l. Mueller Co.; Water Products Division.
    - m. NIBCO INC.





- n. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
  - o. Tyco Fire & Building Products LP.
  - p. United Brass Works, Inc.
  - q. U.S. Pipe.
  - r. Watts Water Technologies, Inc.
  - s. Or approved equal.
2. 175-psig, UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
- a. Description: Iron body and bonnet, bronze seating material, and inside screw.
  - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - c. Pressure Rating: 175 psig minimum.
  - d. End Connections: Mechanical or push-on joint.
  - e. Indicator-Post Flange: Include on valves used with indicator posts.
3. 250-psig, UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
- a. Description: Iron body and bonnet, bronze seating material, and inside screw.
  - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - c. Pressure Rating: 250 psig minimum.
  - d. End Connections: Mechanical or push-on joint.
  - e. Indicator-Post Flange: Include on valves used with indicator posts.
4. 175-psig, UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
- a. Description: Iron body and bonnet and bronze seating material.
  - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - c. Pressure Rating: 175 psig minimum.
  - d. End Connections: Flanged or grooved.
5. 250-psig, UL-Listed or FM-Approved, Iron, OS&Y Gate Valves:
- a. Description: Iron body and bonnet and bronze seating material.
  - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - c. Pressure Rating: 250 psig minimum.
  - d. End Connections: Flanged or grooved.
6. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Crane Co.; Crane Valve Group; Crane Valves.
    - 2) Crane Co.; Crane Valve Group; Stockham Division.
    - 3) Milwaukee Valve Company.
    - 4) NIBCO INC.
    - 5) United Brass Works, Inc.
    - 6) Or approved equal.
  - b. Description: Bronze body and bonnet and bronze stem.
  - c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
  - d. Pressure Rating: 175 psig minimum.
  - e. End Connections: Threaded.

## 2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

### A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. Clow Valve Company; a division of McWane, Inc.
  - c. East Jordan Iron Works, Inc.
  - d. Flowserve.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. M&H Valve Company; a division of McWane, Inc.
  - g. Mueller Co.; Water Products Division.
  - h. U.S. Pipe.
  - i. Or approved equal.
2. Description: Sleeve and valve compatible with drilling machine.
3. Standard: MSS SP-60.
4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
5. Valve: AWWA, cast-iron, nonrising-stem, metal resilient-seated gate valve with one raised-face flange mating tapping-sleeve flange.

### B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

### C. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. American Cast Iron Pipe Company; American Flow Control Division.
  - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. Kennedy Valve; a division of McWane, Inc.
  - g. Mueller Co.; Water Products Division.
  - h. NIBCO INC.
  - i. Tyco Fire & Building Products LP.
  - j. Or approved equal.
2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
3. Standards: UL 789 and "Approval Guide," published by FM Global, listing.



2.10 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. DeZurik/Copes-Vulcan; a unit of SPX Corporation.
  - b. Milliken Valve Company.
  - c. Mosser Valve; a division of Olson Technologies, Inc.
  - d. Mueller Co.; Water Products Division.
  - e. Pratt, Henry Company.
  - f. Val-Matic Valve & Manufacturing Corp.
  - g. Or approved equal.
2. Description: Rubber seated.
3. Standard: AWWA C504.
4. Body Material: Cast or ductile iron.
5. Body Type: flanged.
6. Pressure Rating: 150 psig.

B. UL Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kennedy Valve; a division of McWane, Inc.
  - b. Milwaukee Valve Company.
  - c. Mueller Co.; Water Products Division.
  - d. NIBCO INC.
  - e. Pratt, Henry Company.
  - f. Or approved equal.
2. Description: Metal on resilient material seating.
3. Standards: UL 1091 and "Approval Guide," published by FM Global, listing.
4. Body Material: Cast or ductile iron.
5. Body Type: flanged.
6. Pressure Rating: 175 psig.

2.11 CHECK VALVES

A. AWWA Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. American Cast Iron Pipe Company; American Flow Control Division.
  - c. APCO Willamette Valve and Primer Corporation.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Crane Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. Kennedy Valve; a division of McWane, Inc.
  - h. M&H Valve Company; a division of McWane, Inc.



- i. Mueller Co.; Water Products Division.
    - j. NIBCO INC.
    - k. Watts Water Technologies, Inc.
    - l. Or approved equal.
  2. Description: Swing-check type with resilient seat; with interior coating according to AWWA C550 and ends to match piping.
  3. Standard: AWWA C508.
  4. Pressure Rating: 175 psig.
- B. UL-Listed or FM-Approved Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - b. Clow Valve Company; a division of McWane, Inc.
    - c. Crane Co.; Crane Valve Group; Stockham Division.
    - d. Globe Fire Sprinkler Corporation.
    - e. Kennedy Valve; a division of McWane, Inc.
    - f. Kidde Fire Fighting.
    - g. Matco-Norca.
    - h. Mueller Co.; Water Products Division.
    - i. NIBCO INC.
    - j. Reliable Automatic Sprinkler Co., Inc.
    - k. Tyco Fire & Building Products LP.
    - l. United Brass Works, Inc.
    - m. Victaulic Company.
    - n. Viking Corporation.
    - o. Watts Water Technologies, Inc.
    - p. Or approved equal.
  2. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
  3. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
  4. Pressure Rating: 250 psig.

## 2.12 DETECTOR CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  2. Badger Meter, Inc.
  3. FEBCO; SPX Valves & Controls.
  4. Globe Fire Sprinkler Corporation.
  5. Kennedy Valve; a division of McWane, Inc.
  6. Mueller Co.; Hersey Meters Division.
  7. Victaulic Company.
  8. Viking Corporation.
  9. Watts Water Technologies, Inc.
  10. Or approved equal.



- B. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
- C. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
- D. Pressure Rating: 175 psig.
- E. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

## 2.13 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AMCO Water Metering Systems.
  - 2. Badger Meter, Inc.
  - 3. Carlon Meter.
  - 4. Hays Fluid Controls.
  - 5. McCrometer.
  - 6. Mueller Co.; Hersey Meters Division.
  - 7. Neptune Technology Group Inc.
  - 8. Sensus Metering Systems.
  - 9. Or approved equal.
- C. Displacement-Type Water Meters:
  - 1. Description: With bronze main case.
  - 2. Standard: AWWA C700.
  - 3. Registration: Flow in gallons.
- D. Turbine-Type Water Meters:
  - 1. Standard: AWWA C701.
  - 2. Registration: Flow in gallons.
- E. Compound-Type Water Meters:
  - 1. Standard: AWWA C702.
  - 2. Registration: Flow in gallons.
- F. Remote Registration System:
  - 1. Description: Utility company's standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
  - 2. Standard: AWWA C706.
  - 3. Registration: Flow in gallons.
- G. Remote Registration System:



1. Description: Utility company's standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C707.
3. Registration: Flow in gallons.
4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
5. Visible Display Units: Comply with utility company's requirements for type and quantity.

## 2.14 DETECTOR-TYPE WATER METERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Badger Meter, Inc.
2. Mueller Co.; Hersey Meters Division.
3. Neptune Technology Group Inc.
4. Sensus Metering Systems.
5. Or approved equal.

- B. AWWA, Detector Check Water Meters:

1. Description: Main line, turbine meter with second meter on bypass.
2. Standard: AWWA C703.
3. Registration: Flow in gallons.
4. Pressure Rating: 150 psig.
5. Bypass Meter: AWWA C702, compound-type, bronze case.

- a. Size: At least one-half nominal size of main-line meter.

- C. Fire-Protection, Detector Check Water Meters:

1. Description: Main-line turbine meter with strainer and second meter on bypass.
2. Standards: UL's "Fire Protection Equipment Directory" listing and "Approval Guide," published by FM Global, listing.
3. Registration: Flow in gallons.
4. Pressure Rating: 175 psig minimum.
5. Bypass Meter: AWWA C701, turbine-type, bronze case.

- a. Size: At least NPS 2.

- D. Remote Registration System:

1. Description: Utility company's standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
2. Standard: AWWA C706.
3. Registration: Flow in gallons.

- E. Remote Registration System:

1. Description: Utility company's standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.



2. Standard: AWWA C707.
3. Registration: Flow in gallons.
4. Data-Acquisition Units: Comply with utility company's requirements for type and quantity.
5. Visible Display Units: Comply with utility company's requirements for type and quantity.

## 2.15 PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme; a division of The Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Honeywell Water Controls.
  - d. Watts Water Technologies, Inc.
  - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  - f. Or approved equal.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial pressure of 150 psig.
4. Body Material: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

### B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CLA-VAL Automatic Control Valves.
  - b. Flomatic Corporation.
  - c. OCV Control Valves.
  - d. Watts Regulator Company; Ames Fluid Control Systems.
  - e. Watts Regulator Company; Watts ACV Division.
  - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  - g. Or approved equal.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
3. Pressure Rating: Initial pressure of 150 psig minimum.
4. Main Valve Body: Cast or ductile iron with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

## 2.16 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  - g. Or approved equal.
2. Standard: ASSE 1013 or AWWA C511.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
  5. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
  6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  7. Configuration: Designed for horizontal, straight through flow.
  8. Accessories:
    - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

**B. Double-Check, Backflow-Prevention Assemblies:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  - g. Or approved equal.
2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
5. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

**C. Double-Check, Detector-Assembly Backflow Preventers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. FEBCO; SPX Valves & Controls.
  - d. Watts Water Technologies, Inc.





- e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
    - f. Or approved equal.
  - 2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
  - 5. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved or Steel with interior lining complying with AWWA C550 or that is FDA approved.
  - 6. End Connections: Flanged.
  - 7. Configuration: Designed for horizontal, straight through flow.
  - 8. Accessories:
    - a. Valves: UL 262, "Approval Guide," published by FM Global, listing, approved; OS&Y gate type with flanged ends on inlet and outlet.
    - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- D. Backflow Preventer Test Kits:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Conbraco Industries, Inc.; Apollo Valves.
    - b. FEBCO; SPX Valves & Controls.
    - c. Flomatic Corporation.
    - d. Watts Water Technologies, Inc.
    - e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
    - f. Or approved equal.
  - 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.17 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" on cover; and with slotted, open-bottom base section of length to fit over service piping.
  - 1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" on top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" on cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.



## 2.18 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857, and made according to ASTM C 858.
- B. Ladder: ASTM A 36/A 36M, steel ladder; or PE-encased steel steps.
- C. Manhole: ASTM A 48/A 48M, Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
  - 1. Dimension: 24-inch minimum diameter unless otherwise indicated.
- D. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
  - 1. Dimension: 24-inch minimum diameter unless otherwise indicated.
- E. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

## 2.19 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AquaShield.
    - b. BF Products.
    - c. DekoRRa Products LLC.
    - d. Dunco Manufacturing, Inc.
    - e. G&C Enclosures.
    - f. Hot Box, Inc.
    - g. HydroCowl, Inc.
    - h. Piedmont Well Covers, Inc.
    - i. Watts Water Technologies, Inc.
    - j. Or approved equal.
  - 2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
  - 3. Standard: ASSE 1060.
  - 4. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
  - 5. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
    - a. Housing: Reinforced-aluminum or fiberglass construction.
      - 1) Size: Of dimensions indicated but not less than those required for access and service of protected unit.
      - 2) Drain opening for units with drain connection.
      - 3) Access doors with locking devices.
      - 4) Insulation inside housing.



5) Anchoring devices for attaching housing to concrete base.

b. Electric heating cable or heater with self-limiting temperature control.

**B. Weather-Resistant Enclosures:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AquaShield.
  - b. BF Products.
  - c. DekoRRa Products LLC.
  - d. Dunco Manufacturing, Inc.
  - e. G&C Enclosures.
  - f. Hot Box, Inc.
  - g. HydroCowl, Inc.
  - h. Piedmont Well Covers, Inc.
  - i. Watts Water Technologies, Inc.
  - j. Or approved equal.
2. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
3. Standard: ASSE 1060.
4. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
5. Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
  - a. Housing: Reinforced construction.
    - 1) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
    - 2) Drain opening for units with drain connection.
    - 3) Access doors with locking devices.
    - 4) Anchoring devices for attaching housing to concrete base.

**C. Expanded-Metal Enclosures:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Backflow Prevention Device InnClosures, Inc.
  - b. BF Products.
  - c. Cross Brothers Inc.
  - d. Le Meur Welding & Manufacturing Co.
  - e. V.I.T. Products, Inc.
  - f. Or approved equal.
2. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.
3. Material: ASTM F 1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
4. Type: II, expanded and flattened.
5. Class: Class 1, uncoated carbon steel.



6. Finish: Manufacturer's enamel paint.
7. Size: Of dimensions indicated but not less than those required for access and service of protected unit.
8. Locking device.
9. Lugs or devices for securing enclosure to base.
10. Enclosure Bases: 4-inch minimum thickness precast concrete, of dimensions required to extend at least 6 inches beyond edges of enclosure housings. Include openings for piping.

## 2.20 FIRE HYDRANTS

### A. AWWA Dry-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. American Cast Iron Pipe Company; American Flow Control Division.
  - c. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - d. American Foundry Group, Inc.
  - e. Clow Valve Company; a division of McWane, Inc.
  - f. East Jordan Iron Works, Inc.
  - g. Kennedy Valve; a division of McWane, Inc.
  - h. M&H Valve Company; a division of McWane, Inc.
  - i. Mueller Co.; Water Products Division.
  - j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
  - k. U.S. Pipe.
  - l. Or approved equal.
2. Description: Post type, with one NPS 4-1/2 and two NPS 2-1/2 outlets; and with 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.
3. Standard: AWWA C502.
4. Pressure Rating: 250 psig

### B. UL-Listed, Dry-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; American Flow Control Division.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. American Foundry Group, Inc.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. East Jordan Iron Works, Inc.
  - f. Kennedy Valve; a division of McWane, Inc.
  - g. M&H Valve Company; a division of McWane, Inc.
  - h. Mueller Co.; Water Products Division.
  - i. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
  - j. U.S. Pipe.
  - k. Or approved equal.



2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets; and with 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Hydrant shall have cast-iron body and compression-type valve opening against pressure and closing with pressure.
3. Standards: UL 246 and "Approval Guide," published by FM Global, listing.
4. Design: Base valve.
5. Pressure Rating: 250 psig.
6. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
7. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
8. Direction of Opening: Hydrant valve opens by turning operating nut to left or counterclockwise.
9. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.

C. AWWA Wet-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. Clow Valve Company; a division of McWane, Inc.
  - c. Jones, James Company.
  - d. Mueller Co.; Water Products Division.
  - e. Or approved equal.
2. Description: Post type, with one NPS 4-1/2 and two NPS 2-1/2 outlets and with NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550.
3. Standard: AWWA C503.
4. Pressure Rating: 250 psig.

D. UL-Listed, Wet-Barrel Fire Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American AVK Company; Valves & Fittings Division.
  - b. Clow Valve Company; a division of McWane, Inc.
  - c. Jones, James Company.
  - d. Mueller Co.; Water Products Division.
  - e. Or approved equal.
2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets and with NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet.
3. Standards: UL 246 and "Approval Guide," published by FM Global, listing.
4. Design: Wet barrel.
5. Pressure Rating: 200 psig.
6. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
7. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
8. Direction of Opening: Hydrant valves open by turning operating nut to left or counterclockwise.
9. Exterior Finish: Red alkyd-gloss enamel paint unless otherwise indicated.



## 2.21 FIRE-DEPARTMENT CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Elkhart Brass Mfg. Company, Inc.
  - 2. Fire-End & Croker Corporation.
  - 3. Guardian Fire Equipment, Inc.
  - 4. Kidde Fire Fighting.
  - 5. Potter Roemer.
  - 6. Reliable Automatic Sprinkler Co., Inc.
  - 7. Or approved equal.
- B. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire-department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.
- C. Standard: UL 405.
- D. Connections: Two NPS 2-1/2 inlets and one NPS 6 outlet.
- E. Connections: Four NPS 2-1/2 inlets and one NPS 6 outlet.
- F. Connections: Six NPS 2-1/2 inlets and one NPS 8 outlet.
- G. Inlet Alignment: Inline, horizontal.
- H. Finish Including Sleeve: Polished chrome plated.
- I. Escutcheon Plate Marking: "AUTO SPKR & STANDPIPE."

## 2.22 ALARM DEVICES

- A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General conditions for execution requirements.

**3.2 EARTHWORK**

- A. Comply with excavating, trenching, and backfilling requirements in Section 31 00 00 "Earthwork".

**3.3 PIPING INSTALLATION**

- A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
  - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections NPS 2 and smaller with drilling machine according to the following:
  - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company's standards.
  - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  - 4. Install corporation valves into service-saddle assemblies.
  - 5. Install manifold for multiple taps in water main.
  - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
- F. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
  - 1. Install encasement for tubing according to ASTM A 674 or AWWA C105.
- G. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  - 1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- H. Install PE pipe according to ASTM D 2774 and ASTM F 645.



- I. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- J. Install fiberglass AWWA pipe according to AWWA M45.
- K. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:
  - 1. Under Driveways: With at least 36 inches of cover over top.
  - 2. Under Railroad Tracks: With at least 48 inches of cover over top.
  - 3. In Loose Gravelly Soil and Rock: With at least 12 inches of additional cover.
- L. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- M. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
  - 1. Terminate fire-suppression water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- N. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- O. Comply with requirements in Division 21 Sections for fire-suppression-water piping inside the building.
- P. Comply with requirements in Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

### 3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.



- F. Copper-Tubing, Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- G. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
- H. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- I. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- J. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- L. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139.
- M. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
- N. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- O. Do not use flanges or unions for underground piping.

### 3.5 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  - 1. Concrete thrust blocks.
  - 2. Locking mechanical joints.
  - 3. Set-screw mechanical retainer glands.
  - 4. Bolted flanged joints.
  - 5. Heat-fused joints.
  - 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
  - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
  - 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.



### 3.6 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL-Listed or FM-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass.
- H. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Division 03 Section Cast-in-Place Concrete.

### 3.7 DETECTOR CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves and piping on concrete piers. Comply with requirements for concrete piers in Division 03 Section Cast-in-Place Concrete.

### 3.8 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install turbine-type water meters NPS 2 and smaller in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and include valved bypass around meters unless prohibited by authorities having jurisdiction.
- C. Water Meters: Install turbine-type water meters NPS 3 and larger in meter vaults. Include shutoff valves on water meter inlets and outlets and include valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and include full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- E. Support water meters and piping NPS 3 and larger on concrete piers. Comply with requirements for concrete piers in Division 03 Section Cast-in-Place Concrete.



**3.9 ROUGHING-IN FOR WATER METERS**

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

**3.10 BACKFLOW PREVENTER INSTALLATION**

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Division 03 Section Cast-in-Place Concrete.

**3.11 WATER METER BOX INSTALLATION**

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top 2 inches above surface.

**3.12 CONCRETE VAULT INSTALLATION**

- A. Install precast concrete vaults according to ASTM C 891.

**3.13 PROTECTIVE ENCLOSURE INSTALLATION**

- A. Install concrete base level and with top approximately 2 inches above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

**3.14 FIRE HYDRANT INSTALLATION**

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL-Listed or FM-Approved Fire Hydrants: Comply with NFPA 24.

**3.15 FIRE-DEPARTMENT CONNECTION INSTALLATION**

- A. Install ball drip valves at each check valve for fire-department connection to mains.

- B. Install protective pipe bollards on two sides of each fire-department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications."

### 3.16 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
  - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
  - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
  - 1. Valves: Install chain and padlock on open OS&Y gate valve.
  - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

### 3.17 CONNECTIONS

- A. Connect fire-suppression water-service piping to existing water main. Use tapping sleeve and tapping valve.
- B. Connect fire-suppression water-service piping to interior fire-suppression piping.

### 3.18 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0-psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- D. Prepare test and inspection reports.

### 3.19 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.20 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:
  - 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

### 3.21 PIPING SCHEDULE

- A. Aboveground and vault fire-suppression water-service piping NPS 2 and smaller shall be hard copper tube, ASTM B 88, Type K and ASTM B 88, Type L wrought- or cast-copper-alloy, solder-joint fittings; and brazed pressure-sealed joints.
- B. Aboveground and vault fire-suppression water-service piping NPS 3 and NPS 4 shall be one of the following:
  - 1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.



- C. Aboveground and vault fire-suppression water-service piping NPS 5 to NPS 12 > shall be grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
- D. Underslab fire-suppression water-service piping NPS 2 shall be hard copper tube, copper, pressure-seal fittings; and pressure-sealed joints.
- E. Underslab fire-suppression water-service piping NPS 3 and NPS 4 shall be one of the following:
  - 1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
  - 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
  - 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.
- F. Underslab fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:
  - 1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
  - 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and restrained, gasketed joints.
  - 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.

### 3.22 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- B. Underground fire-suppression water-service shutoff valves NPS 2 and smaller shall be corporation valves or curb valves with ends compatible with piping.
- C. Meter box fire-suppression water-service shutoff valves NPS 2 and smaller shall be meter valves.
- D. Vault fire-suppression water-service shutoff valves NPS 2 and smaller shall be UL-listed or FM-approved, OS&Y, bronze, gate valves.
- E. Underground fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:
  - 1. 200-psig, AWWA, iron, nonrising-stem, metal-seated gate valves.
  - 2. 250-psig, AWWA, iron, nonrising-stem, resilient-seated gate valves.
  - 3. 250-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves.
- F. Indicator-post underground fire-suppression water-service valves NPS 3 and larger shall be 250-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves with indicator-post flange.
- G. Standard-pressure, aboveground and vault fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:



1. 200-psig, AWWA, iron, OS&Y, metal resilient-seated gate valves.
  2. 250-psig, AWWA, iron, OS&Y, resilient-seated gate valves.
  3. 250-psig, UL-listed or FM-approved, iron, OS&Y gate valves.
  4. AWWA or UL-listed or FM-approved butterfly valves.
- H. Fire-suppression water-service check valves NPS 3 and larger shall be one of the following:
1. AWWA or UL-listed or FM-approved check valves.
  2. UL-listed or FM-approved detector check valves.

**END OF SECTION 21 11 00**



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**SECTION 21 12 00****FIRE-SUPPRESSION STANDPIPES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Monitors.
5. Fire-department connections.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

B. Related Sections:

1. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
2. Section 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
3. Section 28 31 11 "Fire Alarm and Integrated Audio/Visual Evacuation System" for alarm devices not specified in this Section.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.6 DEFINITIONS

- A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 300 psig (2070 kPa).
- B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

#### 1.7 SYSTEM DESCRIPTIONS

- A. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

#### 1.8 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. High-Pressure, Fire-Suppression Standpipe System Component: Listed for 250-psig (1725-kPa) minimum 300-psig (2070-kPa) working pressure.
- C. Fire-suppression standpipe design shall be approved by New York City Department of Buildings
  1. Minimum residual pressure at each hose-connection outlet is as follows:
    - a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig (450 kPa).
- D. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

**1.9 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Engineering Services Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York responsible for their preparation to be submitted to Commissioner for review and approval.

**1.10 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Plumbing piping.
  - 2. HVAC hydronic piping.
  - 3. Electrical
- B. Qualification Data: For qualified Installer.
- C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by New York City Department of Buildings, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Fire-hydrant flow test report.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Field quality-control reports.

**1.11 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

**1.12 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Installer Qualifications:



1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
  - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer, licensed in the State of New York to be submitted to the Commissioner for review and approval.
- C. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight Schedule 40, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E. Pipe ends may be factory or field formed to match joining method.
- B. Standard-Weight, Galvanized and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.
- C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:



- a. Anvil International, Inc.
  - b. Corcoran Piping System Co.
  - c. National Fittings, Inc.
  - d. Shurjoint Piping Products.
  - e. Tyco Fire & Building Products LP.
  - f. Victaulic Company.
  - g. Or approved equal.
2. Pressure Rating: 175 psig (1200 kPa) minimum.
  3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick.
  1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  1. Valves shall be UL listed or FM approved.
  2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
  3. Minimum Pressure Rating for High-Pressure Piping: 300 psig (2070 kPa).
- B. Ball Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. Victaulic Company.
    - c. VikingCorp
    - d. Nibco
    - e. Or approved equal.



2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

**C. Bronze Butterfly Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fivalco Inc.
  - b. Global Safety Products, Inc.
  - c. Milwaukee Valve Company.
  - d. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

**D. Iron Butterfly Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Fivalco Inc.
  - c. Global Safety Products, Inc.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Pratt, Henry Company.
  - h. Shurjoint Piping Products.
  - i. Tyco Fire & Building Products LP.
  - j. Victaulic Company.
  - k. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.

**E. Check Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. Anvil International, Inc.



- d. Clow Valve Company; a division of McWane, Inc.
- e. Crane Co.; Crane Valve Group; Crane Valves.
- f. Crane Co.; Crane Valve Group; Jenkins Valves.
- g. Crane Co.; Crane Valve Group; Stockham Division.
- h. Fire-End & Croker Corporation.
- i. Fire Protection Products, Inc.
- j. Fivalco Inc.
- k. Globe Fire Sprinkler Corporation.
- l. Groeniger & Company.
- m. Kennedy Valve; a division of McWane, Inc.
- n. Matco-Norca.
- o. Metraflex, Inc.
- p. Milwaukee Valve Company.
- q. Mueller Co.; Water Products Division.
- r. NIBCO INC.
- s. Potter Roemer.
- t. Reliable Automatic Sprinkler Co., Inc.
- u. Shurjoint Piping Products.
- v. Tyco Fire & Building Products LP.
- w. United Brass Works, Inc.
- x. Venus Fire Protection Ltd.
- y. Victaulic Company.
- z. Viking Corporation.
- aa. Watts Water Technologies, Inc.
- bb. Or approved equal.

- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig (1725 kPa) minimum.
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.

**F. Bronze OS&Y Gate Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. United Brass Works, Inc.
  - f. Or approved equal.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig (1200 kPa).
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

**G. Iron OS&Y Gate Valves:**



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Clow Valve Company; a division of McWane, Inc.
  - d. Crane Co.; Crane Valve Group; Crane Valves.
  - e. Crane Co.; Crane Valve Group; Jenkins Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. Hammond Valve.
  - h. Milwaukee Valve Company.
  - i. Mueller Co.; Water Products Division.
  - j. NIBCO INC.
  - k. Tyco Fire & Building Products LP.
  - l. United Brass Works, Inc.
  - m. Watts Water Technologies, Inc.
  - n. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 300 psig (2070 kPa).
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

**H. Indicating-Type Butterfly Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Global Safety Products, Inc.
  - c. Kennedy Valve; a division of McWane, Inc.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Tyco Fire & Building Products LP.
  - g. Victaulic Company.
  - h. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Valves NPS 2 (DN 50) and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 (DN 65) and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.





6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Mueller Co.; Water Products Division.
  - f. NIBCO INC.
  - g. Tyco Fire & Building Products LP.
  - h. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 300 psig (2070 kPa).
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. Argco
  - d. Or approved equal.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.



- f. Fire Protection Products, Inc.
- g. Flowserve.
- h. FNW.
- i. Jomar International, Ltd.
- j. Kennedy Valve; a division of McWane, Inc.
- k. Kitz Corporation.
- l. Legend Valve.
- m. Milwaukee Valve Company.
- n. NIBCO INC.
- o. Potter Roemer.
- p. Red-White Valve Corporation.
- q. Tyco Fire & Building Products LP.
- r. Victaulic Company.
- s. Watts Water Technologies, Inc.
- t. Or approved equal.

**D. Globe Valves: Preaction**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. Croker
  - d. Or approved equal.

**E. Plug Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Southern Manufacturing Group.
  - b. Fire Protection Products
  - c. Croker
  - d. Or approved equal.

**2.6 SPECIALTY VALVES**

**A. General Requirements:**

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
  - b. High-Pressure Piping Specialty Valves: 300 psig (2070 kPa).
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

**B. Alarm Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Globe Fire Sprinkler Corporation.
  - c. Reliable Automatic Sprinkler Co., Inc.
  - d. Tyco Fire & Building Products LP.
  - e. Venus Fire Protection Ltd.
  - f. Victaulic Company.
  - g. Viking Corporation.
  - h. Or approved equal.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

**C. Pressure-Reducing Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Potter Roemer.
  - h. Tyco Fire & Building Products LP.
  - i. Wilson & Cousins Inc.
  - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  - k. Or approved equal.
2. UL 668 hose valve, with integral UL 1468 reducing device.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Brass or bronze.
5. Inlet: Female pipe threads.
6. Outlet: Threaded with or without adapter having male hose threads.
7. Pattern: Angle.
8. Finish: Rough brass or bronze.

**D. Automatic (Ball Drip) Drain Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.



- b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Or approved equal.
- 2. Standard: UL 1726.
  - 3. Pressure Rating: 175 psig (1200 kPa) minimum.
  - 4. Type: Automatic draining, ball check.
  - 5. Size: NPS 3/4 (DN 20).
  - 6. End Connections: Threaded.

## 2.7 HOSE CONNECTIONS

### A. Adjustable-Valve Hose Connections:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Potter Roemer.
  - h. Tyco Fire & Building Products LP.
  - i. Wilson & Cousins Inc.
  - j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
  - k. Or approved equal.
- 3. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
- 4. Pressure Rating: 300 psig (2070 kPa) minimum.
- 5. Material: Brass or bronze.
- 6. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65, as indicated), as indicated.
- 7. Inlet: Female pipe threads.
- 8. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
- 9. Pattern: Angle.
- 10. Pressure-Control Device Type: Pressure reducing.
- 11. Design Outlet Pressure Setting:
- 12. Finish: Rough brass or bronze.

### B. Nonadjustable-Valve Hose Connections:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:



- a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Kennedy Valve; a division of McWane, Inc.
  - h. Mueller Co.; Water Products Division.
  - i. NIBCO INC.
  - j. Potter Roemer.
  - k. Tyco Fire & Building Products LP.
  - l. Wilson & Cousins Inc.
  - m. Or approved equal.
3. Standard: UL 668 hose valve for connecting fire hose.
  4. Pressure Rating: 300 psig (2070 kPa) minimum.
  5. Material: Brass or bronze.
  6. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
  7. Inlet: Female pipe threads.
  8. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
  9. Pattern: Angle.
  10. Finish: Rough brass or bronze.

**2.8 NPS 1-1/2 BY NPS 2-1/2 (DN 40 BY DN 65) RACK-TYPE HOSE STATIONS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. AFAC Inc.
  2. American Fire Hose & Cabinet.
  3. Angus; Part of Kidde Fire Fighting Organization.
  4. Brooks Equipment Co., Inc.
  5. Elkhart Brass Mfg. Company, Inc.
  6. Fire-End & Croker Corporation.
  7. GMR International Equipment Corporation.
  8. Potter Roemer.
  9. Wilson & Cousins Inc.
  10. Or approved equal.
- C. Hose Rack:
  1. Standard: UL 47.
  2. Material: Brass or bronze with polished chrome-plated; Steel with red-enamel finish.
  3. Type: Hose-rack assembly. Include hose valve, reducer adapter, hose rack, water-retention device, hose pins, and hose.
  4. Operation: Semiautomatic.
  5. Sized to hold fire hose.

D. Hose Valve:

1. Standard: UL 668, NPS 2-1/2 (DN 65), for connecting fire hose.
2. Type: Adjustable.
3. Pressure-Control Device: required.
4. Design Outlet Pressure Setting: Not applicable.
5. Hose Valve and Trim Finish: Polished chrome plated.
6. Pressure Rating: 300 psig (2070 kPa) minimum.
7. Pattern: Angle.
8. Material: Brass or bronze.
9. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
10. Size: NPS 2-1/2 (DN 65).
11. Inlet: Female pipe threads.
12. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
13. Reducer Adapter: NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40).

E. Hose:

1. Standards: NFPA 1961 and UL 219, lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
2. Size: NPS 1-1/2 (DN 40).
3. Length: 125 feet.
4. Jacket: Combination of natural and synthetic threads.
5. Lining: Rubber, plastic, or combination of rubber and plastic compounds
6. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
7. Nozzle: UL 401 spray nozzle unless plain nozzle is indicated.
  - a. Material: Polished brass.
  - b. Type: Plain, for nonadjustable water stream

## 2.9 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
  - i. Or approved equal.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.



5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
12. Finish: Polished chrome plated.
13. Outlet Size: NPS 6 (DN 150).

**B. Flush-Type, Fire-Department Connection:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. GMR International Equipment Corporation.
  - d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer.
  - f. Or approved equal.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 6 (DN 150).

**2.10 ALARM DEVICES**

**A. Alarm-device types shall match piping and equipment connections.**

**B. Water-Motor-Operated Alarm:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Globe Fire Sprinkler Corporation.



- b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
    - e. Or approved equal.
  - 2. Standard: UL 753.
  - 3. Type: Mechanically operated, with Pelton wheel.
  - 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
  - 5. Size: 10-inch (250-mm) diameter.
  - 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
  - 7. Inlet: NPS 3/4 (DN 20).
  - 8. Outlet: NPS 1 (DN 25) drain connection.
- C. Electrically Operated Alarm Bell:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell company.
    - b. Notifier; a Honeywell company.
    - c. Potter Electric Signal Company.
    - d. Or approved equal.
  - 2. Standard: UL 464.
  - 3. Type: Vibrating, metal alarm bell.
  - 4. Size: 6-inch (150-mm) minimum diameter.
  - 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- D. Water-Flow Indicators:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ADT Security Services, Inc.
    - b. McDonnell & Miller; ITT Industries.
    - c. Potter Electric Signal Company.
    - d. System Sensor; a Honeywell company.
    - e. Viking Corporation.
    - f. Watts Industries (Canada) Inc.
    - g. Or approved equal.
  - 2. Standard: UL 346.
  - 3. Water-Flow Detector: Electrically supervised.
  - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  - 5. Type: Paddle operated.
  - 6. Pressure Rating: 250 psig (1725 kPa).
  - 7. Design Installation: Horizontal or vertical.



E. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
  - i. Or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.
5. Or approved equal.

B. Standard: UL 393.

- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.
- E. Water System Piping Gage: Include WATER label on dial face.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.4 WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 22 11 16 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 22 11 19 "Domestic Water Piping Specialties."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

### 3.5 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from the Commissioner. File written approval with Commissioner before deviating from approved working plans.



- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install drain valves on standpipes. Extend drain piping to outside of building.
- F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.
- G. Install alarm devices in piping systems.
- H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.
- J. Drain dry-type standpipe system piping.
- K. Pressurize and check dry-type standpipe system piping and air-pressure maintenance devices.
- L. Fill wet-type standpipe system piping with water.
- M. Connect air compressor to the following piping and wiring:
  - 1. Pressure gages and controls.
  - 2. Electrical power system.
  - 3. Fire-alarm devices, including low-pressure alarm.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

### 3.6 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- L. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.
  - 3. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air supply piping.
    - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
    - c. Install compressed-air supply piping from building's compressed-air piping system.

### 3.8 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 1-1/2 (DN 40) hose-connection valves with flow-restricting device.
- D. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.
- E. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 10 44 13 "Fire Protection Cabinets."

### 3.9 MONITOR INSTALLATION

- A. Install monitors on standpipe piping.

### 3.10 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.

**3.11 IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

**3.12 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run air compressors.
  - 6. Coordinate with fire-alarm tests. Operate as required.
  - 7. Coordinate with fire-pump tests. Operate as required.
  - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

**3.13 PIPING SCHEDULE**

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 4 (DN 100) and smaller, shall be one of the following:
  - 1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- C. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:
  - 1. Standard-weight Schedule 40 or thinwall, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. High-pressure, wet-type, fire-suppression standpipe piping, NPS 4 (DN 100) and smaller, shall be one of the following:



1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- E. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 4 (DN 100) and smaller, shall be one of the following:
1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- F. Standard-pressure, dry-type, fire-suppression standpipe piping, NPS 5 and NPS 6 (DN 125 and DN 150) shall be one of the following:
1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

**END OF SECTION 21 12 00**

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**SECTION 21 13 13****WET-PIPE SPRINKLER SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 21 08 00 "Commissioning of Fire Suppression"

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Fire-protection valves.
  - 3. Fire-department connections.
  - 4. Sprinklers.
  - 5. Alarm devices.
  - 6. Manual control stations.
  - 7. Control panels.
  - 8. Pressure gages.
- B. Related Sections:
  - 1. Section 21 12 00 "Fire-Suppression Standpipes" for standpipe piping.
  - 2. Section 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED

Buildings” where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 300 psig (2070 kPa).
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

#### 1.6 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

#### 1.7 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. High-Pressure Piping System Component: Listed for 300-psig working pressure.
- C. Sprinkler system design shall be approved by New York City Department of Buildings
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 1
    - d. Laundries: Ordinary Hazard, Group 1, Industrial Area
    - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - f. Office and Public Areas: Light Hazard.
  - 3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
    - d. Special Occupancy Hazard: As determined by New York City Department of Buildings



4. Minimum Density for Deluge-Sprinkler Piping Design:
    - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm (6.1 mm/min.) over entire area.
  5. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 225 sq. ft. (20.9 sq. m).
    - b. Storage Areas: 130 sq. ft. (12.1 sq. m).
    - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
    - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
    - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
  6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
  - D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.
- 1.8 SUBMITTAL PROCEDURES
- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- 1.9 ACTION SUBMITTALS
- A. Product Data: For each type of product indicated.
  - B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
    1. Wiring Diagrams: For power, signal, and control wiring.
  - C. Engineering Services Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the state of New York responsible for their preparation to be submitted to Commissioner for review and approval.
  - D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    1. Domestic water piping.
    2. Compressed air piping.
    3. HVAC hydronic piping.
    4. Items penetrating finished ceiling include the following:
      - a. Lighting fixtures.
      - b. Air outlets and inlets.
  - E. Qualification Data: For qualified Installer.
  - F. Welding certificates.
  - G. Fire-hydrant flow test report.

- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Services: Preparation of working plans, calculations, and field test reports by a qualified professional engineer licensed in the State of New York to be submitted to Commissioner for review and approval.
- C. Welding Qualifications: Qualify procedures according to ASME Boiler and Pressure Vessel Code.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
  - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

#### 1.11 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

#### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Schedule 40 Black-Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method.



- B. Malleable- or Ductile-Iron Unions: UL 860.
- C. Cast-Iron Flanges: ASME 16.1, Class 125.
- D. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- F. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. Corcoran Piping System Co.
    - c. National Fittings, Inc.
    - d. Shurjoint Piping Products.
    - e. Tyco Fire & Building Products LP.
    - f. Victaulic Company.
    - g. Or approved equal.
  - 2. Pressure Rating: 175 psig (1200 kPa) minimum.
  - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: .
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be UL listed or FM approved.
  - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
  - 3. Minimum Pressure Rating for High-Pressure Piping: 300 psig (2070 kPa).
- B. Ball Valves:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Victaulic Company.
  - c. VikingCorp.
  - d. Or approved equal.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

**C. Bronze Butterfly Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fivalco Inc.
  - b. Global Safety Products, Inc.
  - c. Milwaukee Valve Company.
  - d. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

**D. Iron Butterfly Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Fivalco Inc.
  - c. Global Safety Products, Inc.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Pratt, Henry Company.
  - h. Shurjoint Piping Products.
  - i. Tyco Fire & Building Products LP.
  - j. Victaulic Company.
  - k. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.

**E. Check Valves:**



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. Anvil International, Inc.
  - d. Crane Co.; Crane Valve Group; Crane Valves.
  - e. Crane Co.; Crane Valve Group; Jenkins Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. Fire-End & Croker Corporation.
  - h. Fire Protection Products, Inc.
  - i. Globe Fire Sprinkler Corporation.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Matco-Norca.
  - l. Metraflex, Inc.
  - m. Milwaukee Valve Company.
  - n. Mueller Co.; Water Products Division.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Reliable Automatic Sprinkler Co., Inc.
  - r. Tyco Fire & Building Products LP.
  - s. United Brass Works, Inc.
  - t. Venus Fire Protection Ltd.
  - u. Victaulic Company.
  - v. Viking Corporation.
  - w. Watts Water Technologies, Inc.
  - x. Or approved equal.
2. Standard: UL 312.
3. Pressure Rating: 300 psig (2070 kPa).
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

**F. Bronze OS&Y Gate Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. United Brass Works, Inc.
  - f. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

**G. Iron OS&Y Gate Valves:**



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Crane Co.; Crane Valve Group; Jenkins Valves.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. Hammond Valve.
  - g. Milwaukee Valve Company.
  - h. Mueller Co.; Water Products Division.
  - i. NIBCO INC.
  - j. Tyco Fire & Building Products LP.
  - k. United Brass Works, Inc.
  - l. Watts Water Technologies, Inc.
  - m. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 300 psig (2070 kPa).
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

**H. Indicating-Type Butterfly Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - a. Anvil International, Inc.
  - b. Global Safety Products, Inc.
  - c. Kennedy Valve; a division of McWane, Inc.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Tyco Fire & Building Products LP.
  - g. Victaulic Company.
  - h. Or approved equal.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Valves NPS 2 (DN 50) and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 (DN 65) and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

**I. NRS Gate Valves:**





1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Mueller Co.; Water Products Division.
  - f. NIBCO INC.
  - g. Tyco Fire & Building Products LP.
  - h. Or approved equal.
2. Standard: UL 262.
3. Pressure Rating: 300 psig (2070 kPa).
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

**J. Indicator Posts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Mueller Co.; Water Products Division.
  - f. NIBCO INC.
  - g. Tyco Fire & Building Products LP.
  - h. Or approved equal.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Hand wheel.

**2.5 TRIM AND DRAIN VALVES**

**A. General Requirements:**

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

**B. Angle Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. NIBCO
  - d. Or approved equal.



C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.
  - f. Fire Protection Products, Inc.
  - g. Flowserve.
  - h. FNW.
  - i. Jomar International, Ltd.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Kitz Corporation.
  - l. Legend Valve.
  - m. Metso Automation USA Inc.
  - n. Milwaukee Valve Company.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Red-White Valve Corporation.
  - r. Southern Manufacturing Group.
  - s. Stewart, M. A. and Sons Ltd.
  - t. Tyco Fire & Building Products LP.
  - u. Victaulic Company.
  - v. Watts Water Technologies, Inc.
  - w. Or approved equal.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Southern Manufacturing Group.
  - b. NIBCO
  - c. Argco
  - d. Or approved equal.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:



- a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
    - b. High-Pressure Piping Specialty Valves: 300 psig (2070 kPa).
  3. Body Material: Cast or ductile iron.
  4. Size: Same as connected piping.
  5. End Connections: Flanged or grooved.
- B. Alarm Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFAC Inc.
    - b. Globe Fire Sprinkler Corporation.
    - c. Reliable Automatic Sprinkler Co., Inc.
    - d. Tyco Fire & Building Products LP.
    - e. Venus Fire Protection Ltd.
    - f. Victaulic Company.
    - g. Viking Corporation.
    - h. Or approved equal.
  2. Standard: UL 193.
  3. Design: For horizontal or vertical installation.
  4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
  5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
  6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- C. Deluge Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFAC Inc.
    - b. BERMAD Control Valves.
    - c. CLA-VAL Automatic Control Valves.
    - d. Globe Fire Sprinkler Corporation.
    - e. OCV Control Valves.
    - f. Reliable Automatic Sprinkler Co., Inc.
    - g. Tyco Fire & Building Products LP.
    - h. Venus Fire Protection Ltd.
    - i. Victaulic Company.
    - j. Viking Corporation.
    - k. Or approved equal.
  2. Standard: UL 260.
  3. Design: Hydraulically operated, differential-pressure type.
  4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
  5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.
- D. Automatic (Ball Drip) Drain Valves:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Or approved equal.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

## 2.7 FIRE-DEPARTMENT CONNECTIONS

### A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
  - i. Or approved equal.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 6 (DN 150).

### B. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.



- b. Elkhart Brass Mfg. Company, Inc.
  - c. GMR International Equipment Corporation.
  - d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer.
- 3. Standard: UL 405.
  - 4. Type: Flush, for wall mounting.
  - 5. Pressure Rating: 175 psig (1200 kPa) minimum.
  - 6. Body Material: Corrosion-resistant metal.
  - 7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
  - 8. Caps: Brass, lugged type, with gasket and chain.
  - 9. Escutcheon Plate: Rectangular, brass, wall type.
  - 10. Outlet: With pipe threads.
  - 11. Body Style: Horizontal.
  - 12. Number of Inlets: Two.
  - 13. Outlet Location: Back.
  - 14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE AUTO SPKR."
  - 15. Finish: Polished chrome plated.
  - 16. Outlet Size: NPS 6 (DN 150).

## 2.8 SPRINKLER SPECIALTY PIPE FITTINGS

### A. Branch Outlet Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. National Fittings, Inc.
  - c. Shurjoint Piping Products.
  - d. Tyco Fire & Building Products LP.
  - e. Victaulic Company.
  - f. Or approved equal.
- 2. Standard: UL 213.
- 3. Pressure Rating: 300 psig (2070 kPa).
- 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- 5. Type: Mechanical-T and -cross fittings.
- 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
- 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
- 8. Branch Outlets: Grooved, plain-end pipe, or threaded.

### B. Flow Detection and Test Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.



- d. Victaulic Company.
    - e. Or approved equal.
  - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 3. Pressure Rating: 300 psig (2070 kPa).
  - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  - 5. Size: Same as connected piping.
  - 6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkhart Brass Mfg. Company, Inc.
    - b. Fire-End & Croker Corporation.
    - c. Potter Roemer.
    - d. Or approved equal.
  - 2. Standard: UL 199.
  - 3. Pressure Rating: 175 psig (1200 kPa).
  - 4. Body Material: Brass.
  - 5. Size: Same as connected piping.
  - 6. Inlet: Threaded.
  - 7. Drain Outlet: Threaded and capped.
  - 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGF Manufacturing Inc.
    - b. Triple R Specialty.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
    - e. Viking Corporation.
    - f. Or approved equal.
  - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 3. Pressure Rating: 300 psig (2070 kPa).
  - 4. Body Material: Cast- or ductile-iron housing with sight glass.
  - 5. Size: Same as connected piping.
  - 6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CECA, LLC.



- b. Corcoran Piping System Co.
  - c. Merit Manufacturing; a division of Anvil International, Inc.
  - d. Or approved equal.
- 2. Standard: UL 1474.
  - 3. Pressure Rating: 300 psig (2070 kPa).
  - 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
  - 5. Size: Same as connected piping.
  - 6. Length: Adjustable.
  - 7. Inlet and Outlet: Threaded.

## 2.9 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFAC Inc.
  - 2. Globe Fire Sprinkler Corporation.
  - 3. Reliable Automatic Sprinkler Co., Inc.
  - 4. Tyco Fire & Building Products LP.
  - 5. Venus Fire Protection Ltd.
  - 6. Victaulic Company.
  - 7. Viking Corporation.
  - 8. Or approved equal.
- B. General Requirements:
  - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
  - 3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
  - 4. Pressure Rating for High-Pressure Automatic Sprinklers: 300 psig (2070 kPa).
- C. Automatic Sprinklers with Heat-Responsive Element:
  - 1. Early-Suppression, Fast-Response Applications: UL 1767.
  - 2. Nonresidential Applications: UL 199.
  - 3. Residential Applications: UL 1626.
  - 4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
  - 1. Characteristics:
    - a. Nominal 1/2-inch (12.7-mm) Orifice: With Discharge Coefficient K between 5.3 and 5.8.
- E. Sprinkler Finishes:
  - 1. Chrome plated.
  - 2. Bronze.
  - 3. Painted.



- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

- G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
  - e. Or approved equal.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

## 2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.

- B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Globe Fire Sprinkler Corporation.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
  - e. Or approved equal.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

- C. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Notifier; a Honeywell company.
  - c. Potter Electric Signal Company.
  - d. Or approved equal.





2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 8-inch (200-mm) minimum- diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

**D. Water-Flow Indicators:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ADT Security Services, Inc.
  - b. McDonnell & Miller; ITT Industries.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Viking Corporation.
  - f. Watts Industries (Canada) Inc.
  - g. Or approved equal.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

**E. Pressure Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
  - i. Or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

**F. Valve Supervisory Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.



- b. Kennedy Valve; a division of McWane, Inc.
- c. Potter Electric Signal Company.
- d. System Sensor; a Honeywell company.
- e. Or approved equal.

- 2. Standard: UL 346.
- 3. Type: Electrically supervised.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design: Signals that controlled valve is in other than fully open position.

## 2.11 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

## 2.12 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
  - 1. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
  - 2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

## 2.13 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AMETEK; U.S. Gauge Division.
  - 2. Ashcroft, Inc.
  - 3. Brecco Corporation.
  - 4. WIKA Instrument Corporation.
  - 5. Or approved equal.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa).
- E. Water System Piping Gage: Include "WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" label on dial face.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 WATER-SUPPLY CONNECTIONS**

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 22 11 16 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 22 11 19 "Domestic Water Piping Specialties."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

**3.3 PIPING INSTALLATION**

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from New York City Department of Buildings. File written approval with Commissioner before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.



- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

### 3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.



- K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

### 3.6 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and 2014 New York City Construction Codes.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
  - 3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

### 3.7 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

### 3.8 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### 3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct The City of New York's service personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

### 3.13 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) shall be the following:
  - 1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger shall be one of the following:
  - 1. Standard-weight Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

3.14 SPRINKLER SCHEDULE

Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright, side-wall dry head, pendant dry head.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers.
5. Special Applications: quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

**END OF SECTION 21 13 13**



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**SECTION 21 13 16****DRY-PIPE SPRINKLER SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

B. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

C. Related Sections:

1. Section 21 12 00 "Fire-Suppression Standpipes" for standpipe piping.
2. Section 21 13 13 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
3. Section 21 13 39 "Foam-Water Systems" for AFFF piping.
4. Section 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
5. Section 28 31 11 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping engineered to operate at working pressure 175 psig (1200 kPa) maximum.

#### 1.6 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
- C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
- D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

#### 1.7 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Engineering Services: Engineer sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer licensed in the State of New York, using performance requirements and criteria indicated, to be submitted to Commissioner for review and approval.

1. Available fire-hydrant flow test records indicate the following conditions:

- a. Date:
- b. Time:



- c. Performed by:
- d. Location of Residual Fire Hydrant R:
- e. Location of Flow Fire Hydrant F:
- f. Static Pressure at Residual Fire Hydrant R:
- g. Measured Flow at Flow Fire Hydrant F:
- h. Residual Pressure at Residual Fire Hydrant R:

C. Sprinkler system engineering services shall be submitted to and approved by the Commissioner.

- 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- 2. Sprinkler Occupancy Hazard Classifications:
  - a. Automobile Parking Areas: Ordinary Hazard, Group 1
  - b. Building Service Areas: Ordinary Hazard, Group 1
  - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1
  - d. General Storage Areas: Ordinary Hazard, Group 1
  - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1
  - f. Office and Public Areas: Light Hazard
- 3. Minimum Density for Automatic-Sprinkler Piping:
  - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
  - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
- 4. Maximum Protection Area per Sprinkler: Per UL listing.
- 5. Maximum Protection Area per Sprinkler:
  - a. Office Spaces: 225 sq. ft. (20.9 sq. m).
  - b. Storage Areas: 130 sq. ft. (12.1 sq. m).
  - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
  - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
  - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

## 1.8 SUBMITTAL PROCEDURES

A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.9 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.



- B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Engineering Services Submittal: For sprinkler systems indicated to comply with performance requirements and criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of New York responsible for their preparation, to be submitted to Commissioner for review and approval.

#### 1.10 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. Compressed air piping.
  - 3. HVAC hydronic piping.
  - 4. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer licensed in the State of New York.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved New York City Department of Buildings including hydraulic calculations if applicable.
- D. Fire-hydrant flow test report.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- F. Field quality-control reports.

#### 1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

#### 1.12 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Installer Qualifications:
  - a. Engineering Services: Preparation of working plans, calculations, and field test reports by a qualified professional engineer licensed in the State of New York to be submitted to Commissioner for review and approval.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
  - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

#### 1.13 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by The City of New York or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
  - 1. Notify Commissioner no fewer than three days in advance of proposed interruption of sprinkler service.
  - 2. Do not proceed with interruption of sprinkler service without Commissioner's written permission.

#### 1.14 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

### PART 2 - PRODUCTS

#### 1.15 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### 1.16 STEEL PIPE AND FITTINGS

- A. Standard Weight Schedule 40, Galvanized-Steel Pipe: ASTM A 53/A 53M, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Galvanized, Steel Couplings: ASTM A 865, threaded.
- D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME B16.1, Class 125.
- G. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Shurjoint Piping Products.
  - c. Victaulic
  - d. Or approved equal.

**H. Grooved-Joint, Steel-Pipe Appurtenances:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
  - a. Anvil International, Inc.
  - b. Corcoran Piping System Co.
  - c. National Fittings, Inc.
  - d. Shurjoint Piping Products.
  - e. Tyco Fire & Building Products LP.
  - f. Victaulic Company.
  - g. Or approved equal.
2. Pressure Rating: 300 psig (2070 kPa) minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

**1.17 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
  1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

**1.18 LISTED FIRE-PROTECTION VALVES**

- A. General Requirements:
  1. Valves shall be UL listed or FM approved.
  2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
- B. Ball Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:



- a. Anvil International, Inc.
    - b. Victaulic Company.
    - c. Mfr #3
    - d. Or approved equal.
  3. Standard: UL 1091 except with ball instead of disc.
  4. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
  5. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
  6. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.
- C. Bronze Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Fivalco Inc.
    - b. Global Safety Products, Inc.
    - c. Milwaukee Valve Company.
    - d. Or approved equal.
  3. Standard: UL 1091.
  4. Pressure Rating: 175 psig (1200 kPa).
  5. Body Material: Bronze.
  6. End Connections: Threaded.
- D. Iron Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Anvil International, Inc.
    - b. Fivalco Inc.
    - c. Global Safety Products, Inc.
    - d. Kennedy Valve; a division of McWane, Inc.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Pratt, Henry Company.
    - h. Shurjoint Piping Products.
    - i. Tyco Fire & Building Products LP.
    - j. Victaulic Company.
    - k. Or approved equal.
  3. Standard: UL 1091.
  4. Pressure Rating: 175 psig (1200 kPa).
  5. Body Material: Cast or ductile iron.
  6. Style: Lug or wafer.
  7. End Connections: Grooved.
- E. Check Valves:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.
  - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - c. Anvil International, Inc.
  - d. Clow Valve Company; a division of McWane, Inc.
  - e. Crane Co.; Crane Valve Group; Crane Valves.
  - f. Crane Co.; Crane Valve Group; Jenkins Valves.
  - g. Crane Co.; Crane Valve Group; Stockham Division.
  - h. Fire-End & Croker Corporation.
  - i. Fire Protection Products, Inc.
  - j. Fivalco Inc.
  - k. Globe Fire Sprinkler Corporation.
  - l. Groeniger & Company.
  - m. Kennedy Valve; a division of McWane, Inc.
  - n. Matco-Norca.
  - o. Metraflex, Inc.
  - p. Milwaukee Valve Company.
  - q. Mueller Co.; Water Products Division.
  - r. NIBCO INC.
  - s. Potter Roemer.
  - t. Reliable Automatic Sprinkler Co., Inc.
  - u. Shurjoint Piping Products.
  - v. Tyco Fire & Building Products LP.
  - w. United Brass Works, Inc.
  - x. Venus Fire Protection Ltd.
  - y. Victaulic Company.
  - z. Viking Corporation.
  - aa. Watts Water Technologies, Inc.
  - bb. Or approved equal.
3. Standard: UL 312
4. Pressure Rating: 300 psig (2070 kPa).
5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.

**F. Bronze OS&Y Gate Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. United Brass Works, Inc.
  - f. Or approved equal.
3. Standard: UL 262.





4. Pressure Rating: 175 psig (1200 kPa).
5. Body Material: Bronze.
6. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Clow Valve Company; a division of McWane, Inc.
  - d. Crane Co.; Crane Valve Group; Crane Valves.
  - e. Crane Co.; Crane Valve Group; Jenkins Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. Hammond Valve.
  - h. Milwaukee Valve Company.
  - i. Mueller Co.; Water Products Division.
  - j. NIBCO INC.
  - k. Shurjoint Piping Products.
  - l. Tyco Fire & Building Products LP.
  - m. United Brass Works, Inc.
  - n. Watts Water Technologies, Inc.
  - o. Or approved equal.
3. Standard: UL 262.
4. Pressure Rating: 300 psig (2070 kPa).
5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Anvil International, Inc.
  - b. Fivalco Inc.
  - c. Global Safety Products, Inc.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Shurjoint Piping Products.
  - h. Tyco Fire & Building Products LP.
  - i. Victaulic Company.
  - j. Or approved equal.
3. Standard: UL 1091.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Valves NPS 2 (DN 50) and Smaller:
  - a. Valve Type: Ball or butterfly.



- b. Body Material: Bronze.
    - c. End Connections: Threaded.
  - 6. Valves NPS 2-1/2 (DN 65) and Larger:
    - a. Valve Type: Butterfly.
    - b. Body Material: Cast or ductile iron.
    - c. End Connections: Flanged, grooved, or wafer.
  - 7. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.
- I. NRS Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - b. American Valve, Inc.
    - c. Clow Valve Company; a division of McWane, Inc.
    - d. Crane Co.; Crane Valve Group; Stockham Division.
    - e. Kennedy Valve; a division of McWane, Inc.
    - f. Mueller Co.; Water Products Division.
    - g. NIBCO INC.
    - h. Tyco Fire & Building Products LP.
    - i. Or approved equal.
  - 3. Standard: UL 262.
  - 4. Pressure Rating: 300 psig (2070 kPa).
  - 5. Body Material: Cast iron with indicator post flange.
  - 6. Stem: Nonrising.
  - 7. End Connections: Flanged or grooved.
- J. Indicator Posts:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - b. American Valve, Inc.
    - c. Clow Valve Company; a division of McWane, Inc.
    - d. Crane Co.; Crane Valve Group; Stockham Division.
    - e. Kennedy Valve; a division of McWane, Inc.
    - f. Mueller Co.; Water Products Division.
    - g. NIBCO INC.
    - h. Tyco Fire & Building Products LP.
    - i. Or approved equal.
  - 3. Standard: UL 789.
  - 4. Type: Horizontal for wall mounting.
  - 5. Body Material: Cast iron with extension rod and locking device.
  - 6. Operation: Wrench

**1.19 TRIM AND DRAIN VALVES****A. General Requirements:**

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

**B. Angle Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. Mfr #3.
  - d. Or approved equal.

**C. Ball Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.
  - f. Fire Protection Products, Inc.
  - g. Flowserve.
  - h. FNW.
  - i. Jomar International, Ltd.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Kitz Corporation.
  - l. Legend Valve.
  - m. Metso Automation USA Inc.
  - n. Milwaukee Valve Company.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Red-White Valve Corporation.
  - r. Southern Manufacturing Group.
  - s. Stewart, M. A. and Sons Ltd.
  - t. Tyco Fire & Building Products LP.
  - u. Victaulic Company.
  - v. Watts Water Technologies, Inc.
  - w. Or approved equal.

**D. Globe Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. VikingCorp



- d. Or approved equal.

E. Plug Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Southern Manufacturing Group.
  - b. VikingCorp
  - c. NIBCO
  - d. Or approved equal.

1.20 SPECIALTY VALVES

F. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
  - b. High-Pressure Piping Specialty Valves: 300 psig (2070 kPa).
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

G. Dry-Pipe Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.
  - b. Globe Fire Sprinkler Corporation.
  - c. Reliable Automatic Sprinkler Co., Inc.
  - d. Tyco Fire & Building Products LP.
  - e. Venus Fire Protection Ltd.
  - f. Victaulic Company.
  - g. Viking Corporation.
  - h. Or approved equal.
- 3. Standard: UL 260
- 4. Design: Differential-pressure type.
- 5. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
- 6. Air-Pressure Maintenance Device:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:



- 1) AFAC Inc.
- 2) Globe Fire Sprinkler Corporation.
- 3) Reliable Automatic Sprinkler Co., Inc.
- 4) Tyco Fire & Building Products LP.
- 5) Venus Fire Protection Ltd.
- 6) Victaulic Company.
- 7) Viking Corporation.
- 8) Or approved equal.

- c. Standard: UL 260.
- d. Type: Automatic device to maintain minimum air pressure in piping.
- e. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 300-psig (2070-kPa) outlet pressure.

7. Air Compressor:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1) Gast Manufacturing Inc.
  - 2) General Air Products, Inc,
  - 3) Viking Corporation.
  - 4) Or approved equal.
- c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- d. Motor Horsepower: Fractional.
- e. Power: 120-V ac, 60 Hz, single phase.

H. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.
  - b. BERMAD Control Valves.
  - c. CLA-VAL Automatic Control Valves.
  - d. Globe Fire Sprinkler Corporation.
  - e. OCV Control Valves.
  - f. Reliable Automatic Sprinkler Co., Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Venus Fire Protection Ltd.
  - i. Victaulic Company.
  - j. Viking Corporation.
  - k. Or approved equal.
3. Standard: UL 260.
4. Design: Hydraulically operated, differential-pressure type.



5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
6. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
7. Air-Pressure Maintenance Device:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - 1) AFAC Inc.
    - 2) Globe Fire Sprinkler Corporation.
    - 3) Reliable Automatic Sprinkler Co., Inc.
    - 4) Tyco Fire & Building Products LP.
    - 5) Venus Fire Protection Ltd.
    - 6) Victaulic Company.
    - 7) Viking Corporation.
    - 8) Or approved equal.
  - c. Standard: UL 260.
  - d. Type: Automatic device to maintain minimum air pressure in piping.
  - e. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 300-psig (2070-kPa) outlet pressure.
8. Air Compressor:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - 1) Gast Manufacturing Inc.
    - 2) General Air Products, Inc,
    - 3) Viking Corporation.
    - 4) Or approved equal.
  - c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - d. Motor Horsepower: Fractional.
  - e. Power: 120-V ac, 60 Hz, single phase.
- I. Automatic (Ball Drip) Drain Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:



- a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Or approved equal.
3. Standard: UL 1726.
  4. Pressure Rating: 175 psig (1200 kPa) minimum.
  5. Type: Automatic draining, ball check.
  6. Size: NPS 3/4 (DN 20).
  7. End Connections: Threaded.

## 1.21 FIRE-DEPARTMENT CONNECTIONS

### A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
  - i. Or approved equal.
3. Standard: UL 405.
4. Type: Exposed, projecting, for wall mounting.
5. Pressure Rating: 175 psig (1200 kPa) minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Round, brass, wall type.
10. Outlet: Back, with pipe threads.
11. Number of Inlets: Two.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or AUTO SPKR."
13. Finish: Polished chrome plated.
14. Outlet Size: NPS 6 (DN 150).

### B. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. GMR International Equipment Corporation.



- d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer.
  - f. Or approved equal.
- 3. Standard: UL 405.
  - 4. Type: Flush, for wall mounting.
  - 5. Pressure Rating: 175 psig (1200 kPa) minimum.
  - 6. Body Material: Corrosion-resistant metal.
  - 7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
  - 8. Caps: Brass, lugged type, with gasket and chain.
  - 9. Escutcheon Plate: Rectangular, brass, wall type.
  - 10. Outlet: With pipe threads.
  - 11. Body Style: Horizontal.
  - 12. Number of Inlets: Two.
  - 13. Outlet Location: Back.
  - 14. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE or AUTO SPKR."
  - 15. Finish: Polished chrome plated.
  - 16. Outlet Size: NPS 6 (DN 150).

#### 1.22 SPRINKLER SPECIALTY PIPE FITTINGS

- A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
- B. Branch Outlet Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. National Fittings, Inc.
    - c. Shurjoint Piping Products.
    - d. Tyco Fire & Building Products LP.
    - e. Victaulic Company.
    - f. Or approved equal.
  - 2. Standard: UL 213.
  - 3. Pressure Rating: 300 psig (2070 kPa).
  - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  - 5. Type: Mechanical-T and -cross fittings.
  - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  - 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- C. Flow Detection and Test Assemblies:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGF Manufacturing Inc.
    - b. Reliable Automatic Sprinkler Co., Inc.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.





- e. Or approved equal.
  - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 3. Pressure Rating: 300 psig (2070 kPa).
  - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  - 5. Size: Same as connected piping.
  - 6. Inlet and Outlet: Threaded.
- D. Branch Line Testers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkhart Brass Mfg. Company, Inc.
    - b. Fire-End & Croker Corporation.
    - c. Potter Roemer.
    - d. Or approved equal.
  - 2. Standard: UL 199.
  - 3. Pressure Rating: 175 psig (1200 kPa) minimum.
  - 4. Body Material: Brass.
  - 5. Size: Same as connected piping.
  - 6. Inlet: Threaded.
  - 7. Drain Outlet: Threaded and capped.
  - 8. Branch Outlet: Threaded, for sprinkler.
- E. Sprinkler Inspector's Test Fittings:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGF Manufacturing Inc.
    - b. Triple R Specialty.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
    - e. Viking Corporation.
    - f. Or approved equal.
  - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 3. Pressure Rating: 300 psig (2070 kPa).
  - 4. Body Material: Cast- or ductile-iron housing with sight glass.
  - 5. Size: Same as connected piping.
  - 6. Inlet and Outlet: Threaded.
- F. Adjustable Drop Nipples:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CECA, LLC.
    - b. Corcoran Piping System Co.
    - c. Merit Manufacturing; a division of Anvil International, Inc.
    - d. Or approved equal.



2. Standard: UL 1474.
3. Pressure Rating: 300 psig (2070 kPa).
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

G. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fivalco Inc.
  - b. FlexHead Industries, Inc.
  - c. Gateway Tubing, Inc.
  - d. Or approved equal.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 300 psig (2070 kPa).
5. Size: Same as connected piping, for sprinkler.

1.23 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.
8. Or approved equal.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 300 psig (2070 kPa).

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.



2. Bronze.
3. Factory Painted.

E. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
  - e. Or approved equal.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

1.24 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Globe Fire Sprinkler Corporation.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
  - e. Or approved equal.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

C. Electrically Operated Alarm Bell:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms; a Honeywell company.
  - b. Notifier; a Honeywell company.
  - c. Potter Electric Signal Company.
  - d. Or approved equal.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 8-inch (200-mm) minimum.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

**D. Pressure Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
  - i. Or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

**E. Valve Supervisory Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Or approved equal.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

**F. Indicator-Post Supervisory Switches:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Potter Electric Signal Company.



- b. System Sensor; a Honeywell company.
  - c. Mfr. #3
  - d. Or approved equal.
- 2. Standard: UL 346.
  - 3. Type: Electrically supervised.
  - 4. Components: Single-pole, double-throw switch with normally closed contacts.
  - 5. Design: Signals that controlled indicator-post valve is in other than fully open position.

#### 1.25 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

#### 1.26 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
- 1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
  - 2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
  - 3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

#### 1.27 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AMETEK, Inc.; U.S. Gauge Division.
  - 2. Ashcroft, Inc.
  - 3. Brecco Corporation.
  - 4. WIKA Instrument Corporation.
  - 5. Or approved equal.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 300 psig (0 to 2070 kPa).
- E. Water System Piping Gage: Include "WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR/WATER" label on dial face.

**PART 3 - EXECUTION****1.28 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements

**1.29 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

**1.30 SERVICE-ENTRANCE PIPING**

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

**1.31 WATER-SUPPLY CONNECTIONS**

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for interior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements in Section 22 11 19 "Domestic Water Piping Specialties" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

**1.32 PIPING INSTALLATION**

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from New York City Department of Buildings. File written approval with Commissioner before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.



- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
  - 1. Pressure gages and controls.
  - 2. Electrical power system.
  - 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.
- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

#### 1.33 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- K. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

#### 1.34 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and New York City Department of Buildings.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.





- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air supply piping.
    - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
    - c. Install compressed-air supply piping from building's compressed-air piping system.

#### 1.35 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

#### 1.36 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

#### 1.37 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

#### 1.38 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.



3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

#### 1.39 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

#### 1.40 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded for 2" or less or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved for greater than 2" joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, dry-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
  1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
  3. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) shall be one of the following:
  1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- E. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6 (DN 125 and DN 150) shall be one of the following:
  1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.



**1.41 SPRINKLER SCHEDULE**

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers
  2. Rooms with Suspended Ceilings: Dry pendent, recessed, flush, and concealed sprinklers as indicated.
  3. Wall Mounting: Dry sidewall sprinklers.
  4. Spaces Subject to Freezing: Upright, dry pendent sprinklers; and dry sidewall sprinklers as indicated.
  5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
  3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
  4. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

**END OF SECTION 21 13 16**



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**SECTION 21 24 00****DRY CHEMICAL EXTINGUISHING SYSTEM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes:
1. Fueling station dry chemical extinguisher system.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (Voc) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. Submittals Package: Submit the shop drawings, product data and quality control submittals specified below at the same time as a package.
1. The shop drawings, product data, and quality control design data shall bear the seal of a professional engineer licensed to practice in the State of New York.
- B. Shop Drawings:
1. Reproducible scale drawing of the complete system, indicating:
    - a. Location of piping and all major components.
    - b. Detail drawings of each major component with instructions for installation into the system.
    - c. Location, type and flow rate of each nozzle.
    - d. Location and size of all pipe and fittings.
    - e. Location and size of the cylinders.
  2. Composite wiring and/or schematic diagrams of the complete system as proposed to be installed (standard diagrams will not be accepted).
- C. Product Data:
1. Catalog sheets, specifications, and installation instructions.
  2. Bill of materials.
  3. Detailed description of system operation.
  4. Name, address and telephone number of nearest fully equipped service organization, including data outlining available inspection and test programs.
- D. Quality Control Submittals:
1. Design Data:
    - a. Calculations for the quantity of dry chemical agent required.
    - b. Design concentration.
    - c. Cylinder storage pressure and internal volume.
- E. Contract Closeout Submittals:
1. System acceptance test report.
  2. Certificates:
    - a. Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.
  3. Operation and Maintenance Data:
    - a. Deliver 2 copies, covering the installed products, to the Commissioner. Include:
      - 1) Operation and maintenance data for each product.
      - 2) Complete point to point wiring diagrams of entire system as installed. Identify all conductors and show all terminations and splices. (Identification shall correspond to markers installed on each conductor.)

- 3) Name, address, and telephone number of nearest fully equipped service organization.

## 1.7 ENGINEERING SERVICES REQUIREMENTS

- A. The dry chemical extinguishing system shall be engineered by Professional Engineers licensed in the State of New York of the Company manufacturing the system or a fire protection company that specializes in the design of dry chemical extinguishing systems. Products of engineering services shall be submitted to the Commissioner for review and approval.
  1. Design approach based on NFPA-17 Dry Chemical Extinguishing Systems, as well as the New York State Fire Code and Nassau County Fire Prevention Ordinance.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Contractor Qualifications: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- C. Regulatory Requirements:
  1. Comply with applicable recommendations and requirements of Pamphlet No. 17 of the National Fire Protection Association, as well as the New York State Fire Code and the New York City Fire Department.
  2. Materials and equipment shall have both Underwriters Laboratories and Factory Mutual approval.
  3. Dry Chemical Cylinders: Conform to Federal Department of Transportation Specifications.
- D. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 16 working hours for the following:
  1. Render advice regarding installation and final adjustment of the system.
  2. Witness final system test and then certify with an affidavit that the system is installed in accordance with the contract documents and is operating properly.
  3. Instruct facility service operators on the operation and service of the system (minimum of 2 one-hour sessions).
  4. Explain available service programs to facility supervisory staff for their consideration.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements provide dry chemical extinguisher system by PYROCHEM, no substitutions allowed.

### 2.2 TYPE AND DESIGN

- A. Type:
  1. Total flooding.

B. Design:

1. System may be either engineered for the project or may be a pre-engineered (package) system conforming to the NFPA-17 definition of such systems.
2. Design for both automatic and manual operation.

2.3 MATERIALS

- A. Pipe and Fittings: Schedule 40, threaded, galvanized steel pipe with standard weight, threaded malleable iron fittings.
  1. Special Fittings: Distributor fittings and restrictor fittings shall be of type and design as recommended by the manufacturer of the system.
- B. Tubing: Electrical metal tubing; conforming to ANSI C80.3, NEC and UL labeled.
- C. Dry Chemical Cylinder and Valve Assembly: Pressurized cylinder containing dry chemical extinguishing material and fitted with a brass valve assembly complete with pressure gauge and wall mounting bracket.
- D. Primary Control Head: Automatic, mechanical.
  1. Internally wired to actuate an alarm and shut down electrically operated devices.
- E. Tandem Control Head: Automatic, mechanical, activated by the primary control head.
- F. Fusible Link Actuator Kit:
  1. Heat sensitive fusible link, temperature rated at 360 degrees F.
  2. Fusible link bracket with EMT tubing adaptors.
  3. 1/16 inch stainless steel cable, crimp sleeves and crimping tool.
- G. Electric Detector: Thermostatic actuator, normally open, with heat sensing element encased in a metal housing.
  1. Detector shall be color coded for temperature rating identification.
- H. Pneumatic Heat Actuator: Brass chamber, vented to prevent normal temperature rise from tripping the system; copper pressure tubing to the control head.
- I. Nozzles: Designed for the hazard to be protected against. Types: Total flooding, local application, plenum and duct. Provide a blow-off type protective cap to protect nozzles installed in greasy atmospheres.
- J. Electric Fire Control: Manually operated remote station, to electrically release the system. The control shall consist of an enclosure with a pull handle, DPST switch, and provided with a green light to indicate "power on" and the system in the set condition, and a red "system operated" light to denote that the system has been manually released.
- K. Instructions: Provide a laminated plastic sign with white engraved lettering on a red background, attached to the cover of the enclosure, and with the following instructions:
  - a. To silence bell, operate the silencing switch.
  - b. Light will remain on, indicating that the system is in the released condition.
  - c. Light will automatically extinguish when the system is returned to the set condition.



d. To test bell and light, press test button.

L. Hazard Isolation Devices:

1. Automatic Electric Shut Off: Electric contact box designed to shut down the electric service to equipment upon the release of the system (cable operated).
  - a. Contact normally open in the system released condition.
  - b. Provide EMT tubing adaptors.

**PART 3 - EXECUTION**

**3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 INSTALLATION**

- A. Install the Work of this section in accordance with NFPA-17 Standard, manufacturer's printed installation instructions and approved shop drawings.
- B. Provide the following hazard isolation devices connected to operate upon the release of the system.
1. Fuel Pump Power
  2. Tank and Dispenser Monitoring and Control Circuits
  3. Fuel Management Power and Control Circuits
  4. Diesel Filtration System Power and Control Circuits

**3.3 FIELD QUALITY CONTROL**

- A. Approval: Obtain written approval from the New York City Fire Department.
- B. System Tests:
1. Notify the Commissioner when the Work of this Section is ready for testing.
  2. Perform the tests in the presence of the Commissioner.
  3. Perform tests in accordance with NFPA-17. Include discharge of expellant gas test.
  4. Furnish to the Commissioner with a written statement, signed and dated, affirming that the system has been tested in accordance with NFPA-17, and left ready for operation.

**END OF SECTION 21 24 00**



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## **SECTION 21 31 13**

### **ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. This Section includes electric-drive, New York City Department of Buildings Approved Automatic Fire Pump with controllers, automatic transfer switches and accessories.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

##### **1.5 PERFORMANCE REQUIREMENTS**

- A. Pump, Equipment, Accessory, Specialty, and Piping Pressure Rating: Refer to Schedule.

##### **1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

- B. Product Data: For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump.
- C. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties, pressure-maintenance pumps, pressure-maintenance-pump controllers, and pressure-maintenance-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Product Certificates - after shipment: Factory certified performance test curves for each fire pump.
- E. Field test reports.
- F. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and flowmeter systems to include in emergency, operation, and maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of fire pumps, pressure-maintenance pumps, and controllers and are based on specific systems indicated.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to the New York City Department of Buildings, and marked for intended use.
- E. Comply with standards of 2014 New York City Construction Codes pertaining to materials, hose threads, and installation.
- F. Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.

#### 1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with all specified requirements, provide products as produced by the manufacture used as the basis of design, or another approved manufacturer listed, or an approved equal manufacturer.

## 2.2 CENTRIFUGAL FIRE PUMPS

- A. Description, General: New York City MEA or BS&A approved, UL 448, factory-assembled and -tested, electric-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head,
  - 1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
  - 2. Nameplate: Complete with capacities, characteristics, and other pertinent data.
- B. Fabricate bases for fire pumps, pressure-maintenance pumps, and controllers (unless wall mounted) with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.
- C. Horizontally Mounted, Split-Case Fire Pumps with pump and driver mounted on same base and connected with coupling.
  - 1. Peerless Pump Company, or approved equal
  - 2. Pump: Axially split cast-iron casing with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless otherwise indicated.
    - a. Impeller: Cast bronze of construction to match fire pump, statically and dynamically balanced, and keyed to shaft.
    - b. Case Wear Rings: Replaceable, bronze.
    - c. Shaft and Sleeve: Steel shaft with bronze sleeve.
      - 1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
      - 2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
  - 3. Coupling: UL 448A listed, flexible coupling capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
  - 4. Driver: UL 1004-5 listed, NEMA MG 1, open-dripproof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Motor shall be NEMA Design B with 1.15 service factor unless otherwise noted on the Schedule or below. Include wiring compatible with controller used.
    - a. Manufacturers:
      - 1) Emerson; U.S. Electrical Motors
      - 2) Lincoln Electric Company (The).
      - 3) Marathon Electric, Inc.
      - 4) WEG Electric Motors Corp.
      - 5) Or approved equal.

## 2.3 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers. Refer to Division 21 Section "Common Work Results for Fire Suppression."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.



2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

## 2.4 INSTALLATION

- A. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.
- B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
  1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between pump base and concrete base for grouting.
  2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.
- D. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.
- E. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- F. Install pressure gages on fire-pump suction and discharge at pressure-gage tapplings.
- G. Support pumps and piping separately so weight of piping does not rest on pumps.
- H. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.
- I. Install flowmeters and sensors where indicated. Install flowmeter-system components and make connections according to manufacturer's written instructions.
- J. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

## 2.5 ALIGNMENT

- A. Laser align split-case fire-pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.

- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

## 2.6 CONNECTIONS

- A. Piping installation requirements are specified in Division 21. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect water supply and discharge piping to fire pumps. Connect water supply and discharge piping to pressure-maintenance pumps.
- D. Connect drain lines to point of disposal for:
  - 1. Pump packing glands
  - 2. Relief valve discharge
  - 3. Weekly test solenoid.
  - 4. Each type of drain shall be piped independently from each other.
- E. Connect flowmeter-system sensors and meters according to manufacturer's written instructions.
- F. Connect controllers to pumps.
- G. Connect fire-pump controllers to building fire-alarm system. Refer to Section 28 31 11 "Fire Alarm and Integrated Audio/Visual Evacuation System.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## 2.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to review field-assembled components and equipment installation, including connections, and to observe field testing. Report results in writing.
- B. Perform field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in the 2014 New York City Construction Codes and NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements



### 3.2 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting:
  - 1. Install fire pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
  - 3. Comply with requirements for vibration isolation devices specified in Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment."
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- D. Support piping and pumps separately, so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 21 12 00 "Fire-Suppression Standpipes".
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Section 21 12 00 "Fire-Suppression Standpipes".
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
- I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- J. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.





### 3.4 ALIGNMENT

- A. Align end-suction and split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

### 3.5 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Section 21 12 00 "Fire-Suppression Standpipes." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect flowmeter-system meters, sensors, and valves to tubing.
- E. Connect fire pumps to their controllers.

### 3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

### 3.7 FIELD QUALITY CONTROL

- A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 26 29 33 "Controllers for Fire-Pump Drivers."
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. After installing components, assemblies, and equipment, including controller, test for compliance with requirements.
  - 2. Test according to NFPA 20 for acceptance and performance testing.
  - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.



- D. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses used for this purposes are for testing only and shall be removed by the Contractor at the conclusion of testing.

### 3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct Commissioner's personnel to adjust, operate, and service fire pumps.

**END OF SECTION 21 31 13**

**SECTION 21 34 00****PRESSURE-MAINTENANCE PUMPS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Multistage, pressure-maintenance pumps.
- B. Related Section:
  - 1. Section 21 39 00 "Controllers for Fire-Pump Drivers" for pressure-maintenance-pump controllers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



**1.5 PERFORMANCE REQUIREMENTS**

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.9 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00" Quality Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**1.11 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

**PART 2 - PRODUCTS**

**2.1 PRESSURE-MAINTENANCE PUMPS**

- A. Pressure-Maintenance Pumps, General: Factory-assembled and -tested pumps with electric-motor driver, controller, and accessories and specialties. Include cast-iron or stainless-steel casing and bronze or stainless-steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.



1. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
- B. Multistage, Pressure-Maintenance Pumps: Multiple-impeller type complying with HI 1.1-1.2 and HI 1.3 requirements for multistage centrifugal pumps. Include base.
  1. Peerless Pump Company, or approved equal by one or these Manufacturers:
    - a. Grundfos Pumps Corp.
    - b. Ebara Pump Co.
    - c. Or approved equal.
  2. Driver: NEMA MG 1, totally enclosed fan cooled or open-drip-proof, squirrel-cage, induction motor complying with NFPA 70. Include wiring compatible with controller used.
  3. Controllers Firetrol Model FTA550F having a short circuit current rating of not less than 30,000 AMPS RMS symmetrical at the operating voltages up to 480 volts.
  4. Enclosure: UL 508 and NEMA 250, Type 2 / 12, polycarbonate, wall-mounting type for field electrical wiring.
  5. Rate controller for scheduled horsepower and include the following:
    - a. Motor circuit protector disconnect switch.
    - b. Motor contactor
    - c. Hand-off-auto selector switch.
    - d. LED indicating lights for: power available, pump running and alarm
    - e. Solid state pressure transducer.
    - f. Controller shall have a password protected operator interface. It shall provide for set point adjustment, display system pressure and 3 phase motor operating conditions.
    - g. Controllers shall record historical operating data and system events.
    - h. Running period timer.
- C. Controllers: UL 508; factory-assembled, -wired, and -tested, across-the-line type for combined automatic and manual operation.
  1. Manufacturer to be the same as the Fire Pump Controller Manufacturer.
  2. Firetrol Model FTA550E having a short circuit current rating of not less than 65,000 AMPS RMS symmetrical at the operating voltages up to 480 volts.
  3. Enclosure: UL 508 and NEMA 250, Type 2, painted steel, wall-mounting type for field electrical wiring.
  4. Rate controller for scheduled horsepower and include the following:
    - a. Circuit breaker disconnect switch.
    - b. Motor starter
    - c. Hand-off-auto selector switch.
    - d. LED indicating lights for: power available, pump running and alarm
    - e. Solid state pressure transducer.
    - f. Controller shall have a password protected operator interface. It shall provide for set point adjustment, display system pressure and 3 phase motor operating conditions.
    - g. Controllers shall record historical operating data and system events.
    - h. Running period timer.
    - i. Low system pressure auxiliary alarm contact.

- D. Accessories and Specialties: Match pressure-maintenance-pump suction and discharge ratings as required for pump capacity rating. Include the following:
    - 1. Circulation relief valve, if required
    - 2. Suction and discharge pressure gages.
  - E. Pressure-Maintenance-Pump Performance Characteristics: Refer to Schedule.
- 2.2 Warranty: The Pump Manufacturer shall warranty the system for 12 months from date of start-up/Substantial Completion.

### PART 3 - EXECUTION

#### 3.2 EXECUTION REQUIREMENTS

- A. Refer to DDC General conditions for execution requirements.

#### 3.3 EQUIPMENT INSTALLATION

- A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
- B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Attach pumps to equipment base using anchor bolts.
- C. Install multistage and regenerative-turbine pressure-maintenance pumps according to HI 1.4.
- D. Install submersible and vertical-turbine pressure-maintenance pumps according to HI 2.4.

#### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:



1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Lubricate pumps as recommended by manufacturer.
- B. Set field-adjustable pressure-switch ranges as indicated.

**END OF SECTION 21 34 00**



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**SECTION 21 39 00**

**CONTROLLERS FOR FIRE-PUMP DRIVERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Full-service, reduced-voltage controllers rated 600 V and less.
  - 2. Controllers for pressure-maintenance pumps.
  - 3. Remote alarm panels.
  - 4. Low-suction-shutdown panels.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 DEFINITIONS**

- A. ATS: Automatic transfer switch(es).



- B. ECM: Electronic control module.
- C. MCCB: Molded-case circuit breaker.
- D. N.O.: Normally open.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-pump controllers and alarm panels shall withstand the effects of earthquake motions determined according to:
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
  - 1. Show tabulations of the following:
    - a. Each installed unit's type and details.
    - b. Enclosure types and details for types other than NEMA 250, Type 2.
    - c. Factory-installed devices.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of integrated unit.
    - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
    - g. Specified modifications.
  - 2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
  - 3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For each type of product indicated, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Product Certificates: For each type of product indicated, from manufacturer.
- D. Manufacturer's factory test reports of fully assembled and tested equipment.
- E. Source quality-control reports.
- F. Field quality-control reports.

#### 1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
  2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

#### 1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Testing Agency Qualifications: Member company of an NRTL.
- C. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with standards of New York City Department of Buildings pertaining to materials and installation.
- F. Comply with NFPA 20 and NFPA 70.
- G. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.



1.13 PROJECT CONDITIONS

A. Environmental Limitations:

1. Ambient Temperature Rating: Not less than 40 deg F (5 deg C) and not exceeding 122 deg F (50 deg C) unless otherwise indicated.
2. Altitude Rating: Not exceeding 6600 feet (2010 m) unless otherwise indicated.

1.14 COORDINATION

- A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

- A. Fire-Pump Controllers, General: UL 218, NFPA 20 and New York City MEA; listed for electric-drive, fire-pump service and service entrance; combined automatic and manual operation; factory assembled wired and factory tested for capacities and electrical characteristics.
1. Firetrol Inc, or approved equal by one or these Manufacturers:
    - a. Eaton Cutler Hammer, Corp.
    - b. Master Control Systems, Inc.
  2. Rate controllers for scheduled fire-pump horsepower and short-circuit withstand rating as shown below or on the Schedule.
  3. Enclosure: UL 50, Type 2, dripproof, indoor, unless special-purpose enclosure is indicated. Include manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
  4. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specific items listed.
    - a. Voltage surge protection
    - b. Isolating means and circuit breaker.
    - c. Motor contactors
    - d. Emergency run mechanism
    - e. "Power on" pilot lamp.
    - f. Alarm.
    - g. Fire-alarm system auxiliary contacts
    - h. Solid state pressure transducer.
    - i. Controller shall have a password protected operator interface. It shall provide for set point adjustment, display system pressure and 3 phase motor operating conditions.
    - j. Controllers shall record historical operating data and system events which may be downloaded to through its USB port.
    - k. Automatic and manual operation.
    - l. Automatic or manual shutdown with and minimum run-time relay to prevent short cycling.
    - m. Automatic weekly test timer and pressure sensing line drain solenoid valve, pipe to floor drain.



- n. Low system pressure audible alarm.
  - 5. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.
  - 6. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2 (DN 15), with globe valves for testing controller mechanism from system to pump controller as indicated. Include two (2) bronze check valves with 3/32-inch (2.4-mm) orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch (2.4-mm) orifice.
- B. Full-Service Fire-Pump Controllers:
- 1. Type Starting: Reduced voltage, solid state, closed transition, soft start/stop.
  - 2. Mounting: Floor-stand type for field electrical connections.
  - 3. Subject to compliance with requirements, provide Firetrol Model FTA1930 (Basis of Design), or an equivalent product from an approved manufacturer listed below. Controller shall be a reduced voltage controller, with short circuit current withstand rating of not less than 100,000 AMPS RMS symmetrical at the operating voltage or one of these manufacturers:
    - a. Eaton Cutler Hammer, Corp.
    - b. Master Control Systems, Inc.
    - c. Or approved equal
- C. Automatic Transfer Switches: Meeting UL 218, UL 1008 and NFPA 20 requirements, transfer switches shall be furnished factory mounted and interwired with the fire pump controllers. Include enclosure complying with UL 50, Type 2, with automatic transfer switch with rating at least equal to fire-pump driver-motor horsepower. Include ampere rating not less than 115 percent of motor full-load current and suitable for switching motor-locked rotor current. The transfer switch shall be electrically operated and mechanically held, and shall be capable of being operated by a manual transfer mechanism located on the switch.
- 1. Subject to compliance with requirements, provide Firetrol Model FTA950 (Basis-of-Design), or an equivalent product from an approved manufacturer listed above under Fire-Pump Controllers, General, or an approved equal. The Automatic Transfer Switch shall be suitable for use with emergency power coming from a local electrical distribution panel, second utility feed or an emergency generator. The transfer switch shall be an ASCO 7000 series with group 5 control panel. The transfer switch short circuit current withstand rating on the normal and emergency power sides shall be the same as the fire pump controller.

## 2.2 GROUT

- A. Description: ASTM C 1107, factory-mixed and –packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
- 1. Properties: nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.

## 2.3 SOURCE QUALITY CONTROL

- A. Test and inspect fire pumps with their controllers according to NFPA 20 for certified shop tests.
- B. Verification of Performance: Rate fire pumps according to requirements indicated.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 CONTROLLER INSTALLATION**

- A. Install controllers within sight of their respective drivers.
- B. Connect controllers to their dedicated pressure-sensing lines.
- C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, and bottom of enclosure not less than 12 inches (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."
- D. Floor-Mounting Controllers: Install controllers on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete".
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- E. Seismic Bracing: Comply with requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- G. Comply with NEMA ICS 15.

### 3.4 STANDALONE ATS INSTALLATION

- A. Wall-Mounting ATS: Install ATS on walls with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, and bottom of enclosure not less than 12 inches (305 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting ATS: Install ATS on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
  - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Seismic Bracing: Comply with requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

### 3.5 REMOTE ALARM AND LOW-SUCTION-SHUTDOWN PANEL INSTALLATION

- A. Install panels on walls with tops not higher than 72 inches (1829 mm) above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."

### 3.6 POWER WIRING INSTALLATION

- A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.7 CONTROL AND ALARM WIRING INSTALLATION

- A. Install wiring between controllers and remote devices and facility's central monitoring system. Comply with requirements in NFPA 20, NFPA 70, and Section 26 05 23 "Control-Voltage Electrical Power Cables."
- B. Install wiring between remote alarm and low-suction-shutdown panels and controllers. Comply with requirements in NFPA 20, NFPA 70, and Section 26 05 23 "Control-Voltage Electrical Power Cables."
- C. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Section 28 31 11 "Fire Alarm and Integrated Audio/Visual Evacuation System."

- D. Bundle, train, and support wiring in enclosures.
- E. Connect remote manual and automatic activation devices where applicable.

### 3.8 IDENTIFICATION

- A. Comply with requirements in NFPA 20 for marking fire-pump controllers.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  - 1. Inspect and Test Each Component:
    - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
    - b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
    - c. Test continuity of each circuit.
  - 2. Verify and Test Each Electric-Driver Controller:
    - a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Commissioner before starting the motor(s).
    - b. Test each motor for proper phase rotation.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Field Acceptance Tests:
  - 1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Commissioner and New York City Department of Buildings.
  - 2. Prior to starting, notify Commissioner of the time and place of the acceptance testing.





3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

F. Controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

### 3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.11 ADJUSTING

A. Adjust controllers and battery charger systems to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

D. Set field-adjustable pressure switches.

### 3.12 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.13 DEMONSTRATION

A. Contractor shall instruct the City of New York's service staff to adjust, operate, and service controllers, remote alarm panels, low-suction-shutdown panels, and to use and reprogram microprocessor-based controls within this equipment.

**END OF SECTION 21 39 00**



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## SECTION 22 00 00

### COMMON WORK RESULTS FOR PLUMBING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### 1.2 DEFINITIONS

- A. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.
- B. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.
- C. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow, operation of equipment.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- H. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- I. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. NP: Nylon plastic.
  - 4. PE: Polyethylene plastic.
  - 5. PVC: Polyvinyl chloride plastic.
- J. The following are industry abbreviations for rubber materials:

CR: Chlorosulfonated polyethylene synthetic rubber.

- 1. EPDM: Ethylene propylene diene terpolymer rubber.

##### 1.3 WORK INCLUDED



- A. The work covered by this section includes, but is not limited to the following:
1. Domestic Water Systems.
  2. Soil, Waste, Vent and Storm Water Systems.
  3. Natural Gas System
  4. Piping, Valves and Fittings
  5. Water Meters and Backflow Prevention Devices
  6. Insulation.
  7. Domestic Water Heaters.
  8. Pumps.
  9. Pressure Tanks.
  10. Identification System.
  11. Excavation and Backfill.
  12. Cutting, Patching and Equipment Painting.
  13. Hangers, Supports and Guides.
  14. Electric Motors.
  15. Electric Motor Controllers.
  16. Internal Wiring of Factory-Assembled Prewired Equipment.
  17. Alarm Wiring, except for Fire Alarm.
  18. Rigging of Equipment.
  19. Furnishing access Doors and Frames to be installed by the General Contractor.
  20. Fire Stopping for Pipe Penetration.
  21. Pipe Penetration and Drains Counterflashing.
  22. Concrete Pads for Equipment.
  23. Alarm Initiating Devices.
  24. Wiring between Water Meter Totalizer and Remote Reading Device.
  25. Concrete tank, alarms, valves, piping.
  26. Heat tracing.
  27. Rain Harvesting System.
- B. Related Work not Included in this Division but Specified Elsewhere
1. Fire alarm wiring.
  2. Finish painting, except for prefinished equipment or as otherwise specified.
  3. Concrete work, except equipment inertia and floating bases.
  4. Base flashing for piping and drains.
  5. Toilet accessories.
  6. Waterproofing.
  7. Power wiring for motors and motor controllers.
  8. Installation of access doors and frames.
- 1.4 SUSTAINABLE DESIGN REQUIREMENTS
- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"



- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.5 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.6 COORDINATION OF WORK**

- A. The plumbing drawings show the general arrangement of piping and appurtenances. Follow these drawings as closely as the actual construction will permit. Conform the plumbing work to the requirements shown on the drawings. Provide offsets, fittings, and accessories, which may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions.
- B. Carefully check space requirements with other trades to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings.
- C. Wherever work interconnects with work specified of other trades, coordinate to ensure that all necessary information is presented so that all the necessary connections and equipment may be properly installed. Identify all items (valves, piping, equipment, etc.) in order that other trades know where to install access doors and panels.
- D. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.
- E. Furnish and set all sleeves for passage of pipes and conduits through structural masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.
- F. Provide required supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.
- G. Examine and compare the contract drawings and specifications with the drawings and specifications of other disciplines and report any discrepancies between them to the Commissioner. Install and coordinate the work of this section in cooperation with the trades installing interrelated work. Before installation, take proper provisions to avoid interferences. All changes required in the work of the contractor, caused by his neglect to do so, are to be made by him at his own expense.
- H. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship and report any conditions, which prevent performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.



- I. Provide required anchor bolts, sleeves, inserts and supports. Direct location of anchor bolts, sleeves, inserts and supports to ensure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports to be paid for by the contractor.
- J. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. Properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.
- K. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.
  - 1. Right-of-Way: Lines, which pitch has the right-of-way over those that do not pitch, i.e., plumbing drains. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
  - 2. Make offsets, transitions and changes in direction in pipes as required to maintain proper head room and pitch on sloping lines whether or not indicated on the drawings. Furnish and install all traps, air vents, drains, etc., as required to affect these offsets, transitions and changes in direction.
- L. Install all plumbing work to permit the removal (without damage to other parts) of water heaters and all other equipment requiring periodic replacement or service. Arrange pipes and equipment to permit access to valves, cocks, starters, motors, and control components, and to clear the openings of swinging doors and access panels.
- M. Provide access panels in equipment as required for inspection and maintenance of internal parts, etc.
- N. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.

#### 1.7 USE OF SITE AND LOAD LIMITATIONS

- A. The contractor shall review all available data on the location and types of pipelines and other underground utilities. The contractor shall not operate equipment over the facilities and shall take care not to damage them or otherwise impair their use. The contractor shall make investigation to verify the location of these facilities before proceeding with construction and/or operations in their vicinity.

#### 1.8 CONTRACTOR'S RESPONSIBILITY FOR EVALUATION

- A. The Commissioner and The City of New York make no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground or other subsurface conditions which may be encountered during the Work. The contractor must make his own evaluation of existing conditions, which may affect methods or expense of performing the Work, based on his own examination of the facility or other information. Failure to examine the drawings or other information shall not relieve the contractor of his responsibility for satisfactory accomplishment of the Work.
- B. The locations of existing services are believed to be as indicated on the plans. The contractor shall verify the location of these services prior to commencing any work and notify the Commissioner of any discrepancies.

#### 1.9 ACCESS TO FIRE PROTECTION EQUIPMENT



- A. The contractor shall not interfere with access to hydrants, fire exits, fire hose stations, fire extinguishers and fire alarm pull stations. In no case shall the contractor's material or equipment be within twenty-five (25) ft of a hydrant or fire alarm pull station.

#### 1.10 EQUIPMENT AND MATERIALS

- A. If products and materials are specified or indicated on the drawings for a specific item or system, the contractor shall use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, in accordance with shop drawings.
- B. All products and materials shall be new, clean, free of defects and free of damage and corrosion.
- C. No permanent equipment shall be used to provide temporary services during construction.
- D. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair.
- E. Make certain that all materials selected directly, or by suppliers, conform to the requirements of the contract drawings and specification. Transmittal of such specifications and drawings, information to persons manufacturing and supplying materials to the project, and rigid adherence thereto, is the Contractor's responsibility. Acceptance of a manufacturer's name by the Commissioner does not release the Contractor of the responsibility for providing materials, which comply in all respects with the requirements in the Contract Documents.
- F. Applicable equipment and materials to be listed by Underwriters' Laboratories and Manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by New York City Department of Buildings
- G. Fully lubricate all equipment when installed and prior to final acceptance.
- H. Do not operate water systems until piping has been tested and cleaned.
- I. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts to have bottom plate and pipe sleeves. Grout all machinery set in concrete under the entire bearing surface. After grout has set, remove all wedges, shims and jack bolts and fill space with grout.
- J. Locate valves, traps, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified herein.
- K. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Commissioner before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special valves, piping, wiring and accessories.

#### 1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Codes, Standards and Fees



1. Codes and Standards:
  - a. Comply with 2014 New York City Construction Codes, UL, and regulations and standards of the New York City Department of Environmental Protection.
  - b. Where codes or standards are listed herein, the applicable portions apply.
  - c. Should any change in plans or specifications be required to comply with regulations, the contractor is to notify the Commissioner.
  - d. The codes and standards listed in the Specifications can be obtained from the organizations listed as follows:
    - 1) OSHA Occupational Safety and Health Act
    - 2) ANSI American National Standard Institute, Inc.
    - 3) ASME American Society of Mechanical Engineers
    - 4) ASTM American Society for Testing and Materials
    - 5) AWWA American Water Works Association
    - 6) UL Underwriters Laboratories, Inc.
    - 7) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
    - 8) NEMA National Electrical Manufacturers Association
    - 9) AIA American Insurance Association
    - 10) AWS American Welding Society
    - 11) ASA American Standards Association
    - 12) IEEE Institute of Electrical and Electronics Engineers
    - 13) NEC National Electrical Code
  - e. The particular specification will be identified by appropriate prefix and number only with the latest revision being applicable unless otherwise noted.
- C. Furnish all materials and equipment new, free from defects and with listings or labels of Underwriter's Laboratories, Inc.
- D. All items of a given type shall be the product of the same manufacturer.
- E. All materials and equipment shall be the product of manufacturers regularly engaged in their manufacture.

#### 1.12 PERMITS AND FEES

- A. Refer to the DDC General Conditions for requirements related to permits and permitting fees.
- A. The Contractor shall be responsible for all required testing and inspections except for Special Inspections. Where required, the City of New York will engage a qualified testing agency to perform Special Inspections.
- B. This contractor shall prepare and file all plans, calculation, forms, etc. required for filing with all agencies required for this work including but not limited to The DEP (Department of Environmental Protection), DEC (Department of Environmental Conservation, Bureau of Air Resources, EPA Environmental protection Agency, and FDNY.

#### 1.13 SPECIAL / CONTROLLED INSPECTION- NYC

- A. Special inspection shall be provided by the City of New York. The contractor shall coordinate with the Commissioner to accomplish all special inspections and provide any access necessary.

#### 1.14 INSPECTIONS / TESTING



- A. Independent testing and inspections shall be provided by the contractor.

#### 1.15 SHOP DRAWINGS

- A. Prepare and submit detailed shop drawings for piping work and other distribution services, including locations and sizes of all openings in floor walls and roofs.
- B. The work described in any shop drawing submission to be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.
- C. If submittals differ from the Contract Document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.
- D. Submit shop drawings and manufacturer's data for the following items in accordance with the Contract Documents:
  1. Coordinated, detailed shop layout drawings of all mechanical rooms, services and distribution systems, including plans, profiles and sections.
  2. Details of piping supports, elbows, anchors and miscellaneous appurtenances.
  3. Hangers, supports, inserts, anchors, guides and foundations.
  4. Valves.
  5. Pressure gauges and thermometers.
  6. Corrosion protective coatings.
  7. Equipment and piping layouts at 3/8 in. scale for the building.
  8. Location and size of sleeves for openings in floors and walls.
  9. Certified equipment performance curves for pumps.
  10. Schedule of pipe and fittings, materials and application, valves, escutcheons, air vents, valve tags and schedules, strainers, and water specialties.
  11. Pump system, including pumps, motors and controllers.
  12. Building automation systems including descriptions, instruments, and alarms.
  13. Flashing.
  14. Equipment identification and certificates.
  15. Pressure tanks and accessories.
  16. Water heaters and accessories.
  17. Plumbing fixture and trim.
  18. Rain Harvesting System
  19. Other shop drawings and submittals as requested within the specification.

#### 1.16 SAMPLES

- A. Submit samples of all items with exposed finishes for review.
- B. Allow sufficient time for consideration without interfering with job schedule.
- C. Duplicate quality and finish to type to be supplied under contract.

#### 1.17 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.18 SUBMISSIONS:



- A. The work described in all shop drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.
- B. Each submitted shop drawing is to include a certification that all related job conditions have been checked and verified and that there are no conflicts.
- C. If submittals differ from the contract document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

**1.19 AS-BUILTS AND EQUIPMENT OPERATION INSTRUCTIONS**

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing requirements.

**1.20 START-UP**

- A. Properly lubricate all pieces of equipment.
- B. Check and clean all pipes of dirt and debris, including strainers.
- C. Prepare each piece of equipment in accordance with manufacturer's installation instructions and have a copy at the equipment.
- D. Fill and vent all water systems.
- E. Check rotation on each motor.
- F. Have representatives of each manufacturer present when hereinafter specified, so that equipment will be started up by manufacturer.

**1.21 ACCESS DOORS IN FINISHED CONSTRUCTION**

- A. Furnish access doors as required for operation and maintenance of concealed equipment, clean-outs, valves, shock absorbers, controls, etc., and coordinate their delivery with the installing trade.
- B. Coordinate and prepare a location, size and function schedule of access doors required and deliver to the Commissioner for review.
- C. Refer to Section 08 31 13 "Access Doors and Frames" for access door requirements.
- D. Unless otherwise indicated, minimum size to be 18" x 18".
- E. Furnish color coded buttons or tabs to indicate location of valves or other equipment located above removable type ceilings where access doors are not required.
- F. Access doors shall have a fire rating compatible with the wall construction in which they are located.

**1.22 SYSTEM IDENTIFICATION**

- A. Piping:



1. All piping, exposed or concealed, shall be identified as to its service in accordance with OSHA and ANSI Standards by one of the following methods:
  - a. Installation of manufactured adhesive band type identification markers.
2. Piping identification markings shall be installed as follows:
  - a. In each room.
  - b. All valve locations.
  - c. At shaft walls.
  - d. Every 40 feet on continuous runs.
3. Valves:
  - a. Valves shall be identified by a tag system utilizing brass tags at 2-inch minimum diameter and attached to the valves using brass chain.
    - 1) The new valve tag identification numbers shall be permanently added to all existing valve tag charts within the building.
4. Equipment:
  - a. Identify all controls such as motor starters not in motor control centers, float switches, and alarms.

#### 1.23 OPERATING & MAINTENANCE INSTRUCTION

- A. Prepare operating and maintenance instructions manual including operating instructions, maintenance instructions, manufacturer's data, specific equipment data.
- B. Provide an alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
- C. Provide operating instructions for complete system, including:
  1. Normal starting, operating, and shut-down
  2. Emergency procedures for fire or failure of major equipment
  3. Summer and winter special procedures
  4. Day and night special procedures
- D. Provide maintenance instructions, including:
  1. Valve tag list and equipment tag list
  2. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated
  3. Required cleaning, replacement and/or adjustment schedule
- E. Provide manufacturer's data on each piece of equipment, including:
  1. Installation instructions.
  2. Drawings and specifications.
  3. Parts list, including recommended items to be stocked.
  4. Complete wiring and temperature control diagrams.



5. Marked or revised prints locating all concealed parts and all variations from the original system design.
6. Test and inspection certificates.

F. Provide specific equipment data including, but not limited to, the following:

1. For Plumbing Systems:

- a. Pumps.
- b. Valves.
- c. Piping.
- d. Accessories.
- e. Pressure reducing valves.
- f. Water heaters.
- g. Water meters.
- h. Strainers.
- i. Flow measuring devices.
- j. Electric wiring.
- k. Pressure tanks.

2. For Automatic Control System:

- a. Drawings and description of system controlled.
- b. Sequence of operation for each system.
- c. Data on components.
- d. Wiring and piping, schematic any layout, for panels and panelboards.
- e. System operating manual, including set points.

G. Provide instruction of operating personnel.

1. Instruct the City of New York's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.
2. Instruction to be by instructors skilled in operation of equipment. Instructions for major equipment to be by equipment manufacturers' representatives.
3. Make arrangements to give instructions by system and not by building areas.
4. Provide five (5) instruction sessions not to exceed six (6) hours each.
5. Instructions on automatic controls to be by manufacturer's representative.

H. Submittals

1. Shop Drawings: Submit three copies for review prior to final issuance.
2. Provide six (6) copies of each operation and maintenance manual.
  - a. Manuals to be 8-1/2" x 11 size in hard-back, 3-ring loose leaf binders. Use more than one volume if required. Do not overfill binders.
  - b. Manuals to be completed and delivered to the Commissioner for approval at least 20 days prior to instruction of operating personnel.
3. Prepare separate manuals for the Plumbing system.

1.24 TOOLS FOR OPERATION, ADJUSTMENT AND SERVICE

- A. Deliver to the Commissioner all special tools needed for proper operation, adjustment and service of equipment.



1.25 RECORD DRAWINGS

- A. Refer to the DDC General Conditions and Section 01 32 34 “Computer Aided Design Coordination” for coordination and record drawing requirements.

PART 2 - PRODUCTS  
NOT USED.

PART 3 - EXECUTION

PART 4 - NOT USED.

**END OF SECTION 22 00 00**



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**SECTION 22 05 13****COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.5 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Motor controllers.
  2. Torque, speed, and horsepower requirements of the load.
  3. Ratings and characteristics of supply circuit and required control sequence.

- 4. Ambient and environmental conditions of installation location.

## 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Re-greasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.





- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Split phase.
  - 2. Capacitor start, inductor run.
  - 3. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

PART 4 - Not Used

**END OF SECTION 22 05 13**

**SECTION 22 05 16****EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Flexible-hose packless expansion joints.
  2. Metal-bellows packless expansion joints.
  3. Rubber packless expansion joints.
  4. Grooved-joint expansion joints.
  5. Pipe loops and swing connections.
  6. Alignment guides and anchors.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Engineering Services Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York responsible for their preparation to be submitted to Commissioner for review and approval.
  - 1. Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Product Certificates: For each type of expansion joint, from manufacturer.

**1.9 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Welding Qualifications: Qualify procedures according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. ASME Boiler and Pressure Vessel Code: Section IX.

**PART 2 - PRODUCTS****2.1 PACKLESS EXPANSION JOINTS**

- A. Flexible-Hose Packless Expansion Joints:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings product name or designation or comparable product by one of the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Flex Pression Ltd.
    - d. Metraflex, Inc.
    - e. Unisource Manufacturing, Inc.
    - f. Or approved equal
  3. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
  4. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  5. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
    - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
  6. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
- B. Metal-Bellows Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Adsko Manufacturing LLC.
    - b. American BOA, Inc.
    - c. Badger Industries, Inc.
    - d. Expansion Joint Systems, Inc.
    - e. Flex-Hose Co., Inc.
    - f. Flexicraft Industries.
    - g. Flex Pression Ltd.
    - h. Flex-Weld, Inc.
    - i. Flo Fab inc.
    - j. Hyspan Precision Products, Inc.
    - k. Metraflex, Inc.
    - l. Proco Products, Inc.
    - m. Senior Flexonics Pathway.
    - n. Tozen Corporation.
    - o. Unaflex.
    - p. Unisource Manufacturing, Inc.
    - q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.



- r. U.S. Bellows, Inc.
    - s. WahlcoMetroflex.
    - t. Or approved equal
  - 3. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  - 4. Type: Circular, corrugated bellows with external tie rods.
  - 5. Minimum Pressure Rating: 150 psig (1035 kPa) unless otherwise indicated.
  - 6. Configuration: Single joint class(es) unless otherwise indicated.
  - 7. Expansion Joints for Copper Tubing: Single Multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.
    - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint.
    - c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.
- C. Rubber Packless Expansion Joints:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
    - b. Flex-Hose Co., Inc.
    - c. Flexicraft Industries.
    - d. Flex-Weld, Inc.
    - e. Garlock Sealing Technologies.
    - f. General Rubber Corporation.
    - g. Mason Industries, Inc.; Mercer Rubber Co.
    - h. Metraflex, Inc.
    - i. Proco Products, Inc.
    - j. Red Valve Company, Inc.
    - k. Tozen Corporation.
    - l. Unaflex.
    - m. Unisource Manufacturing, Inc.
    - n. Or approved equal
  - 3. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
  - 4. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
  - 5. Arch Type: Single arches with external control rods.
  - 6. Spherical Type: Single spheres with external control rods.
  - 7. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F.
  - 8. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F.
  - 9. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig.
  - 10. Material for Fluids Containing Acids, Alkalies, or Chemicals: EPDM.
  - 11. Material for Fluids Containing Gas, Hydrocarbons, or Oil:
  - 12. Material for Water: BR.
  - 13. End Connections: Full-faced, integral steel flanges with steel retaining rings.



## 2.2 GROOVED-JOINT EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anvil International, Inc.
  - 2. Shurjoint Piping Products.
  - 3. Victaulic Company.
  - 4. Or approved equal
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: Galvanized ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: Five, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N, and bolts and nuts.

## 2.3 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Adscos Manufacturing LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Flex-Hose Co., Inc.
    - d. Flexicraft Industries.
    - e. Flex-Weld, Inc.
    - f. Hyspan Precision Products, Inc.
    - g. Metraflex, Inc.
    - h. Senior Flexonics Pathway.
    - i. Unisource Manufacturing, Inc.
    - j. U.S. Bellows, Inc.
    - k. Or approved equal
  - 3. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. Anchor Materials:
  - 1. Steel Shapes and Plates: ASTM A 36/A 36M.
  - 2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
  - 3. Washers: ASTM F 844, steel, plain, flat washers.
  - 4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.



- a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
- a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.
- D. Install grooved-joint expansion joints to grooved-end steel piping

#### 3.3 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

#### 3.4 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.





- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
  - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

- 4. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 5. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- F. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION 22 05 16**



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**SECTION 22 05 17****SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".



1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Smith, Jay R. Mfg. Co.
  2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
  3. Wade Inc.
  4. Or approved equal.
- C. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. Metraflex Company (The).
  4. Pipeline Seal and Insulator, Inc.
  5. Proco Products, Inc.
  6. Or approved equal.



- C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Presealed Systems.
  - 2. Advance Products & Systems, Inc.
  - 3. CALPICO, Inc.
  - 4. Or approved equal.
- C. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.



1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
  3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07 92 00 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 10 "Firestopping."

### 3.3 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
  2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
  4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 10 "Firestopping."

### 3.4 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.



### 3.5 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller than NPS 6 (DN 150): Sleeve-seal fittings.
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel wall sleeves
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system
      - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves
    - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves



5. Interior Partitions:
  - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves
  - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION 22 05 17**



**SECTION 22 05 18****ESCUTCHEONS FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

- 1. Escutcheons.
- 2. Floor plates.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brasstype with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brasstype with polished, chrome-plated finish.



- e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- E. New Piping: One-piece, floor-plate type.
- 3.3 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION 22 05 18**



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**SECTION 22 05 19****METERS AND GAGES FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.

B. Related Sections:

1. Section 21 12 00 "Fire-Suppression Standpipes" for fire protection pressure gages.
2. Section 21 13 13 "Wet-Pipe Sprinkler Systems"
3. Section 22 11 13 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
4. Section 22 11 16 "Domestic Water Piping" for water meters inside the building.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ashcroft Inc.
  2. Ernst Flow Industries.
  3. Marsh Bellofram.
  4. Miljoco Corporation.
  5. Nanmac Corporation.
  6. Noshok.
  7. Palmer Wahl Instrumentation Group.
  8. REOTEMP Instrument Corporation.
  9. Tel-Tru Manufacturing Company.
  10. Trerice, H. O. Co.
  11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  12. Weiss Instruments, Inc.
  13. WIKA Instrument Corporation - USA.
  14. Winters Instruments - U.S.
  15. Or approved equal.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch (127-mm) nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C).
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.



- G. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1percent of scale range.

## 2.2 LIGHT-ACTIVATED THERMOMETERS

### A. Remote-Mounted, Light-Activated Thermometers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Miljoco Corporation.
  - b. Weiss Instruments, Inc.
  - c. Winters Instruments - U.S.
  - d. Or approved equal.
- 2. Case: Plastic, for wall mounting.
- 3. Scale(s): Deg F (Deg C).
- 4. Sensor: Bulb and thermister wire.
  - a. Design for Thermowell Installation: Bare stem.
- 5. Display: Digital.
- 6. Accuracy: Plus or minus 2 deg F (1 deg C).

## 2.3 THERMOWELLS

### A. Thermowells:

- 1. Standard: ASME B40.200.
- 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
- 3. Material for Use with Copper Tubing: CNR.
- 4. Material for Use with Steel Piping: CRES.
- 5. Type: Stepped shank unless straight or tapered shank is indicated.
- 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
- 7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
- 8. Bore: Diameter required to match thermometer bulb or stem.
- 9. Insertion Length: Length required to match thermometer bulb or stem.
- 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
- 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.4 PRESSURE GAGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Ernst Flow Industries.
  - d. Flo Fab Inc.
  - e. Marsh Bellofram.
  - f. Miljoco Corporation.
  - g. Noshok.
  - h. Palmer Wahl Instrumentation Group.
  - i. REOTEMP Instrument Corporation.
  - j. Tel-Tru Manufacturing Company.
  - k. Terice, H. O. Co.
  - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - m. Weiss Instruments, Inc.
  - n. WIKA Instrument Corporation - USA.
  - o. Winters Instruments - U.S.
3. Standard: ASME B40.100.
4. Case: Liquid-filled sealed 6-inch (152-mm) nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in.
9. Pointer: Dark-colored metal.
10. Window: Glass.
11. Ring: Metal.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads.

## 2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flow Design, Inc.
  2. Miljoco Corporation.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Company, Inc.





6. Terice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.
9. Or approved equal.

- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

## 2.7 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Flow Design, Inc.
  2. Miljoco Corporation.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Company, Inc.
  6. Terice, H. O. Co.
  7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  8. Weiss Instruments, Inc.
  9. Or approved equal.
- C. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- D. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
- E. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
- F. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- G. Carrying Case: Metal or plastic, with formed instrument padding.

## 2.8 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Archon Industries, Inc.
  - 2. Dwyer Instruments, Inc.
  - 3. Emerson Process Management; Brooks Instrument.
  - 4. Ernst Co., John C., Inc.
  - 5. Ernst Flow Industries.
  - 6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
  - 7. OPW Engineered Systems; a Dover company.
  - 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
  - 9. Or approved equal.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 125 psig (860 kPa).
- E. Minimum Temperature Rating: 200 deg F (93 deg C).
- F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.



- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Inlets and outlets of each domestic water heat exchanger.
  - 3. Inlet and outlet of each domestic hot-water storage tank.
  - 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.

### 3.3 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### 3.4 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

### 3.5 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
  - 1. Sealed, bimetallic-actuated type.
  - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
  - 1. Liquid-filled, bimetallic-actuated type.
  - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
  - 1. Sealed, bimetallic-actuated type.
  - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
  - 1. Sealed, bimetallic-actuated type.
  - 2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- E. Thermometer stems shall be of length to match thermowell insertion length.



3.6 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).

3.7 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Sealed, Solid-front, direct mounted, metal case.
2. Sealed direct, mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:

1. Sealed, Solid-front, direct mounted, metal case.
2. Sealed, direct, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Sealed Solid-front direct mounted, metal case.
2. Sealed, direct mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.8 PRESSURE-GAGE SCALE-RANGE SCHEDULE

Scale Range for Water Service Piping: 0 to 160 psi.

- A. Scale Range for Domestic Water Piping: 0 to 200 psi.

**END OF SECTION 22 05 19**

**SECTION 22 05 23****GENERAL-DUTY VALVES FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Iron, grooved-end butterfly valves.
5. Bronze lift check valves.
6. Bronze swing check valves.
7. Iron gate valves.
8. Bronze globe valves.
9. Lubricated plug valves.
10. Chainwheels.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221113 "Facility Water Distribution Piping" for valves applicable only to this piping.
3. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
4. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
5. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.
6. Section 334100 "Storm Utility Drainage Piping" for valves applicable only to this piping.
7. Section 334600 "Subdrainage" for valves applicable only to this piping.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- C. ASME Compliance:
  1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  2. ASME B31.1 for power piping valves.
  3. ASME B31.9 for building services piping valves.

- D. NSF Compliance: NSF 61 for valve materials for potable-water service.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

- B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

- D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
4. Wrench: For plug valves with square heads. Furnish The City of New York with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

- F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Stockham Division.
  - b. Kitz Corporation.
  - c. NIBCO:
  - d. Or approved equal.
2. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 300 psig (2070 kPa).
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem and Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron, aluminum.

## 2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Hammond Valve.
  - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - f. Legend Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC: T/S 585-70.
  - i. Red-White Valve Corporation.
  - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - k. Or approved equal.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig (1035 kPa).
  - c. CWP Rating: 600 psig (4140 kPa).





- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

**B. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. DynaQuip Controls.
  - f. Hammond Valve.
  - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - h. Milwaukee Valve Company.
  - i. NIBCO INC T/S 580-70.
  - j. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig (1035 kPa).
  - c. CWP Rating: 600 psig (4140 kPa).
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Regular.

**C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. DynaQuip Controls.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Red-White Valve Corporation.
  - g. NIBCO T/S 590-Y.
  - h. Or approved equal.
- 2. Description:



- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

## 2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

### A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
  - d. Crane Co.; Crane Valve Group; Jenkins Valves.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. DeZurik Water Controls.
  - g. Flo Fab Inc.
  - h. Hammond Valve.
  - i. Kitz Corporation.
  - j. Legend Valve.
  - k. Milwaukee Valve Company.
  - l. NIBCO INC LD-2000.
  - m. Norriseal; a Dover Corporation company.
  - n. Red-White Valve Corporation.
  - o. Spence Strainers International; a division of CIRCOR International, Inc.
  - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - q. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Aluminum bronze.

### B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.



- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- d. Crane Co.; Crane Valve Group; Jenkins Valves.
- e. Crane Co.; Crane Valve Group; Stockham Division.
- f. DeZurik Water Controls.
- g. Flo Fab Inc.
- h. Hammond Valve.
- i. Kitz Corporation.
- j. Legend Valve.
- k. Milwaukee Valve Company.
- l. NIBCO INC LD 2100.
- m. Norriseal; a Dover Corporation company.
- n. Red-White Valve Corporation.
- o. Spence Strainers International; a division of CIRCOR International, Inc.
- p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- q. Or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Center Line.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Kitz Corporation.
- k. Legend Valve.
- l. Milwaukee Valve Company.
- m. Mueller Steam Specialty; a division of SPX Corporation.
- n. NIBCO INC LD 2010.
- o. Norriseal; a Dover Corporation company.
- p. Spence Strainers International; a division of CIRCOR International, Inc.
- q. Sure Flow Equipment Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- s. Or approved equal.



2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated ductile iron.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Center Line.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Kitz Corporation.
- k. Legend Valve.
- l. Milwaukee Valve Company.
- m. Mueller Steam Specialty; a division of SPX Corporation.
- n. NIBCO INC LD 2110.
- o. Norriseal; a Dover Corporation company.
- p. Spence Strainers International; a division of CIRCOR International, Inc.
- q. Sure Flow Equipment Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- s. Or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated ductile iron.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Kennedy Valve; a division of McWane, Inc.
- b. Shurjoint Piping Products.
- c. Tyco Fire Products LP; Grinnell Mechanical Products.
- d. Victaulic Company.
- e. Or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 175 psig (1200 kPa).
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International, Inc.
- b. Kennedy Valve; a division of McWane, Inc.
- c. Mueller Steam Specialty; a division of SPX Corporation.
- d. NIBCO INC.
- e. Shurjoint Piping Products.
- f. Tyco Fire Products LP; Grinnell Mechanical Products.
- g. Victaulic Company.
- h. Or approved equal.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).
- c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
- d. Body Material: Coated, ductile iron.
- e. Stem: Two-piece stainless steel.
- f. Disc: Coated, ductile iron.
- g. Seal: EPDM.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. NIBCO: T/S 413-B
- e. Or approved equal.

2. Description:



- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Vertical flow.
- d. Body Material: ASTM B 61 or ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

**B. Class 125, Lift Check Valves with Nonmetallic Disc:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flo Fab Inc.
  - b. Hammond Valve.
  - c. Kitz Corporation.
  - d. Milwaukee Valve Company.
  - e. Mueller Steam Specialty; a division of SPX Corporation.
  - f. NIBCO INC: T/S 413-Y
  - g. Red-White Valve Corporation.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - i. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Design: Vertical flow.
  - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: NBR, PTFE, or TFE.

**2.7 BRONZE SWING CHECK VALVES**

**A. Class 125, Bronze Swing Check Valves with Bronze Disc:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Hammond Valve.
  - f. Kitz Corporation.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC: T/S 413-B.
  - i. Powell Valves.
  - j. Red-White Valve Corporation.
  - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - l. Zy-Tech Global Industries, Inc.
  - m. Or approved equal.
- 2. Description:



- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

**B. Class 150, Bronze Swing Check Valves with Bronze Disc:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC: T/S 433-B
  - h. Red-White Valve Corporation.
  - i. Zy-Tech Global Industries, Inc.
  - j. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 300 psig (2070 kPa).
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

**2.8 IRON GATE VALVES**

**A. Class 125, NRS, Iron Gate Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Flo Fab Inc.
  - e. Hammond Valve.
  - f. Kitz Corporation.
  - g. Legend Valve.
  - h. Milwaukee Valve Company.
  - i. NIBCO INC: F-619 Non Rising Stem.
  - j. Powell Valves.
  - k. Red-White Valve Corporation.
  - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - m. Zy-Tech Global Industries, Inc.
  - n. Or approved equal.



2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC: f-617-0.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.
- n. Or approved equal.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve
- d. NIBCO INC: F-619-RW.
- e. Or approved equal.

2. Description:





- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

**D. Class 250, OS&Y, Iron Gate Valves:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC: F-667-0.
  - f. Powell Valves.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - h. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 500 psig (3450 kPa).
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid wedge.
  - g. Packing and Gasket: Asbestos free.

**2.9 BRONZE GLOBE VALVES**

**A. Class 125, Bronze Globe Valves with Bronze Disc:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. Kitz Corporation.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC: T/S 211.
  - g. Powell Valves.
  - h. Red-White Valve Corporation.
  - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - j. Zy-Tech Global Industries, Inc.
  - k. Or approved equal.
- 2. Description:



- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron bronze.

**B. Class 125, Bronze Globe Valves with Nonmetallic Disc:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. NIBCO INC: T/S-235-Y.
  - d. Red-White Valve Corporation.
- 2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron bronze.

**C. Class 150, Bronze Globe Valves with Nonmetallic Disc:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. Kitz Corporation.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC: T/S 235-Y.
  - f. Powell Valves.
  - g. Red-White Valve Corporation.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - i. Zy-Tech Global Industries, Inc.
  - j. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig (2070 kPa).
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.



- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron bronze.

## 2.10 LUBRICATED PLUG VALVES

### A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nordstrom Valves, Inc.
  - b. Milliken Valve Company.
  - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
  - d. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-78, Type II.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
  - d. Pattern: Regular or short.
  - e. Plug: Cast iron or bronze with sealant groove.

### B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Nordstrom Valves, Inc.
  - b. Milliken Valve Company.
  - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
  - d. Or approved equal.
- 2. Description:
  - a. Standard: MSS SP-78, Type II.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
  - d. Pattern: Regular or short.
  - e. Plug: Cast iron or bronze with sealant groove.

### C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Homestead Valve; a division of Olson Technologies, Inc.
  - b. Milliken Valve Company.
  - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
  - d. Or approved equal.



2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Homestead Valve; a division of Olson Technologies, Inc.
- b. Milliken Valve Company.
- c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- d. Or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Nordstrom Valves, Inc.
- b. Milliken Valve Company.
- c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- d. Or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type II.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Nordstrom Valves, Inc.



- b. Milliken Valve Company.
- c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- d. Or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type II.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short
- e. Plug: Cast iron or bronze with sealant groove.

G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Homestead Valve; a division of Olson Technologies, Inc.
- b. Milliken Valve Company.
- c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- d. Or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Homestead Valve; a division of Olson Technologies, Inc.
- b. Milliken Valve Company.
- c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- d. Or approved equal.

2. Description:

- a. Standard: MSS SP-78, Type IV.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

## 2.11 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
  - 4. Or approved equal.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to ball valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc.
  - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.3 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.

### 3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.5 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, gate, or plug valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe or angle valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.
    - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
  - 7. For Grooved-End Steel Piping: Valve ends may be grooved.

### 3.6 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

- A. Pipe NPS 2 (DN 50) and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Ball Valves: Two piece, regular port, brass with stainless-steel trim.
  - 3. Bronze Lift Check Valves: Class 125, bronze disc.

4. Bronze Swing Check Valves: Class 150, bronze disc.
5. Bronze Gate Valves: Class 150, RS.

**B. Pipe NPS 2-1/2 (DN 65) and Larger:**

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, ductile-iron disc.
3. Iron, Grooved-End Butterfly Valves: 300 CWP.
4. Iron Swing Check Valves: Class 250, metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 250 resilient seat.
7. Iron, Plate-Type Check Valves: Class 250, plate; resilient seat.
8. Iron Gate Valves: Class 250, OS&Y.

**3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE**

**A. Pipe NPS 2 (DN 50) and Smaller:**

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, nonmetallic disc.
3. Ball Valves: Two piece, regular port, brass with brass trim.
4. Bronze Swing Check Valves: Class 150 disc.
5. Bronze Gate Valves: Class 150 RS.
6. Bronze Globe Valves: Class 150 bronze disc.

**B. Pipe NPS 2-1/2 (DN 65) and Larger:**

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, ductile-iron disc.
4. Iron, Grooved-End Butterfly Valves: 300 CWP.
5. Iron Swing Check Valves: Class 250, metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: Class 250, compact-wafer, resilient seat.
9. Iron, Plate-Type Check Valves: Class 250; single plate; resilient seat.
10. Iron Gate Valves: Class 250, OS&Y.
11. Iron Globe Valves: Class 250.

**END OF SECTION 22 05 23**



**SECTION 22 05 29****HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 05 16 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional Commissioner using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  1. Trapeze pipe hangers.
  2. Metal framing systems.
  3. Fiberglass strut systems.
  4. Pipe stands.
  5. Equipment supports.
- C. Engineering Services Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the Contractor's qualified professional Engineer responsible for their preparation.
  1. Detail fabrication and assembly of trapeze hangers.
  2. Engineering Calculations: Calculate requirements for designing trapeze hangers.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Welding certificates.



## 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. Structural Steel Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, “Structural Welding Code - Steel.”
- C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.



- c. Flex-Strut Inc.
  - d. GS Metals Corp.
  - e. Thomas & Betts Corporation.
  - f. Unistrut Corporation; Tyco International, Ltd.
  - g. Wesanco, Inc.
  - h. Or approved equal.
3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  4. Standard: MFMA-4.
  5. Channels: Continuous slotted steel channel with inturned lips.
  6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  8. Metallic Coating: Electroplated zinc, Hot-dipped galvanized.
  9. Paint Coating: Epoxy.
  10. Plastic Coating: PVC, Polyurethane.
  11. Combination Coating:

#### 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
  10. Or approved equal.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.
- D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Stainless steel.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- H. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
  - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
  - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
  - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
  - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.



### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 91 00 "Painting". Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.



5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:



1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb (340 kg).
    - b. Medium (MSS Type 32): 1500 lb (680 kg).
    - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.



- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION 22 05 29**

**SECTION 22 05 33****HEAT TRACING FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes plumbing piping heat tracing for freeze prevention, snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:
  - 1. Constant wattage.
- B. Related Requirements:
  - 1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
  - 2. Section 230533 "Heat Tracing for HVAC Piping."

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
  - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

**1.8 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

**1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 CONSTANT-WATTAGE HEATING CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. BriskHeat.
  - 2. Chromalox.
  - 3. Delta-Therm Corporation.
  - 4. Easy Heat; a division of EGS Electrical Group LLC.
  - 5. Nelson Heat Trace; a division of EGS Electrical Group LLC.
  - 6. Pyrotenax; a brand of Tyco Thermal Controls LLC.
  - 7. Raychem; a brand of Tyco Thermal Controls LLC.
  - 8. Thermon Americas Inc.
  - 9. Trasor Corp.
  - 10. Or approved equal.
- C. Comply with IEEE 515.1.

- D. Heating Element: Pair of parallel stranded copper bus wires with single-stranded resistor wire connected between bus wires. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight.
- E. Electrical Insulating Jacket: Flame-retardant fluoropolymer.
- F. Cable Cover: Tinned-copper braid.
- G. Maximum Operating Temperature (Power On): 392 deg F (200 deg C).
- H. Maximum Exposure Temperature (Power Off): 185 deg F (85 deg C).
- I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Capacities and Characteristics:
  - 1. Maximum Heat Output: 12 W/ft. (39.4 W/m).
  - 2. Electrical Characteristics for Single-Circuit Connection:
    - a. Volts:
    - b. Phase:
    - c. Hertz:
    - d. Full-Load Amperes:
    - e. Minimum Circuit Ampacity:
    - f. Maximum Overcurrent Protection: CONTROLS
- K. Pipe-Mounted Thermostats for Freeze Protection:
  - 1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F
  - 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
  - 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
  - 4. Corrosion-resistant, waterproof control enclosure.
- L. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters:
  - 1. Automatic control with manual on, automatic, and standby/reset switch.
  - 2. Precipitation and temperature sensors shall sense the surface conditions of roof and gutters and shall be programmed to energize the cable as follows:
    - a. Temperature Span:
    - b. Adjustable Delay-Off Span: 30 to 90 minutes.
    - c. Energize Cables: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
    - d. De-Energize Cables: On detection of a dry surface plus time delay.
  - 3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
  - 4. Minimum 30-A contactor to energize cable or close other contactors.
  - 5. Precipitation sensor shall be freestanding.

6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

M. Programmable Timer for Domestic Hot-Water-Temperature Maintenance:

1. Microprocessor based.
2. Minimum of four separate schedules.
3. Minimum 24-hour battery carryover.
4. On-off-auto switch.
5. 365-day calendar with 20 programmable holidays.
6. Relays with contacts to indicate operational status, on or off, and for interface with central HVAC control-system workstation.

## 2.2 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
  1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
  2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 APPLICATIONS

- A. Install the following types of electric heating cable for the applications described:
  1. Snow and Ice Melting on Roofs and in Gutters and Downspouts: Plastic-insulated, series-resistance heating cable.
  2. Temperature Maintenance for Domestic Hot Water: Self-regulating, parallel-resistance heating cable.





### 3.4 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Freeze Protection for Piping:
  - 1. Install electric heating cables after piping has been tested and before insulation is installed.
  - 2. Install electric heating cables according to IEEE 515.1.
  - 3. Install insulation over piping with electric cables according to Section 22 07 19 "Plumbing Piping Insulation."
  - 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- C. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.5 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Refer to the DDC General Conditions for testing and inspection requirements. Refer to the DDC General Conditions for requirements related to permits and permitting fees.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
  - 2. Test cables for electrical continuity and insulation integrity before energizing.
  - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.7 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage during construction.



- B. Remove and replace damaged heat-tracing cables.

**END OF SECTION 22 05 33**

**SECTION 22 05 48**

**VIBRATION ISOLATION, SEISMIC, WIND & FLOOD LOAD**

**RESTRAINTS FOR PLUMBING COMPONENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 22 08 00 "Commissioning of Plumbing"

**1.2 SUMMARY**

- A. This section includes the following:
  - 1. All equipment and piping as noted on the drawing's schedule or in the specification shall be seismically braced if the building is so classified as listed herein. Vibration control shall apply as described in all cases herein.
  - 2. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, IBC-2006. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.
  - 3. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.
  - 4. Seismic bracing, wind, flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
  - 5. It is the intent of the seismic and wind load portion of this specification to keep all plumbing building system components in place during a seismic or high wind event and additionally operational where the occupancy category of the building so requires as listed herein.
  - 6. All such systems must be installed in strict accordance with seismic/wind codes, component manufacturer's and building construction standards.
  - 7. This specification is considered to be minimum requirements for seismic, wind, flood and vibration control considerations.
  - 8. Any variation, which results in non-compliance with the specification requirements, shall be corrected by the contractor in an approved manner.
- B. The work in this section includes, but is not limited to, the following:
  - 1. Vibration isolation for piping and equipment, all referred to as components.
  - 2. Component isolation bases.
  - 3. Seismic restraints for isolated components.



4. Seismic restraints for non-isolated components.
  5. Wind restraints for isolated components.
  6. Wind restraints for non-isolated components.
  7. Flood restraints for isolated components.
  8. Flood restraints for non-isolated components.
  9. Certification of seismic, wind or flood restraint designs.
  10. Installation supervision.
  11. Design of attachment of housekeeping pads.
  12. All components requiring IBC compliance and certification.
  13. All inspection and test procedures for components requiring IBC compliance.
- C. All plumbing equipment and pipe within, on or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
- D. Components referred to below are typical. (Components not listed are still included in this specification.) All systems that are part of the building in any way are referred to as components, including:
1. Air Separators
  2. Boilers
  3. Compressor
  4. Equipment Supports
  5. Gas Detection Systems
  6. Pipe
  7. Pumps (all types)
  8. Risers
  9. Pumps (all types)
  10. Risers
  11. Supports
  12. Tanks (all types)
  13. Unit Heaters
  14. Vibration Isolators
  15. Water Heaters
  16. Pumps

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for

LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- D. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- 1. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 PERFORMANCE REQUIREMENTS

- E. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- F. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 DEFINITIONS (building and components, 2014 New York City Building Code)

- A. ESSENTIAL FACILITIES, (Occupancy Category IV, 2014 NYCBC)

- 1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

- B. LIFE SAFETY AND HIGH HAZARD

- 1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels. (Life Safety)
  - 2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers. (Life Safety)
  - 3. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells. (High Hazard)
  - 4. Heating systems in any facility in Occupancy Category IV, 2014 NYCBC where the ambient temperature can fall below 32 degrees Fahrenheit. (Life Safety)

- C. General

- 1. Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.
  - 2. Attachment: See Positive Attachment below.
  - 3. Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per 2014 NYCBC. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed. See Section 16 09 .3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.
  - 4. Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also Longitudinal Bracing and Transverse Bracing. Together, they resist environmental loads from any



- direction.
5. Certificate of Compliance: A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents, provided by an approved agency. (Certificate to be supplied by equipment component manufacturer.)
  6. Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.
  7. Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor is 1.5.
  8. Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.
  9. Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.
  10. Consequential Damage: The functional and physical interrelationship of components, their supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.
  11. Equipment: Systems associated with ducts, pipes and conduits also called components.
  12. Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:
    - a. The overflow of inland or tidal waters.
    - b. The unusual and rapid accumulation of runoff of surface waters from any source.
  13. Flood Hazard Area: The greater of the following of two areas:
    - a. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
    - b. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.
  14. Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as zone V, VO, VE or VI-30.
  15. Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.
  16. Gas pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel, gas, fuel oil, medical gas, or compressed air.
  17. Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.
  18. Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.
  19. Importance Factor, G: A factor that accounts for the degree of hazard to human life and damage to property.
  20. Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 17 03 .5 and "Label" and "Manufacturer's Designation" and "Mark").
  21. Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the representative sample of the



- product or material has been tested and evaluated by an approved agency (see Section 17 03 .5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark").
22. Lateral forces: A force acting on a component in the horizontal plane. This force can be in any direction.
  23. Longitudinal bracing: Bracing that prevents a component from moving in the direction of its run.
  24. Longitudinal force: An applied force that happens to be in the same direction as the duct or pipe run.
  25. Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate," "Label" and "Manufacturer's Designation").
  26. Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection Certificate," "Label" and "Mark".)
  27. Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow and seismic based on occupancy of the structure.
  28. Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double-sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.
  29. Seismic: Related to an earthquake. Seismic loads on a structure are caused by wave movements in the earth during an earthquake.
  30. Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group or Occupancy Category and the severity of the design earthquake ground motion at the site.
  31. Seismic Forces: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used in the design of the structure and its components.
  32. Seismic Use Group, Occupancy Category: A classification assigned to a building based on its use as defined in Section 16 04 .516.2.
  33. Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2.
  34. Story Drift Ratio: The story drift (Lateral displacement) divided by the story height.
  35. Transverse bracing: Bracing that prevents a component from moving from side to side.
  36. Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater; or Hawaii.

## 1.8 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

### A. General Design Requirements.

1. SEISMIC CONSIDERATIONS: This project has seismic design requirements as follows:
  - a. Occupancy Category, III (Seismic Design Category C) essential facility.
    - 1) All Components, with the additional requirement of a manufacturer's Certificate of Compliance to prove 'on line' capability ( $I_p = 1.5$ )



2. WIND CONSIDERATIONS: This project has wind design requirements as follows:
  - a. Wind load in hurricane, tornado and/or wind-borne debris regions (90 plus mph) having a building height greater than 60 feet. Rooftop structures; Section 6.5.15.1 of ASCE 7-05 design requirements apply.

**B. General Design Performance Requirements**

1. Seismic and Wind Load Certification and Analysis:
  - a. Attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the mounting system, seismic or wind restraints, fasteners or ICC Certified Concrete Anchors shall be submitted for approval along with the shop drawings. Seismic loads shall have their calculations based on seismic loads as established in Specification Section 1.4, Paragraph B, article 7, Design Seismic Loads. Wind loads shall have their calculations based on Section 1.4, Paragraph B, article 8, Design Wind Loads. A registered professional engineer licensed in the State of New York shall stamp all analysis, or as required by 2014 NYC Construction Codes.
  - b. Unless otherwise specified, all equipment and piping shall be restrained to resist seismic forces. Restraints shall maintain components in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:
    - 1) 2014 New York City Building Code, and ASCE.
    - 2) NFPA (fire protection only)
2. Importance Factor,  $I_p = 1.5$  Components:
  - a. In addition to all of the above provisions, for components having an  $I_p$  greater than 1.0, all trades shall comply with Sections 16 and 17 of the NYC Building Code using, when available, vendors that comply with the provisions stated herein and submitting the special inspections listed within these specifications. Where compliance is not possible, each contractor shall submit a vendor report (form CVC-1 at end of this specification) clearly indicating that none of the specified, listed or other vendors known to the contractor meets the compliance, testing and certification portions of the IBC specification's Sections 16 and 17. Special inspections of the component installation shall still be conducted (Section 1.4, Paragraph B, Article 4) even if no vendors meet the following requirements. All non-isolated and isolated equipment (components) shall be secured to the structure in accordance with that code.
3. All component manufacturers shall submit for approval the following as required below:
  - a. For all life safety system components noted in this specification: the Approved Agency's Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include anchorage, structural and on-line capability. Use of seismic experience data shall be permitted if evidence confirms that the historical based component has the same construction and weight and accompanying center of gravity as submitted unit and basis of experience claim conforms to loads derived in testing with accompanying accelerations based on AC-156. Seismic qualification by seismic experience data based upon nationally recognized procedures acceptable to the





NYC Department of Buildings and 2014 NYC Construction Codes shall be deemed to satisfy the design and evaluation requirements provided that the substantiated seismic capacities equal or exceed the seismic demands determined in accordance with Sections 13.3.1 and 13.3.2 of ASCE 7-05.

- b. In addition, all components needed for the continued operation of the facility in the above stated categories will have the manufacturer of that component submit the Approved Agency's Certificate of Compliance for their equipment when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include on line capability. This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Use Group. Where components do not affect the facility's functional operation but could affect the performance of other components should they dislodge, only anchorage of that component requires compliance. Components needed for continued operation of the building require Analytical or Shaker Test certification through the total component's load path to structure calculated at its center of gravity. Certification shall prove anchorage, structural and on line capability. For use of seismic experience data, see (a) above.
- c. All components containing hazardous or flammable materials will have the manufacturer of the component submit the Approved Agency's Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of C through F. Testing shall be conducted by Analytical or Shaker Test through the total component's load path to structure at its center of gravity and shall prove anchorage, structural capability and hazardous material containment. Testing shall prove that no internal component will rupture to insure against loss of hazardous or flammable (explosive) material that could support combustion, ignite or contaminate.
- d. All components requiring anchorage compliance only, not listed in the above categories, shall have the manufacturer of each component submit a PE stamped calculation package stating that their project specific equipment will accept anchorage by calculating its reactions through the component's load path to structure at its center of gravity at the designated anchorage locations. This requirement is for all projects having a Seismic Design Category of C through F.

4. Special and Periodic Inspection: (Occupancy Category IV Projects)

- a. The following systems shall require Special Inspection and Periodic Special Inspection for seismic installation and anchorage during the course of construction, as defined earlier in this section for all buildings in Seismic Design Categories C through F.
  - 1) All electrical components for standby or emergency power systems require Periodic Special Inspection.\*
  - 2) All electrical equipment in Seismic Design Categories E and F. (Periodic)\*
  - 3) All flammable, combustible and highly toxic piping and their associated mechanical systems. (Periodic)\*
  - 4) All ductwork containing hazardous materials. (Periodic)\*
  - 5) All equipment using combustible or toxic energy sources. (Special -1)
  - 6) All electric motors, transformers, switchgear unit substations and motor control centers. (Special -1)
  - 7) Reciprocating and rotating type machinery. (Special -1)
  - 8) Pipe, 3" and larger. (Special -1)
  - 9) Tanks, heat exchangers and pressure vessels. (Special -1)
  - 10) Isolator units for seismic isolation system. (Periodic)\*
  - 11) Manufacturer's written Quality Control Program for projects in Seismic



Design Categories E or F.

5. Contractor Responsibilities and Approvals: (Occupancy Category IV Projects)
  - a. Each contractor responsible for the installation of the components asterisked above (\*) shall be responsible for submitting a written contractor's Statement of Responsibility (IBC Section 17 06 .1) (as outlined below) to the design team for their approval.
  - b. In addition, all -1 items above require Special Inspection in accordance with IBC Section 17 07 .8 (Form CQAP and SQA-1) at the end of this specification.
  - c. Contractor Shall:
    - 1) Identify the components that are part of the Quality Assurance Plan. (Asterisked above) \*
    - 2) Identify all Special Inspection and Testing for components installed as part of this contract.
    - 3) List control procedures within the contractor's organization for all special inspection and testing, including methods, frequency of reporting and their distribution of those reports.
6. Seismic Use Group I & II, IBC-2000 & Occupancy Category II & III Structures, IBC-2003-2006, Ip 1.0, Seismic Design Category C:
  - a. Projects in these categories require seismic bracing for all life safety and high hazard components, Paragraph 1.3B sub-paragraphs 1, 2, 5 and 6. In addition, any un-braced component that could adversely affect the performance of a component that must remain functional, Ip 1.5, or could cause the failure or release of hazardous materials (gas or liquid fuel), must be braced or anchored to avoid such failure. This includes any component that could fall or move laterally. (Consequential Damage, ASCE 7-05, Section 16 .2 .3.)
7. Design Seismic Loads:
  - a. Projects in the United States have a minimum design load of 0.4g for statically mounted components and 0.5g for resiliently mounted components. Actual loads for both internal and external isolation and/or anchorage of components shall be as above or as calculated for the specific project location but in no event shall it be less than the above.
  - b. Exclusions for seismic restraint of piping and duct shall be according to 2014 New York City Construction Codes and as stated herein. The minimum horizontal restraint capability shall be 0.4g horizontal and 0.27g vertical (in addition to the gravity load). Life safety equipment defined above shall be designed to withstand a horizontal load of 0.9g and a vertical load of 0.6g.
  - c. Analysis for anchorage must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment depth and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in this section, acting through the equipment center of gravity.
  - d. Vertical load shall be calculated at 1/3 the horizontal load as a minimum, or, as prescribed by the code as 0.2 times Sds.
  - e. Internally isolated equipment in lieu of specified isolation and restraint systems must meet all of the requirements of this section, all articles.
  - f. A Seismic Design Errors and Omissions Insurance Certificate MUST accompany



the seismic restraint equipment manufacturer's calculation. Product liability insurance certificates are not acceptable.

- g. Whether the equipment is internally or externally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic or wind attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section. Sheet metal screw attachment is acceptable provided that the following five conditions are met and verified.

- 1) Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.
- 2) Shear and tension allowables are obtained from an accredited third party source, such as ICC or NDS, not from the screw manufacturer.
- 3) Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure.
- 4) Attachment points of the roof-mounted unit to curb and the curb to structure demonstrates structural load path.
- 5) The method of attachment does not violate the NRCA rating of the curb by violating the roof member's waterproofing.

- h. Failure is defined as the discontinuance of any attachment point or load path between component and structure. Permanent deformation of the component is acceptable as long as the component continues to operate without failure and, if permanent, it is within acceptable manufacturing or structural tolerances.

8. Design Wind Loads:

- a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
- 1) If component is curb mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base type B-3 if isolated, Base type B-4 if non-isolated.
  - 2) If component is support mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base type B-5 if isolated, Base type B-6 if non-isolated.
  - 3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.
- b. Loads and calculations shall be based on IBC-2006, figure 1609 and related sections in ASCE 7-05.
- c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), the force on roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.
- d. Equivalent basic wind speed shall be based on IBC-2006, Table 1609.3.1.
- e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

9. Design Flood Loads:

- a. When a building or structure is located in a flood hazard area, anchorage for all



components subjected to those locations shall follow Section 1.4 B 3d. for their proper fastening to structure.

- b. Components used for anchorage purposes shall be hot dipped galvanized, cadmium-plated or powder-coated for the purpose of anti-corrosion.

#### 1.9 SUBMITTALS

- A. Refer to Part 1, General.

- B. Product Data: The manufacturer of vibration isolation, seismic, wind and flood restraints shall provide submittals for products as follows:

- 1. Descriptive Data:

- a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
- b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and restraints by referencing numbered descriptive drawings.

- 2. Shop Drawings:

- a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
- b. Provide all details of suspension and support for ceiling hung equipment.
- c. Where walls, floors, slabs or supplementary steel work are used for restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturer's submittals must include spacing and maximum seismic/wind loads at the restraint points.
- d. Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third party certification.
- e. Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.
- f. Contractor to submit all calculations, drawings, design and signed by NYSPE.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

- B. Manufacturer of vibration isolation, seismic and wind load control equipment or manufacturer's approved representative shall have the following responsibilities:

- 1. Determine vibration isolation and restraint sizes and locations.
- 2. Provide vibration isolation and restraints as scheduled or specified.
- 3. Provide calculations and materials, if required, for restraint of non-isolated equipment.
- 4. Provide installation instructions in writing, drawings and trained field supervision, where necessary, to insure proper installation and performance.
- 5. Certify correctness of installation upon completion, in writing.
- 6. All provisions of Section 1.4, General Design and Performance Requirements.

- C. All manufacturers of any type of equipment including OEM are responsible for Section 1.4.

- D. Equipment manufacturer's substitution of internally or externally isolated and/or restrained

equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their engineering department, PE stamped and certified by an engineer licensed in the State of New York per the section on the Seismic Restraint Design (See Section 1.4B, article 3), stating that the seismic restraints are in full compliance with these specifications. Manufacturer's certification proving on line capability shall be required in addition to all requirements stated in Section 1.4B.

- E. All expenses for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable for:

1. Indoor or outdoor mounted equipment over or adjacent to:
  - a. Office locations
  - b. Assembly areas

F. RELATED WORK

1. Housekeeping pad structural design, including its attachment to building structure, shall be as shown on the contract drawings. Attachment of all components and restraints to the pad and size of the pad shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor, or by the contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad.
2. Roof steel supporting roof-mounted equipment shall be designed for all seismic and wind forces including, but not limited to, tension, compression and moment loads.
3. Chimneys, stacks and boiler breeching passing through floors are to be attached at each floor level with a riser guide.
4. Where ceilings are not braced, lay-in lighting fixtures, weighing more than 20 lbs, shall have at least 2 independent corner diagonal wire ties to structure.
5. Lay-in ceilings in compliance with seismic code requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as panel lights and diffusers less than 40 lbs to T-bar structures. Local codes dictate fixture support requirements.

1.11 CODE AND STANDARDS REQUIREMENTS

A. Codes and Standards

1. 2014 New York City Construction Codes.
2. SMACNA Guidelines for Seismic Restraint of Mechanical Systems, Second Edition (Standard reference, to be used for design purposes only, not code).
3. American Society for Testing and Materials (ASTM) (Standard).
4. International Conference of Building Officials (ICBO) (Standard).
5. ASHRAE (Standard reference, to be used for design purposes only, not code).
6. VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard)



reference, to be used for design purposes only, not code).

- B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

## PART 2 - PRODUCTS

### 2.1 DESCRIPTION

- A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association). Subject to compliance with requirements, provide products manufactured by The VMC Group, including Vibration Mountings & Controls, Amber/Booth or Korfund Dynamics (Basis-of-Design), or a similar product by an approved manufacturer listed below:

1. Senior Flexonics
2. Mason Industries
3. Or approved equal.

### 2.2 VIBRATION ISOLATION TYPES

- A. Type A: Spring Isolator – Free Standing

A\*

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or 1/4" elastomeric acoustical friction pad between the bottom of isolator and the support.
2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.
3. Spring diameters shall be no less than 0.8" of the compressed height of the spring at rated load.
4. Springs shall have a minimum additional travel to solid equal to 50% of the operating deflection.

- B. Type B: Seismically and Wind Restrained Spring Isolator

1. MS, MSS, AEQM, ASCM, AMSR
2. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of 1/4" shall be maintained around restraining bolts and internal elastomeric deceleration bushings. Limit stops shall be out of contact during normal operation. If housings are to be bolted or welded in position, there must be an internal isolation pad or elastomeric cup. Housing shall be designed to resist all seismic forces.

- C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type)

HRSA

1. Hangers shall consist of rigid steel frames containing minimum 1 1/4" thick elastomeric elements at the top and a steel spring with general characteristics as in Type A. The elastomeric element shall have resilient bushings projecting through the steel box.
2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing



- and short-circuiting the spring.
3. Submittals shall include a hanger drawing showing the 30° capability.
  4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.

D. Type D: Elastomer Double Deflection Hanger Isolator

HR

1. Molded (minimum 1 ¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35."
2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.

E. Type E: Combination Spring/Elastomer Hanger Isolator

HRS

1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.
2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
3. 30° angularity feature is not required.

F. Type F: Seismically Restrained Elastomer Floor Isolator

RSM, MB, RUD

1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing specifications.

G. Type G: Pad Type Elastomer Isolator (Standard)

Maxiflex

1. One layer of ¾" thick elastomeric pad consisting of 2" square modules for size required.
2. Load distribution plates shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

H. Type H: Pad Type Elastomer Isolator (High Density)

Fabri-Flex, NDB, NRC

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.
2. Load distribution plate shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

I. Type I: Thrust Restraints



RSHTR, TRK

1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to  $\frac{1}{4}$ " due to thrust forces. Contractor shall supply hardware.
2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.

J. Type J: Pipe Anchors

MDPA, AG

1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum  $\frac{1}{2}$ " thick 60 durometer elastomer.
2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.
3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

K. Type K: Pipe Guides

PG/AG/SWP/SWX

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum  $\frac{1}{2}$ " thickness of 60 durometer elastomer.
2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and replaceable to allow for selection of pipe movement.
3. Guides shall be capable of  $\pm 1 \frac{5}{8}$ " motion, or to meet location requirements.

L. Type L: Isolated Pipe Hanger System

CIH, CIR, TIH, PIH

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
5. Systems shall be pre-compressed to allow for rod insertion and standard leveling.

2.3 SEISMIC RESTRAINT TYPES

A. Type I: Spring Isolator, Restrained

B. MS, MSS, AEQM, ASCM, AMRS

1. Refer to vibration isolation Type B.





C. Type II: Seismically Restrained Elastomer Floor Isolator

MB, RUD

1. Refer to vibration isolation Type F.

D. Type III: All-Directional Seismic Snubber

SR, ER

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of ¼" thick. Applied loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.

E. Type IV: Floor or Roof Anchorage

Cast-In Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

F. Type V: Seismic Cable Restraints

SB, LRC

1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges.

G. Type VI: Rigid Arm Brace

SAB

1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.

H. Type VII: Internal Clevis Cross Brace

ICB

1. Internal clevis cross braces at seismic locations shall be pre-cut pipe or other approved device sized for internal dimensions.

I. Type VIII: Seismic Waterproof Foundation Wall Sleeve



## SWFWS

1. Seismic waterproof foundation wall sleeves shall consist of two elastomeric sleeves that shall be mounted both inside and out of the vertical foundation wall. The conical design shall have a suitably waterproof means of fastening to both concrete and to its concentric utility pipe. Allowable vertical drift shall be  $\pm 2"$  from the installed neutral point along the vertical "y" axis. All fittings shall be stainless steel or galvanized.

## 2.4 EQUIPMENT BASES

### A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

### B. Base Types

#### 1. Type B-1: Integral Structural Steel Base

WFB, SFB, WSB

- a. Rectangular bases are preferred for all equipment.
- b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
- c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.
- d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
- e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2."

#### 2. Type B-2: Concrete Inertia Base

MPF, WPF, CPF

- a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
- b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
- c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6."
- d. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
- e. Forms shall include a minimum concrete reinforcing consisting of 3/8" bars welded in place a maximum of 16" on centers running both ways in a layer 1 to 1 1/2" above the bottom.
- f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
- g. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum operational clearance below the base.

#### 3. Type B-5: Isolated Equipment Supports



R7200/R7300

- a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. The lower frame must accept point support for both seismic attachment and leveling. The upper frame must be furnished with positive fastening provisions, (welding or bolting), to anchor the component to the equipment support so as not to violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.4, Article B, paragraph 7, Design Seismic Loads, are met. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.
- b. All-directional elastomeric snubber bushings shall be minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick elastomeric acoustical pads or cups.
- c. Hardware must be plated and the springs shall be powder-coated or cadmium-plated.
- d. All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
- e. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design wind/seismic loads.

4. Type B-6: Non-Isolated Equipment Supports

R7000

- a. This shall have the same provisions as Type B-5 without the spring isolation.

5. Type B-8: Plumbing Components Structural Base Frames

- a. Where roof mounted plumbing components are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit's base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on type "B" wind /seismic restrained isolation system.
- b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A". Structural Base Frame shall be type RTSBF as manufactured by The VMC Group.

2.5 FLEXIBLE CONNECTORS

A. Type FC-2: Flexible Stainless Steel Hose

1. SS-FP, SS-FW, SS-PM, SS-WE
2. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples.

B. Type BC-2 connector shall be braided bronze for Freon connections.



1. Minimum lengths shall be as tabulated:
  - a.

Flanged	Male Nipples
3 x 14    10 x 26	½ x 9    1 ½ x 13
4 x 15    12 x 28	¾ x 10    2 x 14
5 x 19    14 x 30	1 x 11    2 ½ x 18
6 x 20    16 x 32	1 ¼ x 12
8 x 22	
2. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. All areas that will receive components requiring vibration control, seismic or wind load bracing shall be thoroughly examined for deficiencies that will affect their installation or performance. Such deficiencies shall be corrected prior to the installation of any such system.
- B. Examine all “rough ins” including anchors and reinforcing prior to placement.

#### 3.3 APPLICATIONS

- A. All vibration isolators and seismic, wind restraint systems must be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic, wind restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system specified herein.
- D. The contractor shall not install any isolated components in a manner that makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Overstressing of the building structure must not occur due to overhead support of equipment. Contractor must submit loads to the Commissioner for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.
- G. Seismic cable restraints shall be installed slightly slack to avoid short circuiting the isolated

suspended equipment or piping.

- H. Seismic cable assemblies are installed taut on non-isolated systems. Seismic rigid braces may be used in place of cables on rigidly attached systems.
- I. At locations where seismic cable restraints or seismic single arm braces are located, the support rods must be braced when necessary to accept compressive loads. See Table "E."
- J. At all locations where seismic cable braces and seismic cable restraints are attached to the pipe clevis, the clevis bolt must be reinforced with pipe clevis cross bolt braces or double inside nuts if required by seismic acceleration levels.
- K. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.
- L. Special and Periodic Inspections for items listed in Section 1.4, Article B shall be conducted and submitted on a timely basis.

### 3.4 EQUIPMENT INSTALLATION

- A. Equipment shall be isolated and/or restrained as per Tables B-E at the end of this section.
- B. Place floor mounted equipment on 4" actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck to meet acceleration criteria (see Section 1.4). Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under that section of the contract documents.
- C. Additional Requirements:
  - 1. The minimum operating clearance under all isolated components bases shall be 2."
  - 2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
  - 3. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions, within the limits of the restraints.
  - 4. Ceilings containing diffusers or lighting fixtures must meet seismic requirements by using earthquake clips or other approved means of positive attachment to secure diffuser and fixtures to T-bar structure.
  - 5. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

### 3.5 PIPE

- A. Vibration Isolation of Piping:
  - 1. Plumbing Water Piping (Excludes Sanitary and Drainage Lines): All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Type E hangers shall isolate horizontal pressurized runs in all other locations of the building. Floor supported piping shall rest on Type B isolators. Expansion tanks are considered part of the piping run. The first 3 isolators from



the isolated equipment shall have at least the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" nominal deflection or greater for pipe sizes up to and including 3," 1 3/8" nominal deflection or greater for pipe sizes greater than 3." Where column spacing exceeds 35', isolation hanger deflection shall be 2½" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.

2. Condensate Piping: All ceiling suspended piping in the mechanical equipment room shall be isolated with Type D hangers except where anchor or guided if connected to isolated equipment. All floor supported piping shall be supported with Type F isolators.
3. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B.) Isolator type shall be as listed in Article 1, above.
4. Riser Location: All risers shall be supported on Type J or K anchors or guide restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
5. Control Air Piping: Where control air piping is connected to isolated components, all piping shall be isolated and equipment shall be flexibly connected in horizontal and vertical plane with Type FC-2 flexible connectors.
6. Gas lines shall not be isolated.
7. Fire protection lines shall not be isolated.

**B. Seismic Restraint of Piping.**

1. All high hazard and life safety pipe regardless of size such as fuel oil piping, fire protection mains, gas piping, medical gas piping and compressed air piping and piping with an  $I_p=1.5$  shall be seismically restrained or braced. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping. There are no exclusions for size or distance in this category.
2. Seismically restrain piping, with an  $I_p = 1.0$ , located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1¼" I.D. and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping.
3. Seismically restrain all other piping 2½" diameter and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type VI seismic cable restraints or single arm braces may be used on non-isolated piping.
4. See Table D for maximum seismic bracing distances.
5. Multiple runs of pipe on the same support shall have distance determined by calculation.
6. Rod braces shall be used for all rod lengths as listed in Table E.
7. Clevis hangers shall have braces placed inside of hanger at seismic brace locations.
8. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
9. For fuel oil and all gas piping, transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
10. Transverse restraint for one pipe section may also act as longitudinal restraint for a pipe section of the same or smaller size connected perpendicular to it if the restraint is installed within 24" of the centerline of the smaller pipe or combined stresses are within allowable limits at longer distances.
11. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints. Use Type V or VI restraint, if trapeze is smaller than 48" long.
12. Branch lines may not be used to restrain main lines or cross-mains.
13. Where pipe passes through a fire-rated, seismic gypsum wall, the wall can act as a



lateral/transverse brace for pipe sizes up to and including 6," provided fire stopping material is tight to the pipe.

14. Where pipe passes through a seismic block or concrete wall, the wall can act as a lateral/transverse brace.
15. Where horizontal pipe crosses a building's drift expansion joint, allowance shall be part of the design to accommodate differential motion.
16. Vertical pipe rises between floors shall have their differential movement part of the seismic design for building drift.
17. For horizontal passage of all underground utilities through building's foundation wall, all pipes shall pass freely through an oversized opening and waterproofed accordingly to accommodate maximum allowable building drift. (Seismic Restraint Type VIII).

### 3.6 EXEMPTIONS

#### A. EQUIPMENT:

1. Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.
2. Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor,  $I_p = 1.0$  and there is no possibility of consequential damage.
3. Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an  $I_p = 1.0$  and where flexible connections exist between the component and associated piping.

#### B. DUCT (Applies to $I_p = 1.0$ only)

1. Rectangular, square, and oval air handling ducts less than six square feet in cross sectional area.
2. Round air handling duct less than 28 inches in diameter.
3. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork.

#### C. PIPING and CONDUIT

1. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where  $I_p = 1.0$ .
2. High deformability pipe in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where  $I_p = 1.5$ .
3. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where  $I_p = 1.5$ .
4. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
5. Piping systems, including their supports, designed and constructed in accordance with ASME B31.

#### D. EXEMPTIONS DO NOT APPLY FOR:

##### 1. LIFE SAFETY or HIGH HAZARD COMPONENTS

- a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2006 as listed in Section 1.3 B



High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

2. ELECTRICAL

- a. Includes critical, standby or emergency power components including conduit (1" nominal diameter and larger) cable tray or bus duct, lighting, panels, communication lines involving 911, etc.

3. PIPING

- a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.

4. DUCT

- a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

5. EQUIPMENT

- a. Previously excluded non-life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

3.7 FIELD QUALITY CONTROL, INSPECTION

- A. All Independent Special and Periodic Inspections must be performed and submitted by the Contractor on components as outlined in Section 1.4 B, Article 4. (See also Contractor Responsibility, Section 1.4B, Article 5.) Note: Special Inspection services are to be supplied by the The City of New York.
- B. Upon completion of installation of all vibration isolation devices, the manufacturer's chosen representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or list any that require correction. The contractor shall submit a report to the Commissioner, including the representative's report, certifying correctness of the installation or detailing corrective work to be done.





3.8 Selection Guide for Vibration Isolation and Seismic Restraint

TABLE "B" PLUMBING EQUIPMENT										
	On Grade, Basement or Slab on Grade						Above Grade			
Equipment (See Notes)	HP	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Rest r
Air Compressors & Vacuum Pumps	Up to 10	Floor	B	0.75	---	IV	B	1.50	---	IV
	Over 10	Floor	B	0.75	B-2	IV	B	1.50	B-2	IV
Base Mounted Pumps	Up to 15	Floor	B	0.75	B-2	IV	B	0.75	B-2	IV
	Over 15	Floor	B	0.75	B-2	IV	B	0.75	B-2	IV

Roof Mounted Components use Spec Type B-5, if over occupied areas, Defl, 1.5".

Roof Mounted Components use Spec Type B-6 if over unoccupied areas.

Minimum Deflection Guide for Equipment with Low RPM

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5"
401 thru 600	2.5"
601 thru 900	1.5"
Greater than 900	0.75"

A. General Notes for All Tables:

1. Abbreviations:

- a. Mtg = Mounting
- b. ol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
- c. Defl = Minimum Deflection of Vibration Isolator
- d. Base = Base Type per Section 2.4, Equipment Bases
- e. Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types

2. All deflections indicated are in inches.
3. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.
4. For roof applications, use base Type B-5, and/or B-8 where applicable.
5. Static deflection shall be determined based on the deflection guide for Table "A."
6. Deflections indicated are minimums at actual load and shall be selected for manufacturer's nominal 5," 4," 3," 2" and 1" deflection spring series; RPM is defined as the lowest operating speed of the equipment.
7. Single stroke compressors may require inertia bases with thicknesses greater than 14"



maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8."

### 3.9 Spacing Chart for Suspended Components

Table "D" Seismic Bracing			
(Maximum Allowable Spacing Shown – Actual Spacing to Be Determined By Calculation)			
Equipment	On center Transverse	On Center Longitudinal	Change of Direction
Pipe Threaded, Welded, Soldered or Grooved; Conduit and Conduit Racks			
16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
2.5" & Larger	10 Feet	20 Feet	4 Feet
Boiler Breeching	30 Feet	60 Feet	4 Feet
Chimneys & Stacks	30 Feet	60 Feet	4 Feet

### 3.10 Vertical Hanger Rod Bracing Schedule

Table "E" Hanger Rod Bracing Schedule					
(Stiffener to be maximum 6" from end of rod)					
Rod Dia.	Clamp Size	Maximum Un-braced Rod Length	Steel Angle Size	Clamp Spacing	Min # of Clamps per Stiffener
3/8"	SRBC-1-1/4	19"	1 x 1 x 1/4"	16"	2
1/2"	SRBC-1-1/4	25"	1 x 1 x 1/4"	20"	2
5/8"	SRBC-1-1/4	31"	1 x 1 x 1/4"	24"	2
3/4"	SRBC-1-1/2	37"	1 1/2 x 1 1/2 x 1/4"	28"	2
7/8"	SRBC-1-1/2	43"	1 1/2 x 1 1/2 x 1/4"	33"	2
1"	SRBC-1-1/2	50"	1 1/2 x 1 1/2 x 1/4"	40"	2
1 1/8"	SRBC-1-1/2	62"	1 1/2 x 1 1/2 x 1/4"	50"	2

**END OF SECTION 22 05 48**

**SECTION 22 05 53****IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.
  4. Stencils.
  5. Valve tags.
  6. Warning tags.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.

## 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

## 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

## 1.8 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

#### A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

#### B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Yellow.



4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.



- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

## 2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Aluminum.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
  - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "Danger," "Caution," or "Do Not Operate."
  - 4. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
  - 1. Medium-Pressure, Compressed-Air Piping:
    - a. Background Color: White.
    - b. Letter Color: Black.
  - 2. Domestic Water Piping:
    - a. Background Color: Blue
    - b. Letter Color: White.
  - 3. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Black.
    - b. Letter Color: Yellow.

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 2 inches (50 mm), round.
    - b. Hot Water: 2 inches (50 mm), round.
    - c. Low-Pressure Compressed Air: 2 inches (50 mm), round.
    - d. High-Pressure Compressed Air: 2 inches (50 mm), round.
    - e. Vacuum, N<sub>2</sub>O, CO<sub>2</sub>, 2 inches
  - 2. Valve-Tag Color:
    - a. Cold Water: Green.
    - b. Hot Water: Green.
    - c. Low-Pressure Compressed Air: Green.
    - d. High-Pressure Compressed Air: Green.
  - 3. Letter Color:
    - a. Cold Water: Black.
    - b. Hot Water: Black.
    - c. Low-Pressure Compressed Air: Black.
    - d. High-Pressure Compressed Air: Black.

### 3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 22 05 53**



**SECTION 22 07 19****PLUMBING PIPING INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Roof drains and rainwater leaders.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".



## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
  - 2. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
  - 3. Sheet Jacket Materials: 12 inches (300 mm) square.
  - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to New York City Department of Buildings indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft instructing program recognized by the Department of Labor, Bureau of Apprenticeship and Training.
- C. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to New York City Department of Buildings. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.



2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
  - D. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by the Commissioner. Use materials indicated for the completed Work.
    1. Piping Mockups:
      - a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.
      - b. One each of a 90-degree threaded, welded, and flanged elbow.
      - c. One each of a threaded, welded, and flanged tee fitting.
      - d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.
      - e. Four support hangers including hanger shield and insert.
      - f. One threaded strainer and one flanged strainer with removable portion of insulation.
      - g. One threaded reducer and one welded reducer.
      - h. One pressure temperature tap.
      - i. One mechanical coupling.
    2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
    3. Notify the Commissioner seven days in advance of dates and times when mockups will be constructed.
    4. Obtain the Commissioner's approval of mockups before starting insulation application.
    5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Commissioner specifically approves such deviations in writing.
    6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    7. Demolish and remove mockups when directed.
  - E. Comply with the following applicable standards and other requirements specified for miscellaneous components:
    1. Supply and Drain Protective Shielding Guards: ICC A117.1.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- 1.10 COORDINATION
- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
  - C. Coordinate installation and testing of heat tracing.

## 1.11 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

#### 1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; SoftTouch Duct Wrap.
- b. Johns Manville; Microlite.
- c. Knauf Insulation; Friendly Feel Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap.
- e. Owens Corning; SOFTR All-Service Duct Wrap.
- f. Or approved equal.

#### G. Mineral-Fiber, Preformed Pipe Insulation:

#### 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Fibrex Insulations Inc.; Coreplus 1200.
- b. Johns Manville; Micro-Lok.
- c. Knauf Insulation; 1000-Degree Pipe Insulation.
- d. Manson Insulation Inc. ; Alley-K.
- e. Owens Corning; Fiberglas Pipe Insulation.
- f. Or approved equal.

#### 2. Type I, 850 Deg F (454 Deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied

ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.2 INSULATING CEMENTS

### A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide Ramco Insulation, Inc.; Super-Stik. (Basis-of-Design), or an equivalent product by one of the following:

- a. Rutland
- b. Amerisafe
- c. Or approved equal.

### B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide Ramco Insulation, Inc.; Thermokote V. (Basis-of-Design), or an equivalent product by one of the following:

- a. Rutland
- b. Amerisafe
- c. Or approved equal.

### C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote. (Basis-of-Design) or an equivalent product by one of the following:

- a. Rutland
- b. Amerisafe
- c. Or approved equal.

## 2.3 ADHESIVES

### A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

### B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide the following:

- a. Aeroflex USA, Inc.; Aero seal.
- b. Armacell LLC; Armaflex 520 Adhesive.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
- d. K-Flex USA; R-373 Contact Adhesive.
- e. Or approved equal.



2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
    - e. Or approved equal.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    - d. Mon-Eco Industries, Inc.; 22-25.
    - e. Or approved equal.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
    - e. Or approved equal.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

**2.4 MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
    - c. Mon-Eco Industries, Inc.; 55-50.
    - d. Or approved equal.
  - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Eagle Bridges - Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
    - e. Or approved equal.
  - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
  - 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
  - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  - 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
    - d. Or approved equal.



2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. Eagle Bridges - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
  - f. Or approved equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
    - d. Or approved equal.
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
  5. Color: White.

## 2.6 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide the following:





- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Pittsburgh Corning Corporation; Pittseal 444.
    - f. Or approved equal.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Permanently flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
  5. Color: White or gray.
  6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Or approved equal.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  5. Color: Aluminum.
  6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Mon-Eco Industries, Inc.; 55-50.
    - c. Vimasco Corporation; WC-1/WC-5.
    - d. Or approved equal.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  5. Color: White.
  6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
    - b. Thermaxx
    - c. FitTight
    - d. Or approved equal.

## 2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
    - e. Or approved equal.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.



- b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
  - c. RPR Products, Inc.; Insul-Mate.
  - d. Or approved equal.
- 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Finish and thickness are indicated in field-applied jacket schedules.
  - b. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
  - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper
  - d. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
  - a. Factory cut and rolled to size.
  - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
  - 1. Products: Subject to compliance with requirements, products manufactured by one of the following:
    - a. Pittsburgh Corning Corporation; Pittwrap.



- b. Polyguard Products, Inc.; Insulrap No Torch 125.
- c. Perma-Pipe inc.
- d. Or approved equal.

## 2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches (75 mm).
  - 3. Thickness: 11.5 mils (0.29 mm).
  - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  - 2. Width: 3 inches (75 mm).
  - 3. Thickness: 6.5 mils (0.16 mm).
  - 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  - 2. Width: 2 inches (50 mm).
  - 3. Thickness: 6 mils (0.15 mm).
  - 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  - 5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. ABI, Ideal Tape Division; 488 AWF.
- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- c. Compac Corporation; 120.
- d. Venture Tape; 3520 CW.
- e. Or approved equal.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
- b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
- c. Advance Products & Systems
- d. Or approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, 1/2 inch (13 mm) wide with closed seal.

3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.

B. Staples: Outward-clinching Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

## 2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Engineered Brass Company.
- b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
- c. McGuire Manufacturing.
- d. Plumberex.
- e. Truebro; a brand of IPS Corporation.
- f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
- g. Or approved equal.



2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

**B. Protective Shielding Piping Enclosures:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Truebro; a brand of IPS Corporation.
  - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
  - c. Decoshield Systems
  - d. Or approved equal.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

**PART 3 - EXECUTION**

**3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.



### 3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.



4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.5 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.





- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 07 84 10 "Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 10 "Firestopping."

### 3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and



- unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.



D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 00 "Painting".
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by the Commissioner. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by the Commissioner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings, except where exposed hot pipes and location could cause personal injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1 inch (25 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1 inch (25 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1 inch (25 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1 inch (25 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

C. Stormwater and Overflow:



1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1 inch (25 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1 inch (25 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

E. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.

F. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 2 inches (50 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 2 inches (50 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  1. PVC: 30 mils (0.8 mm) thick.
  2. Aluminum, Smooth 0.032 inch (0.81 mm) thick.
  3. Painted Aluminum, Smooth: 0.020 inch (0.51 mm) thick.



4. Stainless Steel, Type 304, Smooth 2B Finish, 0.020 inch (0.51 mm) thick.

D. Piping, Exposed:

1. PVC: 30 mils (0.8 mm) thick.
2. Aluminum, Smooth, 0.040 inch (1.0 mm) thick.
3. Painted Aluminum, Smooth: 0.016 inch (0.41 mm) thick.
4. Stainless Steel, Type 304, Smooth 2B Finish, 0.020 inch (0.51 mm) thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  1. PVC: None.
  2. Aluminum, Smooth, 0.032 inch (0.81 mm) thick.
  3. Painted Aluminum, Smooth: 0.016 inch (0.41 mm) thick.
  4. Stainless Steel, Type 304 or Smooth 2B Finish: 0.024 inch (0.61 mm) thick.
- D. Piping, Exposed:
  1. PVC: 40 mils (1.0 mm) thick.
  2. Painted Aluminum, 0.024 inch (0.61 mm) thick.
  3. Stainless Steel, Type 304, Smooth 2B Finish: 0.024 inch (0.61 mm) thick.

3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

**END OF SECTION 22 07 19**



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**SECTION 22 08 00****COMMISSIONING OF PLUMBING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 SUMMARY**

- A. This section includes commissioning process requirements for Plumbing systems, assemblies, and equipment.
- B. Related Sections:
  - 1. DDC General Conditions Section for general commissioning process requirements.

**1.3 DESCRIPTION**

- A. Commissioning is a systematic process of confirming that all building systems perform interactively according to the Commissioner's Project Requirements and the Basis of Design and continuing through construction, acceptance and the warranty period with actual verification of performance.
- B. The Commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.
- C. The CxA directs and coordinates the commissioning activities and reports to the Commissioner. All members in the construction process work together to fulfill their contracted responsibilities and meet the objectives of the Commissioner's Project Requirement's as detailed in the Contract Documents.

**1.4 DEFINITIONS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for definitions.

**1.5 SUBMITTALS**

- A. The CxA will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment



specifications. The CxA will notify the Contractor and Commissioner as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

- B. The CxA will receive a copy of the final approved submittals.
- C. In addition, the contractor is to provide the following:
  - 1. Certificate of readiness
  - 2. Certificates of completion of installation, prestart, and startup activities.
  - 3. O&M manuals
  - 4. Test reports
- D. Refer to DDC General Conditions for general commissioning submittal requirements.

## **1.6 QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractor will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

## **1.7 COORDINATION**

- A. Commissioning Kick-Off Meeting – Construction Team: Contractors will attend a meeting of the Commissioning Team, chaired by the CxA, to review the scope of commissioning process activities and the Commissioning Plan with discussions on milestones, activities, and assignments of responsibilities. The flow and type of documents and the amount of submittal data given to the CxA will be determined. Meeting minutes will then be distributed to all parties by the CxA.
- B. Commissioning Meetings: Contractors will attend coordination meetings with the Commissioning Team, chaired by the CxA, to review progress on the Commissioning Plan, construction deficiencies, scheduling conflicts, and to discuss strategies and processes for upcoming commissioning process activities.
- C. Miscellaneous Construction Meetings: The CxA attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in the commissioning process. This will not include 100% meeting attendance, but the CxA shall be provided with the subsequent meeting minutes for review.
- D. Pre-testing Meetings: Contractors will attend pretest meetings with the Commissioning Team, chaired by the CxA, to review startup reports, pre-test inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, sub-system, equipment, and component to be tested.
- E. Testing: Contractors will coordinate with testing personnel and agencies for timing and access for CxA to witness test.



- F. Manufacturers' Inspection and Startup Services: Contractors will coordinate services of manufacturers' inspection and startup services.
- G. Testing, Adjusting and Balancing: Contractors will coordinate with plan and schedule for testing, adjusting and balancing for timing and access for CxA to witness process.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the Contractor shall ultimately be responsible for all standard testing equipment for the plumbing system in Division 22 except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by the contractor.
- B. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the City of New York upon completion of the commissioning process.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the Contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems. These checklists shall be provided to the Contractors for completion. The CxA shall gather and review the completeness and accuracy of these checklists via site visits.
- B. Red-lined Drawings (As-Built): Contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.



- D. Demonstration and Orientation: Contractor will provide demonstration and orientation as required by the specifications. A complete orientation plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any orientation. An orientation agenda for each orientation session must be submitted to the CxA one (1) week prior the orientation session.

### **3.2 CONTRACTOR'S RESPONSIBILITIES**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for contractor's responsibilities.
- B. Attend construction phase controls coordination meetings.
- C. Attend domestic water balancing review and coordination meetings.
- D. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Prepare preliminary schedule for Plumbing system orientations and inspections, operation and maintenance manual submissions, orientation sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for the City of New York. Distribute preliminary schedule to commissioning team members. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- G. Provide detailed startup procedures.
- H. Provide a written list of all user adjustable set-points and reset schedules with a brief discussion of the purpose of each and the range of reasonable adjustments with energy implications
- I. Provide a written schedule frequency to review the various set-points and reset schedules to ensure they are current relevant and efficient values.
- J. Respond to provided new deficiencies and/or responses within five (5) business days.
- K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- L. Coordinate with the CxA to provide 48-hour advanced notice so that the witnessing of equipment and system start-up and testing can begin.
- M. Notify the CxA a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- N. Provide written notification to the Commissioner and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
  - 1. Sanitary waste and vent piping, storm drainage piping, and sump pumps.
  - 2. Domestic water piping, domestic water booster pumps, hot water circulator pumps, and domestic water heaters.



3. Gas piping and gas booster pumps.
  4. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
- O. The equipment supplier shall document the performance of his equipment.
- P. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- Q. Test, Adjust and Balance Contractor
1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
  2. Submit the site-specific testing and balancing plan to the CxA and Commissioner for review and acceptance.
  3. Attend the testing and balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the HVAC&R system.
  4. At the completion of the testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC contractor and the Contractor.
  5. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.
  6. Provide recommended setpoints as determined by Testing, Adjusting, and Balancing such as static pressure and differential pressure setpoints.
- R. Equipment Suppliers
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the City of New York, to keep warranties in force.
  2. Assist in equipment testing per agreements with Contractors.
  3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

### **3.3 CxA'S RESPONSIBILITIES**

#### **A. Roles and Responsibilities**

1. Refer to DDC General Conditions Section "General Commissioning Requirements" for general CxA responsibilities.

#### **B. Cx Team Meetings**

1. Commissioning during the Construction Phase will begin with a 'Commissioning Kick-Off Meeting – for Construction Team' conducted by the CxA where the commissioning process is reviewed with all of the commissioning team members.
2. Additional meetings will be required throughout the Construction and Acceptance phases. The CxA shall attend select meetings related to commissioning as required by the DDC during the Construction and Acceptances phases.

#### **C. Coordination and Scheduling**

1. Coordinate and direct commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications, and consultations with all necessary parties.



2. Coordinate commissioning work with the Commissioner to ensure that commissioning activities are being scheduled into the master project schedule.
3. Coordinate with the Commissioner to witness tests, inspections, and systems startup.

**D. Commissioning Progress**

1. Perform periodic site visits to observe component and system installations, and qualify contractor completed checklists.
2. Report deficiencies to the Commissioner including but not limited to issues related to adequate accessibility required for component maintenance replacement and repair.
3. Review construction meeting minutes for revisions/substitutions relating to the commissioning process.

**E. Pre-Functional Checks**

1. Verify proper installation of components, equipment, systems and assemblies. Sampling procedures may not be employed on systems and equipment.
2. Pre-Functional checks for a piece of equipment shall only be started once the approved checklist for a piece of equipment has been received from the installing contractor indicating the equipment is ready to being its pre-functional checks.
3. Team will not be allowed to move forward into functional testing until all Pre-Functional testing is completed and the team moves onto the Acceptance Phase for the project.

**F. Equipment and System Startup and Verification**

1. Review and approve component, equipment, system, and assembly startup plan developed and submitted by the Contractor.
2. Approve system startup by reviewing startup reports, if contracted; and by selected site observation.
3. Review the Testing, Adjusting and Balancing execution plan for the project, which shall be submitted by the TAB subcontractor.
4. Verify and document the accuracy of the air and water systems balancing by spot testing the air and water reported field values with TAB subcontractors and by reviewing completed reports.

**G. Functional Performance Testing**

1. With assistance from the Contractor, write Functional Performance Testing procedures for all components, equipment or systems to be commissioned.
2. With the assistance of the Contractors, coordinate Functional Performance Testing. Witness and approve Functional Performance Testing performed by the Contractors.
3. With the assistance of the Contractors, coordinate retesting as necessary until satisfactory performance is achieved.
4. Witness seasonal or deferred Functional Performance Testing as necessary.

**H. Issue/Deficiency Logs**

1. The CxA shall prepare a formal, ongoing, online record of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process.
2. Issues will be recorded on an online Commissioning Issues Log for the contractors to resolve to the satisfaction of the Commissioner. Issues will be added by the CxA. Team members are required to post their own responses to issues pertaining to their work. Team members are required to respond to issues added to the list within five (5) working days of being added by the CxA.
3. Issues will be revisited one (1) time to verify that the proper corrections have been made.
4. When issues are resolved, they will be closed on the Issues Log by the CxA.



**I. Operation and Maintenance Data**

1. The CxA shall review of the documentation submitted by the Contractor as required by the Specifications for completeness and accuracy. This commissioning review supplements, but does not replace, the Commissioner's review.
2. Review equipment warranties.

**J. Instruction**

1. The Contractor will provide all documentation and qualified instruction personnel for instruction.
2. The CxA will verify through the Contractor's plan and schedule, instruction agendas, and select observations that proper instruction procedures were followed on all commissioned systems.
3. The CxA will verify that Instruction Video Recordings are executed, collected, and provided to the Commissioner.
4. See appropriate section below pertaining to instruction.

**K. Systems Manual Requirements**

1. Index of Systems Manual with notation as to content storage location if not in actual manual.
2. Executive Summary
3. A list of recommended operational record keeping procedures at the facility level, including sample forms, trend logs, or others, and a rationale for each.
4. Maintenance procedures, schedules and recommendations.
5. Ongoing Optimization
6. Other Attachments

**L. Post Occupancy Review**

1. The CxA will return to the site within the 12-month warranty period to address the following: review current building operations with facility staff and address outstanding issues related to the Commissioner's Project Requirements; Interview facility staff and identify problems or concerns with operating the building; Identify problems covered under warranty or under the original construction contract.
2. The CxA will make suggestions for improvements in the content of the O&M Manuals. Any required changes shall be made by the contractor responsible for that section.
3. The CxA shall assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

**M. Commissioning Final Report**

1. The CxA shall provide a final report following the completion of all Functional Performance Testing. The report is to outline compliance and non-compliance to the construction documents, as well as identify concerns relative to future performance

**3.4 TESTING PREPARATION**

- A. Certify in writing to the CxA that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.



- C. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### **3.5 TESTING, ADJUSTING AND BALANCING VERIFICATION**

- A. Prior to performance of Testing, Adjusting, and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
  - 1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
  - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### **3.6 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Plumbing testing shall include entire Plumbing installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the contractor shall prepare detailed testing plans, procedures, and checklists for Plumbing systems, subsystems, and equipment.





- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Commissioner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.7 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 22 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. Plumbing Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 22 piping Sections. Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
  - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
  - 2. Description of equipment for flushing operations.
  - 3. Minimum flushing water velocity.
  - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, fuel gas, sanitary waste and vent piping, storm drainage piping, sprinkler and domestic water distribution systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.



- F. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:

1. Domestic Hot Water System
2. Domestic Water System
3. Domestic Water Heaters
4. Gas System – Natural Gas
5. Hot Water Circulating Pump
6. Water Booster System
7. Elevator Sump Pump
8. Sewage Ejector Pump

### **3.8 DEFICIENCIES/NON-CONFORMANCE, FAILURE DUE TO MANUFACTURER DEFECT**

A. Deficiencies/Non-Conformance

1. The CxA will record the results of the functional test on the test form. All deficiencies or non-conformance items shall be noted and reported to the Commissioner and Contractors on a standardized form.
2. The Contractor shall respond to new deficiencies within five (5) business days. The response shall either indicate the issue will be corrected with anticipated date of completion indicated or the response should clearly indicate why the Contractor disputes the claim while referencing the contract document in dispute or request further information to clarify the concern.
3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA.
4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
5. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing Contractor.
6. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it, the CxA documents the deficiency and the Contractor's response and intentions or corrections. The CxA and Contractor then proceed to another test or sequence. Once the Contractor corrects the deficiency, the test is rescheduled and repeated in the anticipation of correct operation or function.
7. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the CxA documents the deficiency and the Contractor's response. The deficiency is then forwarded to parties assumed to be responsible for the deficiency. Resolutions are made at the lowest management level possible. Other parties are brought into the discussion as needed. Final interpretive authority is with the Commissioner. Final acceptance authority is with the Commissioner and CxA. The CxA will then document the resolution process. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency. The CxA then reschedules the test as stated in the section above.
8. Deficiencies that are not corrected at the time of documentation, shall be completed by the affected contractor and photo evidence of the deficiency resolution shall be sent to both the Commissioner and the CxA.

B. Failure due to Manufacturer Defect

1. If 10% or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable only by the Commissioner. In such case, the Contractor shall provide the Commissioner with the following.



- i. Within one week of notification from the Contractor the manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Commissioner within two weeks of the original notice.
- ii. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
- iii. The Commissioner will determine whether a replacement of all identical units or a repair is acceptable.
- iv. Two examples of the proposed solution will be installed by the Contractor and the Contractor will be allowed to test the installations for up to one week, upon which the Commissioner will decide whether to accept the solution.
- v. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

### **3.9 APPROVAL**

- A. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA. The CxA recommends acceptance of each test to the Commissioner using a standard form.

### **3.10 DEFERRED TESTING**

- A. Unforeseen Deferred Testing – If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Commissioner. These tests will be conducted in the same manner as the seasonal tests, as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing – During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Contractors, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and record documents due to seasonal testing will be made by the Contractor.

### **3.11 MANUFACTURER'S MANUALS**

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in DDC General Conditions.
- B. The specific content and format requirements for the standard O&M manuals are detailed in DDC General Conditions. Special requirements for the Contractor are found in Division 23.
- C. CxA Review and Approval – Prior to substantial completion, the CxA shall review the O&M manuals, documentation and record documents for systems that were commissioned to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the Contractor and Commissioner, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the Commissioner. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated.



### **3.12 INSTRUCTION OF CITY OF NEW YORK PERSONNEL**

- A. The Contractor shall be responsible for instruction coordination, scheduling, and ultimately for ensuring that instruction is completed.
- B. The CxA shall oversee the instruction of the City of New York for commissioned equipment and systems.
  - 1. The CxA shall interview the City of New York to determine the special needs and areas where instruction will be most valuable. The Commissioner and CxA shall decide how rigorous the instruction should be for each piece of commissioned equipment. The CxA shall communicate the results to the Contractor, who will in turn communicate to the subcontractors and vendors who also have instruction responsibilities.
  - 2. In addition to these general requirements, the specific instruction requirements of the City of New York by contractors, subcontractors and vendors are specified in the individual sections listed in Section 1.2 – Summary.
  - 3. The Contractor responsible for instruction will submit a written instruction plan to the Contractor for review and approval prior to instruction. The Contractor will submit one comprehensive instruction plan to the CxA and the Commissioner.
  - 4. The plan will be reviewed by the CxA and the Commissioner. Comments pertaining to its deficiencies will be forwarded to the Contractor. The instruction plan will be rewritten until approved by the CxA and the Commissioner. The final approved instruction plan will cover the following elements:
    - a. Equipment (included in instruction)
    - b. Intended audience
    - c. Location of instruction
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of instruction on each subject
    - g. Qualified instructor for each subject
    - h. Instructor qualifications
    - i. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
  - 5. For the primary equipment, the Contractor shall provide a discussion of the control of the equipment during the instruction conducted by each subcontractor or vendor.
  - 6. Instruction documentation shall include the following items:
    - a. Copy of the instruction plan, including schedule, syllabus, and agenda.
    - b. Copy of the Commissioner's Project Requirements.
    - c. Copy of the Basis of Design.
    - d. Compiled operations manuals.
    - e. Compiled maintenance manuals.
    - f. Completed manufacturer instruction manuals.
    - g. Red-lined drawings.
    - h. Other pertinent documents.
  - 7. The CxA develops criteria for determining that the instruction was satisfactorily completed, including attending some of the instruction, etc. The CxA recommends approval of the instruction to the Commissioner using a standard form. The Commissioner signs the approval form/letter template.



8. At one of the instruction sessions, the CxA presents a presentation discussing the use of the blank functional test forms for re-commissioning equipment
9. Videotaping of the instruction sessions in DVD format will be provided by the CxA.

### **3.13 FUNCTIONAL BUILDING SYSTEMS DEMONSTRATION TEST (72 HOURS)**

- A. Refer to Addendum to the General Conditions Section “General Commissioning Requirements” for requirements pertaining to 72-Hour Functional Building Systems Demonstration Testing.

**END OF SECTION 22 08 00**



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**SECTION 22 11 13****FACILITY WATER DISTRIBUTION PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract - City of New York Standard Construction Contract.

**1.2 SUMMARY**

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
  - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

**1.7 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

**1.8 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of New York City Department of Buildings for potable-water-service piping, including materials, installation, testing, and disinfection.
  - 3. Comply with standards of New York City Department of Buildings for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York City Department of Buildings, and marked for intended use.
- E. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- F. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- G. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.





2. Protect valves against damage to threaded ends and flange faces.
  3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

#### 1.11 COORDINATION

- A. Coordinate connection to water main with utility company.

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- C. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

#### 2.2 DUCTILE-IRON PIPE AND FITTINGS (FOR INCOMING SERVICES ONLY)

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.



- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
  - 1. Grooved-End, Ductile-Iron Pipe Appurtenances:
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Anvil International, Inc.
      - 2) Victaulic Company of America.
      - 3) Hays Fluid Controls; a division of ROMAC Industries Inc.
      - 4) Star Pipe Products.
      - 5) Or approved equal.
    - c. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
    - d. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

## 2.3 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Rigid Expansion Joints:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. EBAA Iron, Inc.
    - b. U.S. Pipe and Foundry Company.
    - c. Hays Fluid Controls; a division of ROMAC Industries Inc.
    - d. Star Pipe Products.
    - e. Or approved equal.
  - 3. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
    - a. Pressure Rating: 250 psig (1725 kPa) minimum.
    - b. Expansion Required:

**B. Ductile-Iron Flexible Expansion Joints:**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. EBAA Iron, Inc.
  - b. Hays Fluid Controls; a division of ROMAC Industries Inc.
  - c. Star Pipe Products.
  - d. Or approved equal.
2. **Description:** Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
  - a. **Pressure Rating:** 250 psig (1725 kPa) minimum.
  - b. **Offset:**
  - c. **Expansion Required:**

**C. Ductile-Iron Deflection Fittings:**

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. EBAA Iron, Inc.
  - b. Hays Fluid Controls; a division of ROMAC Industries Inc.
  - c. Star Pipe Products.
  - d. Or approved equal.
2. **Description:** Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
  - a. **Pressure Rating:** 250 psig (1725 kPa) minimum.

**2.4 JOINING MATERIALS**

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. **Brazing Filler Metals:** AWS A5.8, BCuP Series.
- C. **Bonding Adhesive for Fiberglass Piping:** As recommended by fiberglass piping manufacturer.
- D. **Plastic Pipe-Flange Gasket, Bolts, and Nuts:** Type and material recommended by piping system manufacturer, unless otherwise indicated.

**2.5 PIPING SPECIALTIES**

- A. **Transition Fittings:** Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.



**B. Tubular-Sleeve Pipe Couplings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cascade Waterworks Manufacturing.
  - b. Dresser, Inc.; Dresser Piping Specialties.
  - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
  - d. Hays Fluid Controls; a division of ROMAC Industries Inc.
  - e. JCM Industries.
  - f. Smith-Blair, Inc.
  - g. Viking Johnson.
  - h. Or approved equal.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
  - a. Standard: AWWA C219.
  - b. Center-Sleeve Material: Manufacturer's standard.
  - c. Gasket Material: Natural or synthetic rubber.
  - d. Pressure Rating: 200 psig (1380 kPa) minimum.
  - e. Metal Component Finish: Corrosion-resistant coating or material.

**C. Split-Sleeve Pipe Couplings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Victaulic Depend-O-Lok.
  - b. Cascade Waterworks Manufacturing.
  - c. Dresser, Inc.; Dresser Piping Specialties.
  - d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
  - e. Or approved equal.
2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
  - a. Standard: AWWA C219.
  - b. Sleeve Material: Manufacturer's standard
  - c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
  - d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
  - e. Pressure Rating: 150 psig (1035 kPa).
  - f. Metal Component Finish: Corrosion-resistant coating or material.

**D. Flexible Connectors:**

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 250 psig (1725 kPa).
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 175 psig (1200 kPa).
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
  - a. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating:
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
  - a. Description:
    - 1) Standard: IAPMO PS 66
    - 2) Electroplated steel nipple. complying with ASTM F 1545.
    - 3) Pressure Rating:.
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. American AVK Co.; Valves & Fittings Div.
  - b. American Cast Iron Pipe Co.; American Flow Control Div.
  - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
  - d. Crane Co.; Crane Valve Group; Stockham Div.



- e. East Jordan Iron Works, Inc.
- f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
- g. McWane, Inc.; Kennedy Valve Div.
- h. McWane, Inc.; M & H Valve Company Div.
- i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
- j. Mueller Co.; Water Products Div.
- k. NIBCO INC.
- l. U.S. Pipe and Foundry Company.
- m. Or approved equal.

2. Nonrising-Stem, Metal-Seated Gate Valves:

- a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
  - 1) Standard: AWWA C500.
  - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
  - 3) End Connections: Mechanical joint.
  - 4) Interior Coating: Complying with AWWA C550.

3. Nonrising-Stem, Resilient-Seated Gate Valves:

- a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - 1) Standard: AWWA C509.
  - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
  - 3) End Connections: Mechanical joint.
  - 4) Interior Coating: Complying with AWWA C550.

4. OS&Y, Rising-Stem, Metal-Seated Gate Valves:

- a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
  - 1) Standard: AWWA C500.
  - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
  - 3) End Connections: Flanged.

5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

- a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
  - 1) Standard: AWWA C509.
  - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
  - 3) End Connections: Flanged.

B. Bronze Gate Valves:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.



- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Red-White Valve Corporation.
- h. Or approved equal.

2. OS&Y, Rising-Stem Gate Valves:

- a. Description: Bronze body and bonnet and bronze stem.
  - 1) Standards: UL 262 and FMG approved.
  - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
  - 3) End Connections: Threaded.

3. Nonrising-Stem Gate Valves:

- a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
  - 1) Standard: MSS SP-80.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
  - b. East Jordan Iron Works, Inc.
  - c. Flowserve.
  - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
  - e. McWane, Inc.; Kennedy Valve Div.
  - f. McWane, Inc.; M & H Valve Company Div.
  - g. Mueller Co.; Water Products Div.
  - h. U.S. Pipe and Foundry Company.
  - i. Or approved equal.
- 2. Description: Sleeve and valve compatible with drilling machine.
  - a. Standard: MSS SP-60.
  - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
  - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.



1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

## 2.8 CHECK VALVES

### A. AWWA Check Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. American AVK Co.; Valves & Fittings Div.
  - b. American Cast Iron Pipe Co.; American Flow Control Div.
  - c. APCO Williamette; Valve and Primer Corporation.
  - d. Crane Co.; Crane Valve Group; Crane Valves.
  - e. Crane Co.; Crane Valve Group; Stockham Div.
  - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
  - g. McWane, Inc.; Kennedy Valve Div.
  - h. McWane, Inc.; M & H Valve Company Div.
  - i. Mueller Co.; Water Products Div.
  - j. NIBCO INC.
  - k. Watts Water Technologies, Inc.
  - l. Or approved equal.
2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
  - a. Standard: AWWA C508.
  - b. Pressure Rating: 175 psig (1207 kPa).

### B. UL/FMG, Check Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
  - b. Crane Co.; Crane Valve Group; Stockham Div.
  - c. Globe Fire Sprinkler Corporation.
  - d. Kidde Fire Fighting.
  - e. MATCO-NORCA, Inc.
  - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
  - g. McWane, Inc.; Kennedy Valve Div.
  - h. Mueller Co.; Water Products Div.
  - i. NIBCO INC.
  - j. Reliable Automatic Sprinkler Co., Inc.
  - k. Tyco Fire & Building Products.
  - l. United Brass Works, Inc.
  - m. Victaulic Company of America.
  - n. Viking Corporation.
  - o. Watts Water Technologies, Inc.
  - p. Or approved equal.





2. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
  - a. Standards: UL 312 and FMG approved.
  - b. Pressure Rating: 250 psig (1725 kPa).

## 2.9 CORPORATION VALVES AND CURB VALVES

### A. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amcast Industrial Corporation; Lee Brass Co.
  - b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
  - c. Jones, James Company.
  - d. Master Meter, Inc.
  - e. McDonald, A. Y. Mfg. Co.
  - f. Mueller Co.; Water Products Div.
  - g. Red Hed Manufacturing & Supply.
  - h. Or approved equal.

### B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

### C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

### D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

## 2.10 WATER METERS

### A. Water meters will be furnished by utility company.

### B. Manufacturers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. AMCO Water Metering Systems.
  - b. Badger Meter, Inc.



- c. Carlon Meter.
- d. Hays Fluid Controls; a division of ROMAC Industries Inc.
- e. McCrometer.
- f. Mueller Co.; Hersey Meters.
- g. Neptune Technology Group Inc.
- h. Sensus Metering Systems.
- i. Or approved equal.

C. Turbine-Type Water Meters:

1. Description:

- a. Standard: AWWA C701.
- b. Registration: Flow in gallons

D. Compound-Type Water Meters:

1. Description:

- a. Standard: AWWA C702.
- b. Registration: Flow in gallons
- c. Remote Registration System:

2. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

- a. Standard: AWWA C706.
- b. Registration: Flow in.

E. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

- a. Standard: AWWA C707.
- b. Registration: Flow in.
- c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
- d. Visible Display Units: Comply with utility company requirements for type and quantity.

F. Water Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

- a. CLA-VAL Automatic Control Valves.
- b. Flomatic Corporation.
- c. OCV Control Valves.
- d. Watts Regulator Co.; Ames Fluid Control Systems.
- e. Watts Regulator Co.; Watts ACV Division.
- f. Wilkins; a Zurn company.
- g. Or approved equal.



2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
  - a. Pressure Rating: Initial pressure of 150 psig (1035 kPa) minimum.
  - b. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
    - 1) Size:
    - 2) Pattern: valve design.
    - 3) Trim: Stainless steel.
  - c. Design Flow Rate:
  - d. Design Inlet Pressure:
  - e. Design Outlet Pressure Setting:
  - f. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

## 2.11 RELIEF VALVES

### A. Air-Release Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Crispin-Multiplex Manufacturing Co.
  - b. GA Industries, Inc.
  - c. Val-Matic Valve & Manufacturing Corp.
  - d. Or approved equal.
2. Description: Hydromechanical device to automatically release accumulated air.
  - a. Standard: AWWA C512.
  - b. Pressure Rating:
  - c. Body Material:
  - d. Trim Material: Stainless steel
  - e. Water Inlet Size:
  - f. Air Outlet Size:
  - g. Orifice Size:
  - h. Design Air-Release Capacity:

### B. Air/Vacuum Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Crispin-Multiplex Manufacturing Co.
  - b. GA Industries, Inc.
  - c. Val-Matic Valve & Manufacturing Corp.
  - d. Or approved equal.
2. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.



- a. Standard: AWWA C512.
- b. Pressure Rating:
- c. Body Material:
- d. Trim Material: Stainless steel.
- e. Inlet and Outlet Size:
- f. Orifice Size:
- g. Design Air Capacity:

C. Combination Air Valves:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
  - a. Crispin-Multiplex Manufacturing Co.
  - b. GA Industries, Inc.
  - c. Val-Matic Valve & Manufacturing Corp.
  - d. Or approved equal.
- 2. Description: Float-operated, hydromechanical device to automatically release accumulated air or to admit air.
  - a. Standard: AWWA C512.
  - b. Pressure Rating:
  - c. Body Material: Cast iron
  - d. Trim Material: Stainless steel brass, or bronze.
  - e. Inlet and Outlet Size:
  - f. Orifice Size:
  - g. Design Air Capacity: at differential pressure.

2.12 VACUUM BREAKERS

A. Pressure Vacuum Breaker Assembly:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Toro Co. (The); Irrigation Division.
  - f. Watts Water Technologies, Inc.
  - g. Wilkins; a Zurn company.
  - h. Or approved equal.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- 5. Size:
- 6. Design Flow Rate:
- 7. Selected Unit Flow Range Limits:
- 8. Pressure Loss at Design Flow Rate:
- 9. Accessories: Ball valves on inlet and outlet.



## 2.13 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Water Technologies, Inc.
  - f. Wilkins; a Zurn company.
  - g. Or approved equal.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
5. Size:
6. Design Flow Rate:
7. Selected Unit Flow Range Limits:
8. Pressure Loss at Design Flow Rate: for NPS 2 (DN 50) and smaller; for NPS 2-1/2 (DN 65) and larger.
9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged or NPS 2-1/2 (DN 65) and larger.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

### B. Double-Check, Backflow-Prevention Assemblies:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Watts Water Technologies, Inc.
  - f. Wilkins; a Zurn company.
  - g. Or approved equal.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Size:
6. Design Flow Rate:
7. Selected Unit Flow Range Limits:



8. Pressure Loss at Design Flow Rate: for NPS 2 (DN 50) and smaller; for NPS 2-1/2 (DN 65) and larger.
9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

#### 2.14 CONCRETE VAULTS

#### 2.15 ALARM DEVICES

- A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

#### 3.3 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 4 to NPS 8 (DN 100 to DN 200) shall be any of the following:



1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
3. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.

- F. Water Meter Box Water-Service Piping NPS 6 shall be same as underground water-service piping.

### 3.4 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient high-pressure, resilient-seated gate valves with valve box.
  2. Relief Valves: Use for water-service piping in vaults and aboveground.
    - a. Air-Release Valves: To release accumulated air.
    - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
    - c. Combination Air Valves: To release or admit air.
  3. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

### 3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Section 33 10 00 "Water Utilities" for piping-system common requirements.

### 3.6 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
1. Install tapping sleeve and tapping valve according to MSS SP-60.
  2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:



1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
  2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  4. Install corporation valves into service-saddle assemblies.
  5. Install manifold for multiple taps in water main.
  6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Bury piping with depth of cover over top at least 30 inches with top at least 12 inches below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least 36 inches (910 mm) cover over top.
- F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- H. Sleeves are specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- I. Mechanical sleeve seals are specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- K. See Section 21 12 00 "Fire-Suppression Standpipes," Section 21 13 13 "Wet-Pipe Sprinkler Systems," for fire-suppression-water piping inside the building.
- L. See Section 22 11 16 "Domestic Water Piping" for potable-water piping inside the building.
- 3.7 JOINT CONSTRUCTION
- A. See Section 33 10 00 "Water Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
  2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
  4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
  5. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.





6. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - a. Dielectric Fittings for NPS 6 and Larger: Use dielectric flange kits.

### 3.8 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  1. Concrete thrust blocks.
  2. Locking mechanical joints.
  3. Set-screw mechanical retainer glands.
  4. Bolted flanged joints.
  5. Heat-fused joints.
  6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  2. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
  3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### 3.9 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

### 3.10 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install turbine-type water meters, NPS 2 (DN 50) and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by New York City Department of Buildings.

- C. Water Meters: Install turbine-type water meters, NPS 3 (DN 80) and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

### 3.11 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

### 3.12 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and New York City Department of Buildings.
- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

### 3.13 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department, New York City department of Environmental Protection, and New York City Department of Buildings.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

### 3.14 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately 2 inches above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

### 3.15 CONNECTIONS

- A. See Section 33 05 00 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to existing water main. Use service clamp and corporation valve.
- C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.16 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

### 3.17 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 31 00 00 "Earthwork."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 33 10 00 "Water Utilities" for identifying devices.

### 3.18 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by New York City Department of Buildings or, if method is not prescribed by New York City Department of Buildings, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by New York City Department of Buildings or, if method is not prescribed by New York City Department of Buildings, use procedure described in AWWA C651 or do as follows:
  - 4. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
  - 5. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    - a. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - b. Submit water samples in sterile bottles to New York City Department of Buildings. Repeat procedure if biological examination shows evidence of contamination.



- B. Prepare reports of purging and disinfecting activities.

**END OF SECTION 22 11 13**

**SECTION 22 11 14****FACILITY NATURAL GAS PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Pipes, tubes, and fittings.
  2. Piping specialties.
  3. Piping and tubing joining materials.
  4. Valves.
  5. Pressure regulators.
  6. Service meters.
  7. Mechanical sleeve seals.
  8. Grout.
  9. Concrete bases.
  10. Gas Booster

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

## 1.6 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.
  - 3. Minimum Operating Pressure of Service Meter:
- B. Natural-Gas System Pressure within Buildings: 0.5 psig (3.45 kPa) or less.
- C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less.
- D. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig (13.8 kPa) but not more than 5 psig (34.5 kPa), and is reduced to secondary pressure of more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa).

## 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.8 SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Piping specialties.
  - 2. Corrugated, stainless-steel tubing with associated components.
  - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 4. Pressure regulators. Indicate pressure ratings and capacities.
  - 5. Service meters. Indicate pressure ratings and capacities.
  - 6. Dielectric fittings.
  - 7. Mechanical sleeve seals.
  - 8. Escutcheons.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.
  - C. Engineering Services Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York responsible for their preparation to be submitted to Commissioner for review and approval.
    1. Detail fabrication and assembly of seismic restraints.
    2. Design Calculations: Calculate requirements for selecting seismic restraints.
  - D. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.
  - E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
  - F. Qualification Data: For qualified professional engineer licensed in the State of New York.
  - G. Welding certificates.
  - H. Field quality-control reports.
  - I. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.
- 1.9 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
  - B. Steel Support Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
  - D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of the New York City Department of Buildings and FDNY.
  - B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
  - C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
  - D. Protect stored PE pipes and valves from direct sunlight.

## 1.11 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area of the project.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by City of New York or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
  - 1. Notify the Commissioner no fewer than two days in advance of proposed interruption of natural-gas service.
  - 2. Do not proceed with interruption of natural-gas service the Commissioner's written permission.

## 1.12 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
  - 6. Mechanical Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:





- 1) Dresser Piping Specialties; Division of Dresser, Inc.
- 2) Smith-Blair, Inc.
- 3) Or approved equal.

- b. Steel flanges and tube with epoxy finish.
- c. Buna-nitrile seals.
- d. Steel bolts, washers, and nuts.
- e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

## 2.2 PIPING SPECIALTIES

### A. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

### B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

### C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

### D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.3 JOINING MATERIALS (ALL GAS PIPING TO BE WELDED)

### A. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 MANUAL GAS SHUTOFF VALVES

### A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.



- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig (862 kPa).
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to New York City Department of Buildings for valves 1 inch (25 mm) and smaller.
  6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig (862 kPa).
  2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.
    - d. McDonald, A. Y. Mfg. Co.
    - e. Perfection Corporation; a subsidiary of American Meter Company.
    - f. Or approved equal.
  2. Body: Bronze, complying with ASTM B 584.
  3. Ball: Chrome-plated bronze.
  4. Stem: Bronze; blowout proof.
  5. Seats: Reinforced TFE; blowout proof.
  6. Packing: Threaded-body packnut design with adjustable-stem packing.
  7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  8. CWP Rating: 600 psig (4140 kPa).
  9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to New York City Department of Buildings.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.



- d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
  - f. Or approved equal.
- 2. Body: Bronze, complying with ASTM B 584.
  - 3. Ball: Chrome-plated bronze.
  - 4. Stem: Bronze; blowout proof.
  - 5. Seats: Reinforced TFE.
  - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 8. CWP Rating: 600 psig (4140 kPa).
  - 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to New York City Department of Buildings.
  - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Bronze Plug Valves: MSS SP-78.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lee Brass Company.
    - b. McDonald, A. Y. Mfg. Co.
    - c. Perfection Corporation; a subsidiary of American Meter Company.
    - d. Or approved equal.
  - 2. Body: Bronze, complying with ASTM B 584.
  - 3. Plug: Bronze.
  - 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Operator: Square head or lug type with tamperproof feature where indicated.
  - 6. Pressure Class: 125 psig (862 kPa).
  - 7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to New York City Department of Buildings.
  - 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. McDonald, A. Y. Mfg. Co.
    - b. Mueller Co.; Gas Products Div.
    - c. Xomox Corporation; a Crane company.
    - d. Or approved equal.
  - 2. Body: Cast iron, complying with ASTM A 126, Class B.
  - 3. Plug: Bronze or nickel-plated cast iron.
  - 4. Seat: Coated with thermoplastic.
  - 5. Stem Seal: Compatible with natural gas.
  - 6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. Operator: Square head or lug type with tamperproof feature where indicated.
  - 8. Pressure Class: 125 psig (862 kPa).



9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to New York City Department of Buildings.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- H. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve.
    - b. Homestead Valve; a division of Olson Technologies, Inc.
    - c. McDonald, A. Y. Mfg. Co.
    - d. Milliken Valve Company.
    - e. Mueller Co.; Gas Products Div.
    - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
    - g. Or approved equal.
  2. Body: Cast iron, complying with ASTM A 126, Class B.
  3. Plug: Bronze or nickel-plated cast iron.
  4. Seat: Coated with thermoplastic.
  5. Stem Seal: Compatible with natural gas.
  6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. Operator: Square head or lug type with tamperproof feature where indicated.
  8. Pressure Class: 125 psig (862 kPa).
  9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to New York City Department of Buildings.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- I. PE Ball Valves: Comply with ASME B16.40.
- J. Valve Boxes:
1. Cast-iron, two-section box.
  2. Top section with cover with "GAS" lettering.
  3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
  4. Adjustable cast-iron extensions of length required for depth of bury.
  5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

## 2.5 EARTHQUAKE VALVES

- A. Earthquake Valves: Comply with ASCE 25.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Vanguard Valves, Inc.
    - b. Milliken Valve Company.
    - c. Mueller Co.; Gas Products Div.
    - d. Flowserve.
    - e. Homestead Valve; a division of Olson Technologies, Inc.
    - f. Or approved equal.



2. Listing: Listed and labeled by an NRTL acceptable to New York City Department of Buildings.
3. Maximum Operating Pressure: 5 psig (34.5 kPa).
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. Nitrile-rubber valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

**B. Earthquake Valves: Comply with ASCE 25.**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Pacific Seismic Products, Inc.
  - b. Vanguard Valves, Inc.
  - c. Milliken Valve Company.
  - d. Mueller Co.; Gas Products Div.
  - e. Flowserve.
  - f. Homestead Valve; a division of Olson Technologies, Inc.
  - g. Or approved equal.
2. Listing: Listed and labeled by an NRTL acceptable to New York City Department of Buildings.
3. Maximum Operating Pressure: 0.5 psig (3.45 kPa).
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 (DN 50) and smaller; flanged for valves NPS 2-1/2 (DN 65) and larger.

**2.6 PRESSURE REGULATORS**

**A. General Requirements:**

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

**B. Service Pressure Regulators: Comply with ANSI Z21.80.**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - d. Invensys.
  - e. Richards Industries; Jordan Valve Div.
  - f. Or approved equal.



2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  3. Springs: Zinc-plated steel; interchangeable.
  4. Diaphragm Plate: Zinc-plated steel.
  5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  6. Orifice: Aluminum; interchangeable.
  7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
  10. Overpressure Protection Device: Factory mounted on pressure regulator.
  11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 0.5 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Actaris.
    - b. American Meter Company.
    - c. Eclipse Combustion, Inc.
    - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    - e. Invensys.
    - f. Maxitrol Company.
    - g. Richards Industries; Jordan Valve Div.
    - h. Or approved equal.
  2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  3. Springs: Zinc-plated steel; interchangeable.
  4. Diaphragm Plate: Zinc-plated steel.
  5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  6. Orifice: Aluminum; interchangeable.
  7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
  10. Overpressure Protection Device: Factory mounted on pressure regulator.
  11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 2 psig (13.8 kPa).

## 2.7 SERVICE METERS

### A. Diaphragm-Type Service Meters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Actaris.



- b. American Meter Company.
    - c. Invensys.
    - d. Or approved equal.
  - 2. Case: Die-cast aluminum.
  - 3. Connections: Steel threads.
  - 4. Diaphragm: Synthetic fabric.
  - 5. Diaphragm Support Bearings: Self-lubricating.
  - 6. Compensation: Continuous temperature and pressure.
  - 7. Meter Index: Cubic feet.
  - 8. Meter Case and Index: Tamper resistant.
  - 9. Remote meter reader compatible.
  - 10. Maximum Inlet Pressure: 0.5 psig.
  - 11. Pressure Loss: Maximum 0.5-inch wg (124 Pa).
  - 12. Accuracy: Maximum plus or minus 1.0 percent.
- B. Rotary-Type Service Meters: Comply with ANSI B109.3.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Meter Company.
    - b. Invensys.
    - c. Actaris.
    - d. Or approved equal.
  - 3. Case: Extruded aluminum.
  - 4. Connection: Flange.
  - 5. Impellers: Polished aluminum.
  - 6. Rotor Bearings: Self-lubricating.
  - 7. Compensation: Continuous temperature and pressure.
  - 8. Meter Index: Cubic feet.
  - 9. Tamper resistant.
  - 10. Remote meter reader compatible.
  - 11. Maximum Inlet Pressure: 0.5 psig.
  - 12. Accuracy: Maximum plus or minus 2.0 percent.
- C. Service-Meter Bars:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Actaris.
    - b. American Meter Company.
    - c. Lyall, R. W. & Company, Inc.
    - d. McDonald, A. Y. Mfg. Co.
    - e. Mueller Co.; Gas Products Div.
    - f. Perfection Corporation; a subsidiary of American Meter Company.
    - g. Or approved equal.



3. Malleable- or cast-iron frame for supporting service meter.
4. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
5. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

**D. Service-Meter Bypass Fittings:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Lyall, R. W. & Company, Inc.
  - b. Williamson, T. D., Inc.
  - c. Actaris.
  - d. Or approved equal.
3. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
4. Integral ball-check bypass valve.

**2.8 DIELECTRIC FITTINGS**

**A. Dielectric Unions:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - f. Wilkins; Zurn Plumbing Products Group.
  - g. Or approved equal.
2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

**B. Dielectric Flanges:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - d. Wilkins; Zurn Plumbing Products Group.
  - e. Or approved equal.





2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
  - e. Or approved equal.
2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.10 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Or approved equal.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
  3. Pressure Plates: Carbon steel.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## 2.11 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## 2.12 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.13 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

## 2.14 GAS BOOSTER

- A. Scope
  - 1. Provide a duplex pre-packaged Natural Gas "GasCube" skid booster system designed and manufactured by Spencer Turbine, Inc., represented by G. A. Fleet Assoc. of Harrison, NY. The skid package shall be pre-wired, pre-piped and factory tested. The following items shall be included in the GasCube; Two (2) UL Listed Natural Gas Boosters, Expansion Joints, Inlet Pressure Switch, Plug Valves and Control Panel.
- B. Hermetic Natural Gas Boosters



1. Each Hermetic Natural Gas Booster, Model GL-1007-R shall be UL Listed and be of centrifugal design built in the overhung construction where the impellers are mounted on the motor shaft. Each booster is rated to compress up to 42,000 ICFH of natural gas at 27.7" WC boost. The specific gravity of the natural gas shall be 0.6.
  2. The pressure shall remain practically constant from the surge limit to the full volume rating while the power consumption shall increase in direct proportion to the volume of gas handled at operating speed. The gas booster performance and design shall be approved and listed by Underwriters Laboratories.
- C. Motors
1. Each motor shall be capable of operating continuously in the natural gas environment. The motor enclosure shall be explosion proof per NEMA Class 1, Division 1, Group D classification with thermal overload protection.
- D. Gas Booster Casings
1. The casing shall be cylindrical fabricated steel construction. The enclosing heads shall be of similar metal, properly braced for strength. The inlet and outlet connections shall be flanged. The casing shall be leak tight to 10-3 cc/sec, with drive fans contained within casing shell.
- E. Impellers
1. The impeller peripheral speed shall not exceed 25,000 FPM. There shall be at least 1/8-inch clearance between each impeller and all stationary parts.
  2. Impellers shall be fabricated from high strength aluminum alloy, and shall be attached to the shaft by a clamped or tapered bushing hub.
- F. Deflectors
1. Fabricated steel deflectors with properly curved guide vanes for directing the gas to each succeeding impeller shall be provided.
- G. Shafts and Bearings
1. The motor shall have an oversized, extended shaft supported by two oversized, anti-friction grease lubricated bearings designed to absorb both thrust and radial loads.
  2. Each shaft shall be sized so that the rotating assembly shall operate at a minimum of 25% removed from the first critical speed.
- H. Check Valves
1. A check valve shall be installed on the inlet of each gas booster. The valve shall be of the low-pressure drop type, approved for natural gas service and mounted in the horizontal position. It shall serve to prevent reversal of natural gas flow. This item is shipped loose and is separate from the GasCube scope of supply.
- I. Flexible Expansion Joints
1. Expansion joints will be supplied for the inlet and discharge of the gas boosters and suitable for natural gas service. Flexible joints will be of the same diameter as the gas



booster's inlet and discharge and shall serve as vibration isolation between the gas booster and the gas train piping.

**J. Low Pressure Switches**

1. Provide one (1) UL Listed, manual reset type low inlet and one (1) UL Listed, low discharge pressure switch. The inlet pressure switch shall shut down the on-line booster in the event of below normal supply pressure, preset at 3.5" W.C. The discharge pressure switch shall activate the low discharge pressure alarm. The switches will be housed in NEMA 4 enclosures and shall not require venting.

**K. Pressure Gauges**

1. Pressure gauges will be supplied on the inlet main to the gas booster and at the discharge of the gas booster. Gauges shall be suitably scaled and shall be suitable by the manufacturer for natural gas service. Gauges will include shut-off cocks.

**L. Inlet and Outlet Plug Valves**

1. Lubricated plug valves will be supplied on the inlet and discharge of each gas booster. Valves shall be gas tight and approved for natural gas service. Valves will be of the same diameter as the gas booster inlet and discharge and shall serve to isolated gas flow to and from each gas booster.

**M. Automatic Recirculation Loop**

1. An automatic recirculation loop from the gas booster discharge to the inlet with heat exchanger shall be supplied, if required by the booster manufacturer, for proper booster operation across the specified full range of flow, otherwise provide a manual recirculation loop.

**N. Control Panel**

1. NEMA 4 PLC Control Panel for the operation of two (2) Spencer Natural Gas Boosters. The control panel will be manufactured by the gas booster manufacturer and will be built in accordance with UL508A Standards for Industrial Control Panels and shall include:
  - a) One (1) OSHA type lock-out/tag-out circuit breaker disconnect switch.
  - b) Two (2) ATL magnetic, non-reversing motor starter for 1-1/2 HP, three phase Gas Booster motor.
  - c) One (1) PLC System
  - d) One (1) Operator Interface Terminal (OIT) color touch screen
  - e) One (1) Control transformer.
  - f) One (1) Power "ON" pilot light.
  - g) One (1) OFF – #1 - #2 - AUTO selector switch to control Gas Boosters.
    - 1) OFF - OFF
    - 2) #1 - Starts Gas Booster #1
    - 3) #2 - Starts Gas Booster #2
    - 4) AUTO - Allows Automatic start/shutdown, lead / lag operation and alternation of booster via direct wiring interconnection with the two (2) chillers. Alternation of the on-line booster shall occur upon each start/shutdown sequence.



- h) Provisions for remote start/shutdown of booster via call to run signals from appliances and individual proof of run contacts to verify booster operation.
- i) Provisions for Low/High Discharge Pressure Switches for Automatic start/shutdown of booster based on GasCube Discharge Pressure
- j) Provisions for a low inlet gas pressure switch to shut down the gas booster, energize a warning indication on OIT, and energize the common alarm relay upon low supply pressure.
- k) Provision for a N.C. motor high temperature switch to shut down the on-line booster, energize a warning light on OIT, energize the common alarm relay and start the stand-by booster motor upon high motor temperature.
- l) Provision for a N.C. high gas temperature switch to shut down the on-line booster, energize a warning light on OIT, energize the common alarm relay and start the stand-by booster upon high gas temperature.
- m) Provisions for a motor starter overload relay to shut down the on-line gas booster, energize a warning indication on OIT, energize the common alarm relay, and start the stand-by booster motor upon a motor overload fault
- n) Provisions for a booster Surge or Overload condition to shut down the on-line gas booster, energize a warning indication on OIT, energize the common alarm relay, and start the stand-by booster motor upon a detected Surge or Overload fault
- o) Provisions to Equalize Booster Run-Time.
- p) Visual displays on OIT:
  - 1) Booster Running
  - 2) Number of starts per hour
  - 3) Motor Starter Aux. Fault
  - 4) Motor Starter Overload Fault
  - 5) Booster Run Time
  - 6) Low Inlet Gas Pressure
  - 7) High Motor Temperature
  - 8) Flow (CFH)
  - 9) Motor Amps
  - 10) Surge
  - 11) Overload
  - 12) E-stop
  - 13) Alarm Silence
  - 14) Alarm Reset
- q) One (1) - Alarm horn (mounted in panel door).
- r) One (1) - "Emergency Stop" Red mushroom-type pushbutton.
- s) One (1) - Set of auxiliary dry alarm contacts for connection to remote common trouble alarm.
- t) Miscellaneous components and hardware to assure proper functioning.

**O. Loss of Power Sequencing**

- P.** In the event of supply power loss to the Spencer Control Panel (SCP), the SCP shall "power up" automatically upon restoration of power supply when the OFF-#1-#2-AUTO selector switch is in the #1 or #2 position (i.e.: facility power outage and restoration by an emergency supply). When in the Auto position, the booster shall "power up" automatically only if a remote dry contact from the appliances or Building Management System (BMS) is maintained in the "closed" position (i.e.: calling for booster to run) or the Low/High Discharge Pressure Switches (Pressure Option) calls for booster to run.



**Q. Vibration, Pneumatic and Performance Test**

1. Each motor and booster assembly shall be balanced for minimum vibration (1.5 mils or less for 3500 RPM units) and shall be capable of operation throughout its' design range without the need for hold down or mounting bolts. Each unit shall be given a complete factory performance test over its full range. The results of this test shall be comparable to ASME Code Test requirements. A multiple orifice plate shall be installed on the end of a fabricated steel pipe section. For this test the pipe section will be at least one and one-half pipe diameters long and the same diameter as the blower outlet on which it will be installed. The outlet sections shall be sized for maximum velocity of 4600 FPM and 100% rated flow.
2. Pressure taps flush with the inside diameter of the test section shall be installed at least one-half pipe diameter before the orifice plate. Sharp-edged orifices shall be opened to atmosphere, a few at a time and pressure, temperature, speed, voltage, amperage, and kilowatt readings shall be recorded for each test point.
3. The air volume at a particular discharge pressure shall then be read from a calibrated orifice chart and the number of open orifices shall multiply this volume. On request, certified performance curves shall then be supplied showing the exact performance and efficiencies of each specific machine. Prior tests on similar or identical machines shall not be acceptable.
4. The GasCube skid shall be pneumatically leak tested at 5 psig.

**R. Start-Up**

1. An authorized factory-trained manufacturer's representative shall perform system start-up services including inspection of the installation and instruction of The City of New York's service staff in the operation and service of the system.

**PART 3 - EXECUTION**

**3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 PREPARATION**

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the NYC Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the NYC Fuel Gas Code requirements for prevention of accidental ignition.

**3.4 INDOOR PIPING INSTALLATION**



- A. Comply with NFPA 54 and the NYC Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

1. New Piping:

- a) Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
- b) Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- c) Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
- d) Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- e) Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
- f) Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- g) Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw.
- h) Piping in Equipment Rooms: One-piece, cast-brass type.
- i) Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
- j) Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.



- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
  - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
  - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    - a) Exception: Tubing passing through partitions or walls does not require striker barriers.
  - 5. Prohibited Locations:
    - a) Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    - b) Do not install natural-gas piping in solid walls or partitions.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- V. Do not use natural-gas piping as grounding electrode.



- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### 3.5 SERVICE-METER ASSEMBLY INSTALLATION (AS PER NATIONAL GRID)

- A. Install service-meter assemblies aboveground on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Division 05 Section "Metal Fabrications" for pipe bollards.

### 3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with service access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### 3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.



5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

D. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1/2 and NPS 5/8 (DN 15 and DN 18): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 1 (DN 25): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).



- E. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
  - 2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
  - 3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

### 3.9 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

### 3.11 PAINTING

- A. Comply with requirements in Section 09 91 00 "Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a) Prime Coat: Alkyd anticorrosive metal primer.
    - b) Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c) Topcoat: Exterior alkyd enamel semigloss.
    - d) Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.



1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

- a) Prime Coat: Quick-drying alkyd metal primer.
- b) Intermediate Coat: Interior latex matching topcoat.
- c) Topcoat: Interior latex flat.
- d) Color: Gray.

2. Alkyd System: MPI INT 5.1E.

- a) Prime Coat: Alkyd anticorrosive metal primer.
- b) Intermediate Coat: Interior alkyd matching topcoat.
- c) Topcoat: Interior alkyd flat.
- d) Color: Gray.

- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to seismic codes at Project.

- 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
- 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
- 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
- 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 6. Use 3000-psig (20.7-MPa), 28-day, compressive-strength concrete and reinforcement as specified in section 03 30 00 "Cast-in-Place Concrete".

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

- 1. Test, inspect, and purge natural gas according to NFPA 54 and the NYC Fuel Gas Code and New York City Department of Buildings.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train City of New York's service personnel to adjust, operate, and maintain earthquake valves.

**3.15 OUTDOOR PIPING SCHEDULE**

- A. Underground natural-gas piping shall be one of the following:
1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
  2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
  3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.
  3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed flared joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

**3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)**

- A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:
1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
  4. Aluminum tube with flared fittings and joints.
  5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.



**3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)**

- A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:
  - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  - 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  - 3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
  - 4. Aluminum tube with flared fittings and joints.
  - 5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with steel welding fittings and welded joints.
  - 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Underground, below building, piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

**3.18 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
  - 1. PE valves.
  - 2. NPS 2 (DN 50) and Smaller: Bronze plug valves.
  - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron plug valves.

**3.19 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.



3. Cast-iron, nonlubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
  2. Bronze plug valve.
  3. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.

**END OF SECTION 22 11 14**



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**SECTION 22 11 16****DOMESTIC WATER PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract – [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
- B. Related Requirements:
1. Section 22 11 13 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.7 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.8 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

**PART 2 - PRODUCTS**

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS (FOR INCOMING SERVICE ONLY)

- A. Mechanical-Joint, Ductile-Iron Pipe:
  - 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.



2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
  - B. Standard-Pattern, Mechanical-Joint Fittings:
    1. AWWA C110/A21.10, ductile or gray iron.
    2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
  - C. Compact-Pattern, Mechanical-Joint Fittings:
    1. AWWA C153/A21.53, ductile iron.
    2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
  - D. Push-on-Joint, Ductile-Iron Pipe:
    1. AWWA C151/A21.51.
    2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - E. Standard-Pattern, Push-on-Joint Fittings:
    1. AWWA C110/A21.10, ductile or gray iron.
    2. Gaskets: AWWA C111/A21.11, rubber.
  - F. Compact-Pattern, Push-on-Joint Fittings:
    1. AWWA C153/A21.53, ductile iron.
    2. Gaskets: AWWA C111/A21.11, rubber.
  - G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
  - H. Appurtenances for Grooved-End, Ductile-Iron Pipe:
    1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      - a. Shurjoint Piping Products.
      - b. Star Pipe Products.
      - c. Victaulic Company.
      - d. Or approved equal.
- 2.4 PIPING JOINING MATERIALS
- A. Pipe-Flange Gasket Materials:
    1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
    2. Full-face or ring type unless otherwise indicated.
  - B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
  - C. Solder Filler Metals: ASTM B 32, lead-free alloys.



- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.5 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Piping Specialties Products.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc.; a Sensus company.
    - g. Viking Johnson.
    - h. Or approved equal.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Central Plastics Company.
    - c. Hart Industries International, Inc.
    - d. Jomar International.
    - e. Matco-Norca.
    - f. McDonald, A. Y. Mfg. Co.
    - g. Watts; a division of Watts Water Technologies, Inc.
    - h. Wilkins; a Zurn company.
    - i. Or approved equal.
  - 2. Standard: ASSE 1079.
  - 3. Pressure Rating: 250 psig (1725 kPa)
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous.

**C. Dielectric Flanges:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
  - b. Central Plastics Company.
  - c. Matco-Norca.
  - d. Watts; a division of Watts Water Technologies, Inc.
  - e. Wilkins; a Zurn company.
  - f. Or approved equal.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 175 psig (1200 kPa).
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

**D. Dielectric-Flange Insulating Kits:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
  - e. Or approved equal.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig (1035 kPa).
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

**E. Dielectric Nipples:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Elster Perfection Corporation.
  - b. Grinnell Mechanical Products; Tyco Fire Products LP.
  - c. Matco-Norca.
  - d. Precision Plumbing Products, Inc.
  - e. Victaulic Company.
  - f. Or approved equal.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EARTHWORK**

- A. Comply with requirements in Section 31 00 00 "Earthwork" for excavating, trenching, and backfilling.

**3.3 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.



- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install PEX piping with loop at each change of direction of more than 90 degrees.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."
- U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

#### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

- F. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
  - 1. D 2846M Appendix.
  - 2. PVC Piping: Join according to ASTM D 2855.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

### 3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric nipples.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

### 3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.





3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
  6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
  7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- F. Install supports for vertical copper tubing every 10 feet (3 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
  3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
  7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
  8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.



3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

### 3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### 3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

#### 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by Commissioner.
- b. During installation, notify Commissioner at least one day before inspection must be made. Perform tests specified below in presence of Commissioner:
  - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
  - 2) Final Inspection: Arrange for Commissioner to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If Commissioner find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by Commissioner.

#### 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

- B. Domestic water piping will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports.

### 3.11 ADJUSTING

- A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by New York City Department of Buildings and 2014 NYC Construction Codes; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to Commissioner.

- B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by New York City Department of Buildings and 2014 NYC Construction Codes or; if methods are not prescribed, follow procedures described below:



- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Submit water samples in sterile bottles to Commissioner. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from Commissioner.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.13 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be one of the following:
- 1. Soft copper tube, ASTM B 88, Type K wrought-copper, solder-joint fittings; and brazed joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger, shall be one of the following:
- E. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
- 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, fittings; and brazed joints.
- F. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
- 1. Hard copper tube, ASTM B 88, Type L cast- or wrought-copper, solder-joint fittings; and brazed joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
- 1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper, solder-joint fittings; and brazed joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint, copper-tube appurtenances; and grooved joints.
- H. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:



1. Hard copper tube, ASTM B 88, Type L wrought copper, solder-joint fittings; and brazed joints.
  2. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
- I. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
  2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
  3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

### 3.14 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

**END OF SECTION 22 11 16**



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**SECTION 22 11 19****DOMESTIC WATER PIPING SPECIALTIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Drain valves.
9. Water-hammer arresters.
10. Air vents.
11. Trap-Seal Primer Device
12. Flexible connectors.
13. Water meters.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile



Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. Include diagrams for power, signal, and control wiring.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.9 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES**

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14

**2.2 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 200 psig unless otherwise indicated.

**2.3 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    - b. Cash Acme; a division of Reliance Worldwide Corporation.





- c. Conbraco Industries, Inc.
  - d. FEBCO; a division of Watts Water Technologies, Inc.
  - e. Rain Bird Corporation.
  - f. Toro Company (The); Irrigation Div.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - i. Or approved equal.
- 2. Standard: ASSE 1001.
  - 3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: Threaded.
  - 6. Finish: Rough bronze.

**B. Hose-Connection Vacuum Breakers:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Arrowhead Brass Products.
  - b. Cash Acme; a division of Reliance Worldwide Corporation.
  - c. Conbraco Industries, Inc.
  - d. Legend Valve.
  - e. MIFAB, Inc.
  - f. Prier Products, Inc.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
  - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - k. Or approved equal.
- 2. Standard: ASSE 1011.
- 3. Body: Bronze, nonremovable, with manual drain.
- 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
- 5. Finish: Chrome or nickel plated.

**C. Pressure Vacuum Breakers**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; a division of Watts Water Technologies, Inc.
  - d. Flomatic Corporation.
  - e. Toro Company (The); Irrigation Div.
  - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - h. Or approved equal.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
- 5. Size:



6. Design Flow Rate:
7. Selected Unit Flow Range Limits:
8. Pressure Loss at Design Flow Rate:
9. Accessories:

- a. Valves: Ball type, on inlet and outlet.

**D. Spill-Resistant Vacuum Breakers:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Conbraco Industries, Inc.
  - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - d. Or approved equal.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 (DN 15).
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

**2.4 BACKFLOW PREVENTERS**

**A. Intermediate Atmospheric-Vent Backflow Preventers:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Cash Acme; a division of Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; a division of Watts Water Technologies, Inc.
  - d. Honeywell International Inc.
  - e. Legend Valve.
  - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - h. Or approved equal.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size:
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

**B. Reduced-Pressure-Principle Backflow Preventers:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.



- c. FEBCO; a division of Watts Water Technologies, Inc.
  - d. Flomatic Corporation.
  - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - g. Or approved equal.
- 2. Standard: ASSE 1013.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
  - 5. Size: NPS 6.
  - 6. Design Flow Rate:
  - 7. Selected Unit Flow Range Limits:
  - 8. Pressure Loss at Design Flow Rate:
  - 9. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved
  - 10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged or NPS 2-1/2 (DN 65) and larger.
  - 11. Configuration: Designed for horizontal, straight-through flow.
  - 12. Accessories:
    - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

**C. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; a division of Watts Water Technologies, Inc.
  - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - f. Or approved equal.
- 2. Standard: ASSE 1047 and is FM Global approved or UL listed.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: maximum, through middle third of flow range.
- 5. Size:
- 6. Design Flow Rate:
- 7. Selected Unit Flow Range Limits:
- 8. Pressure Loss at Design Flow Rate:
- 9. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved.
- 10. End Connections: Flanged.
- 11. Configuration: Designed for horizontal, straight-through flow.
- 12. Accessories:
  - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.



- c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

**D. Hose-Connection Backflow Preventers:**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Conbraco Industries, Inc.
  - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - d. Or approved equal.
- 2. Standard: ASSE 1052.
- 3. Operation: Up to 10-foot head of water (30-kPa) back pressure.
- 4. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm (0.19-L/s) flow.

**E. Backflow-Preventer Test Kits:**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Conbraco Industries, Inc.
  - b. FEBCO; a division of Watts Water Technologies, Inc.
  - c. Flomatic Corporation.
  - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - f. Or approved equal.
- 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

**2.5 WATER PRESSURE-REDUCING VALVES**

**A. Water Regulators:**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Cash Acme; a division of Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.
  - c. Honeywell International Inc.
  - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - f. Or approved equal.
- 2. Standard: ASSE 1003.
- 3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
- 4. Size:
- 5. Design Flow Rate:
- 6. Design Inlet Pressure:
- 7. Design Outlet Pressure Setting:



8. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

**B. Water-Control Valves:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. CLA-VAL.
  - b. Flomatic Corporation.
  - c. OCV Control Valves.
  - d. Watts; a division of Watts Water Technologies, Inc.; Control Valves (Watts ACV).
  - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - f. Or approved equal.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa) minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
  - a. Size:
  - b. Pattern: Globevalve design.
  - c. Trim: Stainless steel.
5. Design Flow:
6. Design Inlet Pressure:
7. Design Outlet Pressure Setting:
8. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

**2.6 BALANCING VALVES**

**A. Copper-Alloy Calibrated Balancing Valves:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Corporation; Bell & Gossett Div.
  - d. NIBCO Inc.
  - e. TAC.
  - f. TACO Incorporated.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Or approved equal.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: Brass



4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

**B. Cast-Iron Calibrated Balancing Valves:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Corporation; Bell & Gossett Div.
  - d. NIBCO Inc.
  - e. TAC.
  - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - g. Or approved equal.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).

**C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.**

**2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES**

**A. Manifold, Thermostatic, Water Mixing-Valve Assemblies:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Leonard Valve Company.
  - b. Powers; a division of Watts Water Technologies, Inc.
  - c. Symmons Industries, Inc.
  - d. Armstrong International
  - e. Or approved equal.
2. Description: Factory-fabricated, thermostatically controlled, water mixing-valve assembly in three-valve parallel arrangement.
3. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
4. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
5. Small-Flow Parallel: Thermostatic, water mixing valve.
6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
8. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
9. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
10. Selected Large-Flow, Tempered-Water Valve Size:
11. Tempered-Water Setting: .
12. Unit Tempered-Water Design Flow Rate:
13. Unit Minimum Tempered-Water Design Flow Rate:
14. Selected Unit Flow Rate at 45-psig (310-kPa) Pressure Drop:
15. Unit Pressure Drop at Design Flow Rate:



16. Unit Tempered-Water Outlet Size: end connection.
17. Unit Hot- and Cold-Water Inlet Size: end connections.
18. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.
19. Piping Finish: Copper.

## 2.8 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).
6. Drain: Factory-installed, hose-end drain valve.

## 2.9 HOSE BIBBS

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.



- d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products.
  - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
  - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
  - j. Or approved equal.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  - 3. Pressure Rating: 125 psig (860 kPa).
  - 4. Operation: Loose key.
  - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  - 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
  - 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 8. Box: Deep, flush mounted with cover.
  - 9. Box and Cover Finish: Polished nickel bronze.
  - 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
  - 12. Operating Keys(s): One with each wall hydrant.

**B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:**

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company.
  - b. Prier Products, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products.
  - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
  - h. Or approved equal.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
- 3. Pressure Rating: 125 psig (860 kPa).
- 4. Operation: Loose key.
- 5. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
- 6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
- 7. Outlet: Concealed.
- 8. Box: Deep, flush mounted with cover.
- 9. Box and Cover Finish: Polished nickel bronze.
- 10. Vacuum Breaker:
  - a. Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
- 11. Operating Keys(s): One with each wall hydrant.



## 2.11 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

### B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

### C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

## 2.12 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Precision Plumbing Products, Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products.
  - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
  - j. Or approved equal.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.



**2.13 AIR VENTS**

**A. Bolted-Construction Automatic Air Vents:**

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 (DN 15) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

**B. Welded-Construction Automatic Air Vents:**

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

**2.14 TRAP-SEAL PRIMER DEVICE (SEE SCHEDULE)**

**2.15 WATER METERS**

**A. Displacement-Type Water Meters:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AALIANT; a Venture Measurement product line.ABB.Badger Meter, Inc.
  - b. Carlon Meter.
  - c. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
  - d. Schlumberger Limited; Water Services.
  - e. Sensus.
  - f. Or approved equal.
2. Description:
  - a. Standard: AWWA C700.
  - b. Pressure Rating: 150-psig (1035-kPa) working pressure.
  - c. Body Design: Nutating disc; totalization meter.
  - d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
  - e. Case: Bronze.
  - f. End Connections: Threaded.

**B. Turbine-Type Water Meters:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AALIANT; a Venture Measurement product line.



- b. ABB.
- c. Badger Meter, Inc.
- d. Hays Fluid Controls.
- e. Master Meter, Inc.
- f. McCrometer, Inc.
- g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
- h. Schlumberger Limited; Water Services.
- i. SeaMetrics Inc.
- j. Sensus.
- k. Or approved equal.

2. Description:

- a. Standard: AWWA C701.
- b. Pressure Rating: 150-psig working pressure.
- c. Body Design: Turbine; totalization meter.
- d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
- g. End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.

C. Compound-Type Water Meters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. ABB.
- b. Badger Meter, Inc.
- c. Master Meter, Inc.
- d. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
- e. Schlumberger Limited; Water Services.
- f. Sensus.
- g. Or approved equal.

2. Description:

- a. Standard: AWWA C702.
- b. Pressure Rating: 150-psig (1035-kPa) working pressure.
- c. Body Design: With integral mainline and bypass meters; totalization meter.
- d. Registration: In gallons (liters) or cubic feet (cubic meters) as required by utility company.
- e. Case: Bronze.
- f. Pipe Connections: Flanged.

- D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
- E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 INSTALLATION**

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with NYC DEP standards and 2014 NYC Construction Codes.
1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- J. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- K. Install water-hammer arresters in water piping according to PDI-WH 201.
- L. Install air vents at high points of water piping.

- M. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- N. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- O. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

### 3.3 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

### 3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Intermediate atmospheric-vent backflow preventers.
  - 3. Reduced-pressure-principle backflow preventers.
  - 4. Double-check, backflow-prevention assemblies.
  - 5. Dual-check-valve backflow preventers.
  - 6. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
  - 7. Double-check, detector-assembly backflow preventers.
  - 8. Water pressure-reducing valves.
  - 9. Manifold, thermostatic, water mixing-valve assemblies.
  - 10. Primary water tempering valves.
  - 11. Outlet boxes.
  - 12. Hose stations.
  - 13. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly according to the New York City Department of Buildings and the device's reference standard.

Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

- B. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

**END OF SECTION 22 11 19**

**SECTION 22 11 23****DOMESTIC WATER PUMPS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Horizontally mounted, in-line, close-coupled centrifugal pumps.
- B. Related Sections include the following:
  - 1. Section 22 11 23.13 "Domestic-Water Packaged Booster Pumps" for booster systems.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS (SEE SCHEDULE)

2.1 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alyan Pump Co.
  - 2. Armstrong Pumps Inc.
  - 3. Bell & Gossett Domestic Pump; ITT Corporation.
  - 4. Marshall Engineered Products Co.
  - 5. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
  - 6. Pentair Pump Group; Aurora Pump.





7. TACO Incorporated.
  8. Thrush Company, Inc.
  9. Or approved equal.
- B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.
- C. Pump Construction:
1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
  2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
  3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
  4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
  5. Bearings: Oil-lubricated; bronze-journal or ball type.
  6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.
- E. Capacities and Characteristics:
1. Capacity
  2. Total Dynamic Head:
  3. Casing Material: Bronze.
  4. Impeller Material: ASTM B 584, cast bronze.
  5. Minimum Working Pressure: 175 psig (1200 kPa).
  6. Maximum Continuous Operating Temperature: 225 deg F (107 deg C).
  7. Inlet and Outlet Size:
  8. Pump Control:
  9. Pump Speed
  10. Motor Horsepower:
  11. Electrical Characteristics:
    - a. Volts: 120.
    - b. Phases: Single.
    - c. Hertz: 60.
    - d. Full-Load Amperes:
    - e. Minimum Circuit Ampacity:
    - f. Maximum Overcurrent Protection:

## 2.2 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
1. Type: Water-immersion temperature sensor, for installation in piping.
  2. Range: 65 to 200 deg F (18 to 93 deg C).
  3. Enclosure: NEMA 250.
  4. Operation of Pump: On or off.

5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac.
7. Settings: Start pump at 105 deg F.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

#### 3.3 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, seal-less centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft(s) horizontal.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete".
  1. Minimum Deflection: 1 inch (25 mm).
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- F. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
  1. Comply with requirements for vibration isolation devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
  2. Comply with requirements for hangers and supports specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- G. Install pressure switches in water supply piping.
- H. Install thermostats in hot-water return piping.
- I. Install time-delay relays in piping between water heaters and hot-water storage tanks.

### 3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    - d. Comply with requirements for flexible connectors specified in Section 22 11 16 "Domestic Water Piping."
  - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 22 11 19 "Domestic Water Piping Specialties."
  - 3. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- D. Connect pressure switches, thermostats, time-delay relays, and timers to pumps that they control.

Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

### 3.5 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for identification of pumps.

### 3.6 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Set thermostats for automatic starting and stopping operation of pumps.
  - 5. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.



- b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
  - c. Verify that pump is rotating in the correct direction.
- 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 7. Start motor.
  - 8. Open discharge valve slowly.
  - 9. Adjust temperature settings on thermostats.
  - 10. Adjust timer settings.

### 3.7 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**END OF SECTION 22 11 23**

**SECTION 22 11 24**

**DOMESTIC WATER PACKAGED BOOSTER PUMPS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Triplex, constant-speed booster pumps.
- B. Related Sections:
  - 1. Section 22 11 23 "Domestic Water Pumps" for domestic-water circulation pumps.

**1.3 DEFINITIONS**

- A. VFC: Variable-frequency controller(s).

**1.4 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified and the booster pump will be fully operational after the seismic event."

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each packaged booster pump specified. Include the following:
  - 1. System design information sheets indicating design parameters of system pressure and flow.
  - 2. Pump type, capacity, power requirements, material and construction.
  - 3. Pump curve indicating design point.
  - 4. Detailed sequence of operation.
  - 5. Packaged system dimension and general arrangement drawing.
  - 6. Catalog information on major components.
  - 7. Electrical power and control wiring diagrams with indication of field wiring connections.
  - 8. All of the above shall be specifically prepared and certified for this project.



## 1.7 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For booster pumps, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

## 1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

## 1.9 QUALITY ASSURANCE

- A. Reference Standards:
  - 1. ANSI/ASHRAE 90A: Energy Conservation in New Building Design.
  - 2. ASME Section VIII: pressure Vessels; Boiler and Pressure Vessel Codes.
  - 3. Hydraulic Institute
  - 4. NEMA MG 1: Motors and Generators
  - 5. NFPA 70: National Electrical Code
  - 6. UL 508: Standard for Industrial Control Equipment
  - 7. UL 778: for motor-operated water pumps
- B. Manufacturing firms regularly engaged in manufacture of the material meeting all capacities and operating characteristics of the specified manufacturer's product whose products have been in satisfactory use, in similar service, for not less than ten (10) years. Manufacturer must be ISO 9000 certified.
- C. The system shall be independently Third Party labeled as a system suitable for the intended use by a Nationally Recognized Testing Laboratory (NRTL) such as UL or ETL, in accordance with OSHA Federal Regulations and NFPA Pamphlet 70, the National Electric Code (NEC) Article 90-7.
- D. Factory Test: The booster system and its component parts shall undergo a hydrostatic pressure and complete operating flow test from zero to 100% design flow rate under the specified suction and net system pressure conditions. This flow rate under the specified suction and net system pressure conditions. This flow test shall be performed by supplying the control panel with the specified incoming voltage. Each pump's performance shall be tested over its full range of flow. All pressure regulators, pressure switches, and other devices shall be set and functions verified. Components shall be tested for hydraulic shock, vibration, or excessive noise. Testing shall also include a hi—pot voltage test of the system. Any parts found to be defective must be replaced prior to shipment. Full documentation shall be maintained by the manufacturer showing flow rates, pressures and amp draws for future service and troubleshooting reference.
- E. Certification: The final system certification shall include copies of the independent Third Party Certifications and test data as recorded by X-Y plotter. The specifying Engineer shall have the option to witness the test. The entire system shall be painted after testing.

- F. The manufacturer of packaged equipment shall be responsible for the complete pumping system and its satisfactory performance as described in this section and shall provide a written guarantee covering all the equipment as well as the system performance for 12 months from date of start-up, not exceeding 18 months from date of shipment. The services of a factory trained engineer shall be provided for start-up and instruction of maintenance personnel.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Retain protective coatings and flange's protective covers during storage.

#### 1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.12 MANUFACTURER'S WARRANTY

- A. Provide manufacturer's warranty covering all valves shall carry a three (3) year warranty against defect of materials, from date of substantial completion.

### PART 2 - PRODUCTS

#### 2.11 DUPLEX, VARIABLE-SPEED BOOSTER PUMPS

- A. Manufacturers:
  - 1. Subject to compliance with all specified requirements, provide products as produced by the manufacturer used as the basis of design. Other manufacturers, whose products have been in satisfactory use in similar service for not less than 10 years, may be submitted for approval as an equal provided the submission contains sufficient information for evaluation and the manufacturer certifies full compliance with the performance, physical characteristic requirements and all operational features of these Specifications.
- B. Variable speed, constant pressure, triplex booster pumps
  - 1. Description: Factory-assembled and tested, packaged, constant speed, booster pump with multiple pumps, piping, valves, sensors, and controls on skids or base, similar to SyncroFlo/ Peerless – GAF Series.
    - a. Manufacturer Basis of Design:
      - 1) SyncroFlo / Peerless – GAF Series
      - 2) Bell Gossett
      - 3) Federal Pump
      - 4) Or approved equal.
  - 2. Pumps: Overhung impeller assembly, separately coupled, vertically mounted on baseplate, multistage, radially split case, centrifugal. Comply with UL 778 and HI 1.1-1.2 and HI 1.3.



- a. Pump Arrangement: Multiplex, with equal-size pumps.
  - 1) Orientation: Mounted vertically.
  - 2) Construction: Stainless-steel fitted.
    - a) Body: Cast iron or stainless steel
    - b) Impellers: 316 stainless steel with internal thrust balance feature each stage.
    - c) Diffusers: 316 stainless steel.
    - d) Shaft: Stainless steel.
    - e) Shaft Sleeves and Bearings: tungsten carbide.
    - f) Seal: Mechanical, high temperature, reversible, silicon carbide.
    - g) Maximum speed: As scheduled on drawings.
  - 3) Coupling: Rigid type.
3. Motors: Single speed, with grease lubricated bearings, unless otherwise indicated open drip-proof enclosure, 1.15 service factor. Select motor that will not overload through full range of pump performance curve.
4. Packaging: All components shall be mounted on a structural channel or I-beam, steel or aluminum, skid suitable for grouting with all interconnecting piping and wiring completed.
  - a. Piping shall be schedule 40, 304 stainless steel or Type "L" copper. Dielectric fittings shall be used where joining dissimilar metals to prevent galvanic action and to stop corrosion. The piping shall be adequately supported independent of pump connections. It shall be arranged with adequate space for maintenance and to allow for removal of any pump without system shutdown. The suction and discharge manifolds piping shall be sized for a maximum velocity of 7 FPS.
    - 1) The factory assemble package shall be constructed to facilitate system installation and to provide for a field adaptable piping configuration as follows: the system base shall be split, allowing for ease of disassembly and reassembly, by the contractor in the field; the suction and discharge manifolds shall be flanged on both ends allowing for field connection to either end of the suction and discharge headers.
    - 2) Contractor shall inspect the jobsite, noting access and installation space limitations and shall coordinate package construction with the manufacturer.
  - b. Full port ball or lug style butterfly type isolation valves shall be installed on the suction and discharge of each pump. Each pump shall be provided with a thermal safety purge valve for over temperature protection.
  - c. Each pump discharge line shall include a pilot operated diaphragm type combination pressure regulating and non-slam check valve. Valves shall be set for higher than normal pressure to provide emergency pressure regulation in the event of full speed pump operation by means of the bypass starter due to a variable frequency drive failure.





- 1) Materials of construction shall be: 316 stainless steel, globe style body, stem, seat, disc retainer, guide bushing, spring and fasteners, ANSI Class 150 flanges, 250 PSIG maximum working pressure. Valve pilot lines shall be equipped with bronze / brass tubing, regulator, strainer, flow stabilizers/opening speed controls, check valves and a minimum of three (3) isolation ball valves, one at each pilot port to facilitate trouble shooting.
  - 2) Valves shall be designed for ease of assembly and maintenance and shall be completely serviceable in-line without need for special tools. Main valve bonnet shall have a removable cap for easy access to spring and upper bearing without having to remove the main valve bonnet or pilot system, valve stems shall have wrench flats. Each valve shall be tested prior to shipment including a pressure test and a functional operational test.
  - 3) In addition to the standard materials, these valves shall be specially constructed for operator convenience, serviceability, noise reduction and corrosion resistance with the following features:
    - a) Position indicator with air vent valve for visual observation of operation
    - b) Ball valves for pilot line strainer blowdown
    - c) Ball valves at every pilot port to facilitate operational testing
    - d) Ribbed silent seats for quiet operation at low flow.
    - e) Oxy-Nitride coated stems for increased lubricity, resistance to mineral deposits and enhanced corrosion protections
  - 4) The regulating valves shall be guaranteed to maintain accurate pressure control without pulsation or wire drawing across the full range of system operation down to a flow of 1 GPM; where required, individual auxiliary pressure regulating valves shall be installed in parallel with each main valve.
  - d. Controller mounted, 4" diameter, glycerin filled, pressure gauges shall be provided for indication of suction, system, and individual pump discharge pressures. All pressure sensing lines for gauges or pressure switches shall be factory piped in copper with brass with shut-off valves.
  - e. The pumps and all components on the discharge side of the pumps shall have a rated working pressure greater than pump shut-off head plus maximum, suction pressure. Pipe all purge valve discharge lines and, when applicable, packing gland drains (separate from purge lines) to a floor drain and make piping interconnection with the precharged diaphragm tank, as shown on the plans.
5. Controls
- a. Operating Sequence and Alarms:
    - 1) The electrical control system shall start, stop and vary the speed of the pumps as required by system demand, via a single common PID controller. The lead pump shall run continuously with the ability to shutdown on no flow. Should the system demand exceed the capacity of the lead pump or should the lead pump fail to operate, the lag pumps shall be started in sequence upon pressure drop. Upon drop in system flow, the pumps shall be stopped in reverse order. The flow sensor shall also be capable of starting the lag pumps. The pumps shall be automatically alternated. If any pump is out of service, pump sequencing shall be automatically shifted.
    - 2) In the event of a low suction pressure condition, the pumps shall be cut-off and alarm shall be activated. Pumps and alarm shall automatically reset when conditions return to normal.



- 3) In the event of a low system pressure condition, the pumps shall be sequenced on and the alarm shall be activated. The pumps and alarm shall automatically reset when conditions return to normal.
- 4) In the event of a low system pressure condition caused by a drive failure, the automatic bypass circuit shall start pumps, in sequence following time delay across-the-line; alarm horn and light shall be energized. This alarm shall require a manual reset.
- 5) In the event of a high system pressure condition, the pumps shall be cut-off and alarm shall be activated. Pumps and alarm shall automatically reset when conditions return to normal.
- 6) In the event of a drive failure, the alarm shall be activated and the remaining pumps shall be started in sequence.
- 7) In the event of an excessively high system flow due to any condition such as a downstream pipe failure, all pumps shall be cut-off and the alarm shall be activated. Manual reset required.
- 8) In the event of a control power failure, the power failure relay shall activate an auxiliary alarm contact, no audible alarm.
- 9) In the event of a failure of a programmable logic controller ("PLC"), electronic pressure or flow sensor, a failure circuit shall activate redundant electromechanical controls and alarm (no audible) and minimum of one pump shall operate automatically.
- 10) All alarms shall be audio-visual, except as noted, with silencing push-button and two (2) sets of Form "C" auxiliary alarm contacts for remote common system trouble alarm (2-NO, 2-NC).
- 11) All start/stop and alarm set points shall be field adjustable. Activation of all start/stop and alarm functions shall follow field adjustable time delays.

b. Pressure and Flow Sensors:

- 1) Pressure Transducers: Shall be factory mounted inside the control panel and factory piped to the to the suction and system headers. The transducers shall have 1.0% accuracy, stainless steel wetted parts and a waterproof enclosure. Transducers shall be IP67 rated, and capable of withstanding over pressurization of double its range. The transducers shall use a digital 1-6 kHz pulse output that can be directly sent to a programmable logic controller (PLC) without requiring an additional analog module for measuring current. The transducers zero set point must be capable of field calibration.
- 2) Pressure Transducer: An additional pressure transducer shall be field installed at the remote diaphragm tank. It shall be a variable capacitance type with two wire 4-20 MA proportional signal for process by the programmable controller at the pump. Transducer shall be heavy duty, industrial grade having an operating temperature range of -20 degrees F to +200 degrees F and a continuously adjustable timing constant of .2 to 1.67 sec. and 2,000 PSI over-pressurization rating. Incorporated in the body shall be a 316SS air bleed. Transducer shall be capable of zero evaluation of 600% of calibrated span and a zero suppression of 500% of calibrated span.



- a) Wiring for the remote pressure transducer shall be furnished and installed by the electrical contractor using a twisted shielded pair of #18 or larger wires carrying 4-20 milliamps DC.
- 3) Pressure Switches: Shall be non-mercury type.
- 4) Flow rate Transducer: Shall be a non-magnetic type, paddle wheel flow sensor, converting pulse rate into volumetric flow of full scale. The accuracy shall be 1% of full scale and repeatable within 0.3%. A "hot-tap" mounting adapter shall be provided by the manufacturer to allow sensor removal without system shutdown. The transducer shall be factory installed in a full size spool piece providing for a straight run of 10 pipe diameters upstream and 5 pipe diameters downstream of the sensor. The spool piece shall be field installed in the suction piping by the contractor.
- a) The flow sensor shall be provided with 20' of wiring to be installed by the electrical contractor. If additional wiring length is needed provide two conductor shielded cable, carrying 8 volts DC.
- c. Control Panel: Factory installed and connected as an integral part of unit complying with NEMA ICS 2 and UL 508; automatic for multiple-pump, variable and constant speed operation with load control and protection functions. It shall be arranged for single common power feed housed in a NEMA-12 enclosure, complete with the following:
  - 1) Circuit breaker disconnect switches interlocked with compartment door, for each pump.
  - 2) Three pole magnetic motor starters with three phase thermal overload protection and low voltage release, for VFD bypass, for each pump.
  - 3) Bypass drive isolation contactors.
  - 4) 115-volt control circuit transformer fused on both the primary and secondary sides with circuitry for automatic transfer of primary to active power feed.
  - 5) Control power available light with auxiliary alarm contacts.
  - 6) H-O-A selector switches, for each pump.
  - 7) Automatic pump alternator with manual override selector switch.
  - 8) Pump run indicating lights.
  - 9) Alarm indicating lights.
  - 10) Audible alarm, silencing push-button and remote trouble alarm contacts.
  - 11) Set of necessary control relays and other accessory devices required to permit the system to operate in conformance with the specifications.
  - 12) Auxiliary contacts (Form "C" (1-NO, 1-NC)) for interface with building automation system, for the following:
    - a) Control power available.
    - b) On-off status of each pump.
    - c) Common system trouble alarm status.
  - 13) Set of panel mounted pressure gauges and switches.
  - 14) Color Touchscreen HMI (Human Machine Interface).
  - 15) Programmable Logic Controller (PLC).
  - 16) Building management system communication module for pump system data via BACNET /LONWORKS.
  - 17) All components shall be mounted on back panels.
  - 18) All internal wiring shall be numbered corresponding to the wiring diagrams.
- d. Color Touchscreen HMI (Human Machine Interface) shall be flush mounted in the door of the control panel. It shall have the following features:



- 1) 320 x 240 resolution, 256 color, 3 MB memory, 5.7" screen size, 520 characters/screen, 300 touchpoints / screen.
- 2) Serial port (for PLC communication), USB port (for programming), and Compact Flash port (for troubleshooting and field-loading program changes).
- 3) The HMI shall be capable of direct communication with the VFD, in the event of a PLC failure.
- 4) The following data shall be accessible through the operator interface.
  - a) System status including flow rate (GPM), current system pressure and setpoint, pump run status, the current speed of the pumps (in %), and the method of speed control. Display system status on all user screens.
  - b) Usage history shall record the maximum instantaneous flow, along with the date and time. Overall and current day totalized flow, pump starts, and pump run hours are also recorded. Usage history may be reset.
  - c) A Set Points Menu system for adjusting setpoints. Display and adjust flow, pressure, differential pressure, VFD speed, power, minimum speed, lead pump shutdown mode, and tank pressurizer set points and time delays. Restore to either factory defaults or the last saved field defaults. Protect adjustable settings with a password.
  - d) Alarm History of the past 200 alarms. Each log shall include individual pump run status, system pressure and run setpoint, alarm type and the date and time. Alarm Type shall be in plain English, not codes requiring a reference list.
  - e) Alarm List of all possible alarms and their current status. Display any current alarms on all user screens.
  - f) Start-up instructions and checklist.
- 5) The HMI shall include a method for transferring data
  - a) Alarms shall automatically copy to an installed compact flash drive.
  - b) Include fault codes from the PLC and the VFD.
  - c) Copy usage data to the drive daily.
  - d) Data shall be stored in a text file, readable by non-proprietary software.
  - e) HMI Software shall allow for program changes to the HMI and PLC to be transferred via the compact flash drive.
- e. The Programmable Logic Controller (PLC) shall be installed on the control panel base pan, not the door, to protect it from damage. The PLC manufacturer shall be clearly marked on the controller, and non-proprietary. The PLC shall continue to function even if the touchscreen is broken, damaged, or removed. The PLC shall have the following features: 32,000 steps of built-in program memory, 7680 auxiliary relays, 320 timers, 235 counters, 8000 data registers, 24,000 extension registers, and 24,000 extension file registers.
- f. Variable Frequency Drives: Each pump shall have its own variable frequency drive with the following features:
  - 1) The drive shall be a voltage source, GTR or IGBT power transistor based inverter - PWM Type. The inverter shall use a high carrier frequency to reduce drive and motor noise.



- 2) Drive shall be capable of operating in an ambient temperature between 15 °F and 100 °F and a line voltage variation of less than 10%.
  - 3) Self-protection features shall include: under voltage and over voltage protection, current overload protection, short circuit protection, power failure protection, ground fault protection, and over-temperature protection.
  - 4) A four digit LED readout shall be provided to indicate the following: drive enabled, output frequency, and all VFD fault conditions.
  - 5) The drive shall be capable of automatically restarting after any of the following: overload over-voltage, converter over-current, inverter over-current, or power failure.
  - 6) The following drive parameters shall be user adjustable: acceleration speed (1 to 300 seconds), deceleration speed (1 to 300 seconds), minimum speed, and maximum speed.
  - 7) The drive shall have a front mounted "HAND-OFF-AUTO" selector switch and a potentiometer for adjusting drive speed in the "HAND" position.
  - 8) Drives shall have a minimum 100,000-amp short circuit current rating.
  - 9) The VFD shall use the following energy saving techniques
    - a) Slows down the motor
    - b) Reduce current
    - c) Reduces voltage
    - d) Evaluates 6 motor characteristics to further increase efficiency
  - 10) VFD shall communicate with the PLC with a DIGITAL connection, with the following capabilities:
    - a) Able to modify 300 different VFD parameters through the PLC and HMI
    - b) Read all VFD data and communicate it to the PLC, HMI, and write to the compact flash drive.
  - 11) VFD drives mounted external to the control panel shall have dust protection.
8. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembling and testing. Protect flanges, pipe openings, and pump nozzles.
  9. Capacity and Characteristics: (See Schedule on drawings)

**C. Precharged Diaphragm Tank**

1. Precharged pneumatic diaphragm tank, built in accordance with ASME Code standards. The tank shall be installed as indicated on the drawings.
2. Tank shall be vertically mounted with the cold water inlet connection located on the bottom, 1/4" vent and air charging valve. All wetted metal parts must be brass or stainless steel.
3. The tank shall be field piped with pressure gauge, pressure sensor, isolation and hose bibb drain valves. Precharge the tank to 5 PSI less than minimum system pressure at the point of connection.
4. Capacity, Air Charge, Working Pressure, and Location: (See Schedule.)
5. Provide auxiliary contacts in the pump controller for interface to building automation system. Include the following:
  - a. Control power available.
  - b. On-off status of each pump.
  - c. Alarm status.

## 2.12 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

## PART 3 - EXECUTION

### 3.11 EXAMINATION

- A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

### 3.12 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for packaged booster pumps. Refer Section 22 00 00 - "Common Work Results for Plumbing."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
  - 4. Install anchor bolts to elevation required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Section 03 30 00 – "Cast-in-Place Concrete".

### 3.13 BOOSTER PUMP INSTALLATION

- A. Install packaged booster pumps level on concrete bases with access for periodic maintenance including removal of pumps, motors, impellers, couplings, and accessories.
  - 1. Do not dismantle packaged booster pumps or remove individual components, without authorization from the manufacturer.
  - 2. Pipe all packing glands to drain.
  - 3. Pipe all thermal safety purge valves to drain, separate from packing gland drain piping.
  - 4. Completely fill the base with non-shrinking grout prior to pump start-up.
- B. Vibration isolation: As specified in Section 22 05 48 "Vibration and Seismic controls for Plumbing Piping and Equipment."
- C. Support connected domestic water piping so weight of piping is not supported by packaged booster pumps.



### 3.14 CONNECTIONS

- A. Piping installation requirements are specified in other Section 22 11 16 – “Domestic Water Piping”. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to packaged booster pumps. Install suction and discharge pipe equal to or greater than size of unit suction and discharge headers.
  - 1. Install shutoff valves on piping connections to each booster pump suction and discharge headers. Install ball valves same size as suction and discharge headers. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
  - 2. Install union or flanged connections on pump suction and discharge headers at connection to domestic water piping.
  - 3. Install piping adjacent to packaged booster pumps to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.15 STARTUP SERVICE

- A. Prior to start-up perform the following:
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers if any.
  - 4. Verify that pump controls are correct for required application.
- B. Engage a factory-authorized service representative to perform the following startup service:
  - 1. Verify that pump controls are correct for the required application.
  - 2. Verify bearing lubrication.
  - 3. Align pump and motor in accordance with the manufacturer's guideline.
  - 4. Prime pumps by opening suction valves and closing discharge valves, and prepare pumps for operation.
  - 5. Start motors.
  - 6. Open discharge valves slowly.
  - 7. Verify that pump system operates in accordance with the specification, adjust settings as required.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial completion, provide on-site assistance in adjusting packaged booster pumps to suit actual occupied conditions. Provide up to two visits to project outside normal occupancy hours for this purpose.

### 3.16 LABELING AND IDENTIFICATION

- A. Install identifying equipment markers and equipment signs on booster pumps. Labeling and identification materials are specified in Division 22 Section 22 05 53 - "Identification for Plumbing Piping and Equipment."

3.17 DEMONSTRATION

- A. Engage a service representative that is properly trained by the manufacturer to instruct the City of New York's service operators to adjust, operate, and service packaged booster pumps. Refer to DDC General Conditions for instruction requirements.

**END OF SECTION 22 11 24**



**SECTION 22 12 23****FACILITY INDOOR WATER STORAGE TANKS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 21 08 00 – “Commissioning of Fire Protection”
- C. Section 22 08 00 – “Commissioning of Plumbing”

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Steel Tank, Field Erected (Fire Reserve Tank).

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 “Construction Waste Management and Disposal”
  - 2. Section 01 81 13 “Sustainable Design Requirements for LEED Buildings”
  - 3. Section 01 81 19 “Indoor Air Quality Requirements for LEED Buildings”
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PERFORMANCE REQUIREMENTS**



- A. Seismic Performance: Steel water tanks shall withstand the effects of earthquake motions determined according to.

- 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water storage tanks.
  - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For steel water storage tanks, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of potable-water storage tank, from manufacturer.
- C. Source quality-control reports.
- D. Purging and disinfecting reports.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. ASME Compliance for Steel Tanks: Fabricate and label steel, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- C. ASME Compliance for FRP Tanks: Fabricate and label FRP, ASME-code, potable-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
- D. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water storage tanks and components. Include appropriate NSF marking.
- E. Comply with NSF 61, "Drinking Water System Components - Health Effects," for



potable-water storage tanks. Include appropriate NSF marking.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 STEEL, NONPRESSURE, POTABLE-WATER STORAGE TANKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. American Tank
  - 2. Rosenwach
  - 3. Isseks Brothers, Inc.
  - 4. Or approved equal.
- C. Description: Steel, horizontal, nonpressure-rated tank.
- D. Manhole: Watertight, for tank more than 36 inches in diameter.
- E. Cover for Open Tank: Steel, with lining same as or similar to tank lining and with shape that encloses top of tank.
- F. Tappings: Factory-fabricated stainless steel, welded to tank.
  - 1. NPS 2-1/2 (DN 65) and Larger: ASME B16.5, flanged.
- G. Specialties and Accessories: Include tappings in the tank and the following:
  - 1. Vacuum relief valve.
  - 2. Free air vent with insect screen.
  - 3. Thermometer.
  - 4. Gage glass, brass fittings, compression stops, and gage-glass guard.
- H. Horizontal Tank Supports: Factory-fabricated steel saddles, welded to tank before testing and labeling.
  - 1. Tank: fabricate Steel Water Storage Tank. Tank material to be 3/8" Carbon Steel A36, bottom and walls, covers to be 3/16". Covers to be supported by 4: channels, 48" centers. Tank to be internally braced with 2" stayrods (or braced externally). Install two (2) 24" x 24" sliding hatches. Install two (2) epoxy coated steel interior ladders and two (2) steel exterior ladders. Paint exterior of tank with one (1) coat of Black Enamel.

2.2 SOURCE QUALITY CONTROL

- A. Test and inspect potable-water storage tanks according to the following tests and inspections and prepare test reports:
  - 1. Pressure Testing for ASME-Code, Potable-Water Storage Tanks:



Hydrostatically test to ensure structural integrity and freedom from leaks. Fill tanks with water, vent air, pressurize to 1-1/2 times tank pressure rating, disconnect test equipment, hold pressure for 30 minutes with no drop in pressure, and check for leaks.

2. Pressure Testing for Non-ASME-Code, Pressure, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks at pressure of above system operating pressure, but not less than 150 psig (1035 kPa). Fill tanks with water, vent air, pressurize tanks, disconnect test equipment, hold pressure for two hours with no drop in pressure, and check for leaks.
3. Testing for Nonpressure, Potable-Water Storage Tanks: Fill tanks to water operating level to ensure structural integrity and freedom from leaks. Hold water level for two hours with no drop in water level.

- B. Restore or replace tanks that fail test with new tanks, and repeat until test is satisfactory.

## **PART 3 – EXECUTION**

### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

### **3.2 INSTALLATION**

- A. Install water storage tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.
  1. Install horizontal tanks on concrete pad steel supports and saddles.
- B. Anchor tank supports and tanks to substrate.
  1. Use steel or FRP straps over or around plastic tanks.
- C. Install tank seismic restraints.
- D. Install thermometers and pressure gages on water storage tanks and piping if indicated. Thermometers and pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."
- E. Install the following devices on tanks where indicated:
  1. Pressure relief valves.
  2. Temperature and pressure relief valves.
  3. Vacuum relief valves.
  4. Tank vents on nonpressure tanks.
  5. Connections to accessories.
  6. Provide stainless steel ladder.

- F. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.



- B. Install piping adjacent to potable-water storage tanks to allow service and maintenance.
- C. Connect water piping to water storage tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge over closest floor drains.
  - 1. General-duty valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
    - a. Valves NPS 2 (DN 50) and Smaller: Gate or ball.
    - b. Valves NPS 2-1/2 (DN 65) and Larger: Gate or butterfly.
    - c. Drain Valves: NPS 3/4 (DN 20) gate or ball valve. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.
  - 2. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Section 221116 "Domestic Water Piping."
  - 3. Connect air piping to hydropneumatic tanks with unions or flanges and gate or ball valves. Make connections to dissimilar metals with dielectric fittings, which are specified in Section 221513 "General-Service Compressed-Air Piping."

#### 3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

#### 3.5 FIELD QUALITY CONTROL

- A. Perform the following final checks before filling:
  - 1. Verify that air precharge in precharged tanks is correct.
  - 2. Test operation of tank accessories and devices.
  - 3. Verify that pressure relief valves have correct setting.
    - a. Manually operate pressure relief valves.
    - b. Adjust pressure settings.
  - 4. Verify that vacuum relief valves are correct size.
    - a. Manually operate vacuum relief valves.
    - b. Adjust vacuum settings.
- B. Filling Procedures: Follow manufacturer's written procedures. Fill tanks with water to operating level.

#### 3.6 CLEANING

- A. Clean and disinfect potable-water storage tanks.
- B. Use purging and disinfecting procedure prescribed by 2014 NYC Construction Codes or, if method is not prescribed, use procedure described in AWWA C652 or as described below:



1. Purge water storage tanks with potable water.
  2. Disinfect tanks by one of the following methods:
    - a. Fill tanks with water-chlorine solution containing at least 50 ppm (50 mg/L) of chlorine. Isolate tanks and allow to stand for 24 hours.
    - b. Fill tanks with water-chlorine solution containing at least 200 ppm (200 mg/L) of chlorine. Isolate tanks and allow to stand for three hours.
  3. Flush tanks, after required standing time, with clean, potable water until chlorine is not present in water coming from tank.
  4. Submit water samples in sterile bottles to testing agency approved by New York City Department of Buildings. Repeat procedure if biological examination made by testing agency shows evidence of contamination.
- C. Prepare written reports for purging and disinfecting activities.

**END OF SECTION 22 12 23**

**SECTION 22 13 16****SANITARY WASTE AND VENT PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Pipe, tube, and fittings.
  2. Specialty pipe fittings.
- B. Related Sections:
1. Section 22 13 29 "Sump Pumps" for effluent and sewage pumps.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

**PART 2 - PRODUCTS****2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

**2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 74, Service.
- B. Gaskets: ASTM C 564, rubber.



- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.

- B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ANACO-Husky.
  - b. Dallas Specialty & Mfg. Co.
  - c. Fernco Inc.
  - d. Matco-Norca, Inc.
  - e. MIFAB, Inc.
  - f. Mission Rubber Company; a division of MCP Industries, Inc.
  - g. Stant.
  - h. Tyler Pipe.
  - i. Wade
  - j. Or approved equal.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

- C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ANACO-Husky.
  - b. Clamp-All Corp.
  - c. Dallas Specialty & Mfg. Co.
  - d. MIFAB, Inc.
  - e. Mission Rubber Company; a division of MCP Industries, Inc.
  - f. Stant.
  - g. Tyler Pipe.
  - h. Wade
  - i. Or approved equal.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

- D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MG Piping Products Company.
  - b. Wade



- c. ANACO-Husky.
  - d. Or approved equal.
- 2. Standard: ASTM C 1277.
  - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 SPECIALTY PIPE FITTINGS

### A. Transition Couplings:

- 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
- 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- 3. Unshielded, Non-pressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dallas Specialty & Mfg. Co.
    - 2) Fernco Inc.
    - 3) Mission Rubber Company; a division of MCP Industries, Inc.
    - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
    - 5) Or approved equal.
  - b. Standard: ASTM C 1173.
  - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 4. Shielded, Non-pressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company; a division of MCP Industries, Inc.
    - 3) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
    - 4) Or approved equal.
  - b. Standard: ASTM C 1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- 5. Pressure Transition Couplings:



- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) Cascade Waterworks Mfg. Co.
  - 2) Dresser, Inc.
  - 3) EBAA Iron, Inc.
  - 4) JCM Industries, Inc.
  - 5) Romac Industries, Inc.
  - 6) Smith-Blair, Inc.; a Sensus company.
  - 7) The Ford Meter Box Company, Inc.
  - 8) Viking Johnson.
  - 9) Or approved equal.
- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Ductile iron.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

**B. Dielectric Fittings:**

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) Central Plastics Company.
    - 3) Hart Industries International, Inc.
    - 4) Jomar International Ltd.
    - 5) Matco-Norca, Inc.
    - 6) McDonald, A. Y. Mfg. Co.
    - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - 8) Wilkins; a Zurn company.
    - 9) Or approved equal.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) Central Plastics Company.
    - 3) Matco-Norca, Inc.



- 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 5) Wilkins; a Zurn company.
- 6) Or approved equal.

b. Description:

- 1) Standard: ASSE 1079.
- 2) Factory-fabricated, bolted, companion-flange assembly.
- 3) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Advance Products & Systems, Inc.
- 2) Calpico, Inc.
- 3) Central Plastics Company.
- 4) Pipeline Seal and Insulator, Inc.
- 5) Or approved equal.

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: 150 psig (1035 kPa).
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.
- 6) Or approved equal.

b. Description:

- 1) Standard: IAPMO PS 66
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 00 00 "Earthwork".

**3.3 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants,



cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of 2014 New York City Construction Codes.
  - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
  - 3. Reduced-Size Venting: Comply with standards of 2014 New York City Construction Codes.
- Q. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- R. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- S. Install force mains at elevations indicated.
- T. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."



- U. Do not enclose, cover, or put piping into operation until it is inspected and approved by New York City Department of Buildings.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

### 3.5 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Shielded, non-pressure transition couplings.
  - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.



4. In Underground Force Main Piping:
  - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
  - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges nipples.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.6 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

- D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
  - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.





7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
  3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
  4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
  5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
  6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
  3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
  7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
  8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- 3.8 CONNECTIONS**
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by 2014 New York City Plumbing Code.



2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by 2014 New York City Plumbing Code.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by 2014 New York City Plumbing Code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for backwater valves, cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.9 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.10 FIELD QUALITY CONTROL

- A. During installation, notify New York City Department of Buildings at least 24 hours before inspection must be made. Perform tests specified below in presence of Commissioner.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by Commissioner to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If testing agency or Commissioner find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by Commissioner.
- D. Test sanitary drainage and vent piping according to procedures of New York City Department of Buildings or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.



2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.11 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### 3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings CISPI heavy-duty hubless-piping couplings; and coupled joints.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: non-pressure transition couplings.



- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- F. Underground, soil, waste, and vent piping shall be any of the following:
  - 1. Service class, cast iron soil pipe and fittings; hub and spigot type with gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings
- G. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
  - 1. Galvanized-steel pipe, pressure fittings, and threaded joints.
- H. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
  - 1. Galvanized-steel pipe, pressure fittings, and threaded joints.
  - 2. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- I. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
  - 1. Hard copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.
  - 2. Ductile-iron, mechanical-joint piping and mechanical joints.
  - 3. Ductile-iron, push-on-joint piping and push-on joints.
  - 4. Ductile-iron, grooved-joint piping and grooved joints.
  - 5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 (DN 40) and pressure transition coupling for NPS 1-1/2 (DN 40) and larger if dissimilar pipe materials.
- J. Underground sanitary-sewage force mains NPS 5 and larger shall be any of the following:
  - 1. Hard copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.
  - 2. Ductile-iron, mechanical-joint piping and mechanical joints.
  - 3. Ductile-iron, push-on-joint piping and push-on joints.
  - 4. Ductile-iron, grooved-joint piping and grooved joints.
  - 5. Pressure transition couplings if dissimilar pipe materials.

**END OF SECTION 22 13 16**

## SECTION 22 13 19

## SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

## 1.2 SUMMARY

## A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Air-admittance valves.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Flashing materials.

## B. Related Requirements:

1. Section 22 14 23 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 33 41 00 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

## 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

## B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

1.7 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that accessories, and components will withstand seismic forces defined in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York City Department of Buildings, and marked for intended use.



- D. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

#### 1.10 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete".
- B. Coordinate size and location of roof penetrations.

#### 1.11 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

### PART 2 - PRODUCTS

#### 2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:

- 1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1) Josam Company.
      - 2) MIFAB, Inc.
      - 3) Smith, Jay R. Mfg. Co.
      - 4) Tyler Pipe.
      - 5) Watts Drainage Products.
      - 6) Zurn Plumbing Products Group.
      - 7) Wade
      - 8) Or approved equal.

- B. Metal Floor Cleanouts:

- 1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by the following and provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Josam Company.
      - 2) Oatey.
      - 3) Sioux Chief Manufacturing Co., Inc.
      - 4) Smith, Jay R. Mfg. Co.
      - 5) Tyler Pipe.
      - 6) Watts Drainage Products.
      - 7) Zurn Plumbing Products Group.
      - 8) Wade
      - 9) Or approved equal.

**C. Cast-Iron Wall Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - g. Wade
  - h. Or approved equal.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
8. Wall Access: Round, nickel-bronze, wall-installation frame and cover.

**2.2 FLOOR DRAINS****A. Cast-Iron Floor Drains:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Commercial Enameling Co.
  - b. Josam Company; Josam Div.
  - c. MIFAB, Inc.
  - d. Prier Products, Inc.
  - e. Smith, Jay R. Mfg. Co.
  - f. Tyler Pipe; Wade Div.
  - g. Watts Drainage Products.
  - h. Zurn Plumbing Products Group
  - i. Or approved equal.
2. Standard: ASME A112.6.3.

**2.3 AIR-ADMITTANCE VALVES****A. Fixture Air-Admittance Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Ayrlett, LLC.
  - b. Durgo, Inc.
  - c. Oatey.
  - d. ProSet Systems Inc.
  - e. RectorSeal.
  - f. Studor, Inc.





- g. Or approved equal.
  - 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
  - 3. Housing: Plastic.
  - 4. Operation: Mechanical sealing diaphragm.
  - 5. Size: Same as connected fixture or branch vent piping.
- B. Stack Air-Admittance Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Durgo, Inc.
    - b. Oatey.
    - c. Studor, Inc.
    - d. Or approved equal.
  - 2. Standard: ASSE 1050 for vent stacks.
  - 3. Housing: Plastic.
  - 4. Operation: Mechanical sealing diaphragm.
  - 5. Size: Same as connected stack vent or vent stack.
- C. Wall Box:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Durgo, Inc.
    - b. Oatey.
    - c. RectorSeal.
    - d. Studor, Inc.
    - e. Or approved equal.
  - 2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
  - 3. Size: About 9 inches wide by 8 inches high by 4 inches deep (230 mm wide by 200 mm high by 100 mm deep).

## 2.4 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Acorn Engineering Company; Elmdor/Stoneman Div.
    - b. Thaler Metal Industries Ltd.
    - c. Oatey
    - d. Or approved equal.
  - 2. Description: Manufactured assembly made of 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-) thick, lead flashing collar and skirt extending at least 10 inches (250 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.



- a. Open-Top Vent Cap: Without cap.
- b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
- c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

### A. Through-Penetration Firestop Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. ProSet Systems Inc.
  - b. Hilti
  - c. 3M
  - d. Or approved equal.
- 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 3. Size: Same as connected soil, waste, or vent stack.
- 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
- 5. Special Coating: Corrosion resistant on interior of fittings.
- 6. See Section 07 84 10 "Firestopping" for additional requirements.

## 2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Open Drains:

- 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
- 2. Size: Same as connected waste piping with increaser fitting of size indicated.

### B. Deep-Seal Traps:

- 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
- 2. Size: Same as connected waste piping.
  - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
  - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

### C. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### D. Sleeve Flashing Device:



1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch (25 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

**E. Stack Flashing Fittings:**

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

**F. Vent Caps:**

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

**G. Frost-Resistant Vent Terminals:**

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

**H. Expansion Joints:**

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

**2.7 FLASHING MATERIALS**

**A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:**

1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

**B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:**

1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

**C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.**

**D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.**



- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install fixture air-admittance valves on fixture drain piping.
- F. Install stack air-admittance valves at top of stack vent and vent stack piping.

- G. Install air-admittance-valve wall boxes recessed in wall.
- H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- J. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- K. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- O. Install vent caps on each vent pipe passing through roof.
- P. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- Q. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- R. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- S. Install wood-blocking reinforcement for wall-mounting-type specialties.
- T. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.3 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:



1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
  2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
  2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
  3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.
- 3.5 LABELING AND IDENTIFYING
- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- 3.6 FIELD QUALITY CONTROL
- A. Perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.
- C. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 3.7 PROTECTION
- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train The City of New York's service personnel to adjust, operate, and maintain grease removal devices.

END OF SECTION 22 13 19



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**SECTION 22 13 24**  
**INLINE MACERATORS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. References
  - 1. Grinder(s) shall, as applicable, meet the requirements of the following industry standards:
    - a. American Society for Testing and Materials (ASTM) A 36: Standard Specification for Carbon Steel Plate
    - b. American Society for Testing and Materials (ASTM) A 536-84: Standard Specification for Ferritic Ductile Iron Castings
    - c. American Society for Testing and Materials (ASTM) B-16.42-1979: Standard Specification for Class 40 Grey Iron Castings
    - d. American National Standards Institute Standards (ANSI) B16.42-1979, Class 150 (Ductile Iron Class 150) Flanges.
    - e. American Iron and Steel Institute (AISI) 303 Stainless Steel
    - f. American Iron and Steel Institute (AISI) 4130 Heat Treated Alloy Steel
    - g. American Iron and Steel Institute (AISI) 4140 Heat Treated Hexagon Steel
    - h. Rockwell Hardness Scale C.

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (Voc) Limits for Adhesives, Sealants, Paints And Coatings for Leed Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to Compliance with requirements, provide SaniBest by Saniflo or a comparable product by one of the following:
  - 1. Yeomans Chicago Corporation: Sewer Chewer
  - 2. Franklin Miller
  - 3. Or approved equal

**2.2 PRODUCT DATA**

- A. Grinder(s)
  - 1. Grinder/pump is manufactured in factory.
- B. Pipe Connections: Sleeved openings large enough for mechanical sleeve seals for drainage piping. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing" and drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping".

**PART 3 - EXECUTION**

**3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install supports, affixed to building substrate, for wall-mounted fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- B. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- C. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- D. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Comply with requirements for atmospheric vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."



**3.5 ADJUSTING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

**3.6 CLEANING AND PROTECTION**

- A. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- B. Provide protective covering for installed fixtures and fittings.

**END OF SECTION 22 13 24**

**SECTION 22 13 29****SUMP PUMPS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 SUMMARY**

- A. Section Includes:
1. Elevator pit sump pumps.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
1. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. Product Data: For each type and size of sewage pump specified. Include the following:
  - 1. System design information sheets indicating design parameters pump type, capacity and power requirements.
  - 2. Pump material and construction drawing.
  - 3. Pump curve indicating design point.
  - 4. Detailed sequence of operation.
  - 5. Electrical power and control wiring diagrams with indication of field wiring connections.
  - 6. Catalog information on major components.
  - 7. All of the above shall be specifically prepared and certified for this project.
- B. Submittals which are generic and not specifically designed to meet the requirements of this project shall not be acceptable.
- C. Operation and Maintenance Data: For each pump to include in emergency, operation, and maintenance manuals.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Reference Standards:
  - 1. Hydraulic Institute
  - 2. NEMA MG 1: Motors and Generators
  - 3. NFPA 70: National Electrical Code
  - 4. UL 508: Standard for Industrial Control Equipment
  - 5. UL 778 for motor-operated water pumps
- C. Firms regularly engaged in manufacture of the specified product and system whose products have been in satisfactory use, in similar service, for not less than ten (10) years.
- D. Prior to shipment the pump manufacturer shall perform quality assurance tests to include: checks for compliance with specifications, operating the pumps submerged in water and verification of the integrity of the motor and cable insulation.
- E. The manufacturer of pumping equipment, or his representative, shall be responsible for the complete pumping system and its satisfactory performance as described in this section and shall provide a written guarantee covering all the equipment as well as the system performance for 12 months from date of start-up, not exceeding 18 months from date of shipment, additional extended Warranty shall apply if included below. The services of a factory trained technician shall be provided for start-up and instruction of maintenance personnel.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to NYC DOB, and marked for intended use.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.



- C. Comply with pump manufacturer's written rigging instructions for handling.

#### 1.9 COORDINATION

- A. Coordinate size and location of concrete pits. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete".

### PART 2 - PRODUCTS

#### 2.1 ELEVATOR PIT SUMP PUMPS

- A. Manufacturer: Subject to compliance with requirements, provide Stancor - Oil-Minder GAF Series (Basis-of-Design), or an equivalent product by an approved manufacturer listed below:
  - 1. Liberty pumps
  - 2. Zoeller
  - 3. Or approved equal.
- B. The installed pump and control system shall be a permanent installation in accordance with ASME Elevator Code A17.1. It shall be capable of automatically pumping water from the pit while preventing the discharge of oil. The control unit, pump, floats and sensor probe shall be factory assembled as a complete, ready to use system and shall be tested and approved by a nationally recognized testing laboratory such as ENTELA.
  - 1. Elevator sump pump systems that do not automatically prevent the discharge of oil or that alarm only in the event of a high liquid condition will not be considered for substitution. Only a complete pump and control system that has been tested and certified, by a nationally recognized testing laboratory, to perform in accordance with the specified operation shall be accepted.
- C. The pump shall be a heavy duty submersible effluent type capable of passing a minimum 3/4" solid, approved to UL 778 standards. Construction features shall include cast iron casing and impeller, mechanical seals housed in a separate oil-filled compartment and 304 stainless steel motor housing.
- D. The control system shall provide for fully automatic pump operation and alarm activation in the event of:
  - 1. Oil present in the sump pit
  - 2. High liquid level
  - 3. High motor amps or a locked rotor
- E. The control system shall include: pump control panel; self-cleaning stainless steel oil sensing probe; and dual floats for automatic pump operation and level alarm. The controls shall be factory assembled as a complete, ready to use system and shall be tested and approved to UL 508 standards.
- F. The pump control panel shall be a NEMA 4X, watertight, dust tight, corrosion resistant, gasketed enclosure. The control panel shall include dual "Oil-Minder Relays" with variable sensitivity settings, magnetic contactor with separate over-current relay, Audio-visual alarm station with light, horn, alarm silencing switch, auxiliary contact for common trouble alarm and clearly marked terminal board.
- G. Pump and float cables, 16' each, shall be provided by the manufacturer.

1. Alternative longer cable lengths shall be provided as required, Contractor to coordinate.
- H. Provide a steel frame and cover suitable for a concrete pit as shown on the drawings. The cover shall have all required openings for the pump discharge lines, float switches and pump removal.
- I. Capacities, Characteristics & Quantity: See Schedule.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before pump installation.

### 3.3 CONCRETE

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 22 Section "Common Work Results for Plumbing."
  1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

### 3.4 INSTALLATION

- A. Excavating, trenching, and backfilling are specified in section 31 00 00 "Earthwork"
- B. Install pumps according to applicable requirements in HI 1.4.
- C. Set submersible pumps on pit floors. Make direct connections to sanitary drainage piping.
  1. Anchor guide-rail supports to pit bottoms and covers. Install pumps so pump and discharge pipe disconnecting flanges make positive seals when pumps are lowered into place.
- D. Construct pump pits and connect to drainage and vent piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

### 3.5 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Section "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.



- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect sanitary drainage and vent piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Install vent piping equal to or greater than size of pump basin vent connection. Refer to Division 22 Section "Sanitary Drainage and Vent Piping."
  - 1. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 26 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for sanitary waste piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.6 STARTUP SERVICE

- A. Prior to startup the Contractor shall perform the following:
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Hang submersible pump power cables, level control cables and pump removal chains permanently so they do not become entangled in the pumps during operation.
  - 3. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
  - 4. Clean pit of all construction debris.
  - 5. Verify that pump controls are correct for required application.
- B. Engage a factory-authorized service representative to perform startup service.
  - 1. Verify that pump controls are correct for required application.
  - 2. Perform motor megger test in accordance with manufacturer's instructions.
  - 3. Start motors.
  - 4. Open discharge valves slowly.
  - 5. Check general mechanical operation of pumps and motors.
  - 6. Set pump controls for automatic start, stop, and alarm operation as required for system application.
  - 7. Verify that pump system operates in accordance with the specification, adjust settings as required. Test and adjust controls and safeties.
  - 8. Remove and replace damaged and malfunctioning components.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to project outside normal occupancy hours for this purpose.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct The City of New York's service staff to adjust, operate, and maintain controls and pumps. Refer to the DDC General



Conditions for instruction requirements.

**END OF SECTION 22 13 29**

**SECTION 22 14 13****FACILITY STORM DRAINAGE PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Pipe, tube, and fittings.
  2. Specialty pipe fittings.
- B. Related Sections:
1. Section 22 14 29 "Sump Pumps" for storm drainage pumps.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
1. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Storm Drainage Piping: 10-foot head of water.
- B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For controlled-flow roof drainage system. Include calculations, plans, and details.

**1.8 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

**1.10 PROJECT CONDITIONS**

- A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by The City of New York or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify the Commissioner no fewer than two days in advance of proposed interruption of storm-drainage service.
  - 2. Do not proceed with interruption of storm-drainage service without the Commissioner written permission.

**PART 2 - PRODUCTS****2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

**2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ANACO-Husky.
    - b. Dallas Specialty & Mfg. Co.
    - c. Fernco Inc.
    - d. Matco-Norca, Inc.
    - e. MIFAB, Inc.
    - f. Mission Rubber Company; a division of MCP Industries, Inc.
    - g. Stant.
    - h. Tyler Pipe.
    - i. Or approved equal.
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ANACO-Husky.
    - b. Clamp-All Corp.
    - c. Dallas Specialty & Mfg. Co.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Stant.
    - g. Tyler Pipe.
    - h. Or approved equal.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Cast-Iron, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following to, the follow:
    - a. MG Piping Products Company.



- b. ANACO-Husky.
  - c. Clamp-All Corp.
  - d. Dallas Specialty & Mfg. Co.
  - e. Or approved equal.
- 2. Standard: ASTM C 1277.
  - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.3 SPECIALTY PIPE FITTINGS

### A. Transition Couplings:

- 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
- 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
- 3. Unshielded, Non-pressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dallas Specialty & Mfg. Co.
    - 2) Fernco Inc.
    - 3) ANACO-Husky.
    - 4) Clamp-All Corp.
    - 5) Dallas Specialty & Mfg. Co.
    - 6) Mission Rubber Company; a division of MCP Industries, Inc.
    - 7) Or approved equal.
  - b. Standard: ASTM C 1173.
  - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - 2) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 4. Shielded, Non-pressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company; a division of MCP Industries, Inc.
    - 3) ANACO-Husky.
    - 4) Clamp-All Corp.
    - 5) Or approved equal.
  - b. Standard: ASTM C 1460.



- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- 5. Pressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Dresser, Inc.
    - 3) EBAA Iron, Inc.
    - 4) Ford Meter Box Company, Inc. (The)
    - 5) JCM Industries, Inc.
    - 6) Romac Industries, Inc.
    - 7) Smith-Blair, Inc.; a Sensus company.
    - 8) Viking Johnson; c/o Mueller Co.
    - 9) Or approved equal.
  - b. Standard: AWWA C219.
  - c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
  - d. Center-Sleeve Material: Ductile iron.
  - e. Gasket Material: Natural or synthetic rubber.
  - f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
  - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  - 2. Dielectric Unions:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Capitol Manufacturing Company.
      - 2) Central Plastics Company.
      - 3) Hart Industries International, Inc.
      - 4) Jomar International Ltd.
      - 5) Matco-Norca, Inc.
      - 6) McDonald, A. Y. Mfg. Co.
      - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      - 8) Wilkins; a Zurn company.
      - 9) Or approved equal.
    - b. Description:
      - 1) Standard: ASSE 1079.
      - 2) Pressure Rating 250 psig (1725 kPa).
      - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
  - 3. Dielectric Flanges:



- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Capitol Manufacturing Company.
    - 2) Central Plastics Company.
    - 3) Matco-Norca, Inc.
    - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - 5) Wilkins; a Zurn company.
    - 6) Or approved equal.
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: 175 psig (1200 kPa) minimum.
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Advance Products & Systems, Inc.
    - 2) Calpico, Inc.
    - 3) Central Plastics Company.
    - 4) Pipeline Seal and Insulator, Inc.
    - 5) Or approved equal.
  - b. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: 150 psig (1035 kPa).
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel-backing washers.
5. Dielectric Nipples:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Elster Perfection.
    - 2) Grinnell Mechanical Products.
    - 3) Matco-Norca, Inc.
    - 4) Precision Plumbing Products, Inc.
    - 5) Victaulic Company.
    - 6) Or approved equal.
  - b. Description:
    - 1) Electroplated steel nipple complying with ASTM F 1545.
    - 2) Pressure Rating: 300 psig 225 deg F.
    - 3) End Connections: Male threaded or grooved.



- 4) Lining: Inert and noncorrosive, propylene.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.



2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
  - N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
    1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
  - O. Install steel piping according to applicable plumbing code.
  - P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
  - Q. Install engineered controlled-flow or siphonic drain specialties and storm drainage piping in locations indicated.
  - R. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
    1. Install encasement on piping according to ASTM A 674 or AWWA C105.
  - S. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
    1. Install encasement on piping according to ASTM A 674 or AWWA C105.
  - T. Install force mains at elevations indicated.
  - U. Plumbing Specialties:
    1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 22 14 23 "Storm Drainage Piping Specialties."
    2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
  - V. Do not enclose, cover, or put piping into operation until it is inspected and approved by Commissioner.
  - W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
  - X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
  - Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.



- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Shielded, non-pressure transition couplings.
  - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
  - 4. In Underground Force-Main Piping:
    - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
    - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples or unions.
  - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.
  - 4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
  - 1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
  - 2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.



1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Section 22 14 23 "Storm Drainage Piping Specialties."

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  6. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
  7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
  3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
  4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
  5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
  6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).



- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  - 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
  - 7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
  - 8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
  - 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
  - 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- K. Install supports for vertical copper tubing every 10 feet (3 m).
- L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
  - 2. Install horizontal backwater valves with cleanout cover flush with floor.
  - 3. Comply with requirements for cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:
  - 1. Storm Sewer: To rainwater harvesting tank.
  - 2. Sump Pumps: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:



1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify Commissioner at least 24 hours before inspection must be made. Perform tests specified below in presence of Commissioner.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  2. Final Inspection: Arrange for final inspection by New York City Department of Buildings to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If New York City Department of Buildings find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by Commissioner.
- D. Test storm drainage piping according to procedures of 2014 NYCPC and New York City Department of Buildings or, in absence of published procedures, as follows:
  1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of New York City Department of Buildings or, in absence of published procedures, as follows:
  1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.



4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 8 (DN 150) and smaller shall be the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
  3. Galvanized-steel pipe, drainage fittings, and threaded joints.
  4. Dissimilar Pipe-Material Couplings: Unshielded, non-pressure transition couplings.
- C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Unshielded, non-pressure transition couplings.
- D. Aboveground storm drainage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be any of the following:
  1. Cast iron
- E. Aboveground storm drainage force mains NPS 2-1/2 to NPS 6 (DN 65 to DN 150) shall be any of the following:
  1. Cast Iron.

**END OF SECTION 22 14 13**



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## SECTION 22 14 23

## STORM DRAINAGE PIPING SPECIALTIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

## 1.2 SUMMARY

- A. Section Includes:
1. Roof drains.
  2. Miscellaneous storm drainage piping specialties.
  3. Cleanouts.
  4. Through-penetration firestop assemblies.
  5. Flashing materials.

## 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

## 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
1. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

## 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

### 2.1 METAL ROOF DRAINS (SEE SCHEDULE)

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company.
    - b. Marathon Roofing Products.
    - c. MIFAB, Inc.
    - d. Smith, Jay R. Mfg. Co.
    - e. Tyler Pipe.
    - f. Watts Water Technologies, Inc.
    - g. Zurn Plumbing Products Group; Specification Drainage Operation.
    - h. Or approved equal.
  - 2. Standard: ASME A112.6.4, for general-purpose roof drains.
  - 3. Body Material: Cast iron.
  - 4. Dimension of Body: Nominal 14-inch (357-mm) diameter.
  - 5. Combination Flashing Ring and Gravel Stop: Required.
  - 6. Flow-Control Weirs: Required.
  - 7. Outlet: Bottom.
  - 8. Extension Collars: Required.
  - 9. Underdeck Clamp: Required.
  - 10. Expansion Joint: Required.
  - 11. Sump Receiver Plate: Required.
  - 12. Dome Material: Aluminum.
  - 13. Perforated Gravel Guard: Stainless steel.
  - 14. Vandal-Proof Dome: Required.
  - 15. Water Dam: 2 inches (51 mm) high.

### 2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Downspout Adaptors:
  - 1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.



2. Size: Inlet size to match parapet drain outlet.

**B. Downspout Boots:**

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.

**C. Conductor Nozzles:**

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

**2.3 CLEANOUTS**

**A. Floor Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.
  - e. Tyler Pipe.
  - f. Watts Water Technologies, Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
  - i. Or approved equal.
2. Standard: ASME A112.36.2M, for cast-iron soil pipe with cast-iron ferrule cleanouts.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

**B. Test Tees:**



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe.
  - e. Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

**C. Wall Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe.
  - e. Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - g. Or approved equal.
3. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
4. Size: Same as connected drainage piping.
5. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch as required to match connected piping.
6. Closure: Countersunk brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
9. Wall Access: Round wall-installation frame and cover.

**2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES**

**A. Through-Penetration Firestop Assemblies:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ProSet Systems Inc.
  - b. Hilti
  - c. Holdrite
  - d. Or approved equal.



2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.
8. See Section 07 84 10 "Firestopping" for requirements.

## 2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
  1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  2. Install expansion joints, if indicated, in roof drain outlets.
  3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 12 inches (305 mm) above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.



- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
  - 1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
  - 3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
  - 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- K. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- L. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- M. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

### 3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 14 13 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.



3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23



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**SECTION 22 35 00****DOMESTIC WATER HEATERS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. This section includes condensing gas-fired storage water heaters for potable water.

**1.3 REFERENCES**

- A. ASME Boiler and Pressure vessel code, section IV, Part HLW
- B. UL 795 “Industrial Gas Heating Equipment”
- C. ANSI Z21.10.3 -2004/CSA 4.3-2004 “Gas Water Heaters”
- D. ASHRAE/IES 90.1-2010
- E. ISO 9001 Quality Management System
- F. CSD-1-2009 “Controls and Safety Devices for Automatically Fired Boilers”
- G. NFPA 70- National Electric Code
- H. NFPA 54- National Fuel Gas Code
- I. NSF/ANSI Standard 61- Drinking Water System Components
- J. ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project’s environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 “Construction Waste Management and Disposal”
  - 2. Section 01 81 13 “Sustainable Design Requirements for LEED Buildings”
  - 3. Section 01 81 19 “Indoor Air Quality Requirements for LEED Buildings”



- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.4 SUBMITTALS

- A. **Product Data:** Include rated capacities; shipping, installed, and operating weights; furnished specialties and accessories for each model indicated.
- B. **Shop Drawings:** Detail equipment assemblies and indicate dimensions, required clearances, components, and size of each field connection
- C. **Wiring Diagrams:** Detail for wiring power signal, differentiate between manufacture- installed and field-installed wiring
- D. **Maintenance Data:** Include in the maintenance manuals specified in Division 1. Include maintenance guide and wiring diagrams

#### 1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for internal wiring of factory wired equipment
- B. **Units:** ETL, UL or CSA Certified as a Complete Gas Fired Water Heater Assembly.
- C. Gas Train shall comply with ANSI Z.21.10.3 or UL 795.
- D. Conform to ASME Section IV. Part HLW for Water Heater construction.

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. **Listing:** The water heater will be listed ETL listed to UL 795 or ANSI Z21.10.3 -2004/CSA 4.3-2004 “Gas Water Heaters”
- C. **ASME Compliance:** Water heater shall bear the ASME HLW stamp and be National Board listed
- D. Water heaters with full rated input of 800,000 BTU will operate at a minimum 94% thermal efficiency at full firing rate when tested to the ANSI Z21.10.3 thermal efficiency test protocol (DOE 10 CFR 431).
- E. The water heater will comply with current ASHRAE 90.1 requirements.
- F. Water heater manufacturer certified to the ISO 9001 International Quality System.

## 1.7 COORDINATION

- A. Coordinate size and location of concrete bases.

## 1.8 MANUFACTURER'S WARRANTY

- A. Storage tank, heating surfaces, and combustion chamber will have a manufacturer's warranty covering manufacturing or material defects, leaks, the production of rusty water and/or chloride stress corrosion cracking. Period of warranty shall be 15 years from date of substantial completion.
- B. Burner and all heater parts: 1-year manufacturer's warranty from date of substantial completion, for all defects.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: The water heaters shall be manufactured by a company that has achieved certification to the ISO 9001 Quality Management System. Subject to compliance with requirements, provide PVI (Basis-of-Design), or one of the following:
  - 1. AO Smith
  - 2. Rheem
  - 3. Or approved equal.
- B. The water heaters shall be ETL listed as a complete unit. The heater shall satisfy 2014 NYCECC standards for both thermal efficiency and stand-by heat losses as established for gas fired water heaters.

### 2.2 CONSTRUCTION

- A. Water heaters will be of the BTU input(s) and storage capacity indicated on the equipment schedule.
- B. The water heater will be a vertical fire tube, design that is constructed and stamped in accordance with Section IV, Part HLW of the ASME code. Water heater will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure.
- C. Water heater will be a single-pass, down-fired, spiraled fire tube design contained within an integral storage tank.
- D. Tank, combustion chamber and fire tubes will be unlined. Lined or plated water heaters will not be acceptable.
- E. Tank, combustion chamber and fire tubes will be constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923 Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2 and ASTM G123 - 00(2005) "Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution."

- F. Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
- G. All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.
- H. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable.
- I. All water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
- J. All tank connections/fittings will be non-ferrous or stainless steel.
- K. To preserve thermal efficiency, the water heater will not use or require a circulator piped from the hot water outlet to the cold water inlet of the heater for the purpose of temperature control during normal operation. Connection for a building return circulation line will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping. Connection to a sidearm tank, if used, will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping.
- L. Finished vessel will not require sacrificial anode rods or impressed current anode rods and none will be used. Water heaters or sidearm storage tanks that employ anode rods of any type will not be acceptable.
- M. Combustion will be provided by a premix, fan-assisted surface burner with a gas train meeting UL, ANSI and FM standards for the input specified.
- N. Burner will be stainless steel.
- O. Gas train components will capable of self-proportionating gas and air to maintain optimum combustion in response to varying vent pressures.
- P. At 399,000 BTU input, the burner will be fixed input.
- Q. At 500,000 BTU input and higher, the burner will employ non-linkage modulation utilizing only a VFD drive to vary gas and air.
- R. Burner NOx emissions will be less than 20 ppm when corrected to 3% oxygen.
- S. Water heater will be a category IV, condensing appliance and vent through PVC or Polypropylene. Water heater will satisfy requirements for sealed combustion. Vents for inlet air and exhaust can terminate in different pressure zones.
- T. Water heater will be ETL listed for connection to a concentric vent termination.

## 2.3 PERFORMANCE

- A. When tested to the ANSI Z21.10.3 standard, water heaters with inputs from 400,000 to 600,000 BTU shall operate at 96% thermal efficiency at full firing rate.

When tested to the ANSI Z21.10.3 standard, water heaters with input of 700,000 BTU shall operate at 95% thermal efficiency at full firing rate.

When tested to the ANSI Z21.10.3 standard, water heaters with input of 800,000 BTU shall operate at 94% thermal efficiency at full firing rate.

- B. When modulated to low fire due to lower hot water demand, water heater efficiency can improve to up to 99% thermal efficiency.
- C. Water heater will meet the thermal efficiency and standby heat loss requirements of ASHRAE 90.1 – 2010.

## 2.4 WATER HEATER TRIM

- A. As a minimum, the heater will be equipped with the following:
1. Electronic flame monitoring
  2. Electronic low water cutoff
  3. An immersion operating control
  4. An immersion UL listed temperature limiting device
  5. An ASME- rated temperature and pressure relief valve
- B. Operating and safety controls shall meet the requirements of UL 795 and FM.
- C. The water heater shall employ an electronic operating control with digital temperature readout. Operator shall be capable of connecting to a building automation system through serial connection using Modbus RTU protocol.
- D. A protocol gateway for BacNet MSTP/IP will be provided.
- E. A protocol gateway for Lonworks will be provided.
- F. A protocol gateway for Modbus TCP/IP will be provided.

## PART 3 – EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install water heaters level and plumb in accordance with manufacturers written instructions and referenced standards.

### 3.3 FINISHING

- A. The storage and heating sections shall be completely factory packaged on a single skid, requiring only job site hookup to utilities, venting, and plumbing. The heater shall be insulated to meet ASHRAE 90.1-2010 standby loss requirements and jacketed with a polyethylene liner



consisting of 100% recycled material. Pressure vessel shall include a ball-type drain valve. The heater shall fit properly in the space provided and installation shall conform to 2014 NYCBC.

#### **3.4 START-UP**

- A. Start up on the unit will be performed by installers who are properly trained by the manufacturer. Provide a copy of the startup report to the Commissioner.

**END OF SECTION 22 35 00**

**SECTION 22 43 00****PLUMBING FIXTURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Refer to fixture schedule on drawings.

**1.3 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.5 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
  - 1. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.6 SUBMITTALS**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.7 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.8 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in operation and maintenance manuals.

**1.9 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

**1.10 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

**PART 2 - PRODUCTS – SEE SCHEDULE ON DRAWINGS****2.1 SUPPLY FITTINGS**

- A. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers: NPS 1/2 (DN 15) chrome-plated, rigid-copper pipe and brass straight or offset tailpieces.

**2.2 WASTE FITTINGS**

- A. Standard: ASME A112.18.2/CSA B125.2.



- B. Drain: Grid with NPS 1-1/2 DN 40 tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2 (DN 40).
  - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated brass or steel wall flange.
  - 3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

## 2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install healthcare plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

- D. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- E. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 CONNECTIONS

Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- A. Comply with requirements for water piping specified in Section 22 11 16 "Domestic Water Piping."
- B. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- C. Comply with requirements for atmospheric vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.6 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.

**END OF SECTION 22 43 00**

**SECTION 22 45 00****EMERGENCY PLUMBING FIXTURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.4 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.5 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**PART 2 - PRODUCTS**



## 2.1 PRODUCTS

### A. Emergency Drench Showers with Eyewash

1. Description: Plumbed, free-standing with emergency shower and eyewash.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Model No. S19-310SSJP or a comparable product by one of the following:
  - a) Chicago Faucets.
  - b) Encon Safety Products.
  - c) Guardian Equipment Co.
  - d) Haws Corporation.
  - e) Lab Safety Supply Inc.
  - f) Murdock, Inc.
  - g) Sellstrom Manufacturing Co.
  - h) Speakman Company.
  - i) WaterSaver Faucet Co.
  - j) Western Emergency Equipment.
  - k) Or approved equal.

### B. Water-tempering Equipment:

1. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve Bradley Model No S19-2100.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley tempering valve or a comparable product by one of the following:
  - a) Armstrong International, Inc.
  - b) Bradley Corporation.
  - c) Haws Corporation.
  - d) Leonard Valve Company.
  - e) Or approved equal.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install healthcare plumbing fixtures level and plumb according to roughing-in drawings.

- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- D. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- E. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Comply with requirements for atmospheric vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.



3.6 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.

**END OF SECTION 22 45 00**

**SECTION 22 46 00****SECURITY PLUMBING FIXTURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

**1.4 Refer to DDC General Conditions for LEED BUILDING Submittal requirements.****1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**PART 2 - PRODUCTS**

## 2.1 PRODUCTS

### A. Security Combination Units, CUR:

1. Description: Back-mounting, accessible, cabinet, security plumbing fixture with integral water closet and lavatory; fabricated from 0.078-inch minimum thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Willoughby Industries Model No. ECW- 3696-R-OF-BP-PM2-LW1-TWE-TW5-LF-RTH-WS-FVT-FV-TG-GB or a comparable product by one of the following:
  - a) Acorn Engineering Company.
  - b) Bradley Corporation.
  - c) Metcraft Industries Inc.
  - d) Willoughby Industries, Inc.
  - e) Or approved equal.

### B. Security Combination Units, CUL:

1. Description: Back-mounting, accessible, cabinet, security plumbing fixture with integral water closet and lavatory; fabricated from 0.078-inch minimum thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Willoughby Industries Model No. ECW- 3696-L-OF-BP-PM2-LW1-TWE-TW5-LF-RTH-WS-FVT-FV-TG-GB or a comparable product by one of the following:
  - a) Acorn Engineering Company.
  - b) Bradley Corporation.
  - c) Metcraft Industries Inc.
  - d) Willoughby Industries, Inc.
  - e) Or approved equal.

### C. Security Combination Units, CUFR:

1. Description: Front-mounting, accessible, cabinet, security plumbing fixture with integral water closet and lavatory; fabricated from 0.078-inch minimum thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Willoughby Industries Model No. ECW- 3696-R-ON-HC-FA-BP-PM2-CW2-TWE-TW5-LF-RTH-FV-TG-GB or a comparable product by one of the following:
  - a) Acorn Engineering Company.
  - b) Bradley Corporation.
  - c) Metcraft Industries Inc.
  - d) Willoughby Industries, Inc.
  - e) Or approved equal.

### D. Security Combination Units, CUFL:

1. Description: Front-mounting, accessible, cabinet, security plumbing fixture with integral water closet and lavatory; fabricated from 0.078-inch minimum thickness, ASTM A 666,





Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.

2. Basis-of-Design Product: Subject to compliance with requirements, provide Willoughby Industries Model No. ECW- 3696-L-ON-HC-FA-BP-PM2-CW2-TWE-TW5-LF-RTH-FV-TG-GB or a comparable product by one of the following:
  - a) Acorn Engineering Company.
  - b) Bradley Corporation.
  - c) Metcraft Industries Inc.
  - d) Willoughby Industries, Inc.
  - e) Or approved equal.

## PART 3 – EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install healthcare plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
  1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- B. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  1. Exception: Use ball, gate, or globe valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- D. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- E. Install traps on fixture outlets.
  1. Exception: Omit trap on fixtures with integral traps.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of



accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Comply with requirements for atmospheric vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.6 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.

**END OF SECTION 22 46 00**

**SECTION 22 47 00****ELECTRIC WATER COOLERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Work included in this section:

- 1. Electric water coolers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

- 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

- 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 QUALITY ASSURANCE

Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

PART 2 – PRODUCTS

2.1 PRODUCTS

A. Electric Water Cooler:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay barrier-free single level wheelchair access Model EZS8 or a comparable product by one of the following:
  - a. Elkay Manufacturing Co.
  - b. Halsey Taylor.
  - c. Haws Corporation.
  - d. Or approved equal.
2. Description:
  - a. Cabinet: All stainless steel.
  - b. Bubbler: One flexible bubbler that will flex on impact and return to original position.
  - c. Glass Filler: Stainless steel gooseneck glass filler 10" high with plastic push lever control.
  - d. Control: Push bar controls on 3 sides.
  - e. Supply: NPS 3/8 with ball valve.
  - f. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
  - g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 EXAMINATION

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install healthcare plumbing fixtures level and plumb according to roughing-in drawings.

- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- D. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- E. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Comply with requirements for atmospheric vent piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.



**3.6 CLEANING AND PROTECTION**

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.

**END OF SECTION 22 47 00**

**SECTION 23 05 00****COMMON REQUIREMENTS FOR HVAC WORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- C. Section 23 05 93 "Testing, Adjusting and Balancing".
- D. Section 23 09 00 "HVAC Instrumentation and Controls".
- E. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Design Criteria
  - 2. Reference Standards
  - 3. Definitions and Interpretations
  - 4. Codes, Permits and Inspections
  - 5. Submittals
  - 6. Quality Assurance
  - 7. Delivery, Storage and Handling
  - 8. Coordination
  - 9. Equipment installation requirements common to equipment sections.
  - 10. Painting and finishing.
  - 11. Concrete bases.
  - 12. Supports and anchorages.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 SCOPE OF WORK**

- A. All equipment and material to be furnished and installed on this project shall be UL or ETL listed, in conformity with the requirements of Commissioner of NYC Dept. of Buildings and suitable for its intended use on this project.

**1.6 DESIGN CRITERIA**

- A. The following will be used as the basis for design and control of the various systems.
- B. The actual peak cooling load occurs on September 16 at 4 PM, when the outdoor conditions are approx. 90 °F DB/ 74 °F WB.
- C. The perimeter cooling capacities are based on closed shades (south side). The SOP for the lab must be that the shades are closed on peak sunny days.
- D. Refer to table on following page for dry bulb and wet bulb design criteria, for both indoor and outside conditions.

Outside Conditions		
	DRY BULB	WET BULB
Summer (New York City Energy Conservation Code)	89 °F.	73°F
Summer (Equipment Sizing)	95°F.	75°F
Cooling Towers	--	78°F
Winter (New York City Energy Conservation Code)	13°F.	--
Winter (Equipment Sizing)	0°F.	--



Indoor Conditions				
Occupancy	Summer		Winter	
	DB	RH	DB	RH
Offices	75°F ± 2°F	50% ± 5%	70°F ± 2°F	Uncontrolled (No Humidification)
Conference Rooms	75°F ± 2°F	50% ± 5%	70°F ± 2°F	Uncontrolled No Humidification
Lunch Room	75°F ± 2°F	50% ± 5%	70°F ± 2°F	Uncontrolled No Humidification
Mechanical Spaces	Ventilation Only		65°F.	Uncontrolled (No Humidification)
Telephone/ Data Closet	72°F ± 3°F		72°F ± 3°F	

## 1.7 VENTILATION RATES

### A. Ventilation rates per ASHRAE 62-2007 & ASHRAE 170-2008.

Occupancy	Ventilation Rate – Minimum OA (Air Changes/hr.)	All Air Exhausted Directly to Outdoors	Fume Hood in Space	Comments
Offices	20 CFM/Person			
Conference Rooms	20 CFM/Person			
Lunch Room	20 CFM/Person			
Mechanical Spaces	Ventilation Only	Yes		
Telephone/Data Closets	Air Conditioning Per Room Load			
Corridors	0.10 CFM/SF			
Toilets	75 CFM exhaust per water closet or urinal	Yes		

## 1.8 HEATING AND COOLING DESIGN LOADS

### A. Heating and Cooling Load

#### 1. People – Labs Spaces

- a. Sensible: 250 BTU/hr per person
  - b. Latent: 250 BTU/hr per person
- 2. People – Offices
  - a. Sensible: 250 BTU/hr per person
  - b. Latent: 200 BTU/hr per person
- 3. People – Conference Rooms, Lunch Room, etc.
  - a. Sensible: 245 BTU/hr per person
  - b. Latent: 155 BTU/hr per person
- 4. Electrical
  - a. Office
    - 1) Lighting = 1.0 watts per sq ft
    - 2) Equipment = 2.2 watts per sq ft
  - b. Public Spaces
    - 1) Lighting = 1.0 watts per sq. ft.

#### 1.9 BUILDING ENVELOPE

- A. The heating and cooling load calculations were based on the following building envelope criteria.
  - 1. The glass will be high-efficiency, insulated, one-inch (1/4-inch glass + ½ inch air space + ¼" float glass), with Low-E coating on surface # 2.
  - 2. Thermally broken frames.
  - 3. Glass with Low-E coating:
    - U glass:
      - Winter: 0.31 (center of glass)
      - Summer: 0.29 (center of glass)
      - U (overall) glass, sash & frame: 0.40
    - SHGF: 0.37
    - SC: 0.42
  - 4. Wall: U value = 0.064 Btu/hr/SF/°F (R-15 insulation)
  - 5. Roof: U value = 0.055 Btu/hr/SF/°F (R-18 insulation)

#### 1.10 HVAC PIPING SYSTEMS PERFORMANCE REQUIREMENTS

- A. The HVAC water, piping components (including valves, fittings, materials, appurtenances, etc.) and installation (including welding, etc.) shall be capable of withstanding the following minimum working pressures and temperatures. Pressures indicated herein are SWP (steam working pressure), unless otherwise noted and are to be considered minimum requirements.

1. Chilled-Water System: 125 psig at 200 deg F.
2. Hot-Water Heating System: 125 psig at 200 deg F.
3. Condenser-Water System: 125 psig at 200 deg F.
4. Makeup-Water System: 125 psig at 200 deg F.
5. Cooling Coil Condensate-Drain System: 125 psig at 200 deg F.
6. Blowdown-Drain System: Equal to pressure of the piping system to which it is connected.
7. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is connected.
8. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is connected.

- B. Grooved end piping systems (including piping, couplings, fittings, valves and accessories) is not acceptable.

#### 1.11 REFERENCE STANDARDS

- A. Comply with the NYCBC 2014 and all other applicable laws, rules, standards, regulations, codes and ordinances of Federal, State and NYC Dept. of Buildings. Modifications required by the above shall be made without additional expense to the City of New York.
- B. The entire installation and all equipment, materials and methods shall comply with 2014 New York City Construction Codes, whether indicated on the Contract Documents or not.
- C. The following published specifications, standards, tests or recommendations shall apply to all work in all sections:

1. Air Conditioning and Refrigeration Institute (ARI).
2. American National Standard Institute (ANSI).
3. Air Moving and Conditioning Association (AMCA).
4. American Society of Mechanical Engineers (ASME).
5. American Society for Testing and Materials (ASTM).
6. National Fire Protection Association (NFPA).
7. American Association of Balancing Contractors (AABC).
8. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
9. Air Diffuser Council (ADC)
10. American Welding Society (AWS).
11. Environmental Protection Agency (EPA)
12. National Environmental Balancing Bureau (NEBB).
13. National Electrical Code (NEC).
14. National Electrical Manufacturer's Association (NEMA)
15. Occupational Safety and Health Administration (OSHA).
16. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
17. Underwriters Laboratories (UL).
18. American Water Works Association (AWWA)
19. Copper Development Corporation (CDA)
20. Expansion Joint Manufacturers Association (EJMA)
21. Manufacturers Standardization Society (MSS)
22. National Sanitation Foundation (NSF)
23. Tubular Exchange Manufacturers Association (TEMA)
24. North American Insulation Manufacturers Association (NAIMA)

#### 1.12 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred

spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by the building occupants. Examples include above ceilings, within furred spaces, enclosures, trenches, crawl spaces and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. Component: An MEP component or element that is part of an MEP system within or without a building system.
- G. DOB – New York City Department of Buildings
- H. NYCBC – New York City Building Code 2014 – which includes the latest editions of the NYC Building Code, NYC Plumbing Code, NYC Mechanical Code, NYC Fuel Gas Code, NYC Energy Conservation Code.
- I. Licensed Professional Engineer: An independent, qualified, licensed Professional Engineer having PE registration from New York State, with significant experience in the applicable field.
- J. Low Pressure Steam: Steam pressure not exceeding 15 psig
- K. High Pressure Steam: Steam pressure above 15 psig

#### 1.13 INTERPRETATION OF THE DRAWINGS AND SPECIFICATIONS

- A. The drawings show the general layout of the various items of equipment. However, the drawings, in general, are diagrammatic and indicate sizes, general locations and equipment connections and do not necessarily indicate every required fitting, support or similar items required for a complete installation. Provide all necessary offsets, fittings, hangers, supports, valves, drains as required for a complete and fully operational mechanical system.
- B. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the diagrammatic intent expressed on the electrical and mechanical drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings.
- C. The contractor shall follow the drawings in laying out the work and check drawings of all trades to verify spaces in which work will be installed. Maintain maximum headroom and where space conditions appear inadequate, the Commissioner shall be notified before proceeding with the installation.
- D. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the

drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.

- E. No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.
- F. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- H. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans and are diagrammatic only, but with the intention that such details shall be incorporated in full.
- I. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- J. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.
- K. In the event that extra work is authorized, and performed by this trade, work shown on drawings depicting such work, and/or described by Bulletin is subject to the base building specifications in all respects.

#### 1.14 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the following requirements:
  - 1. New York City Building Code 2014
  - 2. New York City Mechanical Code 2014
  - 3. New York City Plumbing Code 2014
  - 4. New York City Fuel Gas Code 2014
  - 5. New York City Electrical Code 2014
  - 6. New York City Energy Conservation 2016
  - 7. New York State Department of Health
  - 8. NFPA National Fire Codes
  - 9. New York City Noise Control Regulation
- B. All equipment and material to be furnished and installed on this project shall be UL or ETL listed, in accordance with the requirements of the NYC Dept. of Buildings and suitable for the intended use on the project.
- C. All required permits and inspection certificates shall be obtained, paid for, and made available by the contractor to the Commissioner, except for special inspections. Refer to the DDC General Conditions for requirements related to permits and permitting fees.
- D. Any portion of the work which is not subject to the approval of the New York City Department of Buildings or the Fire Department of New York City, shall be governed by the applicable sections of the overall National Fire Code, as published by the National Fire Protection Association.
- E. Installation procedures, methods, and conditions shall comply with the latest requirements of

The Federal Occupational Safety and Health Act (OSHA).

**1.15 PERMITS AND FEES**

- A. Refer to the DDC General Conditions for requirements related to permits and permitting fees.
- B. The Contractor shall be responsible for all required testing and inspections except for Special Inspections. Where required, the City of New York will engage a qualified testing agency to perform Special Inspections.
- C. This contractor shall prepare and file all plans, calculation, forms, etc. required for filing with all agencies required for this work including but not limited to The DEP (Department of Environmental Protection), DEC (Department of Environmental Conservation), Bureau of Air Resources, EPA Environmental protection Agency, and FDNY.

**1.16 SPECIAL / CONTROLLED INSPECTION- NYC**

- A. Special inspection shall be provided by the City of New York. The contractor shall coordinate with the Commissioner to accomplish all special inspections and provide any access necessary.

**1.17 INSPECTIONS / TESTING**

- A. Independent testing and progress inspections shall be provided by the contractor.

**1.18 SHOP DRAWING REVIEW**

- A. The purpose of the review of shop drawings is to maintain integrity of the design. Unless the contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor's letterhead, review by the Commissioner does not constitute acceptance. It is not to be assumed that the Commissioner has read the text nor reviewed the technical data of a manufactured item and its components except where the Vendor has clearly and specifically pointed out in writing differences between his product and the specified model.
- B. It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades. Review of shop drawings containing errors does not relieve the contractor from making corrections at his expense.
- C. PW3 Expense Affidavits shall be prepared by the contractor.
- D. Application for Equipment Use Permits shall be filed by contractor.
- E. Prepare and submit to the building department a set of "as-built" record drawings for approval, in a form acceptable to the building department.
- F. The Contractor shall prepare all plans, amendments and pay all filing fees that will be required for the fuel burning installation, including boiler plant, chimney, oil piping, fuel oil tanks, gas piping, breeching, and any or all parts of the system.
- G. The welding of all steam piping 15 psig or higher shall be subjected to DOB Special Inspections and shall be in conjunction with Standard Procedure Specifications No. 1 (71) of The National Certified Pipe Welding Bureau. The Special Inspection will be commissioned and paid for by the City of New York.

- H. This Contractor shall be responsible for the installation and filing until the installation has been approved by NYC Dept. of Buildings.

#### 1.19 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.20 SUBMITTALS

- A. Prior to assembling or installing the work, the following shall be submitted for review:
  1. Scale drawings indicating insert and sleeve locations.
  2. Scale drawings showing all piping and duct runs with sizes, elevations and appropriate indication of coordination with other trades.
  3. Catalog information, factory assembly drawings and field installation drawings as required for a complete explanation and description of all items of equipment.
  4. Coordination drawings for access panel and door locations.
  5. Shop drawings detailing fabrication and installation for supports for mechanical materials and equipment.
  6. Certification from the equipment suppliers for all energy-consuming equipment that the equipment fully complies with the applicable municipal, state and federal "Energy Conservation Codes". Equipment submissions will not be accepted for review unless accompanied by such certification in writing.
- B. Welder Certificates signed by Contractor certifying that welders comply with requirements specified herein under "Welding Procedures".

#### 1.21 SPACE LIMITATIONS – COORDINATION OF WORK

- A. The equipment selections used in the preparation of the Contract Documents will fit into the physical spaces provided and indicated, allowing room for access, servicing, removal and replacement of parts, etc. Adequate space shall be provided by the contractor for the equipment installed for clearance in accordance with Code requirements, the requirements of the NYC Dept. of Buildings, and the equipment manufacturer's recommendations
- B. In the preparation of Drawings, a reasonable effort to accommodate the listed acceptable equipment manufacturer's space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for initial access, maintenance access, code required access, and proper fit rests with the Contractor.
- C. Ductwork and piping layouts are shown diagrammatically on the contract documents and do not show all offsets, drops and rises of runs. All ductwork shall be kept as high as possible to maintain ceiling heights as shown on the architectural drawings. Changes in duct sizes and/or locations shall be made where necessary to conform to space conditions or to obtain maximum headroom conditions. The contractor shall allow in his bid for routing of ductwork and piping, as described herein, to avoid obstructions and for coordination among the trades. Exact locations are subject to the approval of the Commissioner.
- D. Physical dimensions and arrangements of equipment to be installed shall be subject to the Commissioner's review.
- E. The Contractor shall coordinate the installation of equipment, ductwork, conduit, bus duct, piping, cable, cable trays, etc., with the lighting fixtures, special ceiling construction, air distribution equipment and the structure.

- F. Provide additional rises, drops and offsets as required. If, after installed, new ductwork, conduit, bus duct, piping or cable is found to be in conflict with the architecture, structure, or other trade work which is shown on the Contract or Coordination Documents, the ductwork, conduit, bus duct, piping or cable shall be relocated without additional Expense to the City of New York.
- G. Where piping, lights, and ductwork conflict, ductwork shall be coordinated to site conditions.
- H. Contractor shall coordinate exact location of all air outlets, thermostats and switches with the reflected ceiling plans.

## 1.22 COORDINATION DRAWINGS

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.
- B. The Coordination Drawings shall include, but not necessarily be limited to, the following:
  - 1. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points and the size of all lines shall be indicated. All beam penetrations, slab penetrations and sleeves shall be indicated, sized and coordinated with all other work. All required code clearance space and required maintenance access space shall be indicated and coordinated with all other work. All work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated.
  - 2. Sheet Metal system layout, including elbow radii and all duct accessories.
  - 3. Piping layout, including valve and specialty locations and valve stem movement.
  - 4. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
  - 5. Equipment connections and support details.
  - 6. Exterior wall and foundation penetrations.
  - 7. Fire-rated wall and floor penetrations.
  - 8. Sizes and location of required concrete pads and bases.
  - 9. Clearances as required by Electric Code.
  - 10. Indicate piping loads and support points for all piping 3" and larger, racked piping, and submit to the Commissioner for review.
  - 11. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
  - 12. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installation.
  - 13. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted item.
  - 14. Requirements for vibration isolation, wind and seismic restraints shall be shown on the coordination drawings by each trade.
  - 15. The contractor shall not install any of his work prior to "sign-off" of final Coordination Drawings (as specified herein). If work proceeds prior to sign-off of Coordination Drawings, any change to the work to correct the interferences and conflicts will be made by the Contractor at no additional expense to the project.

## 1.23 RECORD DOCUMENTS

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.
  - 1. In addition, the drawings shall show:





- a. Ductwork mains and branches, size and location, for both exterior and interior; locations of all dampers and other control devices; filters, boxes, and terminal units and any other equipment requiring periodic maintenance or repair.
  - b. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart, as specified under another section of this work. Indicate horizontal locations of underground piping.
  - c. For underground piping, record dimensions and invert elevations of all piping, including all offsets, fittings, cathodic protection and accessories. Locate dimensions from benchmarks that will be preserved after construction is complete.
  - d. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - e. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
  - f. Updating of all equipment schedule sheets.
- B. The contractor shall maintain on site a record of the up-to-date Commissioning Plan, testing records, and pre-functional and functional testing forms and records
- C. This trade shall submit the "as-built" set for approval by the building department in a form acceptable to the department.

#### 1.24 DOCUMENTATION OF FIRE/SMOKE DAMPERS

- A. In addition to the requirements specified elsewhere in the contract documents, the shall prepare a of drawings showing all new fire smoke dampers installed as part of this project.
- B. All new dampers will be assigned a designation and number by the Contractor and coordinated with and submitted to the Commissioner for review and acceptance.

#### 1.25 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in both hard copy and electronic copy in accordance with the DDC General Conditions. In addition to the requirements specified therein, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  4. Servicing instructions and lubrication charts and schedules.
  5. List of spares: recommended for normal service requirements.
  6. Parts list: identifying the various parts of the equipment for repair and replacement purposes.
  7. Instruction books may be standard booklets but shall be clearly marked to indicate applicable equipment.
  8. Wiring diagrams: generalized diagrams are not acceptable; submittal shall be specifically prepared for this project.
  9. Automatic controls: diagrams and functional descriptions. (See control specification for additional requirements).

1.26 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. All equipment and accessories are to be the product of manufacturers regularly engaged in their manufacture. All items of one type (i.e. fans, pumps, coils, etc.) shall be the products of the same manufacturer.
- C. All equipment furnished as part of the work shall comply with 2014 New York City Energy Conservation Code. Provide certification from the equipment suppliers for all energy-consuming equipment that the equipment fully complies with these codes. Equipment submissions will not be accepted for review unless accompanied by such certification in writing.
- D. Furnish all equipment new and free from defects.
- E. All equipment and materials shall be new and without blemish or defect.
- F. All equipment and materials shall be free of asbestos.
- G. All equipment and material to be furnished and installed on this project shall be listed by Underwriters' Laboratories Inc. (UL) or ETL listed, in accordance with the requirements of the NYC Dept. of Buildings, and suitable for its intended use on the project.
- H. Comply with 2014 New York City Construction Codes.
- I. All insulation, duct lining, etc. shall have a composite (insulation, facing and adhesive) fire and smoke hazard rating as tested by Procedure ASTM E84, NFPA 255 and UL 723 not exceeding:
 

Flame Spread	25
Smoke Developed	50
- J. Electrical equipment and materials shall be products which will meet with the acceptance of the agency inspecting the electrical work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be examined, tested and certified at no additional expense to the project. Where no specific indication as to the type or quality of materials or equipment is indicated, a first class standard article shall be furnished.
- K. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- L. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- M. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- N. It is the intent of these specifications that wherever a specific manufacturer of a product is specified or scheduled, and the specifications includes other approved manufacturers or the

terms “other approved” or “or approved equal” or “equal” are used, the submitted item must conform in all respects to the specified item. Consideration will not be given to claims that the submitted item meets the performance requirements with lesser construction (such as lesser heat exchange surface, smaller motor HP, etc.). Performance as delineated in schedules and in the specifications shall be interpreted as a minimum performance. In many cases equipment is oversized to allow for pick-up loads which cannot be delineated under the minimum performance.

- O. Substituted equipment or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether or not, shall be replaced at the Contractor’s expense. Any modifications of related systems as a result of substitutions shall be made at the Contractor’s expense.
- P. Substitutions of Mechanical Equipment for that shown on the schedules or designated by model number in the specifications will not be considered if the item is not a regular catalogued item shown in the current catalog of the manufacturer.
- Q. Manufacturer’s Recommendations: Where installation procedures of any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

#### 1.27 COMPOSITE CONTROL WIRING DIAGRAM REQUIREMENTS

- A. The Contractor shall furnish the project specific wiring and interlock requirement diagrams from the equipment shop drawings for those items of equipment where there is joint wiring interface responsibility. These wiring and interlock diagrams will be furnished to prepare project specific composite control wiring diagrams that will detail how equipment furnished by the Contractor shall be interconnected to provide fully functioning interrelated systems, including the life safety system, for the overall project.
- B. The items for which the wiring and interlock diagrams shall be furnished shall include but not be limited to motors, starters, variable speed drives, motor operated dampers, water chilling units, cooling towers, fan systems, air handling units, pumping systems, boilers, lighting relays and/or contactors for the remote control of or by lighting systems, the Fire Detection, Alarm and Communication. The Contractor shall add to these drawings, those connections they will make for the control and/or monitoring of the motors, dampers, and other items of equipment. The completed diagram shall include all line and low voltage wiring between control devices, motor start-stop and/or H-O-A stations, control relays, sensors, controllers, switches, differential pressure switches, the Fire Command Station, the Security System, the Building Management System, etc.
- C. The Contractor shall verify that the wiring added to the drawings is correct and can be accommodated. If necessary, corrections shall be made by the Contractor. This process shall be completed prior to commencement of work on the particular piece of equipment or in the area within which the equipment is located.
- D. The intent of this requirement is that single composite drawings shall be available for each item of equipment indicating the wiring that shall be installed in its entirety including interlocks. Any omissions or errors noticed by the Contractor shall be brought to the attention of the Commissioner immediately.
- E. The composite wiring diagrams shall include description of the interlock sequence of operation. The description shall include complete identification of each item shown (relay, motor controller,

etc.), and each item's exact operation shall be related to the interlock sequence.

#### 1.28 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Deliver, store and handle all materials to keep clean and protected from damage.
- C. Equipment shall be shipped with all listed items and control wiring factory installed unless specified otherwise herein and specifically noted on the submittals as a substitution.
- D. Ship materials and equipment in crated sections of sizes to permit passing through available spaces, where required. Store products in shipping containers and maintain in place until installation.
- E. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- F. The Vendor shall shrink-wrap all electronic equipment and spare parts prior to shipping.
- G. Store products in shipping containers and maintain in place until installation.
- H. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of floor.
- I. Protect flanges, fittings, and piping specialties from moisture and dirt.
- J. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.
- K. Protect equipment and other materials from damage after installed from construction debris and other damage.
- L. The Contractor shall check all materials and equipment upon their arrival on the Project Site and verify their condition and compliance with the Contract documents.

#### 1.29 PROTECTION AND CLEANING

- A. It shall be this trade's responsibility to store his materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
- B. The inlet and discharge opening of all terminal units as well as all duct and pipe openings (end pieces) shall be kept capped until all local plastering, parging, etc. is completed, and the units are ready to run.
- C. Equipment and material if left in the open and damaged shall be replaced, repainted, or otherwise refurbished at the discretion of the Commissioner. Equipment and material is subject to rejection and replacement if in the opinion of the commissioner, or in the opinion of the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use is questionable, or that its normal life expectancy has been curtailed.
- D. During the erection, protect all ductwork, duct lining, insulation, piping, and equipment from

damage and dirt. Cap the openings of all ductwork and piping installed. After completion of project, clean the exterior and interior surface of all equipment included in this division of work.

### 1.30 FLUSHING AND CLEANING OF PIPING

- A. All piping systems shall be thoroughly flushed out with the approved cleaning chemicals to remove pipe dope, slushing compounds, cutting oils, and other loose extraneous materials. This also includes any piping systems which are not listed as requiring water treatment.
- B. Water shall not be introduced into piping system without water treatment.
- C. Develop plan for flushing and cleaning piping. Submit plan for approval to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.
- D. Prior to flushing, temporarily remove, isolate or bypass dirt sensitive equipment and devices, including the following:
  - 1. Automatic flow control valves
  - 2. Heating and cooling coils
  - 3. Boilers
  - 4. Flow measuring devices
  - 5. Chillers
  - 6. Heat Exchangers
- E. Reinstall after flushing is complete
- F. Prior to flushing, install fine mesh construction strainers at inlet to all equipment with connections 1-1/2" and larger. Install fine mesh construction element in permanent strainers. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, clean permanent strainers, remove construction strainers.
- G. Flush all piping with cold water at a minimum velocity of 6 feet per second for a minimum one hour, or until water runs clear. Water supply shall be equivalent to piping to be flushed. Drain all low points.
- H. Circulate flush water and clean strainers prior to installing cleaning chemicals. Provide cleaning chemicals, under the direction of the chemical supplier. Following flushing, install cleaning chemicals and circulate through the entire system for a minimum of one hour, or as directed by chemical supplier. Drain system, including all low points. Flush, drain and fill system, circulate for one hour, sample for The Commissioner's use. Drain, flush, fill, circulate and sample until system is free of cleaning chemicals, as indicated by analysis of samples.
- I. Provide temporary pumps and piping to chemically clean piping at a minimum velocity of 6 fps without using the system pumps.
- J. The cleaning chemicals shall be added by the mechanical trade. The chemical supplier shall instruct and oversee as to proper feed rates, shall check that the cleaning solution is actually in each system, shall instruct and oversee the contractor as to when to flush the system and shall check each system following flushing to insure all cleaning chemicals have been removed from each system.
- K. A certificate of cleaning shall be provided by the cleaning supplier to the Commissioner.

**1.31 FIRE AND SMOKE DETECTION**

- A. Fire and smoke detection system will be provided and installed by the Electrical trade. The HVAC trade will provide suitable openings (as recommended the Smoke Detection System Manufacturer) in sheet metal for sensing elements.
- B. This Trade will provide access doors to make all such detection heads accessible.
- C. This trade will provide bracing for smoke detections sampling tubes which exceed 48" in length.

**1.32 ACCESSIBILITY**

- A. Install all work so that parts requiring periodic inspection, operation, maintenance and repair are readily accessible.
- B. Group concealed vales, expansion joints, controls, dampers, and equipment so as to be freely accessible through access doors.

**1.33 SEQUENCING AND SCHEDULING**

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar.

**1.34 ACCESS PANELS**

- A. Locate access panels to access valves, traps, control valves or devices, dampers, damper motors, etc. Access panels shall be sized as necessary for ample access, or as indicated on drawings, but no smaller than 18" x 18" where devices are within easy reach of operator, and at least 24"x24" when operator must pass through opening in order to reach the devices.
- B. See Section 08 31 13 "Access Doors and Frames" for access door requirements.

**1.35 GUARANTEES AND CERTIFICATIONS**

- A. All work shall be guaranteed to be free from leaks or defects. Any defective materials or workmanship as well as damage to the work of all trades resulting from same shall be replaced or repaired as directed for the duration of stipulated guaranteed periods.
- B. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use. For example, in the case of refrigeration systems, it means that the plant has a cooling load. Similarly, for all other systems.
- C. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.
- D. Non-durable replaceable items such as air filter media do not require replacement after the date of acceptance. If received in writing, requests to have earlier acceptance dates established for these items will be honored.
- E. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of heating and air conditioning equipment.

#### 1.36 DIELECTRIC FITTINGS

- A. For all systems, provide dielectric fittings to isolate joined dissimilar materials to prevent galvanic action and stop corrosion. Fittings shall be of the non-reducing type, which shall be suitable for the system fluid, pressure, and temperature and shall not restrict flow.
- B. For factory fabricated equipment, manufacturer shall submit method of compliance or exceptions (if applicable) in writing as part of the shop drawings submission for review by the Commissioner.
- C. It is the intent of this section that all system components (equipment connections, piping, etc.), whether they are field installed or factory fabricated, shall comply with these requirements.
- D. Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain and weld-neck end types that match piping system materials.
- E. Insulating Material: Suitable for system fluid, pressure, and temperature, does not restrict flow.
- F. Dielectric Unions: Factory-fabricated, union-assembly, for 300-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers: Subject to compliance with these specifications, provide product by one of the following:
    - a. Capital Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
    - h. Or approved equal
- G. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.



1. Manufacturers: Subject to compliance with the specifications, provide product by one of the following:
    - a. Capital Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Or approved equal
  - H. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
    1. Manufacturers: Subject to compliance with the specifications, provide product by one of the following:
      - a. Advance Products & Systems, Inc.
      - b. Calpico, Inc.
      - c. Central Plastics Company.
      - d. Pipeline Seal and Insulator, Inc.
      - e. Or approved equal
    2. Separate companion flanges and steel bolts and nuts shall have 300-psig minimum working pressure where required to suit system pressures.
  - I. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F temperature.
    1. Manufacturers: Subject to compliance with the specifications, provide product by one of the following:
      - a. Calpico, Inc.
      - b. Lochinvar Corp.
      - c. Hart Industrial Unions
      - d. Or approved equal
  - J. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F temperature.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Perfection Corp.
      - b. Precision Plumbing Products, Inc.
      - c. Sioux Chief Manufacturing Co., Inc.
      - d. Or approved equal.
- 1.37 DRIVE GUARDS
- A. For all machinery and equipment (whether factory fabricated or field installed) provide OSHA Approved guards for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor.
  - B. Materials: Sheet steel, cast iron, expanded metal or heavy gauge wire mesh rigidly secured so



as to be removable without disassembling pipe, duct, or electrical connections to equipment.

- C. Access for Speed Measurement: One-inch diameter hole at each shaft center

#### 1.38 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers: Subject to compliance with the specifications, provide product by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
    - e. Or approved equal
  - 2. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### 1.39 SLEEVES

- A. Mechanical Sleeves Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular spaces between pipe and sleeve. Connecting bolts and pressure plates cause rubbers scaling elements to expand when tightened.
- B. Galvanized-Steel Sheet: 0.025-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

#### 1.40 ESCUTCHEONS

- A. Provide escutcheons all exposed piping passing through walls, floors partitions and ceilings, except provide close fitting metal escutcheons on both sides of piping (whether exposed or not) through required fire rated walls, floors, partitions & ceilings.
- B. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening through required fire rated walls, floors, partitions & ceilings.
- C. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
- D. Cast Brass: One-piece, with set-screw.

- E. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- F. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated
- G. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated
- H. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- I. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- J. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- K. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

#### 1.41 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

#### 1.42 FIRE-STOPPING

- A. Refer to Section; "FIRESTOPPING".
- B. The Mechanical trade is responsible for firestopping of mechanical work.
- C. Firestopping system must be U.L. approved.
- D. All spaces between ducts or pipes and their respective sleeves shall be packed full depth with mineral wool, or other equally approved fire resistant material, and compressed firmly in place.
- E. Fiberglass shall not be used. Sleeve clearances shall not exceed ½ inch between pipes (or ducts) and sleeves. Use individual sleeves for each pipe or duct. Use escutcheons on both sides of sleeves. This includes spaces between ducts on pipes and their respective sleeves or opening at fan rooms (whether walls are fire rated or not).

#### 1.43 TOOLS AND LUBRICANTS

- A. Furnish special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Lubricants: A minimum of one quart of oil and one pound of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

#### 1.44 SEISMIC AND WIND RESTRAINTS DESIGN

- A. It shall be understood that the requirements of this seismic section are complementary to requirements delineated elsewhere for the support and fastening of equipment and, piping work. Nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this seismic section.
- B. This project requires special provisions for the support and restraint of equipment, piping, ductwork, etc., in the event of earthquake or wind condition so as to comply with the latest edition of the New York City Building Code of 2014.
- C. This Contractor shall provide all required design services, labor, materials, tools and equipment necessary for a complete seismic and wind restraint system for all isolated and non-isolated equipment as indicated in these documents or which may be reasonably implied as essential, whether mentioned in the Drawings and Specifications or not.
- D. It is the intent of the seismic section of this specification to keep all HVAC building system components in place during a seismic or wind event and operational after the seismic event.
- E. As part of the work, the contractor shall engage the services of a New York State licensed professional engineer with experience in the field of equipment support, wind and seismic restraints. He shall select and coordinate the restraints and supports based on the final coordinated drawings showing exact location of piping and equipment and shall coordinate with the Commissioner to ascertain that the connections to the structure will resist the wind and seismic forces to which they might be subjected.
- F. Seismic and Wind support and restraints are specified on the drawings as well as under another section of this Work.
- G. All equipment shall be provided with approved seismic and wind control devices as required to prevent overturning or sliding. Seismic and wind restraints shall be capable of keeping equipment captive under seismic and wind loads.

#### 1.45 VFD AND STARTER ENCLOSURES

- A. Refer to Section 23 05 13 “Motors for HVAC Equipment” for additional requirements.
- B. Refer to Section 23 05 14 – “Variable Frequency Drives” for additional requirements.
- C. Refer to Section 23 05 15 – “Enclosed Controllers” for additional requirements.
- D. Enclosures: Unless otherwise specified herein, NEMA 250, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Conditioned Locations: NEMA 250 Type 1.
  - 2. Outdoor Locations: Type 4X, with space heater and air-cooled cooling unit to maintain temperature within housing as required for proper operation for outdoor temperatures within the range of ASHRAE 99.6 percent winter design temperature and ASHRAE 0.4 percent summer design temperature for the area, plus solar load. Single point electrical connection for controller and enclosure.
  - 3. Other Wet or Damp Indoor Locations: Type 4.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
  - 5. Fan Rooms and Refrigeration Rooms: Type 3R
  - 6. Hazardous Areas Indicated on Drawings: Type 7.
- E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors.

- F. Rain shields installed on fronts, sides and tops of enclosures installed outdoors. Rain shields shall extend a minimum of 30" around all sides of the enclosure. Provide walk-on platform to eliminate standing water.

## PART 2 - PRODUCTS

NOT USED.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
- B. Coordinate mechanical systems, equipment, and materials installation with other building components.
- C. Verify all dimensions by field measurements.
- D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- F. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- G. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
- H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services.
- I. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Commissioner.
- J. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- K. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

- L. Install access panel or doors for maintenance or inspection where units are concealed behind finished surfaces. Access panels and doors are specified under another section of the work.
- M. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

### 3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with the DDC General Conditions.
- B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- C. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
  - 1. Uncover Work to provide for installation of ill-timed Work.
  - 2. Remove and replace defective Work.
  - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
  - 4. Remove samples of installed Work as specified for testing.
  - 5. Install equipment and materials in existing structures.
  - 6. Upon written instructions from the Commissioner, uncover and restore Work to provide for observation of concealed Work.
- D. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.
- E. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- F. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- G. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
- H. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

### 3.4 ROUGH IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications for rough-in requirements.

### 3.5 WELDING PROCEDURE

- A. Pipe welding shall comply with the provisions of the latest revision of ANSI/ASME B31.9 Building Services Piping, or such state or local requirements as may supersede codes mentioned above.
- B. Pipe welding for MPS/HPS (15 psig and above) shall be in accordance with ASME B31.1 Power

Piping Code, or such State or local requirements as may supersede codes mentioned above.

- C. Before any new pipe welding is performed, submit a copy of welding Procedure Specifications together with proof of its qualification as outlined and required by the 2014 New York City Construction Codes.
- D. Before any operator shall perform any pipe welding, submit the operator's instructional record in conformance with provisions of the 2014 New York City Construction Codes, showing that the operator was tested under the approved Procedure Specification submitted.
- E. Restore or replace any work not in accordance with these specifications.
- F. The welding of all steam piping 15 psig or higher shall be subjected to Special Inspections and shall be in conjunction with Standard Procedure Specifications No. 1 (71) of The National Certified Pipe Welding Bureau. One hundred percent (100%) of welds for steam piping over 15 psig or higher shall be radiographed in accordance with NYC High Pressure Steam Rules & Regulations. Radiographic examination shall be performed in accordance with ASME B 31.1 based on the piping pressure. Include the expense of X-Raying, by an independent company, in the HVAC expense.
- G. All steam piping over 2" shall be butt-welded. Piping 2" and under may be socket-welded.

### 3.6 PRESSURE TESTING - ALL PIPING SYSTEMS

- A. Water shall not be introduced into piping systems for testing without water treatment.
- B. All piping systems shall be tested to a hydrostatic pressure at least 1 -1/2 times the maximum operating pressure (but not less than 125 psig) for a sufficiently long time, but not less than 4 hours, without losing pressure, to detect all leaks and defects. Where necessary, piping shall be tested in sections to permit the progress of the job.
- C. Hydrostatic Testing Corrosion Inhibitor
  - 1. If sections of system must be hydrostatically tested prior to clean out, appropriate inhibitor shall be added to the test water at sufficient level to totally passivate metal and provide protective film on pipe surfaces to prevent corrosion prior to clean out and treatment.
  - 2. Contractor shall be responsible to coordinate mechanical treatment with the water treatment. At no time shall the Contractor add water to a system without treatment.

### 3.7 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Commissioner.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

- F. Install equipment to provide the maximum possible headroom where mounting.

### 3.8 EXPANSION ANCHORS

- A. Provide smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 Type 1, Class 3.
- B. Do not exceed  $\frac{1}{4}$  of average valves for a specific anchor size using 2000 psig concrete only, for maximum working load.
- C. Provide spacing and install anchors in accordance with manufacturer's recommendations.

### 3.9 PANS AND DRAINS OVER ELECTRICAL EQUIPMENT

- A. The contractor shall examine the drawings and in cooperation with the Electrical Trade confirm the final location of all electrical equipment be installed in the vicinity of piping and duct work. Plan and arrange all overhead piping no closer than 6'-0" feet in all directions from a vertical line above electrical equipment, including but not limited to, motor control centers, starters, electric motors switchboards, panelboards, or similar equipment.
- B. Piping and duct work is not permitted in Electric Equipment, Transformer, Switch Gear, Elevator Equipment, Telephone Gear and Fire Pump Rooms. Where the installation of piping does not comply with the requirements of the foregoing paragraph, where feasible the piping shall be relocated.
- C. Furnish gutters as follows:
  - 1. Provide and erect a gutter of 16-ounce cold rolled copper or 16-gauge aluminum under every pipe which is within 6'-0" from a vertical line to any motor, electric controllers, switchboards panel boards the like.
  - 2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and carefully pitched to a convenient point for draining. Provide a 3/4" drain, with valve as directed, to nearest floor drain or slop sink, as approved.
  - 3. In lieu of such separate gutters, a continuous protecting drain pan of similar construction adequately supported and braced properly rimmed, pitched and drained to a floor drain or suitable waste, may be provided over any such electrical equipment, and extending 6'-0" in all directions beyond the electrical equipment, over which such piping has to run.

### 3.10 TOOLS AND LUBRICANTS

- A. Furnish special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Lubricants: Furnish a minimum of one quart of oil, and one pound of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

### 3.11 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated

unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
  - 1. Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, Split-casting cast-brass type with polished chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.



2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Sheet Sleeves: For pipes 6 inches and larger, penetrating gypsum-board partitions.
    - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.12 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Pipe Threads: ASME B1.20 for factory-threaded pipe and pipe fittings.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- H. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- J. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.13 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping 2" and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping 2-1/2" and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- B. All welding elbows shall be long radius elbows ANSI B16.9.
- C. Where welding is used, fittings shall be ANSI B-16.9. Welding end fittings shall have the same bursting pressure as pipe of the same size and schedule.

### 3.14 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.15 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Section 09 91 00 "Painting".

- B. Damage and Touchup: Restore marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.16 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate concrete base height with air handling unit manufacturer to assure proper coil condensate drainage.

### 3.17 GROUTING

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
  - 1. Characteristics: Post-hardening, volume adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous and recommended for interior and exterior applications.
  - 2. Design mix: 6000 psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.
- B. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- C. Clean surfaces that will come into contact with grout.
- D. Provide forms as required for placement of grout.
- E. Avoid air entrapment during placement of grout.
- F. Place grout, completely filling equipment bases.
- G. Place grout on concrete bases and provide smooth bearing surface for equipment.
- H. Place grout around anchors.
- I. Cure placed grout.

### 3.18 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS:

- A. Provide supplementary steel, channels and supports required for proper installation, mounting

and support of HVAC work.

- B. All supplementary steel shall be fabricated from structural grade steel conforming to ASTM specifications.
- C. All fittings shall be fabricated from steel conforming to ASTM specifications.
- D. No material shall be introduced into the support system that cannot be identified under an approved ASTM material designation.
- E. Connect supplementary steel and channels firmly to building construction in an acceptable manner.
- F. Refer to Division Section "Metal Fabrications" for structural steel.
- G. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- H. Determine type and size of supporting channels and supplementary steel. Supplementary steel and channels shall be of sufficient strength and size to allow only a minimum deflection in conformance with manufacturer's requirements of loading.
- I. Structural Integrity: Supports shall be designed and installed so that they cannot become disengaged by movements or weight of the supported equipment.
- J. All supplementary steel, channels, supports shall be submitted to Commissioner for review.
- K. Install supplementary steel and channels in a neat and workmanlike manner parallel to walls, floors, and ceiling construction.
- L. Materials and workmanship shall be first class in every respect and shall be subject to the Commissioner's inspection and approval at any time.
- M. Field Welding: Comply with AWS D1.1

### 3.19 PRE-OCCUPANCY SPACE FLUSH OUT

- A. At completion of construction, prior to turn over of the building, the contractor shall conduct a pre-occupancy flush out of the system as follows:
  - 1. All supply air systems shall be run at 100% fan capacity for a period of two weeks.
  - 2. During the flush out, all outside air dampers shall be locked into 100% outside air position. Return air dampers shall be fully closed and all spill air dampers shall be 100% open. Exhaust fans shall be operated at 100% exhaust.
  - 3. Cooling and/or heating coil valves shall be controlled by the building management system to provide properly tempered and dehumidified air.
    - a. Supply air temperature shall be set to provide a maximum space temperature of 78°F, minimum space temperature of 66°F and a maximum space humidity of 60% RH.
  - 4. All exhaust fans that are required to run to maintain proper building pressurization shall be operated at 100% fan capacity for the flush out period.

### 3.20 REFRIGERANT HANDLING



- A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:
1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical refrigeration.
  2. ASHRAE standard 34 and Related Revisions: Number Designation and Safety classification of refrigerants.
  3. United States Environmental Protection Agency (US EPA) requirements of Section 808 (Prohibition of Venting and Regulation of CFC) and applicable State and local regulations of NYC Dept. of Buildings.

**END OF SECTION 23 05 00**



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**SECTION 23 05 13****MOTORS FOR HVAC EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 14 "Variable Frequency Motor Drives (VFD)".
- D. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- E. Section 23 05 93 "Testing, Adjusting and Balancing".
- F. Section 23 09 00 "HVAC Instrumentation and Controls".
- G. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCE STANDARDS**

- A. UL
- B. IEEE standard 143 (latest addition)
- C. IEEE standard C84.1
- D. ANSI,
- E. ANSI C84.1 Electric Power Systems and Equipment.
- F. ANSI/NEMA MG-1 Motors and Generators.
- G. 6ANSI C62.92.4-1991 IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part IV-Distribution
- H. IEEE 141-1993 IEEE Recommended Practices for Electric Power Distribution for Industrial Plant System
- I. IEEE 519-1992 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- J. IEEE 1159-1995 IEEE Recommended Practice for Monitoring Electric Power Quality.
- K. ISO-1400 Standards, such as 14001, 14002, and 14003.
- L. NEMA
- M. ISO-9000 standards (manufacturing standards).

**1.6 DEFINITIONS**

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- B. Field-Installed Motor: motor installed at Project site and not factory installed as an integral component of motorized equipment.

**1.07 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.8 SUBMITTALS**

- A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.





- B. Shop Drawings for Field-Installed Motors: Dimensional plans, elevations, sections, and details including required clearances and service space around equipment. Include the following:
  - 1. Each installed unit's type and details.
  - 2. Nameplate legends.
- C. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in 23 05 48 "Vibration Isolation, Seismic and Wind Load Restraints for HVAC Components." Include the following:
  - 1. Test Reports: Written reports specified in Parts 2 and 3.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to NYC Dept. of Buildings, and marked for intended use.
- D. Comply with NFPA 70, as amended by state and local officials.
- E. Motors shall be UL listed.

#### 1.10 SEISMIC AND WIND LOAD DESIGN

- A. This project is located within a seismic and wind zone requiring special provisions for the support and restraint of equipment, components and piping.
- B. Fabricate unit sections, internal mounting frames and attachments and other section components with restraints to withstand seismic forces defined under another section of this work.

#### 1.11 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.
  - 5. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
  - 6. Matched to torque and horsepower requirements of the load.
  - 7. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- C. Coordinate motor and motor control requirements with all factory fabricated equipment.



- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section.
- E. Where motors will be controlled by variable frequency controllers, they shall be designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

## PART 2 - PRODUCTS

### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.
- D. Fan, motor and VFD shall be selected and supplied by air handling unit manufacturer with capacities as indicated on the schedule and fully compatible with specific air handling unit systems.
- E. Motors shall include permanently sealed bearings and shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents.
- F. MANUFACTURERS:
  - 1. Subject to compliance with requirements, provide products by one of the following:
    - a. Baldor
    - b. Toshiba
    - c. General Electric
    - d. U.S. Motor
    - e. Marathon
    - f. Or approved equal.

### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Motors ½ HP and Larger: Three Phase.
- C. Motors Smaller Than ½ HP: Single Phase.
- D. Frequency Rating: 60 Hz.
- E. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- F. Service Factor: 1.15
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.



- H. Motors shall meet or exceed EPACT (NEMA 1240 Standards) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC).
- I. Enclosure: Suitable for the environment at the motor location:
  - 1. Motors located indoors: Open drip-proof.
  - 2. Motors located outdoors and exposed to the weather: Totally enclosed.
  - 3. Motors located within the equipment airstream: Totally enclosed. Open drip-proof motors in the air-stream will not be permitted.
  - 4. Cooling tower motors: Totally enclosed
  - 5. Motors located within a hazardous environment: Explosion resistant, rated for the Class and Division of the motor environment.
- J. Motors shall be suitable for operation in either vertical, horizontal or angular position.
- K. Motors shall be equipped with suitable electric lead wire positioning gasket at the point where such leads pass through the motor frame into the motor terminal box. Such gaskets shall be arranged to ensure that under no condition will the lead wires be subjected to abrasion against the metal of the motor frame.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design E, medium induction motor.
- B. Efficiency: Premium efficient motors, as defined in NEMA MG 1, and with applicable EPACT efficiency standards.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F, unless otherwise indicated.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motors larger than 7.5 HP; rolled steel for motor smaller than 7.5 HP.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box,



suited to control method.

**B. Motors Used with Variable Frequency Drives:**

1. Ratings, characteristics, and features shall be coordinated with and approved by VFD controller manufacturer.
2. Efficiency: Premium efficient motors, as specified herein
3. Designed with critical vibration frequencies outside operating range of controller output.
4. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
5. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
6. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
7. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

**C. Severe-Duty Motors:** Comply with IEEE 841, with 1.25 minimum service factor, greased bearings, integral condensate drains and capped relief vents. Windings insulated with non-hygroscopic material.

1. Finish: Chemical Resistant Paint over corrosion resistant primer.

**2.5 SINGLE-PHASE MOTORS**

**A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:**

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

**B. Multispeed Motors:** Variable-torque, permanent-split-capacitor type.

**C. Bearings:** Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

**D. Motors 1/20 HP and Smaller:** Shaded-pole type.

**E. Thermal Protection:** Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

**F. Efficiency:** premium efficient motors, as specified herein.

**PART 3 - EXECUTION**

**3.1 EXECUTION REQUIREMENTS**

**A. Refer to DDC General Conditions for execution requirements.**

**3.2 EXAMINATION**

**A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.**



- B. Examine roughing-in of conduit systems to verify actual locations of conduit connections before motor installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 MOTOR INSTALLATION

- A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.
- B. Install motors on concrete base complying with Section 03 30 00 "Cast-in-Place Concrete".
- C. Comply with mounting and anchoring requirements specified in Section "Vibration Isolation, Seismic and Wind Load Restraints for HVAC Components."

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  - 2. Test interlocks and control features for proper operation.
  - 3. Verify that current in each phase is within nameplate rating.
- B. Testing: Perform the following field quality-control testing:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### 3.5 ADJUSTING

- A. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.

### 3.6 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

**END OF SECTION 23 05 13**



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**SECTION 23 05 14****VARIABLE FREQUENCY MOTOR DRIVES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 13 "Motors for HVAC Equipment".
- E. Section 23 05 93 "Testing, Adjusting and Balancing".
- F. Section 23 09 00 "HVAC Instrumentation and Controls".

**1.2 SUMMARY**

- A. Section includes separately enclosed, pre-assembled, solid-state, PWM, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification

section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 REFERENCE STANDARDS

- A. IEEE - Standard 519-1992, IEE Guide for Harmonic Content and Control.
- B. Underwriters Laboratories - UL508C
- C. National Electrical Manufacture's Association (NEMA) - ICS 16800 Parts 1 and 2
- D. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
- E. NEMA ICS 2-222: Overload Relay Class Designation
- F. NEMA - MG 1: Motors and Generators
- G. NFPA – 70: National Electrical Code
- H. International Electro-technical Commission (IEC) 947-4-1- Low-voltage switchgear and Control gear, Part 4-1: Contactors and Motor Starters

#### 1.6 DEFINITIONS

- A. BMS: Building management system.
- B. CPT: Control power transformer.
- C. EMI: Electromagnetic interference.
- D. IGBT: Integrated gate bipolar transistor.
- E. LAN: Local area network.
- F. LED: Light-emitting diode.
- G. MCP: Motor-circuit protector.
- H. NC: Normally closed.
- I. NO: Normally open.
- J. OCPD: Overcurrent protective device.
- K. PCC: Point of common coupling.
- L. PID: Control action, proportional plus integral plus derivative.
- M. PWM: Pulse-width modulated.
- N. RFI: Radio-frequency interference.



- O. TDD: Total demand (harmonic current) distortion.
- P. THD (V): Total harmonic voltage demand.
- Q. VFD: Variable-frequency motor controller.

## 1.7 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFDs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Harmonics: Submit calculations to demonstrate that the total harmonic produced by all of the VFD's connected to the systems at the electrical service point shall be no greater than the allowable harmonics as follows:
  - 1. The total harmonics produced by all of the VFD's connected to the system, including VFD's provided integral with HVAC equipment, at the point of Common Coupling (PCC) shall be no greater than the allowable harmonics for special systems as specified by IEEE Standard 519, tables 10.2 & 10.3 based on the installed KVA. The PCC shall be the primary side of the electrical service transformer(s) for calculating current distortion and the PCC shall be the secondary side of the electrical service transformer(s) for calculating voltage distortion. Where the installed source KVA is not indicated on the electrical drawings, calculations shall be based on 60 percent of the KVA of the service switch, not including the fire pump.

## 1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.9 SUBMITTALS

- A. Product Data: For each type and rating of VFD indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Shop Drawings: For each VFD. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
  - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Enclosure types and details.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of enclosed unit.
    - f. Features, characteristics, ratings, and factory settings of each VFD and installed devices.
    - g. Specified modifications.
    - h. UL listing for series rating of overcurrent protection devices in combination

controllers

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.
  3. Harmonics: Submit calculations to demonstrate that the total harmonic produced by all of the VFD's connected to the systems at the electrical service point shall be no greater than the allowable harmonics, as specified above.
- C. Qualification Data: For qualified testing agency.
- D. Seismic Qualification Certificates: For VFDs, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- E. Product Certificates: For each VFD, from manufacturer.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals. In addition to items specified in DDC General Conditions Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
  2. Manufacturer's written instructions for setting field-adjustable overload relays.
  3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
- 1.10 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Source Limitation: Obtain VFD's of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70, as amended by 2014 NYCBC.
- E. IEEE Compliance: Fabricate and test VFD according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration Isolation, Seismic, Wind & Flood Load Restraints For Electrical Components."
- F. VFDs and options shall be UL listed as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100

KAIC without the need for input fusing.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air-conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

#### 1.12 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without de-rating, under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: 0 deg F to 104 deg F.
  - 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
  - 3. Humidity: Less than 95 percent (noncondensing).
  - 4. Altitude: Not exceeding 3300 feet.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items.

#### 1.13 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
  - 1. Torque, speed, and horsepower requirements of the load.
  - 2. Ratings and characteristics of supply circuit and required control sequence.
  - 3. Ambient and environmental conditions of installation location.
- B. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- E. Submit Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements

#### 1.14 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
  - 1. Manufacturer warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS.

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB Power Distribution, Inc.; ABB Control, Inc.
  2. Yaskawa Electric America, Inc; Drives Division.
  3. Toshiba International Corporation.
  4. Or approved equal.

### 2.2 VARIABLE FREQUENCY CONTROLLERS

- A. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- B. VFD Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of standard efficiency and premium efficiency motors as defined by NEMA MG1.
  2. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
  3. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  4. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to NYC Dept of Buildings.
  5. VFD's for operation of motors 15 HP and larger are to be equipped with a minimum of 12 pulse inverter sections.
  6. VFD's for operation of motors 10 HP or less shall be equipped with a minimum of 6 pulse inverter sections.
  7. VFD's for chillers are to be equipped with a minimum of 12 pulse inverter sections
- C. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- E. Unit Operating Requirements:
1. Input AC Voltage Tolerance: 208V, Plus or minus 5 percent, 380 – 500 V, plus or minus 10 percent of VFD input voltage rating.
  2. Input AC Voltage Unbalance: Not exceeding 3 percent.
  3. Input Frequency Tolerance of 50/60 Hz., Plus or minus 3 percent of VFD frequency rating.
  4. Minimum Efficiency: 96 percent at 60 Hz, full load.
  5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
  6. Ambient Temperature Rating: Not less than 0 deg F and not exceeding 104 deg F.



7. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
  8. Humidity Rating: Less than 95 percent (noncondensing).
  9. Altitude Rating: Not exceeding 3300 feet.
  10. Vibration Withstand: Comply with IEC 60068-2-6.
  11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
  12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
  13. Speed Regulation: Plus or minus 1 percent.
- F. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.
- G. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 2 to 22 seconds.
  4. Deceleration: 2 to 22 seconds.
  5. Current Limit: 50 to minimum of 110 percent of maximum rating.
- H. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop with alarm.
  3. Under- and overvoltage trips.
  4. Inverter over current trips.
  5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
  6. Critical frequency rejection, with three selectable, adjustable deadbands.
  7. Instantaneous line-to-line and line-to-ground overcurrent trips.
  8. Loss-of-phase protection.
  9. Reverse-phase protection.
  10. Short-circuit protection.
  11. Motor over-temperature fault.
  12. Control circuit (120 V) for interlocking with dry contacts in load side motor disconnect to disable start-up attempts with system open.
  13. Snubber networks to protect against malfunction due to system voltage transients.
- I. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- K. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.



- L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- N. Decelerating Energy Absorption: Means of absorbing energy released by decelerating motor (and its driven load) without damage to VFD, motor or load.
- O. DC Bus Choke: For harmonic distortion reduction
- P. Integral Input Disconnecting Means and OCPD: NEMA KS 1, nonfusible switch, with power fuse block and current-limiting fuses with pad-lockable, door-mounted handle mechanism.

## 2.3 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
  - 1. Power on.
  - 2. Run.
  - 3. Overvoltage.
  - 4. Line fault.
  - 5. Over current.
  - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
  - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
  - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    - a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
  - 1. Real-time clock with current time and date.
  - 2. Running log of total power versus time.
  - 3. Total run time.
  - 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
  - 1. Output frequency (Hz).
  - 2. Motor speed (rpm).
  - 3. Motor status (running, stop, fault).
  - 4. Motor current (amperes).
  - 5. Motor torque (percent).
  - 6. Fault or alarming status (code).



7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

**E. Control Signal Interfaces:**

**1. Electric Input Signal Interface:**

- a. A minimum of two programmable analog inputs: 0 to 10 V dc and 4 to 20-mA dc.
- b. A minimum of six multifunction programmable digital inputs.

**2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:**

- a. 0- to 10-V dc.
- b. 4- to 20-mA dc.
- c. Potentiometer using up/down digital inputs.
- d. Fixed frequencies using digital inputs.
- e. RS 485
- f. Keypad Display for local hand operation.

**3. Output Signal Interface: A minimum of two programmable analog output signal(s) (4- to 20-mA dc which can be configured for any of the following:**

- a. Output frequency (Hz).
- b. Output current (load).
- c. DC-link voltage (V dc).
- d. Motor torque (percent).
- e. Motor speed (rpm).
- f. Set point frequency (Hz).

**4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:**

- a. Motor running.
- b. Set point speed reached.
- c. Fault and warning indication (overtemperature or overcurrent).
- d. PID high- or low-speed limits reached.

**F. Damper Control Interface: Closes a dry contact upon a start command to open associated dampers before the motor is allowed to operate in drive or bypass mode. Input to accept damper limit switch contact enclosure to allow the motor to operate.**

**G. Safety Control Interface: Input to accept safety device dry contact closure to stop motor operating in drive and bypass mode.**

**H. Over-Ride Control Interface: Input to accept control system dry contact closure to start motor operation in drive mode at variable speed and in bypass mode.**

**I. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.**



1. Number of Loops: Two.

J. BMS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFD status and alarms and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory. Interface shall allow all parameter settings of VFD to be programmed via BMS control and all output signals and alarms of VFD to be monitored by BMS.

1. Network Communications Ports: Ethernet and RS-422/485.
2. Embedded BAS Protocols for Network Communications (coordinate with BMS Trade): ASHRAE 135 BACnet protocols accessible via the communications ports.

## 2.4 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD at input terminals of all VFDs to less than 5 percent and THD (V) to 3 percent.

1. Protect each VFD against injurious overheating at its full load rating.
2. Line reactors are incorporated as an integral part of the controller equipment in a single cabinet. Include all required field wiring.
3. DC Bus choke: For harmonic distortion reduction.

B. Output Filtering: The variable frequency controllers are suitable for use with standard NEMA Design B motors having a service factor of 1.15 without producing any injurious "ringing" over-voltages as the motor terminals.

C. Incorporate L-C filters (and/or other items) in the output of the drive as required to prevent such over voltages based on the circuit length from VFD to motor.

D. Provide written certification of the suitability of the VFD for use with "standard motors."

E. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

## 2.5 BYPASS SYSTEMS

A. Activation of bypass operation shall not disconnect overcurrent, overload or any other motor protection devices.

B. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

C. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

D. Manual Bypass: magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-Off-Bypass selector switch sets mode and indicator lights give indication of mode selected. Unit shall be capable of stable operation (Starting, stopping and running) with motor completely disconnected from controller (no load).





- E. Bypass Controller: NEMA ICS 2, full voltage, non-reversing enclosed controller with across-the-line starting capability in manual bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode. Bypass controller for motors 75 HP and larger (10 HP and larger when supplied from an emergency generator) are provided with solid-state reduced voltage controller (soft-start) in series with the bypass contactor.
- F. Two-contactor-style bypass allows motor operation via the power converter or the bypass controller: with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- G. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- H. Motor protection from single phase power conditions- the Bypass system must be able to detect a single phase input power while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.

## 2.6 ADDITIONAL REQUIREMENTS

- A. Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass mode. The terminal strip shall allow for independent connection of up to four (4) unique inputs.
- B. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows motor operation. Two separate safety interlock inputs shall be provided when safety is opened; the motor shall be commanded to coast to stop, and the damper shall be commanded to close.
- C. Damper control circuit with end of travel feedback capability.
- D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.
- E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, this password-protected input:
  - 1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
  - 2. Forces VFD to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
  - 3. Reset VFD to normal operation on removal of override signal manually.
- F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- G. Remote digital operator kit.

- H. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0-120 seconds
- I. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

## 2.7 VFD ENCLOSURES

- A. Unless otherwise specified herein, NEMA 250, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Conditioned Locations: NEMA 250 Type 1.
  - 2. Outdoor Locations: Type 4X, with space heater and air-cooled cooling unit to maintain temperature within housing as required for proper operation for outdoor temperatures within the range of ASHRAE 99.6 percent winter design temperature and ASHRAE 0.4 percent summer design temperature for the area, plus solar load. Single point electrical connection for controller and enclosure.
  - 3. Other Wet or Damp Indoor Locations: Type 4.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
  - 5. Fan Rooms and Refrigeration Rooms: Type 3R
  - 6. Hazardous Areas Indicated on Drawings: Type 7, Type 9.
- B. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4, Type 4X, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- C. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R Type 4X, Type 12 enclosures installed in unconditioned interior spaces subject to humidity and temperature swings.
- D. Cooling Fan and Exhaust System: For NEMA 250, Type 1, Type 12; UL 508 component recognized: Supply fan, with stainless steel intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.
- E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors.
- F. Rain shields installed on fronts, sides and tops of enclosures installed outdoors. Rain shields shall extend a minimum of 30" around enclosure. Provide walk-on platform to eliminate standing water.
- G. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated." e.g., when VFD is located in the air stream inside an air-handling unit or in a space used for environmental air (e.g., above a suspended ceiling used for return air).

## 2.8 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFD enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
- B. Standard Displays:



1. Output Frequency
2. Set-Point Frequency
3. Motor Current (amperes)
4. DC- Link-Voltage (VDC)
5. Motor Torque (percent)
6. Motor Speed (RPM)
7. Motor Output Voltage (V).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

F. Spare control-wiring terminal blocks; wired.

## 2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.

1. Test each VFD while connected to a motor that is comparable to that for which the VFD is rated.
2. Verification of Performance: Rate VFDs according to operation of functions and features specified.

B. VFDs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before

VFD installation.

### 3.3 INSTALLATION

- A. VFD's to be installed as part of the Electrical Work.
- B. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Floor-Mounting Controllers: Install VFDs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section.
- D. Roof-Mounting Controllers: Install VFD on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
- E. Seismic Bracing: Comply with requirements specified in Division 26 Section "VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- G. Comply with NECA 1.

### 3.4 IDENTIFICATION

- A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Division 26.
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFD with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

### 3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices and facility's BMS system.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
  - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test continuity of each circuit.
  - 3. Verify that voltages at VFD locations are within 5 percent of motor nameplate rated voltages. If outside this range for any motor, notify the Commissioner before starting the motor(s).
  - 4. Test each motor for proper phase rotation.
  - 5. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. VFDs will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.8 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping



occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Commissioner before increasing settings.

- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 00 00.
- F. Set field-adjustable pressure switches.

### 3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service personnel to adjust, operate, reprogram, and maintain VFDs.

**END OF SECTION 23 05 14**

**SECTION 23 05 15****ENCLOSED CONTROLLERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – “Common Requirements for HVAC Work”.
- C. Section 23 05 48 – “Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components”.
- D. Section 23 05 13 – “Motors for HVAC Equipment”.
- E. Section 23 05 15 – “Variable Frequency Motor Drives”.
- F. Section 23 09 00 – “HVAC Instrumentation and Controls”
- G. Section 23 09 05 – “Sequences of Operation for HVAC Controls”
- H. This Section is itself related to each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Full-voltage manual.
  - 2. Full-voltage magnetic.
  - 3. Reduced-voltage magnetic.
  - 4. Reduced-voltage solid state.
  - 5. Multispeed.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 “Construction Waste Management and Disposal”
  - 2. Section 01 81 13 “Sustainable Design Requirements for LEED Buildings”
  - 3. Section 01 81 19 “Indoor Air Quality Requirements for LEED Buildings”
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED



Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 DEFINITIONS**

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

**1.6 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

**1.7 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.8 ACTION SUBMITTALS**

- A. Product Data: For each type of enclosed controller, include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller, include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Show tabulations of the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Nameplate legends.
    - d. Short-circuit current rating of integrated unit.
    - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs





- f. in combination controllers by an NRTL acceptable to NYC Dept of Buildings  
Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

- 2. Wiring Diagrams: For power, signal, and control wiring.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in DDC General Conditions Section "Operation and Maintenance Data," include the following:
  - 1. Routine maintenance requirements for enclosed controllers and installed components.
  - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
  - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.
- E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- F. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

#### 1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load



without derating, under the following conditions unless otherwise indicated

1. Ambient Temperature: Not less than minus 22 deg F. and not exceeding 104 deg F.
2. Ambient Storage Temperature: Not less than minus 4 deg F. and not exceeding 140 deg F.
3. Humidity: Less than 95 percent (non-condensing).
4. Altitude: Not exceeding 6000 feet.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for controllers, including clearances between controllers and adjacent surfaces and other items.

#### 1.12 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

#### 1.13 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

### PART 2 - PRODUCTS

#### 2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.



- b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
    - f. Or approved equal.
  - 2. Configuration: Nonreversing.
  - 3. Surface mounting.
  - 4. Red Green pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
    - f. Or approved equal.
  - 2. Configuration: Nonreversing.
  - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button bimetallic type.
  - 4. Surface mounting.
  - 5. Red Green pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
    - f. Or approved equal.
  - 2. Configuration: Nonreversing.
  - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button bimetallic type.
  - 4. Surface mounting.
  - 5. Red Green pilot light.
  - 6. N.O./N.C. auxiliary contact.
- E. Magnetic Controllers: Full voltage, across the line, electrically held.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - c. Rockwell Automation, Inc.; Allen-Bradley brand.
  - d. Siemens Energy & Automation, Inc.
  - e. Square D; a brand of Schneider Electric.
  - f. Or approved equal.
2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type.
  - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 50.
6. Melting Alloy Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 10 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
7. Bimetallic Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 10 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
8. Solid-State Overload Relay:
  - a. Switch or dial selectable for motor running overload protection.
  - b. Sensors in each phase.
  - c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
  - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
  - e. Analog communication module.
9. N.C. / N.O., isolated overload alarm contact.
10. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller,



OCPD, and disconnecting means.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - c. Rockwell Automation, Inc.; Allen-Bradley brand.
  - d. Siemens Energy & Automation, Inc.
  - e. Square D; a brand of Schneider Electric.
  - f. Or approved equal.
2. Fusible Disconnecting Means:
  - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
3. Nonfusible Disconnecting Means:
  - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
4. MCP Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
  - d. N.C. /N.O. alarm contact that operates only when MCP has tripped.
  - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
5. MCCB Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
  - e. N.C./N.O. alarm contact that operates only when MCCB has tripped.

## 2.2 ENCLOSURES



- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Other Wet or Damp Indoor Locations: Type 4.
  - 4. Hazardous Areas Indicated on Drawings: Type 7, Type 9.

## 2.3 ENCLOSURES

- A. Unless otherwise specified herein, NEMA 250, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Conditioned Locations: NEMA 250 Type 1.
  - 2. Outdoor Locations: Type 4X, with space heater and air-cooled cooling unit to maintain temperature within housing as required for proper operation for outdoor temperatures within the range of ASHRAE 99.6 percent winter design temperature and ASHRAE 0.4 percent summer design temperature for the area, plus solar load. Single point electrical connection for controller and enclosure.
  - 3. Other Wet or Damp Indoor Locations: Type 4.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
  - 5. Fan Rooms and Refrigeration Rooms: Type 3R
  - 6. Hazardous Areas Indicated on Drawings: Type 7.
- B. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors.
- C. Rain shields installed on fronts, sides and tops of enclosures installed outdoors. Rain shields shall extend a minimum of 30" around enclosure. Provide walk-on platform to eliminate standing water.

## 2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil tight type.
    - a. Pilot Lights: LED types; colors as indicated; push to test.
    - b. Selector Switches: Rotary type.
- B. N.C., N.O., Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 7, Type 9 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

- G. Cover gaskets for Type 1 enclosures.
- H. Terminals for connecting power factor correction capacitors to the load side of overload relays.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Division 03.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven



equipment.

- I. Install power factor correction capacitors. Connect to the line side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.
- J. Comply with NECA 1.

### 3.4 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and BMS system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:





1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Commissioner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cool down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Commissioner before increasing settings.
- D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.



- E. Set field-adjustable circuit-breaker trip ranges, as specified in Division 26 Section.

**3.8 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

**3.9 DEMONSTRATION**

- A. Engage a factory-authorized service representative to instruct the City of New York's service staff to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

**END OF SECTION 23 05 15**



## **SECTION 23 05 16**

### **EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- A. Section 23 05 00 "Common Requirements for HVAC Work".
- B. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- C. Section 23 05 93 "Testing, Adjusting and Balancing".
- D. Section 23 09 00 "HVAC Instrumentation and Controls".
- B. This section is a part of each Division 23 00 00 section.

##### **1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.4 SUMMARY

- A. All piping shall be installed in such a manner as to allow for expansion and contraction by means of offsets or pipe loops without causing undue stress in piping or at connections to equipment
- B. Pipe loops and swing connections.
- C. Alignment guides and anchors.

#### 1.5 PERFORMANCE REQUIREMENTS:

- A. It shall be understood that the requirements of this section are complementary to requirements delineated elsewhere for the support, fastening and restraining of equipment and piping work. Nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this section.
- B. Engineering Services:
  - 1. As part of this scope of work, the HVAC contractor shall engage the services of a licensed professional engineer with experience in the field of piping supports and anchoring and thermal expansion.
  - 2. The contractor's Engineer shall calculate the requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections. He shall select and coordinate the expansion joints, loops, swing connections, anchors, guides and supports based on the final coordinated drawings showing exact location of piping and equipment and shall coordinate requirements with the structural engineer.
  - 3. He shall submit signed and sealed details and calculations as required to demonstrate compliance and obtain approval from the Commissioner.
- C. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- D. Capability: Products to absorb 200 percent of maximum axial movement between anchors.
- E. Where pipe offsets or loops are not detailed or dimensioned on drawings, the contractor is to submit calculations, prepared by a licensed professional engineer, to show that the stress range of the pipe does not exceed 15000 psi. In addition, Contractor shall submit anchoring loads.
  - 1. Where the system is detailed on the documents and the contractor proposes an alternate system or design, the contractor shall submit calculations (sealed and signed by a licensed Professional Engineer licensed in the State of New York) for review.
- F. All expansion compensators shall have a metal nameplate permanently attached bearing inscription of size, type, pressing rating, allowable movement, year of fabrication and manufacturers identification number.
- G. Contractor, in conjunction with information provided by the the expansion joint manufacturer is to submit anchor load calculations for both operating and hydrostatic test conditions.

#### 1.6 SUBMITTALS



- A. Refer to DDC General Conditions 01 33 00 "Submittal Procedures"
- B. Product Data: For each type of product indicated.
- C. Engineering Services Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York, responsible for their preparation, to be submitted to Commissioner for review and approval.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
  - 5. Welding certificates.

## 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Welding Qualifications: Qualify procedures according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adscos Manufacturing LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Flex-Hose Co., Inc.
    - d. Flexicraft Industries.
    - e. Flex-Weld, Inc.
    - f. Hyspan Precision Products, Inc.
    - g. Metraflex, Inc.
    - h. Senior Flexonics Pathway.
    - i. Unisource Manufacturing, Inc.
    - j. U.S. Bellows, Inc.
    - k. Or approved equal
  - 2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. Anchor Materials:
  - 1. Steel Shapes and Plates: ASTM A 36/A 36M.



2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

### 3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."



2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
1. Anchor Attachment to Steel Structural Members: Attach by welding.
  2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION 23 05 16**



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## **SECTION 23 05 19**

### **METERS AND GAGES FOR HVAC PIPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 23 "Valves for HVAC".
- D. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- E. Section 23 05 93 "Testing, Adjusting and Balancing".
- F. Section 23 07 00 "HVAC Insulation".
- G. Section 23 21 13 "HVAC Piping".
- H. This section is itself related to each Division 23 section.

##### **1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.3 LEED BUILDING SUBMITTALS:**

- 1. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.



- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.4 SUMMARY

- A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.
11. Orifice flow meters.
12. Pitot-tube flow meters.
13. Turbine flow meters.
14. Venturi flow meters.
15. Vortex-shedding flow meters.
16. Impeller-turbine, thermal-energy meters.
17. Ultrasonic, thermal-energy meters.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Product Data: For each type of product indicated.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Product Certificates: For each type of meter and gage, from manufacturer.
- E. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

### PART 2 - PRODUCTS

#### 2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ashcroft Inc.
  2. Ernst Flow Industries.
  3. Marsh Bellofram.
  4. Miljoco Corporation.
  5. Nanmac Corporation.
  6. Palmer Wahl Instrumentation Group.



7. REOTEMP Instrument Corporation.
8. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
9. Weiss Instruments, Inc.
10. Or approved equal.

- B. Standard: ASME B40.200.
- C. Case: Sealed type(s); stainless steel with 3" nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.
- E. Connector Type(s): Union joint, adjustable angle with unified-inch screw threads.
- F. Connector Size: 1/2 inch with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

## 2.2 FILLED-SYSTEM THERMOMETERS

### A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ashcroft Inc.
  - b. Marsh Bellofram.
  - c. Miljoco Corporation.
  - d. Palmer Wahl Instrumentation Group.
  - e. REOTEMP Instrument Corporation.
  - f. Terice, H. O. Co.
  - g. Weiss Instruments, Inc.
  - h. Or approved equal.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum; 5-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: plastic.
9. Ring: Stainless steel.



10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

**B. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Marsh Bellofram.
  - d. Miljoco Corporation.
  - e. Palmer Wahl Instrumentation Group.
  - f. REOTEMP Instrument Corporation.
  - g. Terice, H. O. Co.
  - h. Weiss Instruments, Inc.
  - i. WIKA Instrument Corporation - USA.
  - j. Or approved equal.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum; 4-1/2-inch nominal diameter with flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: plastic.
9. Ring: Stainless steel.
10. Connector Type(s): Union joint, with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

**2.3 LIQUID-IN-GLASS THERMOMETERS**

**A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:**

1. Manufacturer: Terice, H. O. Co.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.



6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

**B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flo Fab Inc.
  - b. Miljoco Corporation.
  - c. Palmer Wahl Instrumentation Group.
  - d. Tel-Tru Manufacturing Company.
  - e. Terice, H. O. Co.
  - f. Weiss Instruments, Inc.
  - g. Winters Instruments - U.S.
  - h. Or approved equal.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum, and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

**2.4 LIGHT-ACTIVATED THERMOMETERS**

**A. Direct-Mounted, Light-Activated Thermometers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flo Fab Inc.
  - b. REOTEMP Instrument Corporation.
  - c. Terice, H. O. Co.
  - d. Weiss Instruments, Inc.
  - e. WIKA Instrument Corporation - USA.



- f. Winters Instruments - U.S.
  - g. Or approved equal.
- 2. Case: Metal; 7-inch nominal size unless otherwise indicated.
- 3. Scale(s): Deg F and deg C.
- 4. Case Form: Adjustable angle.
- 5. Connector: 1-1/4 inches with ASME B1.1 screw threads.
- 6. Stem: Aluminum and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
- 7. Display: Digital.
- 8. Accuracy: Plus or minus 2 deg F.

**B. Remote-Mounted, Light-Activated Thermometers:**

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Miljoco Corporation.
  - b. Weiss Instruments, Inc.
  - c. Winters Instruments - U.S.
  - d. Or approved equal.
- 2. Case: Metal, for wall mounting.
- 3. Scale(s): Deg F and deg C.
- 4. Sensor: Bulb and thermister wire.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
- 5. Display: Digital.
- 6. Accuracy: Plus or minus 2 deg F.

**2.5 DUCT-THERMOMETER MOUNTING BRACKETS**

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

**2.6 THERMOWELLS**

- A. Thermowells:
  - 1. Standard: ASME B40.200.
  - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  - 3. Material for Use with Copper Tubing: CNR.
  - 4. Material for Use with Steel Piping: CRES.
  - 5. Type: Stepped shank unless straight or tapered shank is indicated.
  - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1 ASME B1.20.1 pipe threads.
  - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  - 8. Bore: Diameter required to match thermometer bulb or stem.
  - 9. Insertion Length: Length required to match thermometer bulb or stem.
  - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.



11. Bushings: For converting size of thermowells internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.7 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Flo Fab Inc.
  - d. Miljoco Corporation.
  - e. Palmer Wahl Instrumentation Group.
  - f. REOTEMP Instrument Corporation.
  - g. Terice, H. O. Co.
  - h. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - i. Weiss Instruments, Inc.
  - j. Or approved equal.
2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed type(s); cast aluminum; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Flo Fab Inc.
  - d. Miljoco Corporation.
  - e. Noshok.
  - f. Palmer Wahl Instrumentation Group.
  - g. REOTEMP Instrument Corporation.
  - h. Tel-Tru Manufacturing Company.
  - i. Terice, H. O. Co.
  - j. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - k. Weiss Instruments, Inc.
  - l. Or approved equal.
2. Standard: ASME B40.100.



3. Case: Sealed type; cast aluminum 4-1/2-inch nominal diameter with flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.8 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with ASME B1.20.1 pipe threads and surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of stainless-steel pipe with pipe threads.
- C. Valves: Brass or stainless-steel needle with ASME B1.20.1 pipe threads.

## 2.9 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flow Design, Inc.
  2. Miljoco Corporation.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Company, Inc.
  6. Trerice, H. O. Co.
  7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  8. Weiss Instruments, Inc.
  9. Or approved equal.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread: ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: self-sealing rubber.

## 2.10 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flow Design, Inc.
  2. Miljoco Corporation.





3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.
9. Or approved equal.

- B. Furnish two (2) test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch, 0 to 200 psig
- F. Carrying Case: Metal or plastic, with formed instrument padding.

#### 2.11 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Archon Industries, Inc.
  2. Dwyer Instruments, Inc.
  3. Emerson Process Management; Brooks Instrument.
  4. Ernst Co., John C., Inc.
  5. Ernst Flow Industries.
  6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
  7. OPW Engineered Systems; a Dover company.
  8. Penberthy: A Brand of Tyco Valves & Controls - Prophetstown.
  9. Or approved equal.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 150 psig.
- E. Minimum Temperature Rating: 200 deg F.
- F. End Connections for 2" and Smaller: Threaded.
- G. End Connections for 2-1/2" and Larger: Flanged.

#### 2.12 FLOWMETERS

- A. Turbine Flow meters:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - a. ABB; Instrumentation and Analytical.
  - b. Data Industrial Corp.
  - c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
  - d. ERDCO Engineering Corp.
  - e. Hoffer Flow Controls, Inc.
  - f. Liquid Controls; a unit of IDEX Corporation.
  - g. McCrometer, Inc.
  - h. Midwest Instruments & Controls Corp.
  - i. ONICON Incorporated.
  - j. SeaMetrics, Inc.
  - k. Sponsler, Inc.; a unit of IDEX Corporation.
  - l. Or approved equal.
2. Description: Flow meter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
  - a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale.
  - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
  - c. Minimum Pressure Rating: 150 psig.
  - d. Minimum Temperature Rating: 180 deg F.
5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 1-1/2 percent.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flow meter.

**B. Venturi Flow meters:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - a. ABB; Instrumentation and Analytical.
  - b. Gerand Engineering Co.
  - c. Hyspan Precision Products, Inc.
  - d. Preso Meters; a division of Racine Federated Inc.
  - e. S. A. Armstrong Limited; Armstrong Pumps Inc.
  - f. Or approved equal.
2. Description: Flow meter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
  - a. Design: Differential-pressure-type measurement
  - b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
  - c. Minimum Pressure Rating: 250 psig.



- d. Minimum Temperature Rating: 250 deg F.
  - e. End Connections for 2" and Smaller: Threaded.
  - f. End Connections for 2-1/2" and Larger: Flanged or welded.
  - g. Flow Range: Flow-measuring element and flow meter shall cover operating range of equipment or system served.
5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flow meter element, and having 6-inch diameter, or equivalent, dial with fittings and copper tubing for connecting to flow meter element.
- a. Scale: Gallons per minute.
  - b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flow meter element and having two 12-foot hoses, with carrying case.
- a. Scale: Gallons per minute.
  - b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Conversion Chart: Flow rate data compatible with sensor.
9. Operating Instructions: Include complete instructions with each flow meter.
- C. Vortex-Shedding Flow meters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Eastech Flow Controls.
  - b. EMCO Flow Systems; a division of Spirax Sarco, Inc.
  - c. Emerson Process Management; Rosemount.
  - d. Endress+Hauser.
  - e. ISTECH Corporation.
  - f. Or approved equal.
2. Description: Flow meter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.
- a. Design: Flow obstruction device, vortex-measurement type.
  - b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
  - c. Minimum Pressure Rating: 1000 psig.
  - d. Minimum Temperature Rating: 500 deg F.
  - e. Integral Transformer: For low-voltage power operation.
5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flow meter.

## 2.13 THERMAL-ENERGY METERS



**A. Impeller-Turbine, Thermal-Energy Meters:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Data Industrial Corp.
  - b. Hoffer Flow Controls, Inc.
  - c. ISTECH Corporation.
  - d. ONICON Incorporated.
  - e. Or approved equal.
2. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
3. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.
  - a. Design: Total thermal-energy measurement.
  - b. Minimum Pressure Rating: 150 psig.
  - c. Minimum Temperature Range: 40 to 250 deg F.
4. Temperature Sensors: Insertion-type transducer.
5. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.
  - a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or BTUs.
  - b. Battery Pack: Five-year lithium battery.
6. Accuracy: Plus or minus 1 percent.
7. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or BTUs.
8. Strainer: Full size of main line piping.
9. Operating Instructions: Include complete instructions with each thermal-energy meter system.

**B. Ultrasonic, Thermal-Energy Meters:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. EMCO Flow Systems; a division of Spirax Sarco, Inc.
  - b. Siemens Energy & Automation, Inc.
  - c. Flexim
  - d. Panametrics
  - e. Or approved equal.
2. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
3. Flow Sensor: Transit-time ultrasonic type with transmitter.
4. Temperature Sensors: Insertion-type or strap-on transducer.
5. Indicator: Solid-state, integrating-type meter with integral battery pack.
  - a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or BTUs.
  - b. Battery Pack: Five-year lithium battery.



6. Accuracy: Plus or minus 1 percent.
7. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or BTUs.
8. Operating Instructions: Include complete instructions with each thermal-energy meter system.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install remote-mounted pressure gages on panel.
- J. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- K. Install valve and syphon fitting in piping for each pressure gage for steam.
- L. Install test plugs in piping tees.
- M. Install flow indicators in piping systems in accessible positions for easy viewing.
- N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flow meters according to manufacturer's written instructions.
- O. Install flow meter elements in accessible positions in piping systems.
- P. Install wafer-orifice flow meter elements between pipe flanges.
- Q. Install differential-pressure-type flow meter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

- R. Install permanent indicators on walls or brackets in accessible and readable positions.
- S. Install connection fittings in accessible locations for attachment to portable indicators.
- T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- U. Install thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler.
  - 3. Two inlets and two outlets of each chiller.
  - 4. Inlet and outlet of each hydronic coil in air-handling units.
  - 5. Two inlets and two outlets of each hydronic heat exchanger.
  - 6. Inlet and outlet of each thermal-storage tank.
  - 7. Outside-, return-, supply-, and mixed-air ducts.
- V. Install pressure gages in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
  - 3. Suction and discharge of each pump.

### 3.3 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- B. Connect flow meter-system elements to meters.
- C. Connect flow meter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

### 3.4 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

### 3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 150 deg F.
- B. Scale Range for Condenser-Water Piping: 20 to 140 deg F
- C. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.
- D. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F.
- E. Scale Range for Air Ducts: 20 to 160 deg F.

### 3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each pressure-reducing valve shall be Sealed, Solid-front,



pressure-relief direct-mounted, metal case.

- B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be the following:

- 1. Sealed, Solid-front, pressure-relief direct-mounted, metal case.

- C. Pressure gages at suction and discharge of each pump shall be the following:

- 1. Sealed, Solid-front, pressure-relief direct-mounted, metal case.

### 3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 300 psi.
- B. Scale Range for Condenser-Water Piping: 0 to 300 psi.
- C. Scale Range for Heating, Hot-Water Piping: 0 to 300 psi.
- D. Scale Range for Steam Piping: 0 to 350 psi.

### 3.8 FLOWMETER SCHEDULE

- A. Flow meters are specified under another section of this work.

### 3.9 THERMAL-ENERGY METER SCHEDULE

- A. Thermal-Energy Meters are specified under another section of this work.

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**SECTION 23 05 23**

**VALVES FOR HVAC PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".
- F. Section 23 21 13 "HVAC Piping".
- G. Section 23 22 13 "Steam and Condensate Heating Piping".
- H. This section is a part of each Division 23 00 00 section.

**1.02 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.03 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



#### 1.4 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. High-performance butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.
5. Bronze gate valves.
6. Iron gate valves.
7. Bronze globe valves.
8. Iron globe valves.
9. Stop Check Valve
10. Bronze, calibrated – orifice, balancing valve
11. Diaphragm operated, Pressure Reducing valves
12. Diaphragm operated Safety valves
13. Automatic Flow Control valve

B. Triple-Duty valves are not permitted.

#### 1.5 DEFINITIONS

- A. Branch Piping – Any piping from either main distribution piping that serves more than one piece of hydronic equipment or piping from main distribution piping to vertical risers.
- B. CWP: Cold working pressure.
- C. EPDM: Ethylene propylene copolymer rubber.
- D. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- E. NRS: Non-rising stem.
- F. OS&Y: Outside screw and yoke.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. WOG: Water, oil, gas pressure

#### 1.06 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating and trim materials; valve design; pressure and temperature classifications; end connections; arrangements; dimensions and required clearances.
- B. Include list indicting every valve and its application. Include rated capacities, shipping, installed and operating weights; furnished specialties and accessories.



**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- C. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- D. ANSI Compliance:
  - 1. ANSI B16.5 Steel pipe flanges and flange fittings
  - 2. ANSI B16.4 Cast iron fittings
  - 3. ANSI B16-3 Malleable iron fittings
  - 4. ANSI B16-9, ASTM A-234 Weld end fittings
  - 5. ANSI B16.11 Socket weld fittings
  - 6. ASTM B-32, ANSI B16.22 Copper fittings
  - 7. ASTM-A105; ANSI B16.5 Welded flanges, B16.18 Cast copper.
  - 8. ANSI B16.1 Cast iron threaded flanges.
  - 9. ASTM A197 Malleable iron threaded flanges
  - 10. ASME B16.39 Malleable iron unions
- E. MSS Compliance
  - 1. MSS-SP-25 Standard marking systems for valves
  - 2. MSS-SP-55 Quality standard for steel casting
  - 3. MSS-SP-61 Pressure Testing of Steel Valves
  - 4. MSS-SP-67 Butterfly Valves
  - 5. MSS-SP-68 High Pressure Offset Disc Butterfly Valves.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

**PART 2 - PRODUCTS****2.1 HVAC PIPING SYSTEMS PERFORMANCE REQUIREMENTS**

- A. System Pressure and Temperature Ratings shall be as specified in Section 23 05 00 – “Common Requirements for HVAC Work” for the HVAC Piping systems minimum working operating system pressures and temperatures.
- B. Regardless of system pressure rating, valves shall not be designed for less than 150 psi SWP.

**2.2 GENERAL REQUIREMENTS FOR VALVES**

- A. Furnish and install valves shown on the drawings, specified herein and/or as required for the control and maintenance of all piping and equipment.
- B. All valves shall be of first quality of approved manufacture, shall have proper clearances, and shall be tight at the specified test pressure.
- C. Each valve shall have the manufacturer's name or brand, the figure or list number and guaranteed ANSI working pressure cast on the body and cast or stamped on the bonnet.
- D. Refer to HVAC valve schedule (Part 3) for applications of valves.
- E. Triple Duty Valves are not permitted.
- F. Valve Packing and Gasket shall be Asbestos free.
- G. It is the intention to use ball and butterfly valves for shut-off wherever possible.
- H. Gate valves shall be used for steam systems where ball and butterfly valves may not be practical by pressure/temperature or NYC Dept of Buildings.
- I. Valve Sizes: Same as upstream piping unless otherwise indicated.
- J. All valves shall be designed to ANSI B16.5 and B16.34
- K. All gate and globe valves shall be suitable for repacking under system pressure.
- L. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- M. Memory stops, which shall be fully adjustable after insulation is applied, shall be provided for all HVAC valves.
- N. All valves are to be able to take full pressure differential pressure when dead-ended in either direction.
- O. All valves to be functionally tested. To include cycling of valves and topworks, measuring seating torque and verifying leaktight performance of seat.
- P. All valves shall be capable of thermal cycling over its complete pressure vessel rating.
- Q. Valves used for balancing shall be certified suitable for continuous throttling service at a position 35% open.



- R. The shaft packing must be capable of sealing at 1.5 times the pressure vessel rating. Valve stem packing shall be fully accessible for adjustment without removal of operator.
- S. Valves shall be designed to convert from handle operation to automated valve operation without removing the valve from the pipeline.
- T. There must be external indication of disc position on all valves.
- U. Seats shall be fully replaceable in the field.
- V. Valve Actuator Types:
  - 1. Gear Actuator: For valves 6" and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: Seven-position levers for valves 6" and smaller except plug valves.
  - 4. Wrench: For plug valves with square heads. Furnish The City of New York with 1 wrench for every 5 plug valves, for each size square plug-valve head.
  - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; for all valves 3" or larger (all valves sizes for steam over 15 psig) in equipment areas which is more than 7'-0" above finished floor shall be provided with operating chains, sprockets, and guides.. Extend chains to 60 inches above finished floor.
- W. Valves in Insulated Piping: With 2-1/4" stem extensions and the following features:
  - 1. Gate Valves: With rising stem.
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- X. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Threaded: With threads according to ASME B1.20.1.
- Y. Valve Bypass and Drain Connections: MSS SP-45.
- Z. If manually operated, the valve must have a positively retained shaft in case there is a failure of the shaft to disc attachment.
- AA. Self-lubricated bearings should be used. There will be a method of retention to prevent bearing movement.
- BB. No loose parts should be used to attach the shaft to the disc. Two or more pins should be used for complete attachment.
- CC. A double offset shaft should be used to reduce seating torque.
- DD. Valves body material shall be carbon steel. Stainless steel for ball and stem. Shafts shall be 17-4 PH stainless steel. Discs shall be 316 stainless steel. Stem seals shall be TFE. Seats shall be self-energizing TFE or self-energizing TFE totally encapsulating as elastomeric "O" ring. Metal springs or components shall not be used to and in seat sealing



## 2.3 BRONZE BALL VALVES

### A. General

1. All ball valves shall have the following options:
  - a. Balancing stop for hydronic installations.
  - b. 2 1/4" stem extensions all piping systems.
  - c. Stainless steel ball and stem, and multi-filled TFE seats for steam, condensate and high temperature hot water systems.

### B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apollo Valves.
2. Milwaukee Valve Company.
3. NIBCO INC.
4. Or approved equal.

### C. Class 150 - two-piece, full-port, bronze ball valves with bronze trim:

1. Description:
  - a. Standard: MSS SP-80
  - b. SWP Rating: 300 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded or Socket Welded
  - g. Seats: PTFE or TFE. Multi-filled PTFE-C seats for steam, condensate and high temperature water
  - h. Stem: Stainless Steel
  - i. Ball: Stainless Steel.
  - j. Port: Full.
  - k. Locking handles to allow for servicing and equipment removal.
  - l. Stem Extension: 2-1/4"

## 2.4 HIGH PERFORMANCE BUTTERFLY VALVES

### A. General

1. Butterfly valves shall be industrial grade, high performance, lug type, ANSI Class 150.
2. Valves shall be bi-directional dead end service at full ANSI ratings. Valve shall hold full pressure with either flanged connections removed – in either direction.
3. Manufacturer shall certify compliance with bubble tight shutoff requirements at full rated design pressure when flanged
4. The face-to-face dimensions must meet AP Spec I 609 MSS SP 67.
5. Butterfly valves shall have gear operator 6" diameter and larger for ANSI 150 valves;. Valves smaller shall have multi-position latching handle.

### B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bray Controls; a division of Bray International.



2. Jamesbury; a subsidiary of Metso Automation.
3. Milwaukee Valve Company.
4. NIBCO INC.
5. Or approved equal.

C. Class 150, high-performance butterfly valves:

1. Description:
  - a. Standard: MSS SP-68.
  - b. CWP Rating: 285 psig at 100 deg F.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at full rated pressure without use of downstream flange.
  - d. Body Material: Carbon steel.
  - e. Seat: Reinforced PTFE.
  - f. Stem: Stainless steel; offset from seat plane, blow-out proof
  - g. Disc: Stainless Steel
  - h. Service: Bidirectional, bubble-tight shut-off
  - i. Internal Travel Stop

2.5 BRONZE GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milwaukee Valve Company.
2. NIBCO INC.
3. Jamesbury; a subsidiary of Metso Automation.
4. Or approved equal.

B. Class 125, RS Bronze Gate Valves:

1. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
  - d. Ends: Threaded.
  - e. Seat: R-PTFE
  - f. Stem: Bronze.
  - g. Disc: Solid wedge; bronze.
  - h. Packing: Asbestos free.
  - i. Handwheel: Malleable iron, bronze.

2.6 IRON GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milwaukee Valve Company.

B. Class 125, NRS, Iron Gate Valves:

1. Description:



- a. Standard: MSS SP-70, Type I.
- b. 2-1/2" to 12", CWP Rating: 200 psig.
- c. 14" to 24", CWP Rating: 150 psig.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Seat: R-PTFE
- i. Packing and Gasket: Asbestos free.

C. Class 125, OS&Y, Iron Gate Valves:

1. Description:

- a. Standard: MSS SP-70, Type I.
- b. 2-1/2" to 12", CWP Rating: 200 psig.
- c. 14" to 24", CWP Rating: 150 psig.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Seat: R-PTFE
- i. Packing and Gasket: Asbestos free.

2.7 BRONZE GLOBE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Milwaukee Valve Company.
- 2. NIBCO INC.
- 3. Jamesbury; a subsidiary of Metso Automation.
- 4. Or approved equal.

B. Class 125, Bronze Globe Valves with Bronze Disc:

1. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Seat: R-PTFE
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

C. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.





- e. Stem: Bronze.
- f. Disc: PTFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

**2.8 STOP-CHECK VALVES – CLASS 150:**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Crane Co.
- 2. Jenkins Valves; a Crane Company.
- 3. Jamesbury; a subsidiary of Metso Automation.
- 4. Or approved equal.

- B. Description

- 1. Body and Bonnet: Malleable iron.
- 2. End Connections: Flanged.
- 3. Disc: Cylindrical with removable liner and machined seat.
- 4. Stem: Brass alloy.
- 5. Operator: Outside screw and yoke with cast-iron handwheel.
- 6. Packing: Polytetrafluoroethylene-impregnated packing with two-piece packing gland assembly.
- 7. Pressure Class: 150.

**2.9 BRONZE, CALIBRATED-ORIFICE, BALANCING VALVES: CLASS 150:**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Armstrong Pumps, Inc.
- 2. Bell & Gossett Domestic Pump; a division of ITT Industries.
- 3. Flow Design Inc.
- 4. Griswold Controls.
- 5. Taco.
- 6. Or approved equal.

- B. Description:

- 1. Body: Bronze, ball type.
- 2. Ball: Brass or stainless steel.
- 3. Plug: Resin.
- 4. Seat: Reinforced Teflon
- 5. Stem: Blow out proof.
- 6. End Connections: Threaded or socket.
- 7. Flow element: Low loss/high signal Venturi type (+/- % accuracy), 1 to 10 rangeability.
- 8. Pressure Gage Connections: Dual Pete's plug test ports, Integral seals for portable differential pressure meter.
- 9. Handle Style: Full size lever, with memory stop to retain set position.
- 10. Entire assembly shall be rated to working pressures of system, as defined under another section of this work. In no case shall the rating be less than:
  - a. CWP Rating: Minimum 150 psig.
  - b. Maximum Operating Temperature: 250 deg F.



**2.10 DIAPHRAGM-OPERATED, PRESSURE-REDUCING VALVES:**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amtrol, Inc.
  - 2. Armstrong Pumps, Inc.
  - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
  - 4. Or approved equal.
- B. Description:
  - 1. Body: Bronze or brass.
  - 2. Disc: Glass and carbon-filled PTFE.
  - 3. Seat: Brass.
  - 4. Stem Seals: EPDM O-rings.
  - 5. Diaphragm: EPT.
  - 6. Low inlet-pressure check valve.
  - 7. Inlet Strainer: removable without system shutdown.
  - 8. Valve Seat and Stem: Noncorrosive.
  - 9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

**2.11 DIAPHRAGM-OPERATED SAFETY VALVES:**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amtrol, Inc.
  - 2. Armstrong Pumps, Inc.
  - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
  - 4. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 5. Or approved equal.
- B. Description:
  - 1. Body: Bronze or brass.
  - 2. Disc: Glass and carbon-filled PTFE.
  - 3. Seat: Brass.
  - 4. Stem Seals: EPDM O-rings.
  - 5. Diaphragm: EPT.
  - 6. Wetted, Internal Work Parts: Brass and rubber.
  - 7. Inlet Strainer: removable without system shutdown.
  - 8. Valve Seat and Stem: Noncorrosive.
  - 9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

**2.12 AUTOMATIC, PRESSURE-INDEPENDENT, FLOW/PRESSURE CONTROL VALVES:**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Belimo PICCV
  - 2. Siemens PICV



3. Flow Control Industries
  4. Or approved equal
- B. All modulating control valves shall be provided by the same manufacturer.
- C. All control valves shall be industrial quality and must be fully re-buildable.
- D. Balancing valves shall not be used. The control valve must have the ability to limit flow to the maximum design flow for each coil at all valve differential pressure ranges of 5 to 70 PSID.
- E. Each control valve shall be individually flow tested and factory verified to deviate no more than +/-5% through the entire operating pressure range of 5 to 70. All valves shall be tested on a test stand calibrated and verified with traceability to NIST standards.
- F. Manufacturer shall test each valve at an approved third party testing facility with test equipment calibrated and verified with traceability to NIST standards. Testing to verify flow deviates no more than +/-5% when tested at 10 degree increments between 0 and 90 degrees and 5 PSID increments between 5 and 70 PSID. Test reports must be provided with O & M Manual.
- G. In addition to testing, each control valve shall have a calibrated performance tag listing the measured flow rate in 10° rotation increments.
- H. Valves shall require no more than 5 PSID to operate at the flow rates indicated on the flow tag.
- I. Control valve range ability shall be a minimum of 100: 1 through the operating pressure range, at 5 to 70, PSID
- J. Valve bodies 2" and smaller shall be brass. Valve bodies 3" thru 8" shall be ductile iron. All internal parts shall be brass, carbon steel or Teflon except that the Ball and stem shall be stainless steel. Plastic internal parts are not acceptable.
- K. Valve flow characteristics may be modified in valves 8" and smaller without removal from the piping system. All seals may be replaced in valves 3" and smaller without removal from the piping system.
- L. Valve differential pressure rating shall be equal to or greater than the associated pump's design head pressure. Valve assembly and actuator torque shall be selected to close off against this differential pressure.
- M. All valves shall have three (3) factory installed pressure/temperature ports to allow factory and field verification of flow and proper operation.
- N. Description:
1. Body: Brass
  2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
  3. Combination Assemblies: Include bronze or brass-alloy ball valve.
  4. Identification Tag: Marked with zone identification, valve number, and flow rate.
  5. Size: Same as pipe in which installed.
  6. Performance: Each control valve shall be individually flow tested and factory verified to deviate no more than  $\pm 5\%$  through the entire operating pressure range.
  7. Minimum CWP Rating: 150 psig.
  8. Maximum Operating Temperature: 250 deg F.



- O. All valves shall be warranted by the manufacturer for no less than a full 5 years from the date of substantial completion. The warranty provided by the actuator manufacturer shall apply to actuators.
- P. The control valve manufacturer shall provide written guarantee that the heating and cooling coils will meet or exceed design delta T performance at all load conditions as projected by an ARI certified coil program at time of commissioning. The valve manufacturer will replace the valve if this performance level cannot be met.

### **PART 3 - EXECUTION**

#### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

#### **3.2 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

#### **3.3 VALVE INSTALLATION**

- A. Piping installation requirements are specified under another section of this work.
- B. Drawings indicate general arrangements of piping, fittings and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install chainwheel for all valves 3" and larger (and all valve sizes for steam over 15 psig) in equipment areas which is more than 6' – 0" above the finished floor. Provide operating chains, sprockets and guides. Extend chain to 60 inches above finished floor.
- G. Install valves in position to allow full stem movement.



H. Install check valves for proper direction of flow and as follows:

1. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
2. Lift Check Valves: With stem upright and plumb.

### 3.4 VALVE APPLICATIONS

- A. On all branch piping, provide an isolation valve on supply line and shut-off valve on return line.
- B. Chilled water piping connections to air conditioning units, fan coil units, etc. shall include all necessary gate valves, air vent valves, drain connections and automatic valves.
- C. Chilled and hot water piping connections to individual chilled beams shall include an isolation valve on the supply lines and combination balancing/shut-off valve on return lines.
- D. Hydronic Equipment (cabinet heaters, unit ventilators, unit heaters, fin tube, water coil, hydronic terminal equipment, etc. – except chilled beams) – Return Line: shut-off valves.
- E. Branch Piping from hydronic main distribution piping- provide an isolation valve on supply and combination balancing and shut-off valve on return line.
- F. All radiators, fin tube, hydronic equipment shall be individually valved on both the supply and return lines.
- G. For hot water systems above 200°F, use valves rated for 300 psi operating pressures.
- H. Open condenser-water valve schedule
  1. 150 Psig Working Pressure
    - a. Pipe 2-1/2" And Smaller:
      - 1) Ball Valves: Two-piece, full port, bronze with stainless-steel trim.
      - 2) Bronze Swing Check Valves: Class 150, bronze with bronze disc.
      - 3) Gate Valves: Not used
      - 4) Globe Valves: Class 150, bronze, metallic disc.
    - b. Pipe 3" and Larger:
      - 1) Iron Valves, 2-1/2" to 4": flanged ends.
      - 2) Iron Ball Valves, 2-1/2" to 10": Class 150.
      - 3) Iron, High Performance Butterfly Valves, Flanged, 2-1/2" to 12": 200 CWP, EPDM seat, stainless-steel disc.
      - 4) Iron, High Performance Butterfly Valves, Flanged, 14" to 24": 150 CWP, EPDM seat, stainless-steel disc.
    - c. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
    - d. Iron Swing Check Valves with Closure Control, 2-1/2" to 12": Class 125, lever.
    - e. Iron, Center-Guided Check Valves, 2-1/2" to 24": Class 125, resilient seat.
    - f. Iron, Plate-Type Check Valves: Class 150
- I. Steam-condensate valve schedule
  1. 150 psig Working Pressure – 600# WOG, ANSI 150#



- a. Pipe 2" and Smaller:
  - 1) Ball Valves: Two piece, full port, bronze with stainless-steel trim.
- b. Pipe 2-1/2" and Larger:
  - 1) High-Performance Butterfly Valves: Class 150, single flange.

**J. VAV Terminal Box Reheat Coils**

- 1. Supply:
  - a. Ball Valves (shut-off).
    - 1) Note that with a PICC control valve, as specified above, no balancing valve is required.
  - b. Y-Type strainer with blow-off valve
- 2. Return:
  - a. Ball Valve (shut-off)
  - b. Automatic, Pressure-Independent Control valve (Automatic throttling/Modulating).

**K. Pumps:**

- 1. Discharge:
  - a. Balancing Valve (Balancing Valve not required for Pumps with VFD or where pressure independent valves are used)
    - 1) 2" and Smaller: Ball valve.
    - 2) 2-1/2" and Larger: Lubricated plug valve.
  - b. Isolation/Shutoff Service:
    - 1) 2-1/2" and below – Ball valves.
    - 2) 3" and above – Butterfly Valves
  - c. Multi-Port Check Valves:
    - 1) 2" and Smaller: Bronze swing check valves with nonmetallic disc.
    - 2) 2-1/2" and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal -seat check valves.
- 2. Suction:
  - a. Y-Type strainer with blow-off valve
  - b. Isolation/Shutoff Service:
    - 1) 2-1/2" and below – Ball valves.
    - 2) 3" and above – Butterfly Valves



- L. If valve applications are not indicated, use the following:
1. Isolation/Shutoff Service:
    - a. 2-1/2" and below – Ball valves.
    - b. 3" and above – Butterfly Valves
  2. Dead-End Service: High Performance Butterfly Valve, Single-flange (lug) type.
  3. Throttling Service, Steam: Globe. Butterfly valves shall not be used for throttling/modulating.
- M. Select valves, except wafer types, with the following end connections:
1. All valves shall be threaded or flanged, sweat valves are not acceptable.
  2. For Copper Tubing, 2" and Smaller: Threaded ends.
  3. For Copper Tubing, 2-1/2" to 4": Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  4. For Copper Tubing, 5" and Larger: Flanged ends.
  5. For Steel Piping, 2" and Smaller: Threaded ends.
  6. For Steel Piping, to 4": Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  7. For Steel Piping, 5" and Larger: Flanged ends.
- N. Isolation/shut-off valves
1. Closed Water Systems – Chilled Water, Hot Water, Dual-Temp Water, etc.
    - a. 150 psig Working Pressure – Class 150
      - 1) Pipe 2-1/2" and Smaller:
        - a) Ball Valves: Two-piece, full port, stainless steel trim.
      - 2) Pipe 3" and Larger:
        - a) High-Performance Butterfly Valves: Class 150 flanged.
  2. Open Water Systems – Condenser Water, etc.
    - a. 150 psig Working Pressure – Class 150
      - 1) Pipe 2" and Smaller:
        - a) Ball Valves: Two-piece, full port, bronze with stainless steel trim.
      - 2) Pipe 2-1/2" and Larger:
        - a) High-Performance Butterfly Valves: Class 150 flanged.
        - b) Resilient seated valves for cooling towers.
    - b. All cooling tower valves shall be motorized.
  3. Low Pressure Steam and Condensate (Up To 14 Psig)



- a. 150 psig Working Pressure – 600 # WOG, ANSI 150 #
  - 1) Pipe 2" and Smaller:
    - a) Ball Valves: Two-piece, full port, stainless steel trim.
  - 2) Pipe 2-1/2" and Larger:
    - a) High-Performance Butterfly Valves: Class 150 flanged.

O. Lubricated Plug Valves at Pump Discharge

CATEGORY	SIZE	RATING	FITTING	NORDSTROM VALVE FIGURE NUMBER	WALWORTH VALVE FIGURE NUMBER
Up to 125 psi Operating pressure	Up to 3"	200# CWP (190# @ 200° F)	Threaded, Wrench Operated	Figure 142	Figure 1796
	3" to 5"	200 # CWP (190# @ 200° F)	Threaded, Wrench Operated	Figure 143	Figure 1797
	6" – 12"	200 # CWP (190# @ 200° F)	Flanged, Worm Gear Operated	Figure 1169	Figure 1707

P. Check valves (other than multi-port check valves)

- 1. Check valves shall be bronze, threaded for sizes 2-1/2" and smaller with regrinding bronze disc. For sizes 3" and larger, check valves shall be iron body with regrind – renew bronze disc and seat ring with bolted cover.

CATEGORY	SIZE	RATING	FITTING	STOCKHAM VALVE FIGURE NUMBER	MILWAUKEE VALVE FIGURE NUMBER
Up to 125 psi Operating pressure	Up to 2-1/2"	CLASS 125	Threaded	Figure B 321	Figure 509
	3" and larger	CLASS 125	Threaded	Figure G-931	Figure F-2974M

Q. Multi-port check valves at pump discharge

- 1. Multi-port check valve shall be semi-steel.
- 2. Multi-port check valves shall be installed at pump discharge, as follows





CATEGORY	SIZE	RATING	MANUFACTURER	MUELLER VALVE FIGURE NUMBER
Up to 125 psi Operating pressure	Up to 3"	125# ANSI (175#@100°F)	Mueller	101 MAP Wafer
	4" and larger"	125# ANSI (200# @ 150°F)	Mueller	105 MAP Globe Type

**3.5 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

**END OF SECTION 23 05 23**



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**SECTION 23 05 33****HEAT TRACING FOR HVAC PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- A. Section 23 05 00 "Common Requirements for HVAC Work".
- B. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- C. Section 23 05 93 "Testing, Adjusting and Balancing".
- D. Section 23 09 00 "HVAC Instrumentation and Controls".
- B. Section 23 21 13 "HVAC Piping".
- C. This section is itself related to each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes heat tracing with the following electric heating cables:
  - 1. Self-regulating, parallel resistance.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
  - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to NYC Dept. of Buildings, and marked for intended use.

**1.8 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
  - 1. Manufacturer Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.



2. Nelson Heat Trace.
  3. Pyrotenax; a division of Tyco Thermal Controls.
  4. Raychem; a division of Tyco Thermal Controls.
  5. Trasor Corp.
  6. Or approved equal.
- B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Stainless-steel braid and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Maximum Operating Temperature: 300 deg F.
- H. Capacities and Characteristics:
1. Maximum Heat Output: 12 W/ft.
  2. Piping Diameter: 2" – 16".
  3. Number of Parallel Cables: 2
  4. Spiral Wrap Pitch: 4 inches
  5. Volts: 120/208 V. Coordinate with electrical trade.
  6. Phase: 3
  7. Hertz: 60
  8. Full-Load Amperes: As Scheduled
  9. Minimum Circuit Ampacity: As Scheduled.

## 2.2 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
- D. Corrosion-resistant, waterproof control enclosure.
- E. Provide end-of-circuit light indicator with installation kit, similar to Terminator Beacon, as manufactured by Thermon.
- F. Provide output signal to BMS indicating operation.



## 2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Section 23 05 53 "Identification for HVAC Piping and Equipment."
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Section 23 07 00 - "HVAC Insulation."
- E. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- F. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Protect installed heating cables, including non-heating leads, from damage.

### 3.4 CONNECTIONS

- A. Ground equipment according to Division 26.
- B. Connect wiring according to Division 26.



**3.5 FIELD QUALITY CONTROL**

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
  - 1. Test cables for electrical continuity and insulation integrity before energizing.
  - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION 23 05 33**



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**SECTION 23 05 48****VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- D. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.

**1.2 SUMMARY**

- A. This section specifies required vibration control and seismic restraints for all equipment. Also included are the wind load requirements for all equipment in outdoor locations.
- B. It is the intent of this section to keep all HVAC building system components in place during a seismic or high wind event and remain fully operational after such an event.
- C. The work in this section includes, but is not limited to the following:
  - 1. Vibration isolation of HVAC piping, ductwork and equipment.
  - 2. Seismic restraints design requirements for equipment (components).
  - 3. Wind design requirements for equipment (components).
  - 4. Seismic restraints for all isolated and non-isolated HVAC equipment.
  - 5. Wind restraints for isolated and non-isolated HVAC piping, ductwork and equipment.
  - 6. Provisions for flood control for all below, at grade or above grade locations located within flood hazard area.
  - 7. Certification of seismic restraint designs and installation supervision.
  - 8. Certification of wind load restraint designs and installation supervision.
  - 9. All equipment, components requiring NYCBD certification.
  - 10. All inspection and test procedures for equipment, components requiring NYCBD certification.
  - 11. Equipment isolation bases
  - 12. Metal pipe hangers and supports.
  - 13. Trapeze pipe hangers
  - 14. Metal framing systems.
  - 15. Thermal-hangers shield inserts.
  - 16. Fastener systems.
  - 17. Pipe stands.
  - 18. Equipment supports.
  - 19. Isolation pads.
  - 20. Isolation mounts.
  - 21. Restrained elastomeric isolation mounts.
  - 22. Freestanding and restrained spring isolators.
  - 23. Housed spring mounts.



24. Elastomeric hangers.
25. Spring hangers.
26. Spring hangers with vertical-limit stops.
27. Pipe riser resilient supports.
28. Resilient pipe guides.
29. Freestanding and restrained air-mounting system.
30. Restrained vibration isolation roof-curb rails.
31. Seismic snubbers.
32. Steel and inertia vibration isolation equipment bases.

- D. All mechanical equipment, pipe and ductwork, within, on or outdoors of the building and entry of services to the building, up to and including, the utility connection, is part of this Specification.
- E. Unless otherwise specified, all equipment, piping and ductwork shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping or ductwork in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the contract documents.
- F. This specification is considered to be minimum requirements for seismic, wind, flood and vibration control considerations.

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### 1.5 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

- A. General Design Requirements.
  1. Seismic Considerations: This project has seismic design requirements as follows:



- a. Seismic Use Group II.
  - b. Seismic Design Category C.
  - c. All Components, with the additional requirement of a manufacturer's Certificate of Compliance to prove 'on line' capability ( $I_p = 1.0$ )
2. Wind Considerations: This project has wind design requirements as follows:
  - a. Wind load in hurricane, tornado and/or wind-borne debris regions (90 plus mph) having a building height greater than 60 feet. Rooftop structures; Section 6.5.15.1 of ASCE 7-05 design requirements apply
3. Refer to Structural Design Load Parameters in Structural contract documents.

#### 1.6 SCOPE OF WORK

- A. The Contractor under this section of the specifications shall provide all required design, labor, materials, tools, equipment and services necessary for the complete and safe control of excessive noise and vibration due to the operation of equipment and/or due to interconnecting piping, ductwork or conduit as well as to provide complete seismic and wind restraint systems for all isolated and non-isolated equipment as indicated herein or which may be reasonably implied as essential, whether mentioned in the Drawings and Specifications or not.
- B. Design seismic restraints and wind restraints for the HVAC systems and components including preparing comprehensive engineering analysis (signed and sealed) by a qualified professional engineer, commissioned by contractor, using performance requirements and design criteria defined herein and under another section of the work.
- C. It shall be understood that the requirements for the seismic and wind restraints as specified herein and on the drawings are complementary to requirements delineated elsewhere under other sections of this work for the support, fastening and isolating of equipment, ductwork and piping work. Nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this and other related sections.
- D. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
- E. This specification is considered to be minimum requirements for seismic consideration.
- F. This Section includes general and procedural requirements for the design of seismic control for mechanical components and installations.
- G. Seismic Restraints shall be installed to restrain and protect piping in the event of an earthquake and shall be installed in addition to pipe hangers, brackets and supports. Seismic Restraints shall not be used in lieu of regular hangers and supports as are otherwise required to support the piping.
- H. Anchors shall be designed to accommodate seismic forces plus any forces imposed by expansion joints or pipe bends and loops. Loads and details of attachment to structure shall be submitted to Commissioner for coordination and approval.
- I. Provide seismic restraints for every mechanical system including piping, equipment and ductwork within the building and on the roof of the building, complete, as shown and specified per Contract Documents.



- J. All outdoor equipment, including roof-mounted components shall comply with "Wind Load", (NYCDBD) Requirements, as specified herein. There shall be no decrease of the effects of wind load on component due to other structures or components acting as blocks or screens.
- K. All below, at grade or above grade locations located in a flood hazard area as defined and located herein, shall comply with the requirements of this section.
- L. Seismic bracing, wind and flood load, and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
- M. The equipment referred to below are typical. (Equipment not listed is still included in this specification.) All systems that are part of the building in any way are referred to as equipment, including, but not limited to:
  - 1. AC Units
  - 2. Adapter Curb
  - 3. Air Handling Units
  - 4. Chilled Beams
  - 5. Air Separators
  - 6. Boilers
  - 7. Cabinet Unit Heaters
  - 8. Chillers
  - 9. Compressor
  - 10. Cooling Towers
  - 11. Ductwork
  - 12. Equipment Supports
  - 13. Fans (all types)
  - 14. Fan Coil Units
  - 15. Heat Exchangers
  - 16. Humidifiers
  - 17. Pipe
  - 18. Pumps (all types)
  - 19. Risers
  - 20. Supports
  - 21. Tanks (all types)
  - 22. Unit Heaters
  - 23. Unit Ventilators
  - 24. VAV Boxes
  - 25. Vibration Isolators
  - 26. Water Heaters

#### 1.7 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- E. Life Safety Systems:
  - 1. All systems involved with fire protection including fire dampers and smoke exhaust systems.

- F. Anchor: A device, such as an expansion bolt, for connecting duct or pipe bracing members into
- G. Approved Agency: An established and recognized agency, or other qualified person, regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the New York City Department of Buildings as being qualified for such purposes.
- H. Attachments, Seismic: Means by which components and their supports are secured or connected to the seismic-force-resisting system of the structure. Such attachments include anchor bolts, welded connections and mechanical fasteners.
- I. Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per section BC1609 of 2014 NYCBC. New York City Department of Buildings shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE-7-05 shall be used after determination of basic wind speed by New York City Department of Buildings. See 2014 NYCBC Section 1609.3 ASCE-7-05 for basic wind speed determination in non-hurricane prone regions. In no event shall the wind speed for the wind load design be less than 100 mph.
- J. Bracing: Metal channels, cable or hanger angles that prevent ducts and pipe from breaking away from the structure during an earthquake. See also Longitudinal Bracing and Transverse Bracing. Together, they resist lateral loads from any direction.
- K. Certificate of Compliance: A certification stating that materials and products meet specified standards or that work was done in compliance with approved construction documents by an approved agency. (Certificate to be supplied by equipment component manufacturer)
- L. Component: A part or element of an architectural, electrical, mechanical, or structural system.
- M. Component, equipment: A mechanical or electrical components or element that is part of a mechanical and/or electrical system within or without a building system.
- N. Dynamic properties or piping: The tendency of pipe to change in weight and size because of the movement and temperature of fluids in them. This does not refer to movement due to seismic forces.
- O. Equipment: Systems associated with ducts, pipe and conduit. It includes all non-structural components within the facility and/or serving this facility, such as equipment located in/out of building or outside of the main structure on grade - also called components.
- P. Essential Facilities: Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.
- Q. Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:
  - 1. The overflow of inland or tidal waters.
  - 2. The unusual and rapid accumulation of runoff of surface waters from any source.
- R. Flood Hazard Area: The greater of the following of two areas:
  - 1. The area within a flood plain subject to a 1-percent or greater chance of flooding in any year.
  - 2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.



- S. Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as zone V, VO, VE or VI-30.
- T. Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.
- U. Gas pipes: For the purposes of this Section gas pipe is any pipe that carries fuel, gas fuel oil, medical gas, or compressed air.
- V. Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.
- W. Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.
- X. Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency.
- Y. Isolation System: The collection of structural elements that includes individual isolator units, structural elements that transfer force between elements of the isolation system and connections to other structural elements.
- Z. Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the same and identification of an approved agency and that indicated that the representative sample of the product or materials has been tested and evaluated by an approved agency.
- AA. Lateral Forces: force acting on a duct or pipe in the horizontal plane. This force can be in any direction.
- BB. Licensed Professional Engineer: An independent, qualified, licensed Professional Engineer having PE registration from New York State, with significant experience in the field of seismic design, equipment support and seismic restraints.
- CC. Life Safety and High Hazard:
  - 1. All systems involved with fire protection including but not limited to sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels. (Life Safety)
  - 2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment including but not limited to, all lighting, generators, fuel oil systems, transfer switches and transformers. This also includes critical, standby or emergency power components including conduit (1" nominal diameter and larger) cable tray or bus duct, lighting, panels, communication lines involving 911, etc. (Life Safety)
  - 3. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Branches must be end tied.



4. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override!
  5. Non life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers shaving a weight greater than 75 lbs. require independent seismic bracing.
  6. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc. or manually operated systems used for smoke evacuation, purge or fresh air relief. (Life Safety)
  7. All gases or fluids which must be contained in a closed system which are flammable or combustible including but not limited to fuel oil piping, gas piping. Any gas which poses a health hazard if released into the environment including but not limited to, lab gas piping, compressed air piping. (High Hazard)
  8. Heating systems
- DD. Longitudinal Bracing: Bracing that prevents a duct or pipe from moving in the direction of its run.
- EE. Longitudinal Force: A lateral force that happens to be in the same direction as the duct or pipe.
- FF. Manufacturer's Designation: identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules.
- GG. NYCBC – 2014 New York City Construction Codes – which includes the latest editions of the NYC Building Code, NYC Plumbing Code, NYC Mechanical Code, NYC Fuel Gas Code, NYC Energy Conservation Code.
- HH. Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow, and seismic based on occupancy of the structure.
- II. Occupancy Importance Factor: A factor assigned to each structure according to its Seismic Use Group as prescribed in 2014 NYCBC Chapter 16.
- JJ. Positive Attachment: A mechanical device designed to resist seismic forces that connected a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Glue and friction due to gravity do not create positive attachments. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.
- KK. Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group or occupancy category and the severity of the design earthquake ground motion at the site.
- LL. Seismic Force: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used on the design of the structure and its components.
- MM. Seismic Use Group: A classification assigned to a building based on its use as defined in NYCBC Chapter 16.
- NN. Seismic: Related to an earthquake. Seismic loads on a structure are caused by wave movements in the earth during an earthquake.
- OO. Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in the 2014 NYC Building Code Chapter 16.

- PP. Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection or placement of equipment or components and connections to ensure compliance with the approved contract documents and referenced standards as required by the 2014 NYC Building Code or its referenced standards. Special Inspectors shall be retained by the City of New York.
- QQ. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- RR. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- SS. Transverse bracing: Bracing that prevents a duct or pipe from moving from side to side.
- TT. Wind –Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater.

#### 1.8 APPLICABLE PUBLICATIONS CODES AND STANDARDS

- A. NYC Building Code 2014 (NYCBC)
- B. NYC Mechanical Code 2014
- C. NYC Energy Conservation Code 2016
- D. NFPA 70 - National Electric Code
- E. International Energy Conservation Code
- F. SMACNA Guidelines for Seismic Restraint of Mechanical Systems
- G. NFPA 13 and 14 for Fire Protection System (Standard)
- H. American National Standard Institute (ANSI)
- I. Air Moving and Conditioning Association (AMCA)
- J. American Society of Mechanical Engineers (ASME)
- K. American Society for Testing and Materials (ASTM)
- L. National Fire Protection Association (NFPA)
- M. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- N. Occupational Safety and Health Administration (OSHA).
- O. Underwriters Laboratories (UL).

#### 1.9 PERFORMANCE REQUIREMENTS:

- A. Engineering Services:





1. As part of this work, engage the services of a professional engineer licensed in the State of New York with experience in the field of equipment support, vibration isolation and seismic and wind restraints.
2. The Contractor's Engineer shall prepare comprehensive engineering analysis using performance requirements and design criteria indicated and as required by the NYC Department of Buildings.
3. The Contractor's Engineer shall select and coordinate the isolators, restraints and supports based on the final coordinated drawings showing exact location of ductwork, piping and equipment and shall coordinate with the structural engineer to ascertain that the connections to the structure will resist the forces to which they might be subjected. He shall design seismic-restraint hangers and supports for piping and equipment
4. He shall engineer supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water and design the equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
5. Participate in the preparation of Coordination Drawings to show space requirements for the seismic restraints and supports for the piping, ductwork and equipment.
6. Be responsible for the performance of all special inspections as required by the 2014 NYCBC.
7. Be responsible for the continuous inspections and periodic inspections as required by the 2014 NYCBC.
8. Purchased and/or fabricated equipment must be designed to safely accept external forces of load in any direction for all rigidly and resiliently supported equipment, piping and ductwork without failure and permanent displacement of the equipment. Life safety equipment such as fire pumps, smoke exhaust fans, emergency generators and other life safety designated equipment must be capable of accepting external forces (as required by the specific design category for the project) in any direction without permanent displacement or failure of the equipment.
9. He shall submit signed and sealed details and calculations as required demonstrating compliance and obtaining approval to the Commissioner for review and approval.

**B. Wind-Restraint Loading**

1. Minimum 150 MPH - 60-lb/sq. ft. (or greater where required by 2014 NYCBC) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

**C. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.**

**1.10 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.11 SUBMITTALS**

- A. The manufacturers of the vibration isolation and seismic and wind restraints shall provide submittals for products as follows:

1. Descriptive Data:
  - a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with specifications.



- b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic and wind restraints by referencing numbered descriptive drawings.
- B. Shop Drawings: Signed and sealed by a qualified Professional Engineer licensed in the State of New York.
  1. Submit fabrication and installation details for equipment bases including dimensions, structural member sizes and support point locations and include calculations for the vibration isolators and restraints detailing compliance with the specifications.
  2. Provide all details of suspension and support for ceiling hung equipment.
  3. Provide specific details of seismic restraints, wind restraints and anchors, include number, size and locations of each piece of equipment.
- C. Product Data: For the following:
  1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the New York City Department of Buildings.
    - b. Annotate to indicate application of each product submitted and compliance with requirements.
  3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- D. Engineering Services Submittal: For vibration isolation, wind and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of New York responsible for their preparation.
  1. Engineering Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
    - a. Coordinate engineering calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
  2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
  3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
  4. Seismic and Wind Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.



- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
  - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
  - d. Preapproval and Evaluation Documentation: By an agency acceptable to the New York City Department of Buildings, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- E. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- F. Welding certificates.
- G. Qualification Data: For professional engineer and testing agency.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

#### 1.12 MANUFACTURER'S RESPONSIBILITY

- A. The manufacturer of the vibration isolation and seismic and wind restraint equipment shall have the following responsibilities:
  - 1. Determine vibration isolation and seismic and wind restraint sizes and locations.
  - 2. Provide vibration isolation and seismic and wind restraints as scheduled or specified.
  - 3. Provide calculations and materials for restraint of un-isolated equipment.
  - 4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
  - 5. Certify correctness of installation upon completion.
  - 6. All manufacturers providing equipment and/or vibration/seismic/wind control systems must provide a Seismic Design Error and Omissions Insurance Certificate for their firm and their design consultant to certify their ability to provide engineering and design as required by this section.

#### 1.13 QUALITY ASSURANCE:

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Substitution of internally or externally isolated and restrained equipment supplied by the equipment manufacturer, in lieu of the isolation and restraints specified herein, will be acceptable provided that all the requirements of the specifications are fully met. The equipment manufacturer shall provide a letter of guarantee from their Engineering Department, signed and sealed by the Contractor's Professional Engineer licensed in the State of New York stating that the isolators and restraints are in full compliance with these specifications.
- C. Letters from field offices or representatives are not acceptable. All expenses for converting to the specified vibration isolation and/or restraints shall be borne by the contractor.

- D. Internal isolation is not acceptable for the following:
  - 1. Roof Mounted Equipment located over or adjacent to:
    - a. Lab spaces
    - b. Critical Office locations such as Executive and Conference areas
    - c. Assembly Areas.
- E. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to New York City Department of Buildings.
- F. Comply with seismic-restraint requirements in the NYCBC unless requirements in this Section are more stringent.
- G. Welding: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- H. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to New York City Department of Buildings, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer licensed in the State of New York.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Vibration Mountings & Controls, Inc. (VMC)
  - 2. Amber/Booth Company, Inc. (AB)
  - 3. Korfund Dynamics Corporation.
  - 4. Kinetics Noise Control.
  - 5. Mason Industries.
  - 6. Or approved equal.

### 2.2 VIBRATION ISOLATORS

- A. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel base plates, and factory cut to sizes that match requirements of supported equipment.
- B. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with base plate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
- C. Restrained Mounts: All-directional mountings with seismic restraint.



1. **Materials:** Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  2. **Neoprene:** Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. **Restrained Spring Isolators:** Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
- E. **Housed Spring Mounts:** Housed spring isolator with integral seismic snubbers.
- F. **Elastomeric Hangers:** Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- G. **Spring Hangers:** Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
- H. **Spring Hangers with Vertical-Limit Stop:** Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
- I. **Pipe Riser Resilient Support:** All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- J. **Resilient Pipe Guides:** Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.3 SEISMIC-RESTRAINT

- A. **General Requirements for Restraint Components:** Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to New York City Department of Buildings.
- B. **Snubbers:** Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. **Anchor bolts** for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  2. **Resilient Isolation Washers and Bushings:** Oil- and water-resistant neoprene.
  3. **Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.**
- C. **Channel Support System:** MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. **Restraint Cables:** ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.



- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic - and wind-control devices to indicate capacity range.

## 2.5 VIBRATION ISOLATION TYPES

- A. Type A - Spring Isolators, Freestanding,
  - 1. Spring type isolator shall be freestanding, laterally stable without housing, snubbers or guides and shall include a steel reinforced, ribbed neoprene cup (1/4-inch minimum thickness) between the baseplate and the support.
  - 2. Mountings shall have leveling bolts on top, consisting of an adjusting bolt, cap screw and washer.
  - 3. Springs shall not be welded to the base plate or cup.
  - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 5. Minimum Additional Travel to solid: 50 percent of the required deflection at rated load.
  - 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 8. Base plates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to base plate underside.
  - 9. Base plates shall limit floor load to 500 psi



10. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
11. Similar to:
  - a. Type AC – VMC
  - b. Type SW – AB
  - c. Or approved equal

**B. Type B - Spring Isolator – Housed Springs with Seismic Restraint Limit Stops**

1. Restrained spring type isolator shall be free standing, laterally stable and shall have a Type A spring isolator within a rigid welded steel housing that includes vertical limit stops to prevent spring extension when weight is removed. Or when equipment is exposed to uplift loads such as wind loading.
2. The housing serves as blocking during erection and shall be located between the equipment and supporting structure. Housing shall be hot dip galvanized.
3. There shall be a minimum clearance of ¼ inch between the restraining bolts and the housing and spring to prevent interference with spring performance.
4. Limit stops shall be out of contact during normal operation.
5. When used in seismic applications, neoprene bushings shall be incorporated in the limit stop plate.
6. Springs shall not be welded to the housing or cup.
7. Minimum Additional Travel to solid: 50 percent of the required deflection at rated load.
8. Similar to:
  - a. Type AWRS - VMC
  - b. Type ASCM – AB
  - c. Or approved equal

**C. Type C – Combination Spring/Elastomer Hanger Isolator**

1. Hangers shall consist of rigid steel spring in series with a 0.2-inch (minimum) deflection neoprene element. Spring shall be color-coded and elastomeric element molded in specific colors for proper identification of rated load capacity.
2. Frames containing minimum 1-1/4" thick elastomeric elements at the top and a steel spring with general characteristics as in type 1.
3. Minimum additional travel time to solid: 50 percent of the required election at rated load.
4. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before short-circuiting the spring.
5. Hanger locations requiring pre-compression for holding pipe at fixed elevation shall be type pre-compressed or pre-positioning.
  - a. Type RSH-30 – VMC
  - b. Type BRSA – AB
  - c. Or approved equal

**D. Type D - Elastomer Double Deflection Isolator**

1. Hangers shall consist of rigid steel frames containing minimum 1-1/2" elastometric elements at the top and a steel spring with general characteristics as in type 1. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before short-circuiting the spring. Hanger locations requiring pre-compression for holding pipe at fixed elevation shall be type pre-compressed or pre-positioning.



- a. Type RHD – VMC
- b. Type HRD/BRB – AB
- c. Or approved equal

**E. Type E – Combination Spring/ Elastomer Hanger Isolator**

- 1. Spring and Durulene elements in a steel retainer box with the features as described for Type C and Type D isolators.
- 2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
  - a. Type RSH – VMC
  - b. Type BSR – AB
  - c. Or approved equal

**F. Type F – Seismically Restrained Elastomeric Floor Isolator**

- 1. Captive elastomeric mount molded from neoprene or EPDM compound conforming to the requirements of ASTM D2000.
- 2. Load bearing elastomeric element shall be housed in a cast ductile iron housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection.
- 3. A minimum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric d bushings.
- 4. Mount shall incorporate a fail-safe captive design and shall have minimum deflection of 0.2", restrained spring isolator shall have a type 1 spring isolator within a rigid housing
  - a. Type RSM/MB – VMC
  - b. Type RSM – AB
  - c. Or approved equal

**G. Type G – Pad Type Elastomer Isolator (Standard)**

- 1. One layer of ¾" thick elastomeric pad consisting of 2" square modules for size required.
- 2. Load distribution plates shall be as required.
- 3. Bolting required for seismic compliance. Elastometric and duct washers and bushings shall be provided to prevent short-circuiting.
  - a. Type Maxiflex – VMC
  - b. Type Maxiflex – AB
  - c. Or approved equal

**H. Type H – Pad Type Elastomer Isolator (High Density)**

- 1. Laminated canvas duct and neoprene, maximum loading 1000 psi, minimum ½" thick.
- 2. Load distribution plate shall be used, as required.
- 3. Bolting required for seismic compliance. Elastometric and duct washers and bushings shall be provided to prevent short-circuiting.
  - a. Type Fabriflex – VMC
  - b. Type NDB – AB
  - c. Or approved equal





I. Type I - Thrust Restraints

1. A spring element similar to Type A Isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to  $\frac{1}{4}$ ". Hardware may be supplied by contractor.
2. Restraint shall be easily converted in the field from compression type to tension type.
3. Thrust restraints shall be installed on all cabinet head fans, axial or centrifugal fans whose thrust exceeds 10% of unit weight.
  - a. Type RSHTR – VMC
  - b. Type TRK – AB
  - c. Or approved equal

J. Type J - Pipe Anchors

1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum of  $\frac{1}{2}$ " thick 60 durometer elastomer.
2. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.
3. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
  - a. Type MDPA – VMC
  - b. Type AB/AG – AB
  - c. Or approved equal

K. Type K – Pipe Guides:

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum  $\frac{1}{2}$ " thickness of 60 durometer elastomer.
2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and re-insertable to allow for selection of pipe movement.
3. Guides shall be capable of a +/- 1-5/8" motion, or to meet location requirements.
  - a. Type PG – VMC
  - b. Type PG – AB
  - c. Or approved equal

L. Type L – Isolated Pipe Hanger System

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
5. System shall be pre-compressed to allow for rod insertion and standard leveling.
  - a. Type CIH, CIR, TIH, PIH – VMC
  - b. Type CIH, CIR, TOH, PIH – AB
  - c. Or approved equal

## 2.6 SEISMIC RESTRAINT TYPES

### A. Type I - Seismic Restrained Steel Mounts

1. Refer to Isolation Type B.
2. Steel spring isolators incorporating elastomeric snubbers in all directions. The snubbers shall be adjustable in all directions and allow a maximum of 1/4" travel in all directions before contacting the elastomer cushion.
3. Spring diameters shall be no less than 0.8 times the compressed height of the spring at the rated load.
4. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection.
5. Housing shall be of welded steel construction. Gray iron castings are not permitted.
6. Springs shall be color coded for proper identification of rated load capacity.
  - a. Type Series AEQM, AWMR, ASCM – VMC
  - b. AB
  - c. Or approved equal

### B. Type II Seismically - Restrained Elastomer Floor Isolator

1. Refer to Vibration Isolation Type F
  - a. Type RSM - VMC
  - b. Type RSM – AB
  - c. Or approved equal

### C. Type III - All Directional Seismic Snubber

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of 1/2" thick. Rated loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.
  - a. Type SR - VMC
  - b. Type ER – AB
  - c. Or approved equal

### D. Type IV - Floor or Roof Anchorage

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates machine screw, bolting or welding. Power shots are unacceptable.
  - a. Cast-In Plates - VMC
  - b. Type FA – AB
  - c. Or approved equal

### E. Type V - Seismic Cable Restraints

1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation.



angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Single arm braces with resilient bushings can be substituted for seismic cable restraints.

- a. Type SCR - VMC
- b. Type ERS – AB
- c. Or approved equal

**F. Type VI - Rigid Arm Brace**

- 1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.

- a. Type SAB - VMC
- b. Type SAB – AB
- c. Or approved equal

**G. Type VII - Internal Clevis Cross Brace**

- 1. Internal clevis cross braces at seismic locations shall be pre-cut pipe sized for internal dimensions.

- a. Type ICB - VMC
- b. Type SAB – AB
- c. Or approved equal

**H. Type VIII - Seismic Waterproof Foundation Wall Sleeve**

- 1. Seismic waterproof foundation wall sleeves shall consist of two elastomeric sleeves that shall be mounted both inside and out of the vertical foundation wall. The conical design shall have a suitably waterproof means of fastening to both concrete and to its concentric utility pipe. Allowable vertical drift shall be plus or minus 2" from the installed neutral point along the vertical "y" axis. All fittings shall be stainless steel or galvanized.

- a. Type SWFWS - VMC
- b. Type SWFWS – AB
- c. Or approved equal

**2.7 EQUIPMENT BASES**

- A. Steel Base: Factory-fabricated, welded, structural steel bases and rails.
- B. Inertia Base: Factory-fabricated, welded, structural steel bases and rails ready for placement of cast-in-place concrete.
- C. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic forces in accordance with the project location (fastening to metal deck is unacceptable).

## 2.8 EQUIPMENT BASE TYPES

### A. Type B-1 – Integral Structural Steel Base

1. Rectangular bases are preferred for all equipment.
2. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is limited. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
3. All perimeter members shall be wide flange, structural steel beams with a minimum depth equal to 1/10 of the longest dimension of the equipment. Built-in adjustable motor slide rails shall be supplied as an integral part of the base.
4. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
5. Height saving brackets shall be used in all mounting locations to provide a minimum base clearance of 2".
  - a. Type WFB – VMC
  - b. Type SFB/WSB – AB
  - c. Or approved equal

### B. Type B-2 - Concrete Inertia Base

1. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertial foundations.
2. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
3. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6" and the base depth shall not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
4. Height saving brackets shall be used in all mounting locations to provide a minimum base clearance of 2".
  - a. Type MPF/WPF – VMC
  - b. Type CPF – AB
  - c. Or approved equal

5. Concrete inertia bases thickness shall be in accordance with the following schedule:

MOTOR SIZE	MINIMUM INERTIA BASE THICKNESS
5 HP TO 20 HP	6"
20 HP TO 75 HP	8"

### C. Type B – 3 - Seismic Roof Isolation Curb

1. The structural steel spring isolation curbs shall bear directly on the roof support structure and be flashed and waterproofed into the roof's membrane waterproofing system.
2. Equipment manufacturer's or field-fabricated curbs shall not be used.
3. The curb shall consist of a rigid steel lower section containing properly spaced pockets with fully adjustable spring isolators. All springs shall be color-coded for proper identification and spring pocket shall allow for easy removal or replacement of any spring without disturbance of the supported equipment. Pockets shall have removable waterproof covers to allow for spring adjustment.
4. Spring pockets shall contain combination vertical and horizontal restraint in conjunction with a 1/4-inch thick neoprene rubber bushing that will resist wind and seismic forces. All springs shall be installed in series with a 1/4-inch-thick neoprene acoustical cup or pad.



5. The curb shall be the sound attenuating type utilizing standard 2-inch roof insulation supplied and installed to act thermally outside and acoustically inside. Curbs supplied without this feature shall be factory acoustically lined with 2-inch duct liner. An airtight neoprene seal shall be incorporated into the curb design to prevent air leakage or infiltration. Air seal must not be exposed so that it could be damaged or that in the event of the air seal failure, water could leak into the curb's interior.
6. Wood nailer and flashing shall be provided and curbs shall be manufactured to NRCA standards. Curbs shall include a means of incorporating a sound barrier package, consisting of two layers of waterproof gypsum board. Individual pier supported curbs are not acceptable.
  - a. Type RIC or Type P – VMC
  - b. Or approved equal

**D. Type B-3: Seismic Restrained Vibration Isolation Roof Curb**

Option: Sound Package 1 & 2 VMC/AB-RPFMA/SRPFMA

1. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
2. Curb-mounted rooftop equipment shown on isolation schedule shall be mounted on structural seismic spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. The lower frame must accept point support for both seismic attachment and leveling. The upper frame must be designed with positive fastening provisions (welding or bolting), to anchor the rooftop unit to the curb, which will not violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.
3. All-directional elastomeric snubber bushings shall be minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick elastomeric acoustical pads or cups.
4. Hardware must be plated and the springs shall be powder-coated or cadmium-plated.
5. The curb's waterproofing shall be designed to meet all NRCA requirements.
6. All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
7. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
8. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.
9. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
10. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
11. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter flashed over roof materials.
12. Isolated curbs shall be supplied with a continuous air seal between the upper floating member and the stationary wood nailer.

Option #1 Where sound barrier package is required, curb shall have full size lay in attenuation panels having a minimum STC rating of 60 when combined with the roof



deck's rating. Attenuation system shall add a full sound attenuation structural floor to the curb capable of spanning the curb's width and designed for live loads of 20 psf. Panels shall not weigh more than 6 psf. The 4" nominal galvanized panel shall be joined to allow for airtight construction and additionally shall have a support system where the panels are used below an outside condenser section. Panels shall be waterproof for both outdoor and indoor application. The space below the curb panels and the roof deck shall have 4" of insulation contractor furnished and installed.

Curb wall construction shall utilize the roofer's standard insulation where curbs use the TAS open thermal acoustical screening system. Solid wall curbs shall use 2" of the factory duct liner installed by the curb manufacturer. The entire curb shall have a continuous neoprene elastomeric air seal. Type RPFMA shall use an open return system with the roof return opening set as far as possible from the unit's return opening.

- a. Type P6200/P6300 – VMC
- b. Or approved equal

**E. Type B-4: Seismic Non-Isolated Curbs**

**Sound Package VMC-RPFMA/SRPFMA System**

- 1. Seismic curbs shall have all provisions as Type B-3 curbs with the exception of spring isolation.
- 2. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.
  - a. Type P6000 – VMC
  - b. Or approved equal

**F. Type B-5 - Isolated Equipment Supports**

- 1. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as described for Type B-3.
- 2. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.
- 3. Hardware must be plated and the springs shall be powder coated or cadmium plated.
- 4. The curb's waterproofing shall be designed to meet all area requirements.
- 5. Curb shall have sound attenuation panels having a minimum STC rating of 60 when combined with the roof deck's rating. As well as continuous elastomeric air seal. Panels shall be waterproof.
- 6. The space below the curb panel and the roof deck shall have 4" of insulation provided by the contractor.
  - a. Type R7200/7300 – VMC
  - b. Type RT7200/7300 – AB
  - c. Or approved equal

**G. Type B-6 – Non- Isolated Equipment Supports**

- 1. Same provisions as Type B-5 base – Isolated Equipment supports but without spring isolation.
  - a. Type R7000 – VMC
  - b. Type R7000 – AB



- c. Or approved equal

**H. Type B-7: Computer Room Unit Base**

1. Computer Room air conditioning units shall be welded or bolted to welded structural steel stands having a minimum 0.5 “G” certified lateral acceleration capabilities, but no less than the design seismic loads.
  2. Elastomeric isolated stands shall have 1” of adjustment to accommodate floor irregularities and 0.25” of nominal static deflection.
  3. Spring isolated stands shall have 1” of adjustment to accommodate floor irregularities and 2” of nominal static deflection.
  4. Bolting or welding is required to meet seismic criteria.
  5. Stands to have positive fastening provisions for bolting of computer room unit to seismic floor stand and fastening of seismic isolated floor stand to structure, capable of carrying the design seismic loads.
- a. Type SFS – VMC
  - b. Or approved equal

**I. Type B-8 AHU / AC unit Structural Base Frames**

1. Where roof mounted Air Conditioning or Air Handling Units are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit’s base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit’s base frame and shall be supported on type “B” wind /seismic restrained isolation system.
  2. Isolator deflection shall be either 1.5” or 2.5” depending on the tonnage of the roof mounted component as shown in Isolation Table “A”.
- a. Type RTSBF - VMC.
  - b. Or approved equal

**J. Type B-9: Structural Adapter Curbs**

1. Structural Adapter Curbs will be designed to match the replacement unit’s curb dimensions to the existing unit’s curb dimensions, matching both supply and return air delivery systems of both components or creating a plenum to accommodate airflow of both components.
  2. The new adapter curb will be structurally designed to rest on the existing curb only and carry the new unit’s load directly to building steel or concrete thru stanchions that are welded or bolted to both within the confines of the existing curb. Additionally, the new roof mounted unit will be welded or bolted to the structural adapter and shall demonstrate load path of all loads from all components into the building structure.
  3. Where the installed unit component’s height to the unit’s electrical disconnect box is in excess of 78”, a service platform or other suitable staging shall be utilized.
- a. Type PSAC-6000 -VMC
  - b. Or approved equal

**K. Type B-10 Structural Isolated Adapter Curbs:**

1. Where isolation is required to be incorporated into the adapter curb, isolation and restraining system shall be similar to the requirements highlighted under Base Type B-



3. Isolator deflection shall be either 2" or 3" deflection as required by Isolation Table "A".

- a. Type PSAC-6200 or PSAC-6300 - VMC
- b. Or approved equal

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT ISOLATION AND RESTRAINT

- A. Equipment shall be isolated and restrained as per the requirements specified herein.
- B. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all submittal data. Locations of all vibration isolation products shall be selected for ease of inspection and adjustment, as well as for proper operation.
  - 1. Place floor mounted equipment on 4" high concrete housekeeping pads properly doweled or expansion shielded to the deck to meet acceleration requirements. Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under another Division.
  - 2. Additional requirements:
    - a. The minimum operating clearance under inertia bases shall be 2"
    - b. The minimum operating clearances under other bases shall be 2"
    - c. Ceilings containing diffusers must meet seismic zone requirements by using earthquake clips or other approved means of positive attachment to secure diffuser.
- C. Spring isolators shall be installed after all equipment is installed without changing equipment elevations. After the entire installation is complete and under full operational load, the spring isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolators or the isolation system.

#### 3.2 PIPING AND DUCTWORK ISOLATION AND RESTRAINTS

- A. Vibration isolation hangers shall be positioned as close as possible to the structure without coming in contact with any object (including the structure).
- B. Hanger rods shall not contact any object that would short circuit the isolator.
- C. Parallel running pipes may be hung together on a trapeze that is isolated from the building. Do not mix vibration isolated and non-isolated pipes on the same trapeze.
- D. Attention must be paid to movements of piping caused in expansion and contraction. Pre-compressed hangers shall only be used if installed along with piping.
- E. Isolation hangers shall be installed for all piping in equipment rooms or for 50 ft. from vibrating equipment, whichever is greater. To avoid reducing the effectiveness of equipment isolators, at least three of the first hangers from the equipment should provide the same deflection as the equipment isolators, with a maximum limitation of 2-inch deflection. The remaining hangers shall be spring or combination spring and rubber with a minimum of 0.75-inch deflection.
- F. To prevent load transfer to the equipment flanges when the piping system is filled, the first three hangers adjacent to the equipment shall be the positioning type.



- G. Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use restrained vibration isolators. They should be selected according to the guidelines for hangers.

### 3.3 VIBRATION ISOLATION OF PIPING

- A. All spring type isolation hangers shall be pre-compressed if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All piping in the machine room shall be isolated as well as pressurized runs in other locations of the building.
- B. Horizontal pressurized piping runs in all other locations of the buildings shall be isolated by Type E hangers.
- C. Floor supported piping shall rest on Isolators. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment.
- D. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1 3/8" deflection for pipe sizes thereafter. Where column spacing exceeds 35', isolation hangers' deflection shall be 2 1/2" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.
- E. Steam and Condensate Piping:
  - 1. All ceiling suspended piping in the mechanical equipment room shall be isolated with Type D hangers.
  - 2. All floor supported piping shall be supported with Type F isolators.
- F. Domestic water lines in the machine room shall only be isolated if connected to isolated equipment. Isolator type shall be as listed in Article 1, above.
- G. All risers shall be supported on Type J or K anchors or guided restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
- H. Control Air Piping:
  - 1. Where control air piping is connected to mechanical piping equipment shall be flexibly connected in horizontal and vertical plane with Type FC-2 flexible connectors.
- I. Gas lines shall not be isolated.
- J. Vertical riser supports for pipe 3" diameter and larger shall be isolated from the structure using anchors and guides.

### 3.4 SEISMIC RESTRAINT OF PIPING:

- A. All high hazard and life safety pipe regardless of size such as fuel oil piping, fire protection mains, gas piping, medical gas piping and compressed air piping and piping with an  $I_p=1.5$  shall be seismically restrained or braced. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping. There are no exclusions for size or distance in this category.



- B. Seismically restrain piping, with an  $I_p = 1.0$ , located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1½" I.D. and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping.
- C. Seismically restrain all other piping 2½" diameter and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type VI seismic cable restraints or single arm braces may be used on non-isolated piping.
- D. Multiple runs of pipe on the same support shall have distance determined by calculation.
- E. Rod braces shall be used for all rod lengths as listed in Table E.
- F. Clevis hangers shall have braces placed inside of hanger at seismic brace locations.
- G. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
- H. For fuel oil and all gas piping, transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
- I. Transverse restraint for one pipe section may also act as longitudinal restraint for a pipe section of the same or smaller size connected perpendicular to it if the restraint is installed within 24" of the centerline of the smaller pipe or combined stresses are within allowable limits at longer distances.
- J. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints. Use Type V or VI restraint, if trapeze is smaller than 48" long.
- K. Branch lines may not be used to restrain main lines or cross-mains.
- L. Where pipe passes through a fire-rated, seismic gypsum wall, the wall can act as a lateral/transverse brace for pipe sizes up to and including 6," provided fire stopping material is tight to the pipe.
- M. Where pipe passes through a seismic block or concrete wall, the wall can act as a lateral/transverse brace.
- N. Where horizontal pipe crosses a building's drift expansion joint, allowance shall be part of the design to accommodate differential motion.
- O. Vertical pipe rises between floors shall have their differential movement part of the seismic design for building drift.
- P. For horizontal passage of all underground utilities through building's foundation wall, all pipes shall pass freely through an oversized opening and waterproofed accordingly to accommodate maximum allowable building drift. (Seismic Restraint Type VIII).

### 3.5 VIBRATION ISOLATION OF DUCTWORK:

- A. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type A or Type E isolators. Actual spring deflection shall be a minimum of 0.75."

- B. All duct runs having air velocity of 1500 feet per minute (fpm) or more shall be isolated from the building structure by Type E combination spring elastomer hangers or Type A floor spring supports. Spring deflection shall be a minimum of 0.75."

### 3.6 SEISMIC RESTRAINT OF DUCTWORK:

- A. Restrain rectangular ductwork with cross sectional area of 4 square feet or larger. Type V seismic cable restraints or Type VI single arm braces shall be used on duct.
- B. Ducts that serves a life safety function or carries toxic materials in an "Essential or High Hazard Facility" must be braced with no exceptions regardless of size or distance requirements.
- C. Restrain round ducts with diameters of 20" or larger. Type V seismic cable restraints or Type VI single arm braces.
- D. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
- E. See Table D for maximum seismic bracing distances.
- F. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
- G. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
- H. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
- I. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.

### 3.7 SCHEDULE OF ISOLATORS RESTRAINTS AND EQUIPMENT BASES

HVAC EQUIPMENT TABLE "A"										
			ON GRADE, BASEMENT OR SLAB ON GRADE				ABOVE GRADE			
EQUIPMENT (SEE NOTE)		MTNG	ISOL	DEFL. (IN)	BASE	RESTR	ISOL	DEFL. (IN)	BASE	RESTR
AIR HANDLING UNITS INDOOR		FLR.	B	0.75		IV	B	1.5		IV
		CLG	E	0.75		V	E	0.75		V
AIR COMPRESSOR TANKS	TO 10 HP	FLR.	B	0.75		IV	B	1.5		IV
	10 HP	FLR.	B	0.75	B-2	IV	B	1.5	B-2	IV



HVAC EQUIPMENT TABLE "A"										
			ON GRADE, BASEMENT OR SLAB ON GRADE				ABOVE GRADE			
EQUIPMENT (SEE NOTE)		MTNG	ISOL	DEFL. (IN)	BASE	RESTR	ISOL	DEFL. (IN)	BASE	RESTR
AXIAL FANS (INLINE TYPE)		FLR.	B	0.75		IV	B			IV
		CLG	E	0.75		V	E			V
BASE MOUNTED PUMPS	TO 15 HP	FLR.	B	0.75	B-2	IV	B	0.75	B-2	IV
	15 HP	FLR.	B	0.75	B-2	IV	B	1.5	B-2	IV
BOILERS		FLR.	G	0.1		IV	B	0.75		IV
CABINET FANS & PACKAGED AHU INDOOR	TO 1 HP	FLR.	F	0.2		IV	B	0.75		IV
		CLG	D	0.35		V	E	0.75		V
	1 HP	FLR.	B	0.75		IV	B			IV
		CLG	E	0.75		V	E			V
CENTRIF. CHILLERS		FLR.	B	0.75		IV	B	1.75		IV
CENTRIF. FANS ARR. 1 & 3	CLASS 1	FLR.	B	0.75	B-1	IV	B	1.5	B-1	IV
	CLASS 2 & 3	FLR.	B	0.75	B-2	IV	B	1.5	B-2	IV
CENTRIF. FANS (VENT SETS) ARR. 9 & 10	CLASS 1	FLR.	B	0.75		IV	B		SEE NOTE 2	IV
	CLASS 2 & 3	CLG	E	0.75	B-2	V	E		B-2	V
COMPUTER ROOM UNITS		FLR.	F	0.2	B-7	IV	B	1.5	B-7	IV
CONDENSATE PUMPS		FLR.	F	0.2	IF REQ.	IV	F	0.2	IF REQ.	IV
COOLING TOWERS		FLR.	B	1.0		IV	B	2.5	B-5	IV



HVAC EQUIPMENT TABLE "A"										
			ON GRADE, BASEMENT OR SLAB ON GRADE				ABOVE GRADE			
EQUIPMENT (SEE NOTE)		MTNG	ISOL	DEFL. (IN)	BASE	RESTR	ISOL	DEFL. (IN)	BASE	RESTR
CURB MITD. EQUIPMENT (NON-ISOL.)		ROOF				IV			B-6	IV
FAN COIL UNITS		FLR.	F	0.2		IV	B	0.75		IV
		CLG	D	0.35		V	E	0.75		V
RECIPROCATI NG OR SCREW CHILLERS		FLR.	F	0.20			B	1.50		IV
		ROOF					A	2.50	B-5	IV
UNIT/CAB HEATERS		CLG	D	0.3		V	D	0.3		V
ROOFTOP AHU/AC < 10 TON	<10 TON	ROOF					A	1.50	B-3 -3	IV
	>10 TON	ROOF					A	2.50	B-3 -3	IV

Minimum Deflection Guide for Table "A"

UNITS LOWEST R.P.M	DEFLECTION
LESS THAN 400	3.50"
401 TO 600	2.50"
601 TO 900	1.50"
OVER 900	0.75"

NOTES FOR TABLE A

GENERAL: ISOL = ISOLATOR,  
DEFL = DEFLECTION,  
REST = SEISMIC RESTRAINT.  
MTNG = MOUNTING.



ALL DEFLECTIONS INDICATED ARE IN INCHES.

- Note 1: For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide
- Note 2: For roof applications, use base Type B-5.
- Note 3: Curb Type B-3 shall use sound barrier RPFMA when there is no concrete under rooftop units. Curbs can be used for return plenums. (See Option #1)
- Note 4: Curb Type B-3: Where curbs require supply and return sound attenuation, package type SRRFMA shall be used. (See Option #2)
- Note 5: Units may not be capable of point support. If external isolation is required, provide Type B-1 base for entire unit.
- Note 6: Static deflection shall be determined based on the deflection guide for Table "A".
- Note 7: Deflection indicated are minimums at actual load and shall be selected for manufacturer's nominal 5", 4", 3", 2" and 1" deflection spring series, RPM is defined as the lowest operating speed of the equipment.
- Note 8: Single stroke compressors may require inertia bases with thickness greater than 14" maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8".
- Note 9: Floor mounted fans, substitute base Type B-2 for class 2 or 3 or any fan having static pressure over 5".
- Note 10: Indoor utility sets with wheel diameters less than 24" need not have deflections greater than .75".
- Note 11: Curb mounted fans with curb area less than 9 square feet are excluded.
- Note 12: For equipment with multiple motors, Horse Power classification applies to largest single motor.

### 3.8 SPACING CHART FOR SUSPENDED COMPONENTS

Table "D" Seismic Bracing (Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	On Center Transverse	On Center Longitudinal	Change Of Direction
Duct			
All Sizes	30 Feet	60 Feet	4 Feet

Pipe Threaded, Welded, Soldered, Conduit and Conduit Racks			
To 16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet

### 3.9 VERTICAL HANGER ROD BRACING SCHEDULE

Table "E" Hanger Rod Bracing Schedule (Stiffener to be maximum 6" from end of rod)					
Rod Dia.	Clamp Size	Maximum Un-braced Rod Length	Steel Angle Size	Clamp Spacing	Min # of Clamps per Stiffener
3/8"	SRBC-1-1/4	19"	1 x 1 x 1/4"	16"	2
1/2"	SRBC-1-1/4	25"	1 x 1 x 1/4"	20"	2
5/8"	SRBC-1-1/4	31"	1 x 1 x 1/4"	24"	2
3/4"	SRBC-1-1/2	37"	1 1/2 x 1 1/2 x 1/4"	28"	2
7/8"	SRBC-1-1/2	43"	1 1/2 x 1 1/2 x 1/4"	33"	2
1"	SRBC-1-1/2	50"	1 1/2 x 1 1/2 x 1/4"	40"	2
1 1/8"	SRBC-1-1/2	62"	1 1/2 x 1 1/2 x 1/4"	50"	2

### 3.10 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic - and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.11 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to New York City Department of Buildings.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.12 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
  - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to New York City Department of Buildings providing required submittals for component.
- C. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports a maximum of 30 feet o.c., and longitudinal supports a maximum of 50 feet o.c.
  - 3. Brace a change of direction longer than 12 feet (3.7 m).
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to New York City Department of Buildings providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- I. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are





- encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.13 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

### 3.14 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:



1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe 4" and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe 4" and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. 1/4" to 3-1/2": 12 inches long and 0.048 inch thick.



- b. 4" - 12" long and 0.06 inch thick.
- c. 5" and 6": 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.15 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.16 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
- D. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.17 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.18 INSPECTION

- A. On completion of installation of all vibration isolated and seismic restraint devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system. Contractor shall submit a report to the Commissioner, including the manufacturer's representative's final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.
- B. All special inspections on components required to be seismically restrained must be performed in accordance with the 2014 New York City Construction Codes.



1. The professional engineer engaged by the City of New York shall be responsible for the performance of all special inspection.
  - C. Continuous inspection: The full –time observation of work by an approved special inspector pursuant to the 2014 NYC Building Code Chapter 17. The following pieces of equipment require these inspections:
    1. All equipment using combustible energy sources.
    2. All electric motors, transformers, switchgear unit substations and motors control centers.
    3. Reciprocating and rotating type machinery.
    4. Pipe, 3 inches & larger.
    5. Tanks, heat exchangers & pressure vessels.
  - D. Periodic inspection: Intermittent observation of work by an approved special inspector of the following pieces of equipment in compliance with the NYCBC Chapter 17.
    1. All smoke control systems during construction & prior to concealment for leakage testing
    2. All smoke control systems prior to occupancy for pressure differential testing.
    3. Isolator units for seismic isolation system.
    4. All flammable, combustible piping and their associated mechanical systems.
- 3.19 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - B. Tests and Inspections:
    1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to New York City Department of Buildings.
    2. Schedule test with The Commissioner, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
    3. Obtain Commissioner's approval before transmitting test loads to structure. Provide temporary load-spreading members.
    4. Test at least four of each type and size of installed anchors and fasteners selected by Commissioner.
    5. Test to 90 percent of rated proof load of device.
    6. Measure isolator restraint clearance.
    7. Measure isolator deflection.
    8. Verify snubber minimum clearances.
    9. Test and adjust air-mounting system controls and safeties.
    10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
  - C. Remove and replace malfunctioning units and retest as specified above.
  - D. Prepare test and inspection reports.
- 3.20 ADJUSTING
- A. Adjust isolators after piping system is at operating weight.



- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust air-spring leveling mechanism.
- D. Adjust active height of spring isolators.
- E. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.21 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service personnel to adjust, operate, and maintain air-mounting systems. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 05 48**



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**SECTION 23 05 53****IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- A. Section 23 05 00 "Common Requirements for HVAC Work".
- B. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- C. Section 23 05 93 "Testing, Adjusting and Balancing".
- D. Section 23 09 00 "HVAC Instrumentation and Controls".
- B. This section is itself related to each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the



LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

**1.7 COORDINATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.





4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

**B. Plastic Labels for Equipment:**

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Yellow.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

**C. Label Content:** Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

**D. Equipment Label Schedule:** For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## **2.2 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.



## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Blue.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch .
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Brass.



2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  1. Tag Material: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size: Approximately 4 by 7 inches.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "Danger," "Caution," or "Do Not Operate."
  4. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified under another section.



- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
  - 1. Primary Chilled-Water Piping:
    - a. Background Color: White.
    - b. Letter Color: Yellow.
  - 2. Secondary Chilled Water (serving Chilled Beams)-Water Piping:
    - a. Background Color: White.
    - b. Letter Color: Blue.
  - 3. Condenser-Water Piping:
    - a. Background Color: White.
    - b. Letter Color: Black.
  - 4. Heating Water Piping:
    - a. Background Color: White.
    - b. Letter Color: Red.
  - 5. Refrigerant Piping:
    - a. Background Color: Red.
    - b. Letter Color: Yellow.
  - 6. Low-Pressure Steam Piping:
    - a. Background Color: Blue.
    - b. Letter Color: Yellow.



7. Steam Condensate Piping:
  - a. Background Color: Blue.
  - b. Letter Color: White.

### 3.5 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
  1. Blue: For cold-air supply ducts.
  2. Yellow: For hot-air supply ducts.
  3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  1. Valve-Tag Size and Shape:
    - a. Chilled Water: 2 inches, round.
    - b. Condenser Water: 2 inches, round.
    - c. Refrigerant: 2 inches, round.
    - d. Hot Water: 2 inches, round.
    - e. Gas: 2 inches, square.
    - f. Low-Pressure Steam: 2 inches, round.
    - g. High-Pressure Steam: 2 inches, square.
    - h. Steam Condensate: 2 inches, round.
  2. Valve-Tag Color:
    - a. Chilled Water: Green.
    - b. Condenser Water: Natural.
    - c. Refrigerant: Natural.
    - d. Hot Water: Green.
    - e. Gas: Yellow.
    - f. Low-Pressure Steam: Natural.
    - g. Steam Condensate: Natural.



3. Letter Color:
  - a. Chilled Water: Black.
  - b. Condenser Water: Black
  - c. Refrigerant: Black
  - d. Hot Water: Black
  - e. Gas: Black
  - f. Low-Pressure Steam: Black
  - g. Steam Condensate: Black

### 3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 23 05 53**



## **SECTION 23 05 93**

### **TESTING, ADJUSTING, AND BALANCING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 09 00 "HVAC Instrumentation and Controls".
- E. This section is itself related to each Division 23 00 00 section.

##### **1.2 SUMMARY**

- A. Section includes
  - 1. Testing, Adjusting and Balancing of Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Testing, Adjusting and Balancing of Hydronic Piping Systems:
    - a. Constant-flow hydronic systems.
    - b. Variable-flow hydronic systems.
  - 3. Leakage Testing, Air Distribution System
  - 4. Measurement of final operating conditions of HVAC Systems.
  - 5. Sound measurement of equipment operating conditions.
  - 6. Vibration measurement of equipment operating conditions.
  - 7. Measurement of the Indoor Air Quality (IAQ) after the completion of the final balancing.
- B. Testing, balancing and adjusting shall in no way relieve the Contractor of the warranty requirements.
- C. The Contractor shall furnish all fuel, water and electricity required in performing the testing, balancing and adjusting of mechanical systems.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:



1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SCOPE OF WORK

A. General:

1. Testing, adjust and confirm design airflows and water flow rates, pressure drops, operating pressures, temperatures and heat transfer performance for HVAC systems, including, but not limited to chilled water system, condenser water system, electric heating system, outside ventilation air, supply air, return air, fire safety ventilating systems and exhaust air systems, including all associated pumps, heat exchangers, coils, fans, dampers, diffusers, fan coil units, terminal devices, chilled beams, lab hoods, valves and accessories, cooling towers, chillers, etc.
2. Provide all necessary labor, materials, products, equipment and services to balance and test all HVAC systems, to verify conformance to specified quantities, and to the design of the mechanical system and for the testing of all the fire safety ventilations systems.
3. Provide openings required for pitot tube traverses. After balancing, close sheet metal openings with removable gasketed plugs. Submit samples of proposed plugs to the Commissioner for approval.
4. Conduct regular inspections during the mechanical systems installation and report on ductwork installation (likely to produce abnormal leakage or restrictions to airflow), piping installation, proper placement of dampers or valves, and any circumstance which will encumber the testing and balancing of the mechanical systems.
5. Review Drawings and Specifications prior to submitting the tender and ensure that adequate provisions are made in the mechanical installation to facilitate the balancing of all air, steam and water systems; make written recommendations to the Commissioner with the tender where additional measures may be required.
6. Include all items of labor, materials, products, equipment and devices required to comply with standards and codes of the NYC Dept of Buildings in accordance with the contract documents to balance all air and hydronic systems, to verify conformance to specified quantities and to the design of the mechanical system. Where quantities, sizes or other requirements indicated on the drawings or herein specified are in excess of the standard or local code requirements, the specifications and drawings shall govern.

- B. All work related to the preparation of the systems shall be the responsibility of the Contractor. No work shall proceed on the Testing, Balancing and Adjusting until all items required to be



completed prior to the start of Tab work outlined in this section are complete.

## 1.6 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work
- F. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes
  - 1. The balance of air, and hydronic distribution systems.
  - 2. Adjustment of all systems to provide design quantities and pressures.
  - 3. Verification of performance of all equipment and automatic controls;
  - 4. Sound and vibration measurements.
  - 5. Indoor Air Quality (IAQ) measurements
- G. Test: To determine quantitative performance of equipment.
- H. Adjust: To regulate the specified air and fluid flow rates and air patterns at the terminal equipment (e.g., reduce fan speed, throttling, diffuser directional vane adjustment, etc.).
- I. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- J. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- K. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data sheets should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- L. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- M. Main: Duct or pipe containing the system's major or entire fluid flow.
- N. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.
- O. Branch main: Duct or pipe serving two or more terminals.
- P. Branch: Duct or pipe serving a single terminal.
- Q. "Data Register": See description hereinafter.

## 1.7 REFERENCE STANDARDS



- A. All testing, balancing, and adjusting shall be performed in accordance with the latest applicable industry standards, those standards referenced in the applicable Division 23 specifications, including the following:
- B. Code for Design of Heating, Ventilation and Air Conditioning (GBJ 19-87, GB 50019-2003).
- C. Environmental Air Quality Standards GB 3095-96.
- D. NEEB Testing, Adjusting and Balancing model specifications
- E. NEBB "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems"
- F. ASHRAE - Standard 111 - 1988 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
- G. ASHRAE - 2003 HVAC Applications Handbook: Chapter 37, Testing, Adjusting and Balancing.
- H. SMACNA - HVAC System Testing, Adjusting and Balancing (TAB) and Certification of Testing, Adjusting and Balancing Technicians.
- I. SMACNA "HVAC Air Duct Leakage Test Manual", First Edition, 1985.
- J. All equipment and material to be furnished and installed on this Project shall be in accordance with the requirements of the NYC Dept of Buildings and suitable for its intended use on this Project.

1.8 SUBMITTAL PROCEDURES

1.9 Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.10 SUBMITTALS

- A. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.
- B. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- C. Submittal data shall include, but not be limited to:
  - 1. Water and Air Balance Procedures, Recording Forms and Test Equipment.
  - 2. Water and Air Balance Test Reports.
  - 3. Vibration and Alignment Readings.
  - 4. Sound Level Reading Test Equipment and Reporting Forms.
  - 5. Pump Test Data.
  - 6. Ductwork Leakage Test Data.
  - 7. Chiller Test Data.
  - 8. Cooling Tower Test Data.
  - 9. Air Handling Unit Test Data.
  - 10. Fan Coil Unit Test Data.
  - 11. Terminal Equipment including fan coil units and VAV terminal test data.
  - 12. Heat Exchange Test Data.
  - 13. Hydrostatic Test Logs.
  - 14. Final Air and Water Balance Readings.



- D. Certified TAB reports.
- E. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### 1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Testing and Balancing Agency Qualifications:
  - 1. The Contractor shall employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
  - 2. The independent testing, adjusting, and balancing agency shall be qualified in those testing and balancing disciplines required for this project.
- C. IAQ Testing:
  - 1. The Independent Testing, Adjusting and Balancing agency shall test the building air systems identified above, to produce an IAQ report.
  - 2. The testing and balancing agency, shall provide IAQ testing shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

#### 1.12 CONTRACTOR RESPONSIBILITIES

- A. Prepare each system for testing and balancing.
- B. Cooperate with the testing agencies, provide access to all work, equipment and systems. Operate individual equipment and systems as requested by the testing and balancing agency.
- C. Put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing. Operate systems and under conditions required for proper testing, adjusting, and balancing.
- D. Notify the Commissioner two weeks prior to time system will be ready for testing, adjusting, and balancing. Project readiness shall include:
  - 1. Systems are started and running (fans and pumps have been checked for proper rotation).
  - 2. Permanent electrical power wiring is complete.
  - 3. Verification that all ductwork is fabricated and installed as specified.
  - 4. Ceilings are installed in critical areas where diffuser air pattern adjustment may be required. Access to balancing devices is provided.



5. All equipment and ductwork access doors are securely closed.
6. A complete review of the Contractor Combined Services Drawings (CSD) for coordination of the provisions for the TAB process and instrumentation needed.
7. All balancing, smoke and fire/smoke dampers are installed and in full open positions.
8. All isolation and balancing valves are open and control valves are operational.
9. System installation is complete, with Controls and Instrumentation installed and fully operational.
10. The Testing Agency will provide the necessary input in the form of recommendation, and engineering drawings to facilitate testing construction.

E. This Contractor shall be responsible for the leakage testing of the duct work. The Contractor shall provide the required equipment and labor for testing. The Contractor shall provide any special instrumentation and record all data for submittal to the Commissioner. The Commissioner shall be given two weeks prior notification of and be present during initial testing. Subsequent testing shall be coordinated with and witnessed by the Commissioner.

F. All duct work etc. that is found to exceed the permissible leakage rates shall be immediately repaired by the Contractor, at no additional expense to the City of New York and in a timely manner so as not to interfere with the progress of the work.

#### 1.13 SEQUENCING AND SCHEDULING

A. Sequencing work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

B. Engage a TAB entity certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

C. TAB Conference: Meet with Commissioner on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

- a. The Contract Documents examination report.
- b. The TAB plan.
- c. Coordination and cooperation of trades.
- d. Coordination of documentation and communication flow.

D. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

#### 1.14 DRAWING AND CONSTRUCTION REVIEW



- A. Perform a preconstruction review of the following documents:
  - 1. Contract construction drawings
  - 2. Contract specifications
  - 3. Addenda
  - 4. Submittal data
  - 5. Shop drawings
  - 6. Automatic Control drawings
  - 7. Contractors Combined Services Drawings (all trades).
- B. Prepare a report of the preconstruction review list of recommended changes to allow most effective balancing.
- C. Perform a construction review of the mechanical installation during the progress of the project. Purpose of the reviews to be:
  - 1. Identify potential problems for performing balancing.
  - 2. Identify modifications which will aid balancing.
  - 3. Schedule and coordinate balancing with other work and other trades.
- D. Prepare a report of both preconstruction review and construction review to verify acceptance of installed conditions.
- E. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, the Contractor shall schedule and conduct a conference with the Commissioner and installers of the mechanical systems. The objective of the conference is to review the preconstruction and construction report and final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

#### 1.15 PROJECT/SITE CONDITIONS

- A. General: Do not proceed until systems requiring testing, adjusting and balancing are clean and free from debris, dirt, and discarded building materials.
- B. Air balance and testing shall not begin until system has been completed and is in full working order. The Contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation with the final filters in place on all air handling units and shall continue the operation of same during each working day of testing and balancing.

#### 1.16 PROJECT CONDITIONS

- A. Occupancy: The City of New York will occupy the site and existing building during entire TAB period. Cooperate with the City of New York during TAB operations to minimize conflicts with the City of New York's operations.

#### 1.17 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

### PART 2 - PRODUCTS



Not Used

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 FACTORY TESTING

- A. All factory testing shall be performed in accordance with the latest applicable industry standards, with the manufacturer's recommendations and as specified in other sections of this work.

#### 3.3 FIELD TESTING - GENERAL

- A. During the progress of the Work, tests shall be made as specified herein and as required by the Commissioner. Tests shall be conducted by the Contractor and shall include all equipment apparatus and services required to perform the tests.
- B. The Contractor shall submit proposed test procedures, in soft and hard copy, recording forms and test equipment for review at least six (6) months prior to the start and execution of testing.
- C. Leaks, damage, or defects discovered or resulting from tests shall be repaired or replaced to a like new condition. Leaky pipe joints, ductwork, etc., shall be removed and replaced with acceptable materials.
- D. All equipment and instruments required for tests as well as additional thermometer wells, gauge and instrument connections shall be installed at no additional expense to the City of New York.
- E. All instruments used for testing and balancing must have been calibrated within a period of three (3) months prior to balancing. Instrument calibration shall be certified.
- F. Submit six (6) hard copies and six (6) soft copies of each complete testing and balancing and IAQ report to the Contractor, and to the Commissioner's review. Send two (2) copies of the report to the Contractor and the Commissioner. The Contractor shall submit individual testing and balance reports for each individual office floor, hotel floor, and residential floor air distribution system and each ventilation system within two (2) weeks after the completion of the testing and balancing of systems.

#### 3.4 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.



- E. Examine ceiling plenums and under floor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Verify that all required air transfer ducts have been properly located and installed.
- G. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- I. Examine test reports specified in individual system and equipment Sections.
- J. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- L. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine system pumps to ensure absence of entrained air in the suction piping.
- P. Examine operating safety interlocks and controls on HVAC equipment.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.5 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.



6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.6 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and ASHRAE 111 and in this Section.
  1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, install test ports and duct access doors that comply with requirements specified under another section of this work.
  2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to the requirements specified under another section of this work.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.7 WELDING INSPECTION:

- A. Visual Inspection: Perform in accordance with Industry Standards. Cut out and test defective welds. If the percentage of defective welds is excessive, cut out and test additional welds as directed by the Commissioner.
- B. Obtain the radiographs of the steam piping. If any welds are in question, then cut out and test welds. If, based on the radiographs, the percentage of defective welds is excessive, then cut out and test additional welds as directed by the Commissioner.

### 3.8 VERIFICATION OF CONTROL OPERATION

- A. General: Perform the checks outlined in the following for all air system controls:
- B. Thermostats and humidistats - Verify calibration and operation of all thermostats and humidistats. Any Deficiencies shall be reported for correction. Recheck after correction. Record thermostat set point and output signal, space temperature.
- C. Damper Operation - Verify operation and position for all dampers. Any Deficiencies shall be reported for correction. Recheck after correction.
- D. Other Controls - Simulate control operations in accordance with design requirements and manufacturer's recommendations. Any deficiencies shall be reported for correction. Recheck after correction.

### 3.9 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS





- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

### 3.10 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
- B. Note that fan powered mixing boxes are calibrated at factory. However, due to changing inlet conditions, recalibrate each mixing box in field as part of this work and provide reading for box (CFM), and primary air at maximum and minimum setting and corresponding inlet and outlet static pressure.
  - 1. NC (Noise Criteria) Tests: Operate the air handling systems after balancing, to determine that the schedule NC ratings in the spaces are not exceeded.
- C. All volume dampers and VAV boxes shall be positioned for maximum air flow before taking initial supply airflow and static pressure readings. Advise Commissioner immediately if design airflows of air handling units are not achieved before proceeding with further testing.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.



- c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
    - b. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions
    - c. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
    - d. Obtain approval from the City of New York for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
    - e. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- E. Measure air outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- F. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
  - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.11 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS



- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Note that VAV boxes are calibrated at factory. Nevertheless, recalibrate each VAV box in field as part of this work. Air balancer shall show two readings for each box, minimum and maximum and corresponding inlet and outlet static pressure.
- C. Note that fan powered mixing boxes are calibrated at factory. However, due to changing inlet conditions, recalibrate each mixing box in field as part of this work and provide reading for box (CFM), and primary air at maximum and minimum setting and corresponding inlet and outlet static pressure.
  - 1. NC (Noise Criteria) Tests: Operate the air handling systems after balancing, to determine that the schedule NC ratings in the spaces are not exceeded.
- D. All volume dampers and VAV boxes shall be positioned for maximum air flow before taking initial supply airflow and static pressure readings. Advise Commissioner immediately if design airflows of air handling units are not achieved before proceeding with further testing.
- E. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 3. Measure total system airflow. Adjust to within indicated airflow.
  - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  - 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  - 8. Record final fan-performance data.



- F. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- G. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.
  4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Adjust terminal units for minimum airflow.
  6. Measure static pressure at the sensor.
  7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

### 3.12 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.



- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.13 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Commissioner and comply with Section 23 21 23 "HVAC Pumps".
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5



percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

### 3.14 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### 3.15 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment, including, but not limited to, pre-heat coils, CPD equipment, etc.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

### 3.16 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

### 3.17 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor RPM.
4. Efficiency rating.



5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.18 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.

### 3.19 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

### 3.20 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### 3.21 PROCEDURES FOR BOILERS

- A. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.



### 3.22 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
  - 1. Entering- and leaving-water temperature.
  - 2. Water flow rate.
  - 3. Water pressure drop.
  - 4. Dry-bulb temperature of entering and leaving air.
  - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6. Airflow.
  - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Airflow.
  - 3. Air pressure drop.
  - 4. Inlet steam pressure.

### 3.23 LEAKAGE TESTING, AIR DISTRIBUTION SYSTEM

- A. General: Each air distribution system shall be tested for leakage before insulation is applied. After portions of the Work are completed, the following tests shall be made in the presence of the Commissioner. Five (5) days advance written notice of the tests shall be given to the Commissioner, who in turn will notify other parties interested.
- B. Furnish all gauges, blowers, instruments, test equipment, and labor required for tests, and make all provisions for removal of test equipment after tests have been made.
- C. Test all ductwork unless otherwise indicated in this Section.
- D. Leakage test shall be in accordance with test method described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual, except as modified in this Section. Air leakage shall not exceed limits specified.
- E. Air leakage testing during erection shall include separate leakage air tests of built up air handling casings, discharge and intake plenums, machine room ductwork, complete and/or partial air risers, each completed and/or partial horizontal distribution system, and, after all ductwork is installed and central station apparatus is erected, leakage testing of the pressure side of the whole system up to the inlet of the variable air volume and fan powered terminal unit boxes. Test ducts/casings with positive pressure on the discharge side of the system fan and under negative pressure on the suction side of the system fan. Include testing of flexible runouts. It is the intent of the Specifications that ductwork shall be tested in sections, if required, in order to permit work of other trades to proceed.
- F. Do not insulate ductwork until it has been successfully tested.





G. Ductwork (+/-) 2.0" w.g (or less) external static pressure class (see following schedule):

1. Representative samples of ductwork (approximately 20% of total linear feet of ductwork) shall require leakage test as described below.
2. Commissioner will decide samples of ductwork to be tested and date of leakage test to be conducted.
3. If test results are good, remainder of ductwork is permitted to proceed without further testing. If ductwork fails test, repair all ductwork including ductwork not tested. Then repeat leakage tests for new samples of ductwork as described above.
4. Before insulation is applied, run fan at design static pressure and check all joints for all ductwork, risers and branches.

H. Ductwork (+/-) 3.0" w.g (or greater) external static pressure class (see following schedule):

1. All distribution ductwork, plenums, headers, mains and branches shall be individually tested with a blower, orifice section, U-tube gauge board tubing and cocks. arranged to indicate the amount of air leakage Tests shall be made during installation. The blower shall maintain the required test pressure differential across the orifice plate. Leaks which cause an air loss greater than the permissible leakage rate, defined below and, noisy or whistling leaks, shall be repaired and a retest made.
2. Each branch shall be isolated from the remainder of the system by means of seals, plugs, or caps.
3. Leakage Testing: Leakage testing shall utilize blower which shall maintain the design pressure class (see chart below) pressure differential across the orifice plate. Leaks which cause an air loss greater than the permissible leakage rate, defined below or noisy or whistling leaks, shall be repaired and a retest made.

I. All ductwork:

1. All ductwork on the roof, spaces shall be tested after all riser tests have been accepted (where required) and after risers have been connected to the mains but before the branches have been connected to the risers.
2. Mains shall be tested as described for risers and branches.

J. After the acceptance of the tests by the City of New York, the branches shall be connected to the risers and the ductwork shall be released for insulation.

K. Permissible leakage rates:

Duct System	Pressure Classification External Static Pressure	SMACNA Seal	SMACNA Leakage Classification (Table 4-1)
All supply ducts with VAV/CV terminal boxes from fan discharge to terminal box	+4" wg	A	6
All supply ducts in systems without VAV/CV terminal boxes from fan discharge to terminal box	+4" wg	A	6
All supply ducts downstream of VAV/CV terminal boxes to diffusers or chilled beams	+3" wg	B	12
All return and general exhaust ducts (toilets, MER Ventilation, non-lab exhaust)	-3" wg	B	12
All fume hood, laboratory and all other special exhaust systems.	-4" wg	A	6



### 3.24 OPERATING TESTS

- A. General: After the various systems are pressure-tested and cleaned as hereinbefore specified, each piping and air handling system shall be tested in the presence of the Commissioner. Five-days advance written notice of the tests shall be given to the Commissioner by the Contractor who in turn will notify other parties interested.
- B. Furnish all gauges, instruments, test equipment and labor required for the tests. Adjust all equipment to perform with the least possible noise and vibration consistent with its duty. Quietness of operation of all equipment is a requirement. Any equipment producing objectionable noise in occupied spaces must be repaired or removed and replaced with satisfactory equipment.
- C. Piping Systems: operate the heating systems, and make adjustments in controls and equipment, and complete necessary balancing to deliver not less than the water quantities shown on the drawings at each equipment item.
- D. NC (Noise Criteria) Tests: Operate the air handling systems after balancing, to determine that the scheduled NC ratings in the spaces are not exceeded.

### 3.25 SOUND AND VIBRATION TESTING

- A. Sound Traps and Silencers:
  - 1. After installation: measure total system pressure before and after attenuators.
  - 2. If pressure loss exceeds maximum static pressure loss schedules on drawings: at no charge, replace attenuators and/or modify entrance and/or discharge aerodynamic flow to obtain specified performance.
- B. Noise Criterion Levels:
  - 1. After air systems are properly air balanced, the resulting octave band noise levels should be measured in all spaces specified to determine compliance, in accordance with National Environmental Balancing Board (NEBB) Procedural Standards for the Measurement and Assessment of Sound and Vibration.
  - 2. If design noise levels are exceeded, the air balancer shall check all air moving devices to insure all fan systems are operating at the lowest rpm and static pressure to deliver (exhaust) the design cfm from the most remote point. If the balancer needs to make a sheave change to accomplish this, the change should be at no charge to the City of New York's.
- C. Rotating Equipment Vibration Levels
  - 1. After systems are properly air and water flow balanced, vibration levels of all equipment shall be tested in accordance with National Environmental Balancing Board (NEBB) Procedural Standards for the Measurement and Assessment of Sound and Vibration.
  - 2. If equipment vibration levels are found to be excessive then the equipment shall have the necessary repairs performed and/or be dynamically balanced to reduce vibration.

### 3.26 INDOOR AIR QUALITY TESTING

- A. Equipment Specification:
  - 1. An infrared photo acoustic analyzer shall be used to monitor for carbon dioxide, carbon monoxide, and total volatile organic compounds levels. It is a real time analyzer



equipment. The sampling installation in the building shall extend into the outside air, supply air and return air of each central HVAC system. In tenant areas the sampling points shall be as close as possible to the occupants breathing zones.

2. Calibration shall be performed in accordance with manufacturer specifications and recommended procedures.

**B. Application (Analytical Methodology)**

1. The analytical method used shall be a direct reading of the infrared spectroscopy technique, which classifies different organic compounds by their ability to absorb energy of specific wavelengths in the infrared region, specifically, center wavelength 3.4  $\mu\text{m}$  and 3.6  $\mu\text{m}$  respectively, as well as determine carbon dioxide and carbon monoxide in parts per million (ppm). The sub detection levels of the instrument, in parts per million (ppm) and milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ), shall be as follows:
  - a. Carbon dioxide = 1.7 ppm;
  - b. Carbon monoxide = 0.2 ppm;
  - c. Total volatile organic compounds, center wavelength 3.4  $\mu\text{m}$  = 0.036  $\text{mg}/\text{m}^3$ . The instrument is calibrated for propane at this wavelength. The detection level of this filter is sensitive to changes in relative humidity.
  - d. Total volatile organic compounds center wavelength 3.6  $\mu\text{m}$  = 0.07  $\text{mg}/\text{m}^3$ . The instrument is calibrated for formaldehyde at this wavelength.

**C. Indoor Air Quality Periodic Testing**

1. Two different sampling strategies shall be used, time specific sampling and 24-hour Continuous Monitoring.
2. The first strategy shall be the collection of indoor gaseous air quality data from a floor at a specific point in time (known as Time Specific Sampling), providing a snapshot of ambient conditions which are to be compared to applicable indoor air quality standards for verification of compliance with operating parameters.
3. The second strategy (known as 24-Hour Continuous Monitoring) expands upon the first through the use of additional equipment and provides a 24-hour study of conditions on the floor. The enhanced data produced by this configuration provides a more comprehensive view of ambient conditions and can record transient conditions that occur any time during monitoring. A graphical representation of gas concentrations over the sampling period is provided as part of the report.

**D. Time-Specific Sampling**

1. Indoor Gaseous Air Quality Monitoring for carbon dioxide ( $\text{CO}_2$ ), carbon monoxide (CO) and two classes of total volatile compounds (TVOC) utilizing air sampling and the Infrared Photo acoustic Multi-Gas Analyzer shall be performed at 4 locations on each floor as well as at the central HVAC equipment. This survey shall also include a visual inspection of the MER for parameters adversely affecting indoor air quality. The inspection should be focused on mechanical hygiene and should follow the parameters dictated by EPA's guidelines such as the "Building Air Quality: A Guideline for Building Owners and Facilities Managers".
2. 24-Hour Continuous Monitoring
  - a. Continual monitoring of Gaseous Indoor Air Quality Parameters shall include: carbon dioxide ( $\text{CO}_2$ ), carbon monoxide (CO) and two classes of total volatile organic compounds (TVOC). This monitoring shall be performed utilizing air sampling installations and Infrared Photo-acoustic Multi-Gas Analyzer configured



for continuous, unattended operation for a 24-hour period. This survey shall include a visual inspection of the MER for parameters adversely affecting indoor quality. The inspection should be focused on mechanical hygiene and should follow the parameters dictated by EPA's guidelines such as the "Building Air Quality" A Guideline for Building Owners and Facilities Managers"

### 3.27 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 3 percent.
  - 2. Air Outlets and Inlets: Plus or minus 3 percent.
  - 3. Heating-Water Flow Rate: Plus or minus 3 percent.
  - 4. Cooling-Water Flow Rate: Plus or minus 3 percent.

### 3.28 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.29 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the contractor's testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract



Documents.

3. Nomenclature sheets for each item of equipment.
  4. Data for terminal units, including manufacturer's name, type, size, and fittings.
  5. Notes to explain why certain final data in the body of reports vary from indicated values.
  6. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Number, make, and size of belts.
    - i. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
  3. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.



- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

**F. Apparatus-Coil Test Reports:**

**1. Coil Data:**

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

**2. Test Data (Indicated and Actual Values):**

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

**G. Gas-Fired Heat Apparatus Test Reports:** In addition to manufacturer's factory startup equipment reports, include the following:

**1. Unit Data:**

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.



- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore (if applicable).
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches (if applicable).
- g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.



- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft.
    - g. Indicated air flow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual air flow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- J. Air-Terminal-Device Reports:
1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft.
  2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary air flow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final air flow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- K. System-Coil Reports: For reheat coils, chilled beams and water coils of terminal units, include the following:
1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.





2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
  1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig.
    - h. Required net positive suction head in feet of head or psig.
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.
  2. Test Data (Indicated and Actual Values):
    - a. Static head in feet of head or psig.
    - b. Pump shutoff pressure in feet of head or psig.
    - c. Actual impeller size in inches.
    - d. Full-open flow rate in gpm.
    - e. Full-open pressure in feet of head or psig.
    - f. Final discharge pressure in feet of head or psig.
    - g. Final suction pressure in feet of head or psig.
    - h. Final total pressure in feet of head or psig.
    - i. Final water flow rate in gpm.
    - j. Voltage at each connection.
    - k. Amperage for each phase.
- M. Instrument Calibration Reports:
  1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.



### 3.30 INSPECTIONS

#### A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
  - a. Measure airflow of at least 75 percent of air outlets.
  - b. Measure water flow of at least 75 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

#### B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Commissioner.
2. The Contractor's TAB test and balance engineer shall conduct the inspection in the presence of the Commissioner
3. The Commissioner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "Failed."
5. If the number of "Failed" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

#### C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

#### D. Prepare test and inspection reports.

### 3.31 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION 23 05 93**

**SECTION 23 07 00****HVAC INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".
- F. Section 23 31 20 "Fire-Resistive Duct-Pipe Insulation and Enclosure".

**1.2 SUMMARY**

- A. Section includes thermal insulation on all ductwork, casings, plenums, housing, piping, fittings, valves, equipment and all other necessary items connected into the system subject to condensation or loss of heat.
- B. In addition, the section includes:
  - 1. Insulation Materials
    - a. Fiberglass
    - b. Calcium silicate.
  - 2. Insulating cements, Adhesives & Mastics.
  - 3. Sealants.
  - 4. Factory-applied jackets.
  - 5. Field-applied fabric-reinforcing mesh.
  - 6. Field-applied cloths.
  - 7. Field-applied jackets.

**1.3 DEFINITIONS:**

- A. Exposed: Indoor ducts, piping or equipment located in mechanical rooms and in areas which will be visible without removing ceilings or opening access panels.
- B. Concealed: Indoor ducts, piping or equipment which is not exposed.
- C. Outdoor: ducts, piping or equipment which is exposed to the weather.
- D. Insulation thermal conductivity: No greater than value listed, in Btu- inch/hour-square foot-

degrees F at 75 degrees F mean temperature.

- E. Water Vapor Permeance (ASTM E97 or E96, Procedure A): No more than value listed, in perms.
- F. Water vapor permeability (ASTM C355): No greater than value listed, in perm-inch.
- G. Puncture resistance (ASTM D781): No less than value listed.
- H. Density: no less than value listed, in pounds per cubic foot.

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 REFERENCE STANDARDS

- A. The following published Specifications' standards, tests or recommended methods apply to work in this Section:
  - 1. ASTM E 84, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.
  - 2. NFPA 255 – Surface Burning Characteristics of Building Materials.
  - 3. UL 723 – Surface Burning Characteristics of Building Materials.
  - 4. ANSI/ASTM C553 – Mineral Fiber Blanket and Felt Insulation.
  - 5. ASTM C335 – Thermal Conductivity of Pipe Insulation.
  - 6. ANSI/ASTM C612 – Mineral Fiber Block and Board Thermal Insulation.
  - 7. ASTM C411 - Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation.
  - 8. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties



- by Means of the Heat Flow Meter Apparatus.
9. ASTM C533 – Standard Specifications for Calcium Silicate Block and Pipe Thermal Insulation
  10. ASTM C 547 - Standard Specification for Mineral Fiber Pipe Insulation.
  11. ASTM C 585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Normal Sizes of Pipe and Tubing (NPS System).
  12. ASTM C 795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
  13. ASTM C 916 (1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation
  14. ASTM C 920 (2008) Standard Specification for Elastomeric Joint Sealants
  15. ASTM C 921 (2009) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
  16. ASTM D 774/D 774M (1997; R 2007) Bursting Strength of Paper
  17. ASTM C 1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
  18. ASTM E 96 - Test Method for Water Vapor Transmission of Materials
  19. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
  20. ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
  21. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
  22. ASTM E 2336, 'Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems'
  23. ASTM C 1338, 'Fungi Resistance of Insulation Materials and Facings Standard'.
  24. ASTM E119, Standard Method of Fire Tests of Building Construction and Materials; 2-hour Wall Panel Test, and 2-hour External Total Engulfment Test.
  25. ASTM E814, Standard Method of Fire Test of Through-Penetration Fire Stops; 2-hour Firestop Test.
  26. ASTM E136, Combustibility.
  27. C518-91, Aging Test.
  28. UL 1978, First Edition of the Standard for Grease Ducts.
  29. UL 263, Full Scale External (Engulfment) Fire Test.
  30. UL 1479, Through - Penetration 3-hour Firestop Test.
  31. Underwriters Laboratories of Canada, ISO 6944-1985, 1- & 2-hour Large Ventilation Duct Fire Resistive Enclosure Test.
  32. Underwriters Laboratories of Canada, CAN4-S115-M85/UL1479, 1- & 2-hour Through-Penetration Firestop Tests.
  33. Underwriters Laboratories of Canada, ULC S102-M88, flammability.
  34. ISO 6944-1985, 'Fire Resistive Tests - Ventilation Ducts'.

## 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories shall be fire hazard rated and listed by Underwriters' Laboratory, Inc., using the Steiner Tunnel Test Method for Fire Hazard Classification of Building Materials, Standard UL 723 (ASTM E-84) and NFPA 255. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction.
- C. All Insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E.84, NFPA 255 or UL 723 not exceeding:



Flame Spread            25  
Smoke Developed       50

- D. Flameproofing treatments which are subject to deterioration from moisture or humidity are not acceptable.
- E. Accessories such as adhesives, mastics, cements, and tapes for fittings shall have the same component rating as listed above. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed requirements. Treatment of jackets or facings to impart flame and smoke-safety shall be permanent. The use of water soluble treatments is prohibited.
- F. Provide insulation that meets or exceed the requirements of ASHRAE 90.1, ASHRAE 90.2. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling.
- G. Materials shall be compatible with insulation materials. jackets and substrates and for bonding insulation to itself and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state.
- H. Products shall not contain asbestos, lead, mercury or mercury compounds.
- I. Products that come in contact with stainless steel shall meet ASTM C 795 requirements and shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- J. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state.
- K. All insulation materials shall be designed, manufactured, and tested in facilities which are certified and registered to ISO 9000 (ANSI/ASQ 90) series quality standards.
- L. All equipment and materials shall be UL listed.
- M. Maintain ambient conditions required by manufacturers of tapes, adhesives, mastics, cements and insulation materials.
- N. Insulation materials and accessories furnished and installed hereunder shall be accompanied by manufacture's current submittal or data sheets showing compliance with applicable specifications.
- O. Insulation materials, including all weather and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.
- P. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.
- Q. Fire resistive duct wrap shall be installed by manufacturer trained, experienced workers specializing in fire resistive ductwork enclosure application with 3 years minimum experience in such installations.
- R. Standard Products: Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 3 years prior.
- S. All equipment and materials shall be approved for use in New York City by the NYC DOB and

FDNY.

#### 1.08 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.9 SUBMITTALS

- A. Submit shop drawings for insulation materials, vapor barrier materials, adhesives, fastening devices and finishes and jacketing.
- B. Submit a schedule listing the work that will be insulated and a description of insulation materials and finishing procedures and a certificate indicating compliance with 2014 NYCBC.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. All of the insulation materials and accessories covered by this specification shall be delivered to the job site in the manufacturer's unopened containers and stored in a safe, dry place with appropriate labels and/or other product identification.
- C. Use whatever means are necessary to protect the insulation materials and accessories before, during, and after insulation. No insulation materials shall be installed that has become damaged in any way. Also use all means necessary to protect work and materials installed by other trades.
- D. If any insulation material has become wet because of transit or job site exposure to moisture or water, Do not install such material, and shall remove it from the job site.

#### 1.11 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 232113 "HVAC Piping."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.12 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

**PART 2 - PRODUCTS****2.1 GENERAL**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Fiberglass:

- a. Owens Corning Fiberglass Corp.
- b. Certain Teed Corp./Insulation Group
- c. Johns Manville Corp.
- d. Knauf Fiberglass Armstrong Pumps Inc.
- e. Or approved equal.

2. Calcium Silicate:

- a. Industrial Insulation Group
- b. Certain Teed Corp./Insulation Group
- c. Johns Manville Corp.
- d. Or approved equal.

3. Finishes, adhesives and sealants:

- a. Foster Products Div.,
- b. H.B. Fuller Co.,
- c. Epolux Mfg Co.,
- d. Childers Products Co.
- e. Armstrong World Industries.
- f. Or approved equal

4. Weld pins:

- a. AGM Industries, Inc. and Duro-Dyne Corp.
- b. Childers Products Co. and
- c. Armstrong World Industries.
- d. Or approved equal

5. Custom-Fit, pre-molded, PVC pre-molded fittings covers (UL Class 1):

- a. Manville Corp. (Zeston).
- b. Epolux Mfg Co.,
- c. Childers Products Co.
- d. Or approved equal.

6. Insulating & finishing cement:

- a. Keene Corp.,
- b. Insulation Industries, Inc. and
- c. Ryder Industries, Inc.
- d. Or approved equal.

7. Fire Resistive Duct, Pipe and Equipment Insulation





- a. 3M
  - b. Hilti
  - c. Holdrite
  - d. Or approved equal.
- B. Insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E.84, NFPA 255 or UL 723 not exceeding:
- Flame Spread 25  
Smoke Developed 50
- C. All fiberglass insulation products used for ductwork, piping, or equipment insulation shall be formaldehyde free.
- D. Materials shall be compatible with insulation materials, jackets and substrates and for bonding insulation to itself and to surfaces to be insulated.
- E. Sealants shall be permanently flexible, with a temperature range of minus 100 deg F to plus 300 deg F.
- F. Products shall not contain asbestos, lead, or mercury compounds.
- G. Note that insulation (with vapor barrier) shall be continuous across all duct joints, pipe joints, hot water reheat coil pipe bends (insulated end caps), diffusers, etc. so as to provide a continuous, fully insulated (with uninterrupted vapor barrier) from the fan discharge to the diffusers.
- H. Insulation on all cold surfaces must be applied with a continuous unbroken vapor seal. Hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. All penetrations of the All Service Jacket and exposed ends of insulation shall be sealed with vapor barrier mastic.
- I. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion.
- J. All piping and ductwork shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier shall be continuous, including material covered by the hanger saddle.
- K. Sections of ductwork or equipment (such as heads, pumps, etc.) requiring periodic servicing shall be insulated with sheet metal covers lined with the same type and thickness of material as the adjoining insulation.

## 2.2 PIPE INSULATION

- A. Fiberglass pipe insulation located in equipment rooms and/or where exposed shall be of the sectional type having a density of 6 lbs./cu. ft. (minimum). Other fiberglass insulation to be of the 1-piece type with a density of 5-lbs./cu ft. (minimum).
- B. Type P-1: Molded Fiberglass, Pre-Formed Insulation for Cold Pipes.
1. The maximum K factor shall be 0.24 at 75°F mean temperature with a minimum density



- of 4 lb. per cubic foot.
2. Insulation shall be pre-formed, rigid, molded, one-piece fiberglass insulation that is bonded with thermosetting resin.
  3. The insulation shall be provided with a factory applied all service or all-purpose vapor barrier jacket consisting of fire retardant laminate with white kraft facing, glass scrim reinforcing and aluminum foil. White, kraft paper, reinforced with a glass fiber yarn and bonded to an aluminum foil, with self- sealing longitudinal closure laps (SSL) and butt strips. Comply with ASTM C547.
  4. The insulation shall be similar to Owens-Corning 650 ASJ or approved equal.
- C. Type P-1A: Molded Fiberglass, Pre-Formed Insulation for Cold Pipes with Custom Fit Covers.
1. Insulation material, thickness and vapor seal shall be the same as for Type P-1, with custom fit covers. Covers shall be as specified herein.
- D. Type P-2: Molded Fiberglass, Pre-Formed Insulation for Hot Pipes.
1. High temperature, Type I, glass fibers bonded with a thermosetting resin.
  2. The maximum K factor shall be 0.24 at 75°F mean temperature. Insulation shall be capable of continuous service at a pipe temperature of 450° F without oxidation, burnout of binders or development of odors or smoke. The insulation shall be provided with a factory applied, All-Service (ASJ) Vapor-Retarder Jacket - white, kraft paper, reinforced with a glass fiber yarn and bonded to an aluminum foil, with self- sealing longitudinal closure laps (SSL) and butt strips.
  3. Insulation shall be pre-formed, rigid, molded, one-piece fiberglass insulation that is bonded with thermosetting resin. Insulation shall be 11 lbs. per cubic foot density fiberglass rated for a maximum service temperature of 850° F (454C).
  4. Minimum thickness of insulation shall be as specified herein. However, sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +110F.
  5. All fittings, valves, flanges and pipe terminations shall be fully insulated with glass fiber insulation and molded fitting covers. Comply with ASTM C533.
  6. The insulation shall be similar to Johns Manville Micro-Lok HP or approved equal.
- E. Type P-2A: Molded Fiberglass for Hot Pipes with Custom Fit Covers.
1. Insulation material and thickness shall be the same as for Type P-2 with custom fit covers.
  2. Covers shall be as specified herein.
- F. Type P-3: Calcium Silicate.
1. High temperature, noncombustible, inorganic, hydrous calcium silicate with non-asbestos fibrous reinforcement.
  2. The maximum K factor shall be 0.41 at 200° F mean temperature with a minimum density of 14 lbs. per cu. ft. Insulation shall be fastened in place with 16-gauge copper-clad wire on 18" maximum centers. Comply with ASTM C533, ASTM C450, and ASTM C585.
  3. The insulation shall be similar to Industrial Insulation Group Thermo-12 Gold or approved equal.

## 2.3 INSULATION COVERS

- A. Covers shall be designed and fabricated especially for utilization on piping, including all flanges, fittings, valves, expansion joints, vents, pipe terminations, drains and all other parts of the system.



- B. The covers shall be molded white PVC jacket, UL Class 1 with a maximum permeance of 0.05.
- C. Comply with ASTM C 450 and ASTM C 585 for dimensions used in pre-forming insulation to cover valves, elbows, tees and flangers.
- D. Removable and reusable insulation covers must be fabricated to conform to the shape and contour of the equipment requiring insulation. Covers to ensure good appearance and proper thermal performance.
- E. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
- F. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
- G. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
- H. Install removable insulation covers as indicated in the contract documents. Installation shall conform to the following:
  - 1. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  - 2. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- I. Custom-Fit Covers:
  - 1. Cover Components shall be:
    - a. Inner Jacketing – 18 oz. color-coded Teflon fiberglass cloth with a nominal weight of at least 18 oz. per square yard and a service temperature rating of at least 550 F.
    - b. Outer Jacketing - 18 oz. color coded Teflon fiberglass cloth.
    - c. All Hardware – 304 stainless steel
    - d. Covers shall be constructed as a preformed single piece cover and the closing seam shall be located at the gravitational bottom.
    - e. All valve covers shall be manufactured as one (1) piece body and bonnet.
    - f. Individual covers thereof shall not weigh more than 75#. All seams shall be sewn using a locked stitch with a minimum of eight (8) stitches per inch. The thread must be able to withstand the full process temperature without degradation.
    - g. Gussets - 18 oz. color-coded Teflon fiberglass cloth.
    - h. D Rings – D – Rings for use with seam attachment shall be welded double D – shaped rings of .12 or greater diameter Type 304 stainless steel wires.
    - i. Velcro fastening system for securement of loose strap ends and closing system for small covers shall be heat and flame resistant nylon and shall be a minimum of 1" wide.
    - j. Sewing Thread - .021 – 20# tensile strength Teflon Coated fiberglass thread.



- k. ID Tags – 304 Stainless steel.
- l. Terminal ends – The draw cord for cinching of cover terminal ends around adjacent insulation, valve packing, etc. shall be of 3/16" braided Nomex cord. Terminal ends shall be 8 oz. color coded Teflon cloth flaps.
- m. Individual covers thereof shall not weigh more than 75#. All seams shall be sewn using a locked stitch with a minimum of eight (8) stitches per inch. The thread must be able to withstand the full process temperature without degradation.
- n. Hog rings or staples shall not be used as a method of seam closure.
- o. Insulation within the jacket shall be held in place with stainless steel quilt pins to prevent shifting.
- p. Cinch belts and Velcro flaps shall be used to hold the cover in place. Belts shall be made of outer jacket materials and two stainless steel D-ring fasteners. Velcro fasteners shall be used to secure end of belts to cover after cinching.
- q. Belts and D-Rings and Velcro flaps shall be used on all parting faces. Securement of the belts and Velcro flap traps to the weather barrier (pouter skin of the cover) shall be sewn to the cover and shall be sufficient to withstand the stress of removing and reinstalling the cover. Belt lengths and number of straps utilized shall be sufficient to affect a snug and proper fit without gaps or sagging of the cover.
- r. Each cover shall have a SS identification tag.

## 2.4 DUCT AND EQUIPMENT INSULATION

### A. Type D-1: Fiberglass Blanket with Vapor Barrier.

- 1. The maximum K factor shall be 0.28 at 75°F mean temperature with a minimum density of 1 lb. pcf. The insulations shall be provided with a factory-applied reinforced foil faced, flame resistant, scrim-kraft facing vapor barrier. Comply with ASTM C533 and ASTM C1290.
- 2. The insulation shall be equal to Johns Manville Microlite or approved equal.

### B. Type D-2: Rigid Fiberglass Board with Vapor Barrier.

- 1. The maximum K factor shall be 0.23 at 75°F mean temperature with a minimum density of 4.25 lb. pcf. The insulation shall be provided with a factory-applied reinforced foil faced, flame resistant, scrim-kraft facing vapor barrier. Comply with ASTM C612.
- 2. The insulation shall be equal to Manville Type 814 Spin-Glas AP or approved equal.

### C. Type D-3: Fiberglass Blanket for Hot Ducts.

- 1. The maximum K factor shall be 0.28 at 75°F mean temperature with a minimum density of 1 lb pcf. The insulations shall be provided with a factory-applied, flame resistant, reinforced foil facing. Comply with ASTM C553.
- 2. The insulation shall be equal to Johns Manville Microlite or approved equal.

### D. Type D-4: Fiberglass Board for Hot Ducts.

- 1. The maximum K factor shall be 0.23 at 75°F mean temperature with a minimum density of 4.25 lb. pcf. The insulation shall be provided with a factory-applied reinforced foil faced, flame resistant, scrim-kraft facing. Comply with ASTM C612.
- 2. The insulation shall be equal to Manville Type 814 Spin-Glas AP or approved equal.

### E. Type D-5: Weatherproof Fiberglass Board.

- 1. The maximum K factor shall be 0.22 at 75°F mean temperature with a minimum density



- of 6 lb. The insulation shall be provided with a factory-applied all purpose or all service jacket facing.
2. The insulation shall be equal to Manville Type 817 Spin-Glas AP or approved equal.
- F. Type D-6: High Temperature Calcium Silicate Insulation.
1. The maximum K factor shall be 0.42 at 200° F mean temperature with a minimum density of 14 lbs. per cu. ft. Insulation shall be fastened in place with 16-gauge copper-clad wire on 18" maximum centers.
  2. The insulation shall be equal to Industrial Insulation Group Thermo-12 Gold or approved equal.
- G. Type D-7: Fire Resistive Duct Wrap Insulation/enclosure, as specified herein and under section 233120.

## 2.5 FIRE RESISTIVE WRAP INSULATION/ENCLOSURE (TYPE D-7)

- A. Fire resistive duct wrap/enclosure must be approved for use in NYC by NYCDOB and FDNY.
- B. Fire resistive wrap insulation/enclosure is specified under section 23 31 20 – Fire-Resistive Duct-Pipe Insulation and Enclosure.
- C. The Smoke Developed Index and Flame Spread Index (ASTM E 84) of the bare blanket and of the foil-encapsulated blanket shall be 0/0. The foil encapsulation shall be bonded to the core blanket material.
- D. The product shall be listed with both UL and Intertek (OPL) for 2 hour rated application.

## 2.6 EQUIPMENT INSULATION

- A. Type E-1: Fiberglass Rigid Equipment Insulation with Vapor Barrier.
  1. The maximum K factor shall be 0.23 at 75°F mean temperature with a minimum density of 4.25 lb. pcf. The insulation shall be provided with a factory-applied reinforced foil faced, flame resistant, scrim-kraft facing vapor barrier. Comply with ASTM C612.
  2. Insulation shall be firmly held in place with copper clad wire or pins and clips on 12" centers.
  3. All joints and voids shall be filled with mineral wool cement.
  4. All joints and breaks in the vapor barrier shall be sealed with strips of the vapor barrier facing adhered with vapor barrier adhesive.
  5. The insulation shall be similar to Johns Manville Microlite or approved equal.
- B. Type E-2: Fiberglass Rigid Equipment Insulation:
  1. The maximum K factor shall be 0.23 at 75°F mean temperature with a minimum density of 4.25 lb. pcf. The insulation shall be provided with a factory-applied reinforced foil faced, flame resistant, scrim-kraft facing vapor barrier. Comply with ASTM C612.
  2. Insulation shall be firmly held in place with copper clad wire or pins and clips on 12" centers.
  3. All joints and voids shall be filled with mineral wool cement.
  4. The insulation shall be equal to Manville Type 814 Spin-Glas AP or approved equal.
- C. Type E-3: High Temperature Block Insulation.
  1. High temperature insulation shall be molded hydrous calcium silicate with a maximum K



- factor of 0.42 at 200°F mean temperature and a minimum density of 11 lb. pcf.
2. The insulations shall be provided with a factory-applied, flame resistant, reinforced foil facing. Comply with ASTM C553.
  3. Insulation shall be firmly wired in place with copper clad wire or galvanized steel bands on 12" centers.
- D. Type E-4: Fire Resistive Duct Wrap Insulation, as specified herein and under another under section 233120.

INSULATION SCHEDULE - PIPING			
PIPING SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
CHILLED WATER SUPPLY & RETURN	P-1	1-1/2"	YES
CHILLED WATER SUPPLY AND RETURN EXPOSED IN MER	P-1A	1-1/2"	YES
HOT WATER SUPPLY & RETURN (100°F - 140°F)	P-2	1-1/2"	NO
HOT WATER SUPPLY & RETURN (100°F - 140°F) EXPOSED IN MER	P-2A	2"	NO
HOT WATER SUPPLY & RETURN (140°F - 250°F) UP TO 6" IPS	P-2	2"	NO
OVER 6" IPS	P-2	3"	NO



INSULATION SCHEDULE - PIPING			
PIPING SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
HOT WATER SUPPLY & RETURN  (140°F - 250°F)  EXPOSED IN MER  UP TO 6"  OVER 6' IPS	P-2A     P-2A	2"     3"	NO     NO
CONDENSER WATER	P-1	2"	YES
CONDENSER WATER  EXPOSED IN MER	P-1A	2"	YES
OUTDOOR CONDENSER WATER	P-1	2"	YES, WITH WEATHRPROOF ENCLOSURE
LOW PRESSURE STEAM  (0 TO 14 PSIG) AND CONDENSATE  UP TO 1-1/2" IPS  2" TO 6" IPS  OVER 6" IPS	P-2     P-2  P-2	1-1/2"     3"  3-1/2"	NO     NO  NO
LOW PRESSURE STEAM  (0 TO 14 PSIG) AND CONDENSATE  EXPOSED IN MER  UP TO 1-1/2" IPS  2" TO 6" IPS  OVER 6" IPS	P-2A     P-2A  P-2A	1-1/2"     3"  3-1/2"	NO     NO  NO



INSULATION SCHEDULE - PIPING			
PIPING SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
ALL PIPING SUBJECT TO FREEZING SUCH AS IN OUTDOOR AIR INTAKE PLENUM OR DISCHARGE/EXHAUST AIR PLENUM	P-1	2"	YES, WITH HEAT TRACING AND WEATHERPROOF ENCLOSURE
ALL PIPING LOCATED WITHIN CEILING SPACES BELOW ROOF	P-1	2"	YES
ALL PIPING LOCATED WITHIN CEILING SPACES ABOVE OR BELOW SPACES THAT ARE SUBJECT TO AMBIENT CONDITIONS OR ARE NOT CONDITIONED	SAME AS PIPING SYSTEM	2"	
STEAM HUMIDIFICATION PIPING	SAME AS LOW PRESSURE STEAM		
FUEL OIL SUPPLY AND RETURN	P-3	1"	NO
STEAM SAFETY AND RELIEF	P-2	1"	NO
ENGINE EXHAUST AND MUFFLER	P-2	3"	NO
DOMESTIC MAKE-UP WATER	P-1	1/2"	YES
DRAINS FROM AC UNITS, FAN COILS COOLING COIL DRIP PANS AND MISCELLANEOUS PIPING SUBJECT TO SWEATING	P-1	1-1/2"	YES





INSULATION SCHEDULE - DUCTWORK			
DUCT SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
ALL AIR CONDITIONING AND/OR HEATING SUPPLY DUCTWORK (LOW, MEDIUM & HIGH PRESSURE) FROM FAN DISCHARGE TO DIFFUSERS (INCLUDING PLENUM, TERMINAL BOXES, GRILLES & REGISTERS):			
CONCEALED	D-1	1-1/2"	YES
ROUND	D-1	1-1/2"	YES
EXPOSED	D-2	1"	YES
ALL AIR CONDITIONING AND/OR HEATING SUPPLY DUCTWORK (LOW, MEDIUM & HIGH PRESSURE) FROM FAN DISCHARGE TO ANY TERMINAL DEVICE			
CONCEALED	D-1	1-1/2"	YES
ROUND	D-1	1-1/2"	YES
EXPOSED	D-2	1"	YES



INSULATION SCHEDULE - DUCTWORK			
DUCT SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
ALL AIR CONDITIONING AND/OR HEATING SUPPLY DUCTWORK (LOW, MEDIUM & HIGH PRESSURE) FROM AIR TERMINAL DEVICE TO DIFFUSERS, GRILLES & REGISTERS):			
CONCEALED	D-1	1-1/2"	YES
ROUND	D-1	1-1/2"	YES
EXPOSED	D-2	1-1/2"	YES
RETURN AIR DUCTWORK, INSTALLED IN HUNG CEILING WHERE SPACES IMMEDIATELY ABOVE AND BELOW ARE AIR CONDITIONED	NONE	NONE	NO
RETURN AND EXHAUST AIR DUCTWORK LOCATED WITHIN CEILING SPACES, SOFFITS OR RUN EXPOSED, THAT ARE BELOW ROOFS,			
ROUND	D-1	1-1/2"	YES
EXPOSED	D-1	1"	YES



INSULATION SCHEDULE - DUCTWORK			
DUCT SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
RETURN AND EXHAUST AIR DUCTWORK LOCATED WITHIN CEILING SPACES, SOFFITS OR RUN EXPOSED, THAT ARE EITHER BELOW OR ABOVE SPACES THAT ARE SUBJECT TO AMBIENT CONDITIONS OR NON AIR CONDITINED SPACES			
ROUND	D-1	1-1/2"	YES
EXPOSED	D-1	1"	YES
RETURN AND EXHAUST AIR DUCTWORK LOCATED WITHIN MERS			
ROUND	D-1	1-1/2"	YES
EXPOSED	D-1	1"	YES
OUTDOOR INTAKE PLENUM AND DUCTS FROM LOUVERS TO AIR HANDLING UNITS	D-2	2"	YES
OUTDOOR AIR INTAKE DUCTWORK BETWEEN LOUVERS AND PLENUMS AND AIR HANDLING UNITS	D-2	2"	YES
EXHAUST AIR DUCTWORK BETWEEN AUTOMATIC DAMPERS AND LOUVERS	D-2	1"	NO
ALL DUCTWORK WHERE AIR FLOW TEMPERATURE MAY EXCEED 85°F	D-2	2"	YES



INSULATION SCHEDULE - DUCTWORK			
DUCT SYSTEM	INSULATION TYPE	THICKNESS	VAPOR BARRIER REQUIRED
NON-AIR CONDITIONED AND NON-HEATED OUTSIDE AIR SUPPLY DUCTS.  EXCEPTIONS:	D-1	2"	YES
	D-1	2"	YES
	D-1	2"	YES
DUCTWORK RUNNING IN UNHEATED AREAS			
CONCEALED	D-2	2"	
ROUND	D-2	2"	
EXPOSED	D-2	2"	
EXHAUST DUCTWORK FROM WET OR HUMID AREAS	D-2	2"	YES
FUME HOOD AND BSC EXHAUST DUCTWORK LOCATED WITHIN SHAFTS	D-7	SEE SPECS	



INSULATION SCHEDULE - EQUIPMENT			
EQUIPMENT	INSULATION TYPE	THICKNESS	VAPOR BARRIER
CENTRIFUGAL REFRIGERATION MACHINES	E-1	2"	YES
EVAPORATORS, DEHUMIDIFIERS AND EXCHANGERS	E-1	2"	YES
CHILLED WATER PUMPS, SECONDARY PUMPS AND EXPANSION TANKS	E-1	2"	YES
SINGLE INLET FANS DOWNSTREAM OF COOLING COIL	E-1	2"	YES
HOT WATER EXPANSION TANK (MAX. 250 F)	E-2	1"	NO
HOT WATER CONVERTERS, HEAT EXCHANGERS AND HW GENERATORS (MAX. 250 F)	E-2	1"	NO
BOILERS	E-3	2"	NO



INSULATION SCHEDULE – BREECHINGS, VENTS & EXHAUSTS			
EQUIPMENT	INSULATION TYPE	THICKNESS	VAPOR BARRIER
BOILER BREECHING	D-7	4"	NO
HOT WATER EXPANSION TANK (MAX. 250 F)	D-5	1"	NO
HOT WATER CONVERTERS, HEAT EXCHANGERS AND HW GENERATORS (MAX. 250 F)	D-5	1"	NO
BOILERS	D-7	2"	NO
ENGINE EXHAUST AND MUFFLER	P-3	2"	NO
DOMESTIC MAKE-UP WATER	P-1	1/2"	YES
PIPING SUBJECT TO SWEATING	P-1	1-1/2"	YES

## 2.7 DUCTWORK, EQUIPMENT, BREECHINGS & EXHAUST

- A. Exhaust air ductwork between automatic dampers and louvers, outdoor air intake duct from louvers to air handling unit, outside air intake duct from plenum to air handling unit, and any system when temperature may exceed 85°F.
- B. Ducts and sheet metal plenums behind louvers that containing a percentage of outside air. Provide vapor barrier. Insulation shall be: 2" thick, Type D-2.
- C. All supply air sheet metal plenums. Insulation shall be: 2" thick, Type D-2.
- D. Thickness shall be equal to the depth of the steel angles, except that the thickness shall be not less than 1 inch and not more than 2 inches. Insulation is not required where sound-lining is of minimum thickness specified for insulation.

## 2.8 PLENUMS, HOUSINGS AND CASINGS

- A. Insulate plenums, housings and casings in the following systems:
  - 1. Air conditioning systems supply and return.
  - 2. Outside air intake: all systems.
  - 3. Mixing plenums: all systems.
  - 4. Exhaust ductwork between dampers and louvers.

5. All humidifier housings.

## 2.9 FINISHES, ADHESIVES, SEALANTS AND JACKETS

- A. Materials shall be compatible with insulation materials, jackets and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Custom-Fit Covers. The covers shall be as specified herein.
- C. Vapor barrier coating. The white vapor barrier coating shall be applied over 10 x 10 or 20 x 20 mesh white glass, polyester or nylon cloth reinforcing membranes. It shall have a 31 mil dry film thickness with a maximum permeance of 0.05. The coating shall be similar to Foster Tite-Fit 30-35 with UL label.
- D. White finishing and insulating cement. One (1) coat shall be applied over hexagonal wire mesh. The cement shall be similar to Keene Superslick or approved equal.
- E. Off-white vapor seal adhesive. The adhesive shall be non-flammable, solvent based, quick setting and with a maximum permeance of 0.05. The adhesive shall be equal to Foster Spark-fas 85-20 or approved equal.
- F. Flexible vapor barrier sealant and bedding compound. The compound shall be equal to Foster Foamseal 30-45 or approved equal.

## 2.10 WIRE, BANDING AND FASTENING DEVICES

- A. The wire shall be a minimum 16-gauge copper clad annealed steel wire. The bands shall be ¾ inch nominal width with wing seals, of minimum thickness as follows:
  1. Aluminum: 0.007 inches where exposed to weather, 0.20 inches.
  2. Galvanized steel: 0.005 inches.
  3. Stainless steel: 0.005 inches.
- B. The staples shall be the outward clinching type of corrosion resistant steel. The weld pins which support and fasten the duct insulation shall be a minimum 1/8-inch diameter with speed washer or integral flange of minimum 1-3/8 inch diameter.
- C. Insulation tape: The tape shall be UL rated with all service or foil-scrim jacket to match insulation and of width as noted. The tape shall be similar to Compac Corp. UL ASJ or UL FKJ PS Tape or approved equal.

## 2.11 PIPING, VALVES AND FITTING

- A. Minimum insulation thickness in inches, shall comply with the table below for the associated piping system and pipe sizes. Overall conductance shall comply with ASHRAE 90.
- B. Piping Systems described shall be fully insulated including all flanges, fittings, valves, expansion joints, vents, drains and all other parts of the systems.
- C. All fittings, valves, flanges, pipe terminations shall be fully insulated with preformed molded fitting insulation of same material, density and thickness as used for adjacent piping. Finish shall be with molded PVC fitting cover.
- D. Flange insulation shall extend a minimum of 1" beyond the end of the bolts, and the bolt area shall be filled with Mineral Wool Cement.

**2.12 HEAT TRACING FOR PIPING**

- A. Heat tracing for piping is specified under section 230523.
- B. Piping shall be insulated as described herein, except thickness shall not be less than 2" for all pipe sizes. Insulation will be installed over electric heat tracing.
- C. Staples for fastening insulation shall not be used in order to prevent potential short circuiting of electric wires. Use stainless steel bands.
- D. The following piping shall be heat traced:
  - 1. Outdoor Condenser Water
  - 2. Outdoor Domestic Water
  - 3. Water piping exposed to unheated spaces or ambient conditions.
  - 4. All piping located within ceiling spaces located below roofs shall be insulated with a minimum of 2" insulation and heat traced.
  - 5. All piping located within ceiling spaces located below or above other spaces that are subject to ambient conditions shall be insulated with a minimum of 2" insulation and heat traced.

**2.13 WEATHERPROOFING FINISHES FOR OUTDOOR DUCTWORK**

- A. Ductwork shall be insulated as specified herein and provided with a weatherproof finish as described herein.
- B. Finish with a .016" thick aluminum jacket which has a factory applied moisture barrier. For all applications where it is available, the jacketing shall be factory attached to the insulation and installed per manufacturer's recommendation.
- C. Where field applied jacketing must be used, it shall be applied with 2" overlap facing down from the weather and shall be secured with aluminum bands and seals applied on 12" centers with bands applied directly over butt overlaps.
- D. Fittings shall be insulated and finished with mitered sections of the insulation with factory attached aluminum jackets installed per manufacturer's recommendation.

**2.14 WEATHERPROOF FINISHES FOR OUTDOOR PIPING**

- A. Piping shall be insulated as specified herein and provided with a weatherproof finish.
- B. Finish with a .016" thick aluminum jacket which has a factory applied moisture barrier. For all applications where it is available, the jacketing shall be factory attached to the insulation and installed per manufacturer's recommendation.
- C. Where field applied jacketing must be used, it shall be applied with 2" overlap facing down from the weather and shall be secured with aluminum bands and seals applied on 12" centers with bands applied directly over butt overlaps.
- D. Fittings and valves shall be insulated and finished with mitered sections of the insulation with factory attached aluminum jackets installed per manufacturer's recommendation.

**2.15 FANS**

- A. Insulate air conditioning supply and return fans located in non-air conditioned spaces, except



non-ducted double width, double inlet fans and fans located inside insulated casings.

- B. Insulation shall be minimum 2 inch, or as required to match sizes of reinforcing angles, Type D-2, with vapor seal.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufactures recommendations.
- C. Verify, by inspecting product labeling, submittal data, and/ or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

### 3.3 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory- applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.
- D. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been fully tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Before applying insulation, complete and approve the required pressure leakage tests of joints and connections. In addition, clean surfaces of dust, grease and foreign matter and dry before application of insulation.
- B. Insulation shall not be installed on pipe and black metal until the surface has received a prime coat of paint. All insulation joints shall be butted firmly together and all jackets shall be smoothly and securely installed.
- C. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full



length section will sit. Except for specific exception, insulate entire specified equipment, piping and duct systems.

- D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts, piping including fittings, valves, and specialties.
- E. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, pipe and duct system as specified herein.
- F. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- G. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- H. Install multiple layers of insulation with longitudinal and end seams staggered.
- I. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- J. Keep insulation materials dry during application and finishing.
- K. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- L. Install insulation with least number of joints practical.
- M. Sections of ductwork or equipment (such as heads, pumps, etc.) requiring periodic servicing shall be insulated with sheet metal covers lined with the same type and thickness of material as the adjoining insulation.
- N. Do not startup and operate chilled water system prior to completion of insulation for the entire chilled water piping system and complete closure of building from the external atmosphere.
- O. Do not operate air handling system with conditioned air prior to completion of insulation of the entire duct distribution system for that air handling system.
- P. Proceed with installation only after unsatisfactory conditions have been corrected.
- Q. Insulation on all cold surfaces must be applied with a continuous unbroken vapor seal. Hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- R. Note that insulation (with vapor barrier) shall be continuous across all duct joints, hot water or steam reheat coil pipe bends (insulated end caps), diffusers, etc. so as to provide a continuous, fully insulated with uninterrupted vapor barrier from the fan discharge to the diffusers.
- S. Do not weld anchor pins to ASME labeled pressure vessels.
- T. Select insulation hangers and adhesive that are compatible with service temperatures and substrates.
- U. Do not over-compress the insulation during construction.
- V. Repair punctures, tears and penetrations with tape or mastic to maintain vapor-barrier seal.



### 3.5 INSULATION INSTALLATION REQUIREMENTS - PIPING

- A. Piping systems described shall be insulated as follows, including all flanges, fittings, valves, expansion joints, vents, drains and all other parts of the system. Valve and flange insulation shall be removable and re-installable.
- B. All piping subject to freezing such as in outdoor air or discharge plenums or outdoors shall be insulated with a minimum of 2" insulation.
- C. On longitudinal overlaps, provide 2 inch minimum. For exposed work, install toward ceiling or wall. Insulation passing through sleeves or other openings shall be continuous. Install metal frames to protect edges of openings in insulation. At penetration of fire or smoke barriers, wrap pipe with rock-wool insulation, seal jackets seam and seal end joints to adjacent sections of insulation.
- D. Where specified thickness of insulation exceeds available single layer thickness, install insulation in two (2) layers with joints staggered.
- E. Fill voids with insulating cement.
- F. For valves, fittings, flanges and accessories insulation type shall be as noted on the Schedule. Insulate valves including bonnets, flanges, fittings, strainers, expansion joints and specialties.
- G. Insulation for strainers, expansion joints, fittings and accessories requiring servicing or inspection shall be removable and replaceable without damage, and enclosed within two-piece, No. 18-gauge aluminum covers fastened with cadmium-plated bolts and nuts. Insulation shall be of the same material, density and thickness as adjacent piping insulation.
- H. Wiring, banding and fastening devices: Secure the insulation to the piping in accordance with the following minimum requirements:
  - 1. Molded fiberglass: self-sealing laps may be used. Staples are not permitted on vapor sealed piping.
  - 2. For pipe fitting insulation, loops or wire shall be installed to secure mitered segments of insulation. The wire shall be spiraled from end to end on blanket insulation. Outdoor piping weatherproof aluminum jackets shall be banded at circumferential joints and at the center of each section.
- I. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with



- insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- J. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- 3.6 INSULATION INSTALLATION REQUIREMENTS – DUCTS, PLENUMS, CASINGS, HOUSINGS & EQUIPMENT
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
  - B. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - C. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - D. Do not over compress insulation during installation.
  - E. Impale insulation over pins and attach speed washers.
  - F. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
    1. Fiberglass blanket: Install 2-inch lap strip at one end; peel insulation for 2 inch and lap strip along longitudinal joints. Secure bottom of rectangular ducts over 24 inches wide with two rows of weld pins 12 inches on center. Secure joints with outward clinching staples 6 inches on center. Seal all strips with foil vapor barrier tape and vapor seal adhesive.
    2. Fiberglass board: Seal joints and breaks in facings with 3-inch-wide tape to match facing and adhere with vapor seal adhesive. Apply 5-inch-wide tape corners. Weld pins on top, sides and bottom.



3. Weld pins and anchors: spacing shall be minimum 12 inch centers and minimum two (2) rows per side of duct. Maximum permissible load shall be 5 lb. for 2-inch x 2-inch baseplate and 10 lb. for 2-3/4-inch x 2-3/4-inch baseplate. Clip off pin penetrations flush with insulation surface or facing. Seal pins and washers with 4 inch square pieces of Type F-9 vapor barrier tape to match facing and adhere with vapor seal adhesive
4. Adhesives and coatings:
  - a. Apply at following rates, in accordance with the manufacturer's recommendations:
    - 1) Vapor barrier coating shall be 50 sq. ft./gal.
    - 2) Vapor seal adhesive shall be 100 sq. ft./gal.
    - 3) Outdoor mastic (vinyl acrylic) shall be 12 sq. ft./gal.
  - b. Adhere jackets and facing with adhesive. Lap sealing for full width of lap. Surface which will be adhered shall be completely coated with adhesive.

### 3.7 VAPOR BARRIER - GENERAL INSTALLATION REQUIREMENTS

- A. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  1. Install insulation continuously through hangers and around anchor attachments.
  2. Extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- B. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- C. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- D. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- E. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
  1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  2. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

### 3.8 INSTALLATION OF MINERAL-FIBER INSULATION - PIPING

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten



- bands without deforming insulation materials.
- 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
- 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
- 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

**B. Insulation Installation on Pipe Flanges:**

- 1. Install preformed pipe insulation to outer diameter of pipe flange.
- 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

**C. Insulation Installation on Pipe Fittings and Elbows:**

- 1. Install preformed sections of same material as straight segments of pipe insulation when available.
- 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

**D. Insulation Installation on Valves and Pipe Specialties:**

- 1. Install preformed sections of same material as straight segments of pipe insulation when available.
- 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
- 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 4. Install insulation to flanges as specified for flange insulation application.

**3.9 INSTALLATION OF MINERAL-FIBER INSULATION – DUCTS AND PLENUMS**

**A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.**

- 1. Apply adhesives according to manufacturer's recommended coverage of duct and plenum surfaces.
- 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
- 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - b. Do not over compress insulation during installation.
  - c. Impale insulation over pins and attach speed washers.
  - d. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation



facing.

4. For ducts and plenums, if required, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - b. Do not over compress insulation during installation.
    - c. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface.

Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.

### 3.12 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.





1. Apply adhesives according to manufacturer's recommended coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not over compress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Secure each layer of insulation with stainless-steel bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.



2. Fabricate boxes from aluminum, at least 0.060 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.13 INSTALLATION OF CALCIUM SILICATE INSULATION

#### A. Insulation Installation on Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

### 3.14 INSTALLATION OF PHENOLIC INSULATION

- A. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
- B. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

### 3.15 FIELD-APPLIED JACKET INSTALLATION

#### A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

#### B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

#### C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

#### D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end

joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### 3.16 FIRESTOPPING AT FIRE SEPARATIONS

- A. Refer to Division 7 Section; "Firestopping"
- B. Firestopping system must be U.L. approved.
- C. Firestop all wrapped ductwork and piping penetrating fire rated concrete floors, gypsum board, block, concrete wall assemblies and gypsum board shaft wall assemblies.

### 3.17 FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

### 3.18 PROTECTION

- A. Replace damaged insulation, which cannot be satisfactory repaired, including insulation with vapor barrier damage and moisture- saturated insulation.
- B. Coordinate protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

### 3.19 SAFETY PRECAUTIONS

- A. Contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. Conduct all job site operations in compliance with applicable provisions of the Occupational safety and health Act, as well as with all state and/ or local safety and health codes and regulations that may apply to the work.

**END OF SECTION 23 07 00**



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**SECTION 23 08 00****COMMISSIONING OF HVAC****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 SUMMARY**

- A. This section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
  - 1. DDC General Conditions Section for general commissioning process requirements.

**1.3 DESCRIPTION**

- A. Commissioning is a systematic process of confirming that all building systems perform interactively according to the Commissioner's Project Requirements and the Basis of Design and continuing through construction, acceptance and the warranty period with actual verification of performance.
- B. The Commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.
- C. The CxA directs and coordinates the commissioning activities and reports to the Commissioner. All members in the construction process work together to fulfill their contracted responsibilities and meet the objectives of the Commissioner's Project Requirement's as detailed in the Contract Documents.

**1.4 DEFINITIONS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for definitions.

**1.5 SUBMITTALS**

- A. The CxA will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment



specifications. The CxA will notify the Contractor and Commissioner as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

- B. The CxA will receive a copy of the final approved submittals.
- C. In addition, the contractor is to provide the following:
  - 1. Certificate of readiness
  - 2. Certificates of completion of installation, prestart, and startup activities.
  - 3. O&M manuals
  - 4. Test reports
- D. Refer to DDC General Conditions for general commissioning submittal requirements.

## **1.6 QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

## **1.7 COORDINATION**

- A. Commissioning Kick-Off Meeting – Construction Team: Contractors will attend a meeting of the Commissioning Team, chaired by the CxA, to review the scope of commissioning process activities and the Commissioning Plan with discussions on milestones, activities, and assignments of responsibilities. The flow and type of documents and the amount of submittal data given to the CxA will be determined. Meeting minutes will then be distributed to all parties by the CxA.
- B. Commissioning Meetings: Contractors will attend coordination meetings with the Commissioning Team, chaired by the CxA, to review progress on the Commissioning Plan, construction deficiencies, scheduling conflicts, and to discuss strategies and processes for upcoming commissioning process activities.
- C. Miscellaneous Construction Meetings: The CxA attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in the commissioning process. This will not include 100% meeting attendance, but the CxA shall be provided with the subsequent meeting minutes for review.
- D. Pre-testing Meetings: Contractors will attend pretest meetings with the Commissioning Team, chaired by the CxA, to review startup reports, pre-test inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.



- E. Testing: Contractor will coordinate with testing personnel and agencies for timing and access for CxA to witness test.
- F. Manufacturers' Inspection and Startup Services: Contractor will coordinate services of manufacturers' inspection and startup services.
- G. Testing, Adjusting and Balancing: Contractor will coordinate with plan and schedule for testing, adjusting and balancing for timing and access for CxA to witness process.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the contractor shall ultimately be responsible for all standard testing equipment for the HVAC&R system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by the Contractor.
- B. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the City of New York upon completion of the commissioning process.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems. These checklists shall be provided to the Contractors for completion. The CxA shall gather and review the completeness and accuracy of these checklists via site visits.
- B. Red-lined Drawings (As-Builts): The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.



- C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
- D. Demonstration and Orientation: Contractor will provide demonstration and orientation as required by the specifications. A complete orientation plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any orientation. A orientation agenda for each orientation session must be submitted to the CxA one (1) week prior the orientation session.

### **3.2 CONTRACTOR'S RESPONSIBILITIES**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for contractor's responsibilities.
- B. Attend construction phase controls coordination meetings.
- C. Attend testing, adjusting, and balancing review and coordination meetings.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Prepare preliminary schedule for mechanical system orientations and inspections, operation and maintenance manual submissions, orientation sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for The City of New York. Distribute preliminary schedule to commissioning team members at the beginning of the construction phase.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- G. Provide detailed startup procedures.
- H. Provide a written list of all user adjustable set-points and reset schedules with a brief discussion of the purpose of each and the range of reasonable adjustments with energy implications
- I. Provide a written schedule frequency to review the various set-points and reset schedules to ensure they are current relevant and efficient values.
- J. Respond to provided new deficiencies and/or responses within five (5) business days.
- K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- L. Coordinate with the CxA to provide 48-hour advanced notice so that the witnessing of equipment and system start-up and testing can begin.
- M. Notify the CxA a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- N. Provide written notification to the Commissioner and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.





1. HVAC&R equipment including all chillers, boilers, pumps, fans, air handling units, ductwork, dampers, terminals, unit heaters, and all other equipment furnished under this Division.
  2. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
  3. Fire detection and smoke detection devices furnished under other divisions of the specification.
- O. The equipment supplier shall document the performance of his equipment.
- P. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- Q. Test, Adjust and Balance Contractor
1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
  2. Submit the site-specific testing and balancing plan to the CxA and Commissioner for review and acceptance.
  3. Attend the testing and balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the HVAC&R system.
  4. At the completion of the testing and balancing work, and the submittal of the final testing and balancing report, notify the Contractor.
  5. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.
  6. Provided recommended setpoints as determined by Testing, Adjusting, and Balancing such as static pressure and differential pressure setpoints.
- R. Equipment Suppliers
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the City of New York, to keep warranties in force.
  2. Assist in equipment testing per agreements with Contractors.
  3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

### **3.3 CxA'S RESPONSIBILITIES**

#### **A. Roles and Responsibilities**

1. Refer to DDC General Conditions Section "General Commissioning Requirements" for general CxA responsibilities.

#### **B. Cx Team Meetings**

1. Commissioning during the Construction Phase will begin with a 'Commissioning Kick-Off Meeting – for Construction Team' conducted by the CxA where the commissioning process is reviewed with all of the commissioning team members.
2. Additional meetings will be required throughout the Construction and Acceptance phases. The CxA shall attend select meetings related to commissioning as required by the DDC during the Construction and Acceptances phases.

#### **C. Coordination and Scheduling**



1. Coordinate and direct commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications, and consultations with all necessary parties.
2. Coordinate commissioning work with the Commissioner to ensure that commissioning activities are being scheduled into the master project schedule.
3. Coordinate with the Commissioner to witness tests, inspections, and systems startup.

**D. Commissioning Progress**

1. Perform periodic site visits to observe component and system installations, and qualify contractor completed checklists.
2. Report deficiencies to the Commissioner including but not limited to issues related to adequate accessibility required for component maintenance replacement and repair.
3. Review construction meeting minutes for revisions/substitutions relating to the commissioning process.

**E. Pre-Functional Checks**

1. Verify proper installation of components, equipment, systems and assemblies. Sampling procedures may not be employed on systems and equipment.
2. Pre-Functional checks for a piece of equipment shall only be started once the approved checklist for a piece of equipment has been received from the installing contractor indicating the equipment is ready to being its pre-functional checks.
3. Team will not be allowed to move forward into functional testing until all Pre-Functional testing is completed and the team moves onto the Acceptance Phase for the project.

**F. Equipment and System Startup and Verification**

1. Review and approve component, equipment, system, and assembly startup plan developed and submitted by the Contractor.
2. Approve system startup by reviewing startup reports, if contracted; and by selected site observation.
3. Review the Testing, Adjusting and Balancing execution plan for the project, which shall be submitted by the Contractor.
4. Verify and document the accuracy of the air and water systems balancing by spot testing the air and water reported field values with Contractor and by reviewing completed reports.

**G. Functional Performance Testing**

1. With assistance from the Contractor, write Functional Performance Testing procedures for all components, equipment or systems to be commissioned.
2. With the assistance of the Contractors, coordinate Functional Performance Testing. Witness and approve Functional Performance Testing performed by the Contractor.
3. With the assistance of the Contractor, coordinate retesting as necessary until satisfactory performance is achieved.
4. Witness seasonal or deferred Functional Performance Testing as necessary.

**H. Issue/Deficiency Logs**

1. The CxA shall prepare a formal, ongoing, online record of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process.
2. Issues will be recorded on an online Commissioning Issues Log for the contractors to resolve to the satisfaction of the Commissioner. Issues will be added by the CxA. Team members are required to post their own responses to issues pertaining to their work. Team members are required to respond to issues added to the list within five (5) working days of being added by the CxA.



3. Issues will be revisited one (1) time to verify that the proper corrections have been made.
4. When issues are resolved, they will be closed on the Issues Log by the CxA.

**I. Operation and Maintenance Data**

1. The CxA shall review of the documentation submitted by the Contractor as required by the Specifications for completeness and accuracy. This commissioning review supplements, but does not replace, the Commissioner's review.
2. Review equipment warranties.

**J. Instruction**

1. The Contractor will provide all documentation and qualified instruction personnel for instruction.
2. The CxA will verify through the Contractor's plan and schedule, instruction agendas, and select observations that proper instruction procedures were followed on all commissioned systems.
3. The CxA will verify that Instruction Video Recordings are executed, collected, and provided to the Commissioner.
4. See appropriate section below pertaining to instruction.

**K. Systems Manual Requirements**

1. Index of Systems Manual with notation as to content storage location if not in actual manual.
2. Executive Summary
3. A list of recommended operational record keeping procedures at the facility level, including sample forms, trend logs, or others, and a rationale for each.
4. Maintenance procedures, schedules and recommendations.
5. Ongoing Optimization
6. Other Attachments

**L. Post Occupancy Review**

1. The CxA will return to the site within the 12-month warranty period to address the following: review current building operations with facility staff and address outstanding issues related to the Commissioner's Project Requirements; Interview facility staff and identify problems or concerns with operating the building; Identify problems covered under warranty or under the original construction contract.
2. The CxA will make suggestions for improvements in the content of the O&M Manuals. Any required changes shall be made by the contractor responsible for that section.
3. The CxA shall assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

**M. Commissioning Final Report**

1. The CxA shall provide a final report following the completion of all Functional Performance Testing. The report is to outline compliance and non-compliance to the construction documents, as well as identify concerns relative to future performance

### **3.4 TESTING PREPARATION**

- A. Certify in writing to the CxA that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.



- B. Certify in writing to the CxA that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### **3.5 TESTING, ADJUSTING AND BALANCING VERIFICATION**

- A. Prior to performance of Testing, Adjusting, and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
  - 1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
  - 2. The Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### **3.6 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.



- D. The CxA along with the contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Commissioner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.7 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 23 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 23 piping Sections. The Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
  - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
  - 2. Description of equipment for flushing operations.
  - 3. Minimum flushing water velocity.
  - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.



- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- G. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:
  - 1. Air Handling Unit with Enthalpy Wheel
  - 2. Heating & Ventilation Unit
  - 3. Variable Air Volume Units
  - 4. Water Cooled Chiller
  - 5. Cooling Tower
  - 6. Side Stream Filter
  - 7. Chilled Water Pumps
  - 8. Hot Water Pumps
  - 9. Freeze Protection Pumps
  - 10. Condensing Boiler
  - 11. Hot Water Unit Heater
  - 12. Fuel Oil Pumps
  - 13. Fuel Oil Tank
  - 14. Fin Tube Radiators
  - 15. Exhaust Fans
  - 16. Gas Fired Unit Heaters
  - 17. Air Curtain
  - 18. CRAC Units
  - 19. Cabinet Unit Heater
  - 20. Plate & Frame Heat Exchanger
  - 21. Fuel Oil Pumps
  - 22. Air Separator
  - 23. Expansion Tank
  - 24. Ductwork
  - 25. Testing, Adjusting and Balancing
  - 26. VFD

### **3.8 DEFICIENCIES/NON-CONFORMANCE, FAILURE DUE TO MANUFACTURER DEFECT**

- A. Deficiencies/Non-Conformance
  - 1. The CxA will record the results of the functional test on the test form. All deficiencies or non-conformance items shall be noted and reported to the Commissioner and Contractors on a standardized form.
  - 2. The Contractor shall respond to new deficiencies within five (5) business days. The response shall either indicate the issue will be corrected with anticipated date of completion indicated or the response should clearly indicate why the Contractor disputes the claim while referencing the contract document in dispute or request further information to clarify the concern.
  - 3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA.
  - 4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.



5. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing Contractor.
6. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it, the CxA documents the deficiency and the Contractor's response and intentions or corrections. The CxA and Contractor then proceed to another test or sequence. Once the Contractor corrects the deficiency, the test is rescheduled and repeated in the anticipation of correct operation or function.
7. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the CxA documents the deficiency and the Contractor's response. The deficiency is then forwarded to parties assumed to be responsible for the deficiency. Resolutions are made at the lowest management level possible. Other parties are brought into the discussion as needed. Final interpretive authority is with the Commissioner. Final acceptance authority is with the Commissioner and CxA. The CxA will then document the resolution process. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency. The CxA then reschedules the test as stated in the section above.
8. Deficiencies that are not corrected at the time of documentation, shall be completed by the affected contractor and photo evidence of the deficiency resolution shall be sent to both the DDC Project Manager and the CxA.

**B. Failure due to Manufacturer Defect**

1. If 10% or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable only by the Commissioner. In such case, the Contractor shall provide the Commissioner with the following.
  - i. Within one week of notification from the Contractor the manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Commissioner within two weeks of the original notice.
  - ii. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
  - iii. The Commissioner will determine whether a replacement of all identical units or a repair is acceptable.
  - iv. Two examples of the proposed solution will be installed by the Contractor and the Contractor will be allowed to test the installations for up to one week, upon which the Commissioner will decide whether to accept the solution.
  - v. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

**3.9 APPROVAL**

- A. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA. The CxA recommends acceptance of each test to the Commissioner using a standard form.

**3.10 DEFERRED TESTING**

- A. Unforeseen Deferred Testing – If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon



approval of the Commissioner. These tests will be conducted in the same manner as the seasonal tests, as soon as possible. Services of necessary parties will be negotiated.

- B. Seasonal Testing – During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the Contractor, with The City of New York and the CxA witnessing. Any final adjustments to the O&M manuals and record documents due to seasonal testing will be made by the Contractor.

### **3.11 OPERATION AND MAINTENANCE MANUALS**

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in DDC General Conditions.
- B. The specific content and format requirements for the standard O&M manuals are detailed in DDC General Conditions. Special requirements for the Contractor are found in Division 23.
- C. CxA Review and Approval – Prior to substantial completion, the CxA shall review the O&M manuals, documentation and record documents for systems that were commissioned to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the Contractor, or Commissioner, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the Commissioner. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated.

### **3.12 INSTRUCTION OF NEW YORK CITY PERSONNEL**

- A. The Contractor shall be responsible for instruction coordination, scheduling, and ultimately for ensuring that instruction is completed.
- B. The CxA shall oversee the instruction of the City of New York for commissioned equipment and systems.
  - 1. The CxA shall interview the City of New York to determine the special needs and areas where instruction will be most valuable. The Commissioner and CxA shall decide how rigorous the instruction should be for each piece of commissioned equipment. The CxA shall communicate the results to the Contractor. Who will in turn communicate to the subcontractors and vendors who also have instruction responsibilities.
  - 2. In addition to these general requirements, the specific instruction requirements of the City of New York by contractors, subcontractors and vendors are specified in the individual sections listed in Section 1.2 – Summary.
  - 3. The Contractor responsible for instruction will submit a written instruction plan for review and approval prior to instruction. The Contractor will submit one comprehensive instruction plan to the CxA and the Commissioner.
  - 4. The plan will be reviewed by the CxA and the Commissioner. Comments pertaining to its deficiencies will be forwarded to the Contractor. The instruction plan will be rewritten until approved by the CxA and the Commissioner. The final approved instruction plan will cover the following elements:
    - a. Equipment (included in instruction)
    - b. Intended audience





- c. Location of instruction
  - d. Objectives
  - e. Subjects covered (description, duration of discussion, special methods, etc.)
  - f. Duration of instruction on each subject
  - g. Qualified instructor for each subject
  - h. Instructor qualifications
  - i. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
5. For the primary HVAC equipment, the Contractor shall provide a discussion of the control of the equipment during the mechanical or electrical instruction conducted by each subcontractor or vendor.
6. Instruction documentation shall include the following items:
- a. Copy of the instruction plan, including schedule, syllabus, and agenda.
  - b. Copy of the Commissioner's Project Requirements.
  - c. Copy of the Basis of Design.
  - d. Compiled operations manuals.
  - e. Compiled maintenance manuals.
  - f. Completed manufacturer instruction manuals.
  - g. Red-lined drawings.
  - h. Other pertinent documents.
7. The CxA develops criteria for determining that the instruction was satisfactorily completed, including attending some of the instruction, etc. The CxA recommends approval of the instruction to the Commissioner using a standard form. The Commissioner signs the approval form/letter template.
8. At one of the instruction sessions, the CxA presents a presentation discussing the use of the blank functional test forms for re-commissioning equipment
9. Videotaping of the instruction sessions in DVD format will be provided by the CxA

### **3.13 FUNCTIONAL BUILDING SYSTEMS DEMONSTRATION TEST (72 HOURS)**

- A. Refer to Addendum to the General Conditions Section "General Commissioning Requirements" for requirements pertaining to 72-Hour Functional Building Systems Demonstration Testing.

**END OF SECTION 230800**



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## **SECTION 23 09 00**

### **HVAC INSTRUMENTATION AND CONTROLS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 19 "Meters and Gauges for HVAC Piping".
- D. Section 23 05 23 "Valves for HVAC Piping".
- E. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- F. Section 23 05 93 "Testing, Adjusting and Balancing".
- G. Section 23 09 05 "Sequences of Operation for HVAC Controls".
- H. Section 23 33 10 "Dampers".
- I. Section 23 36 00 "Air Terminal Units".
- J. Section 23 08 00 "Commissioning of HVAC"
- K. This section itself related to each Division 23 00 00 section.

##### **1.2 SUMMARY**

- A. Contractor shall provide all required labor, materials, tools, equipment and services necessary for the complete and safe installation and properly operating monitoring and control systems described and/or indicated herein or on the drawings or which may be reasonably implied as essential, whether mentioned in the Drawings and Specifications or not.
- B. Furnish an open protocol Building Management System (BMS) that is a totally native BACnet-based networked Direct Digital Control (DDC) system, including an operator's workstation using Microsoft Windows, Windows 7 Professional, vista Professional, Windows Server 2008 or SQL Server 2008 as the operating system and shall be based on a distributed control system in accordance with this specification. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135, BACnet. In other words, all workstations and DDC controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may only be used for communication to systems installed under other sections.
- C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-



based control software and every controller in system, including unitary controllers. These must be in compliance with front end systems PICS and BACnet Interoperability Building Blocks (BIBBs). Provide all hardware and software to backup, restore, troubleshoot and install the system.

- D. Provide all line and low voltage power, interlock and control wiring to all BMS panels, devices, terminal units, controllers, dampers, equipment, etc. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26 and all national, state and local electrical codes.
- E. Cables for 120/24 volt AC. wiring, communications wiring and low level signal wiring (i.e., 4-20 mA analog) shall always be run in separate raceways.
- F. Furnish and install controls for the Air Valves as outlined in other sections of this work. The airflow controls shall be seamlessly integrated into the BMS by the Contractor using BACnet-compliant hardware and software so that there is no distinction from the operator's interface between the different control systems. Furnish air valve controls and associated duct mounted devices to the sheet metal contractor for installation. Furnish and install all control devices for a complete and operable airflow tracking control system. Contractor's BMS trade shall be responsible for a complete turnkey control system including design documents, furnishing all required air valves and related control devices, installation of all equipment other than that which must be done by the sheet metal trade, start-up, commissioning, final acceptance and customer instruction.
- G. Furnish and install controls for the Air Quality Monitoring System. The air quality monitoring system shall be seamlessly integrated into the BMS by the Contractor using BACnet-compliant hardware and software so that there is no distinction from the operator's interface between the different control systems. Furnish and install all control devices for a complete and operable air quality monitoring system. BMS trade shall be responsible for a complete turnkey control system including design documents, furnishing all required central and remote sampling equipment and all related control devices, installation of all equipment, start-up, commissioning, final acceptance and customer instruction.
- H. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- I. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- J. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- K. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- L. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- M. Provide all power wiring to all control panels and control devices requiring power.
- N. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.



- O. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- P. Provide a comprehensive operator and technician instruction program as described herein.
- Q. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- R. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
- S. All standard, devices and system set up shall conform to customer's facility procedures and standards.
- T. Furnish, install and fit-up in complete working order, with all accessories required, the Automatic Temperature Control (ATC) and Building Management System (BMS), shown on the design drawings, construction documents and specified herein. The systems shall be properly connected, piped and wired in a manner conforming to NYC codes, laws, ordinances and guidelines. Contractor shall be responsible for installing all needed cabling and Ethernet connections required for proper network communications for the entire BMS.
- U. All point and device names shall comply with the MSKCC Plant Operations/IT standards and conventions and shall be approved before implementation and included in the shop drawings submittal. Coordinate graphics and user interface programming with Commissioner to ensure that all specified points and alarms communicate and operate on the Head End system.
- V. Coordinate with air quality monitoring system.

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SYSTEM DESCRIPTION**

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. The Building Management System (BMS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation for the operator interface, after-hours billing program, demand limiting, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software and associated passwords required to program application specific controllers and all field level devices and controllers will be left with the Commissioner. All software and associated passwords required to make any program changes anywhere in the system along with scheduling, and trending applications will be left with the Commissioner. All software and associated passwords required to program and make future changes to field engineering tools including graphical programming and applications will be left with the Commissioner.
- C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- D. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.
- E. Room sensors shall be provided with digital readout that allows the user to view room temperature, view outside air temperature, adjust the room set point within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow technician to balance VAV zones and access any parameter in zone controller.
- F. All control equipment used to perform any or all of the specified smoke control sequences shall be UL-864 UUKL listed and tested by FDNY. FDNY approval letter required. This includes all field controllers and global control devices. Non UUKL rated equipment shall not be networked



to any devices on the network performing smoke control sequences unless isolated by a UUKL rated device. See drawings for actual sequence of operations.

- G. All system alarms are to be set up based on the alarm parameters specified in the system sequence of operations. Alarms shall be enabled and put into service only after they have been tested and commissioned. Contractor shall submit a list of points containing alarm extensions for review and approval. After approval the contractor will be responsible for full implementation of alarm including alarm names, alarm texts and alarm enabling.
- H. The electrical power and interlock wiring for all controls, signal devices, equipment, alarms, etc., shall be in accordance with the manufacturers and or suppliers detailed wiring diagrams and instructions.
- I. All power and control wiring, conduit and wiring connections required for the complete installation, including wiring to smoke dampers and combination fire/smoke dampers and their motors, shall be provided by Contractor in accordance with the Electrical Specification requirements.

Control system shall be on emergency power. Network control panels, servers, dedicated operator interface PC's and advanced application control panels serving major mechanical systems shall be furnished with an Uninterruptable Power Supply (UPS). UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt Amps needed for panel.

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- C. The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- D. The Building Management System (BMS) shall be configured and installed, commissioned and serviced by a factory instructed installer. Contractor's installer shall have an in-place support facility within 2 hours response time of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.
- E. The BMS trade shall provide a full time, on site, project management for this work for direct supervision of the configuration, installation, start up, and commissioning of the BMS system. The contractor's installer shall provide emergency contact cell phone numbers and email addresses to the Commissioner. The Contractor's vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.
- F. The Contractor and their vendors shall manufacturer, manage, and distribute all equipment, control devices, accessories and related items to ISO 9000 series and 14000 series standards.



- G. All BMS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- H. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- I. Testing of the control system as per testing procedures based on ASHRAE standards 135 and 135.1 and that the components were tested to BACnet International, BACnet Testing Laboratories standards.

#### 1.7 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
  - 2. Latest ANSI/ASHRAE Standard 135, BACnet.
  - 3. Uniform Building Code (UBC), including local amendments.
  - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. US.
  - 5. National Electrical Code (NEC).
  - 6. FCC Part 15, Subpart J, Class A.
  - 7. EMC Directive 89/336
  - 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences
  - 9. NFPA 90A
  - 10. 2014 New York City Construction Codes
  - 11. NEMA Standards
  - 12. UL-873 (Temperature Indication and Regulating Equipment)
  - 13. The BACnet Manufacturers Association (BMA)
  - 14. BACnet International, BACnet Testing Laboratories - BACnet Testing Laboratories was established by BACnet International to test products as per BACnet standard and support compliance testing and interoperability testing activities.
  - 15. All ISO 9000 series standards, ISO 14000 series standards (for environmental issues), ISO 16484-5, etc.
  - 16. Except as otherwise indicated the Contractor shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by NYC Dept of Buildings and the Commissioner.
- B. The control system installation shall comply with NFPA, NEMA, NEC, and all NYC and national codes, standards, and guidelines referenced in this specification.

#### 1.8 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."
- B. Design and Installation Submittals - Submittal shall include the following;
  - 1. Control riser diagram showing all DDC controllers, network repeaters, and network wiring.
  - 2. One-line schematics and system flow diagrams showing the location of all control devices.





3. Points list for each DDC controller, including: Tag, Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number.
4. The contractors written description for each sequence of operations, to include the following:
5. Sequences shall reference input/output and software parameters by name and description.
6. The sequences of operations provided in the submittal that shall represent the detailed analysis needed to create actual programming code from the design documents based on the controls design documents.
7. Points shall be referenced by name, including all software points such as but not limited to programmable set points, range limits, time delays, alarms, and so forth.
8. The sequence of operations shall cover normal operation and operation under the various alarm conditions applicable to that system.
9. Detailed Bill of Material list for each panel, identifying: quantity, part number, description, the number of modules in each panel and associated options.
10. Control Damper Actuator Schedules. This spreadsheet type schedule shall include a separate line for each damper and a column for each of the damper attributes, including: Fail-Safe Position, Damper Type and Actuator Type.
11. Control Valve Schedules. This spreadsheet type schedule shall include a separate line for each valve and a column for each of the valve attributes, including: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.
12. Cataloged cut sheets of all equipment used. This includes, but is not limited to, the following: DDC panels, peripherals, sensors, actuators, dampers, and so forth.
13. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes, also include installation and start up instructions
14. Range and scale information for all transmitters and sensors. This sheet shall clearly indicate one device and any applicable options. Where more than one device to be used is on a single sheet, submit two sheets, individually marked.
15. Hardware data sheets for all operator workstations, local access panels, and portable operator terminals.
16. Software manuals for all applications programs to be provided as a part of the operator workstations, portable operator terminals, programming devices, and so forth for evaluation for compliance with the performance requirements of this Specification.
17. The controls contractor shall include their BACnet PICS and BIBB statements (as described in ASHRAE 135) for each device.
18. The controls contractor shall supply to the MSKCC the Commissioner all certified testing documentation from its vendors, subcontractors, suppliers and/or distributors.

**C. BACnet Device Object Naming Conventions**

1. The Contractor's BMS manufacturer's representative shall submit a BACnet Device Object Naming Convention Plan (DONCP) to the Commissioner during the submittal process. The plan must be approved by the Commissioner prior to implementation. It is the responsibility of the Contractor to coordinate the DONCP with the Commissioner.
2. The DONCP shall be designed to eliminate any confusion between individual points in a facility/campus wide BMS system. It will also be designed to allow for future expansion and consistency. Each device on a BACnet internetwork (including other manufacturer's devices) must have a unique device instance. This is a major consideration when adding to an existing system or interconnecting networks. Thorough and accessible site documentation is critical.



3. A consistent object (point) naming convention shall be used to facilitate familiarity and operational ease across an eventual large campus or inventory of facilities. The following section is designed as recommendations only. It is the responsibility of the Contractor to coordinate the DONCP with the Commissioner.
  4. BACnet requires that all devices have a Device object name that is unique throughout the entire work. To comply with this requirement all BACnet devices should be configured with a Device Object Name that is based on the naming conventions described in this section. This includes all physical devices as well as any logical BACnet devices that are represented by gateways. The vendor shall coordinate with the Commissioner's staff to ensure that the correct names are used. Device Object Name properties shall support strings of at least 50 characters in length.
  5. Every system device has addresses by which any other BACnet device can identify it and route information to and from it. Although there are a number of addresses to consider, the scheme is fairly straightforward. It can become complicated, however, if addresses have not been documented adequately or there is no logical addressing scheme.
  6. When you set up and plan a BACnet network or add to an existing network, considering and documenting your addressing scheme is of the utmost importance. Adopt a hierarchical and uniform addressing scheme for device instances to help you quickly identify the function and location of different devices when troubleshooting. Additionally, it's very important to document every element of your addressing scheme and update the site documentation with any changes.
  7. This section first covers the important addressing issues with respect to BACnet LANs and it gives a practical application you can use to check your understanding. BACnet addressing - Three types of addresses are important in any BACnet system: network numbers, media access control (MAC) addresses, and device instances. Each BACnet device has these addresses associated with it. Though all three can be thought of as addresses, they are all very different both in how they function and how they are assigned.
    - a. Network numbers - Identifies the network to which a BACnet device belongs. Every network on a BACnet LAN has a unique numerical identifier—a network number. This network number is used by BACnet devices only; it does not rely on nor does it affect any other network protocols. LANs connected by a router must have different network numbers. No interconnected BACnet networks can have the same network number. Network number range is 1–65534, for a maximum of 65534 interconnected BACnet networks.
    - b. MAC addresses - Hardware-oriented. The MAC address uniquely identifies a device on its particular network. Each network type—Ethernet and MS/TP—has its own MAC addressing scheme. A device that exists on two or more networks will have a MAC address for each one. Devices can have the same MAC addresses as long as they are on networks with different network numbers.
    - c. Ethernet devices - For Ethernet LANs, the IEEE assigns a certain range of MAC addresses to manufacturers of Ethernet products. Manufacturer then assigns a unique MAC address to each of its Ethernet devices.
    - d. MS/TP devices - For devices on an MS/TP LAN, you assign the MAC address for each controller. For BACtalk VLCs, these are assigned with DIP switches. Devices on an MS/TP LAN are designated as either masters or slaves, which affects how they can be addressed. This is a requirement of the BACnet specification. All BACtalk MS/TP devices are masters.
    - e. Device instances - Software-oriented. The device instance identifies the device to the BACnet software and is the address most often encountered. The device instance is a shortcut to having to specify a MAC address and network number each time an operation is performed. Device instances range from 0–4194302.
- D. Closeout Submittals including Operator and Maintenance Data – Submittal shall include the following;



1. Operation and Maintenance Instructions - Contractor shall prepare five (5) three ring bound binders, titled "Automatic Temperature Control and Monitoring Systems Submittal and Operation and Maintenance Data." Mark the identification on both front and spine of each binder. Each binder shall be a heavy duty 3 ring, vinyl covered binder (3" maximum) with pocket folders for folded sheet information. Binders shall be properly indexed (thumb tabbed). In addition to these hardcopy documents, contractor will also provide a CD with soft copy pdf files of the same information included in the binders.
2. Each binder shall contain the following information:
  - a. Name and address of Commissioner, Contractor, and index of equipment, including vendor (name and address).
  - b. Complete brochures, descriptive data and parts list, etc., on each piece of equipment, including all approved shop drawings.
  - c. Complete maintenance and operating instructions, prepared by the manufacturer, on each major piece of equipment.
  - d. Complete shop drawing submittal on temperature and monitoring controls including control diagrams updated to reflect "as built" conditions.
  - e. All wiring and component schematics necessary for building operators to troubleshoot, repair and expand the system.
  - f. All brochures shall be submitted to the Commissioner prior to final inspection of the building.
  - g. Provide a framed set of schematic drawings and sequence of operation to be hung at each local panel and at the central computer as directed by the Commissioner.
  - h. The recommended spare parts list. Maintenance instructions and spare parts list for each type of control device. Include that type data, product and shop drawings in maintenance manual.
3. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

#### 1.10 TECHNICAL PROPOSAL

- A. Technical proposals shall be prepared in accordance with these specifications. Six (6) copies of the proposal shall be submitted with the bid. Proposals that are unbound, loose, loose in a file folder, stapled, stapled in a manila file folder, etc., will not be acceptable. The technical proposal shall include the following data/information as a minimum. The order of listing here is not intended to indicate, nor should it be construed to indicate, the relative importance of the data/information:

1. Information on organizational capability to handle this project (management, operators, manufacturing, single source responsibility, etc.)

#### B. Service Capabilities:

1. Number of Service Technicians dedicated to service of building automation systems including, technician names, years of service with the contractor, and factory instructing records.
2. Evidence of 24 hr x 7-day emergency service capability including:
3. After Hours service procedures



4. List of locally installed building automation systems of similar size and scope
5. Information on instructing program to demonstrate specification compliance.

C. System Configuration as Proposed:

1. Describe system architecture including a schematic layout with location and type (model number) of all control panels.
2. Describe system operation, functions and control techniques.
3. Network layout including topologies, speeds, protocols, location of switches and ring managers.
4. Modularity.
5. Migration strategies to protect the City of New York's investment in BMS system.
6. Technical data to support the information on the hardware and software proposed for this solution including any integrated systems and/or solutions.
7. Panel Specification Sheets including communication port interfaces
8. Front End Server Hardware and Software Specification Sheets including:
9. Include remote alarm paging capabilities
10. Operator help menu descriptions
11. Custom Report Generator Description
12. Graphical Zone Scheduling Application Details
13. Include environment and space requirements for panels, CPU's and other major devices.
14. Detailed description of all operating, command, application and energy management software provided for this project.
15. Include a point's list for all input and output devices provided by the proposed systems.
16. Include a list of pre-built reports provided to the Commissioner to demonstrate specification compliance.

D. A signed certificate stating the Contractor "has read the performance and functional requirements, understands them and his technical proposal will comply with all parts of the specification."

1. Line by line specification concordance statement.

E. Other requirements for inclusion in the technical proposal are located throughout this specification.

F. Submit technical proposals with pricing in accordance with "Instructions to Bidders".

G. Failure to submit technical proposal containing the information outlined above will result in rejection of bidder's proposal.

1.11 WARRANTY

- A. Manufacturer Warranty shall cover all expenses for parts, labor, associated travel, and expenses for a period of one year from date of Substantial Completion.
- B. Hardware and software vendors supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.
- C. This warranty shall apply equally to both hardware and software.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide HVAC instrumentation and controls by one of the following:
  - 1. Johnson Controls BACnet
  - 2. Alerton Controls BACnet
  - 3. Siemens Apogee BACnet
  - 4. Or approved equal.

**2.2 Network Architecture**

- A. Intranet Network
  - 1. The Contractor shall be responsible for installation of primary and secondary LAN's required to support the complete BMS system. The Operator Workstation for the building shall be located as advised by the Commissioner.
- B. BACnet Primary LAN
  - 1. Primary LAN for the building automation system shall consist of a high speed network utilizing BACnet over Ethernet or BACnet/IP. The Primary LAN shall be used for communications between BACnet B-BC devices, B-AAC devices, B-ASC devices, and the Operator Workstation. The network shall be configured to allow for a redundant communication path from all network level controllers to the server. Managed network switches shall be used for this purpose.
- C. BACnet Secondary LAN
  - 1. A secondary LAN, separate from the Primary LAN shall be used for communications between B-ASC devices and the B-BC or B-AAC that provides BACnet router services for the device. The Secondary LAN shall utilize BACnet MS/TP for communications. The intent of the separate Primary LAN and Secondary LAN is to isolate traffic between B-BC's or B-AAC's and their associated B-ASC devices from the primary LAN.

**2.3 OPERATOR INTERFACE**

- A. The system shall be capable of supporting an unlimited number of clients using standard Web browser. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the Building Automation System (BAS), shall not be acceptable.
- C. The Web browser client shall support at a minimum, the following functions:
  - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, notice of access failure shall be displayed. Security using authentication and encryption techniques to prevent unauthorized access shall be implemented.



2. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
3. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
4. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
5. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
  - a. Modify common application objects, such as schedules and setpoints in a graphical manner.
  - b. Commands binary objects to start and stop.
  - c. View logs and charts.
  - d. View alarms.
6. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

**D. Alarms**

1. Alarm feature shall allow user configuration of criteria to create, route, and manage alarms and events. It shall be possible for specific alarms from specific points to be routed to specific alarm recipients. System shall be capable of routing alarms to recipients via email and texting. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
  - a. Allow configuration to generate alarms on any numeric, binary, or data point in the system.
  - b. Generate alarm records that contain a minimum of a timestamp, original state, acknowledged state, alarm class and priority.
  - c. Allow the establishment of alarm classes that provide the routing of alarms with similar characteristics to common recipients.
  - d. Allow a user, with the appropriate security level, to manage alarms - including sorting, acknowledging, and tagging alarms.

**E. Reports and Summaries**

1. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
  - a. All points in the BAS
  - b. All points in each BAS application
  - c. All points in a specific controller
  - d. All points in a user-defined group of points
  - e. All points currently in alarm
  - f. All BAS schedules
  - g. All user defined and adjustable variables, schedules, interlocks and the like.
2. Reports shall be exportable to .pdf, .txt, or .csv formats.
3. The system shall allow for the creation of custom reports and queries.



**F. Schedules**

1. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
  - a. Regular schedules
  - b. Repeating schedules
  - c. Exception Schedules
2. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
3. It shall be possible to define one or more exception schedules for each schedule including references to calendars
4. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days. Holidays and special days shall be user-selected with the pointing device or keyboard.

**G. Password**

1. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, Based on an assigned password.
2. Each user shall have the following: a user name, a password, and access levels.
3. The system shall provide the capability to require a password of minimum length and require a combination of characters and numerical or special characters.
4. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
5. The system shall provide unlimited flexibility with access rights. A minimum of four levels of access shall be provided along with the ability to customize the system to provide additional levels.
6. A minimum of 100 unique passwords shall be supported.
7. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
8. The system shall automatically generate a report of log-on/log-off and system activity for each user.
9. All log data shall be available in .pdf, .txt, and .csv formats.

**H. Dynamic Color Graphics**

1. The graphics application program shall be supplied as an integral part of the User Interface.
2. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
3. The graphics shall be able to display real-time data that is acquired, derived, or entered.
4. Graphics runtime functions –Each graphic application shall be capable of the following functions:
  - a. All graphics shall be fully scalable
  - b. The graphics shall support a maintained aspect ratio.
  - c. Multiple fonts shall be supported.
  - d. Unique background shall be assignable on a per graphic basis.



5. Operation from graphics – It shall be possible to change values (set points) and states in systems controlled equipment within the Web browser interface.
6. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all runtime binding.

**I. Historical Data Collection**

1. All numeric, binary or data points in the system database shall allow their values to be logged over time (trend log). Each historical record shall include the point's name, a time stamp including time zone, and the point's value.
2. The configuration of the historical data collection shall allow for recording data based on change of value or on a user-defined time interval.
3. The configuration of the historical data collection shall allow for the collection process to stop or rollover when capacity has been reached.
4. A historical data viewing utility shall be provided with access to all history records. This utility shall allow historical data to be viewed in a table or chart format.
5. The history data table view shall allow the user to hide/show columns and to filter data based on time and date. The history data table shall allow exporting to .txt, .csv, or .pdf file formats.
6. The historical data chart view shall allow different point histories to be displayed simultaneously, and also provide panning and zooming capabilities.

**J. Audit Log**

1. For each log entry, provide the following data;
2. Time and date
3. User ID
4. Change or activity: i.e., Change set point, add or delete objects, commands, etc.

**K. Database Backup and Storage**

1. The user shall have the ability to back up the System Controller databases.

**2.4 OPERATOR INTERFACE DASHBOARD**

**A. General**

- B.** Contractor shall provide browser-accessed dashboard that shall reside on the BMS server and can support up to 150 simultaneous users as part of standard installation for viewing of system data on a display, kiosk or personal computer. The dashboard software shall reside on the BMS BACnet network, and can share the BMS server for the control system.

**C. Information Display - The web-based dashboard information screens shall:**

1. Support displaying up to 50 buildings.
2. User shall be able to navigate by clicking on icons and/or navigate via a touchscreen without the need for any additional configuration.
3. The dashboard shall support auto rotation of pages to support a display with no user interface (for example, touchscreen, mouse or keyboard). The pages to be displayed can be selected as a subset of all possible pages in the dashboard. The time to view each page and the order in the pages are cycled through shall be configurable.
4. The dashboard application shall include the following pages at a minimum:





- a. Home page
  - b. Consumption page
  - c. Summary page
  - d. Demand page
  - e. Green Facts page
  - f. Weather page
5. The end user shall be able to compare measured data for one (1) entity against measured data for a second entity.
6. For each resource that is defined (e.g. Water, Gas, etc.) one (1) consumption page shall be used.
7. The end user shall be able to view current data on one of the following time scales:
  - a. Cumulative data for today, displayed in hour increments.
  - b. Cumulative data for the current week, displayed in daily increments.
  - c. Cumulative data for the current month, displayed in daily increments.
  - d. Cumulative data for the current year, displayed in monthly increments.
8. The user shall be able to see:
  - a. Today's data compared against the data for the same day last week.
  - b. This week's data compared against the data for the same week last year.
  - c. This month's data compared against the data for the same month last year.
  - d. This year's data compared against the data for last year.
9. The end user shall be able to view historical data in one of the following time scales:
  - a. Complete data for yesterday, displayed in hour increments.
  - b. Complete data for last week, displayed in daily increments.
  - c. Complete data for last month, displayed in daily increments.
  - d. Complete data for last year, displayed in monthly increments.

**D. Dashboard Data**

1. The database for the dashboard must be on the BMS enterprise network and remotely hosted on a third-party network. The database should be on-site to maintain security and privacy.
2. Energy Dashboard data shall reside on site and shall remain in the BMS.
3. The dashboard shall support Microsoft SQL database.
4. The dashboard shall allow for the importation of external data via CSV file format.
5. BMS shall utilize Web Services to pull real time weather data via the world wide web.

**E. Browser Technology**

1. The following browsers shall be supported:
  - a. Microsoft Edge
  - b. Firefox
  - c. Safari
  - d. Google Chrome

**F. Dashboard Licensing**



1. The Energy Dashboard shall utilize software licensing that will run in perpetuity, without the need for additional service and/or subscription fees.
2. No dedicated server or embedded controller shall be needed to host energy dashboard software.

**G. Configuration**

1. End users shall be able to connect remotely (including dashboard location) to the system to make changes to the configuration using a browser.
2. Energy Dashboard shall be maintainable by end-user staff with limited instructing and support common image files including JPEG and PNG.
3. User generated/supplied content to include foreground images, background images, text, and icons.
4. Consumption pages for the resources defined—one (1) for each resource type for which he wishes to display consumption data. Consumption data is the total amount of a resource used over time, for example this is a kWh reading.
5. The system designer shall be able to configure:
  - a. One or more home pages.
  - b. One or more summary consumption pages. This page shows the total consumption for each configured entity within the system and a total for the entire enterprise.
  - c. One or more current demand pages. This page shows the current demand for a given entity.
  - d. One or more weather pages using weather station data from either NOAA or Google.
  - e. One or more green facts pages. This page is intended to inform the user of relevant environmental information. It is expected that this type of display will be used in relation to LEED certification.
6. Support ability to add additional capacity (more buildings, more meters) without the need for additional hardware.

**H. Security**

1. Dashboard Ability to restrict data behind a firewall or within a DMZ.
2. Dashboard application shall not allow the user to update the system data. For example, the user shall not be allowed to update the present-value of an analog-value.
3. The dashboard shall require a user authorization via user name and password to access the configuration screens.

**I. Reporting**

1. BMS shall be provided with reporting software containing both template reports and the ability to create custom reports without any additional software or hardware.

**J. Automated Monitoring Based Commissioning**

1. The AMBCx system provided shall be able to satisfy fault detection and diagnostics (FDD) and analysis of the following major mechanical and energy systems in the facility, including, but not limited to, the following:
  - a. Boiler and other related heating plants.
  - b. Chilled water plants.



- c. Building radiation
  - d. Heat pumps for heating, cooling, and heat recovery, plus associated cooling towers and boilers as applicable.
  - e. Constant and variable speed fan and pumps.
  - f. Variable frequency drives.
  - g. Air and water economizers and heat recovery cycles.
  - h. Air distribution and ventilation systems, including, but not limited to, terminal devices (VAV, mixing boxes, reheats).
  - i. Exhaust fan systems.
  - j. Fan coils with heating and/or cooling.
  - k. Building related process systems and equipment (medical gas, medical vacuum, compressed air).
  - l. Lighting systems and controls.
  - m. Operating schedules.
  - n. Combined heat and power systems.
- 2. The AMBCx system shall be able to interface directly with the project BMS and energy/performance metering system to provide information on HVAC and lighting systems that are being controlled.
  - 3. Measurement and sensing devices shall be supplied and installed and field-tested by the Contractor according to the requirements specified in the contract documents
  - 4. The AMBCx system shall be able to analyze a combination of hard-wired (analog and digital I/O) and virtual points (setpoints, calculated variables) in a system using real-time and historical time-series data to the following (the actual set of analysis capabilities for a particular building shall be dependent on the BMS data available from that building):
    - a. Minimum Required Capabilities:
      - 1) Determine the stability of control devices (valves/actuators/speed drives).
      - 2) Determine the degree of error above reasonable thresholds.
      - 3) Compare sensor readings to setpoint and flag out-of-range errors from faulty sensors.
      - 4) Compare outputs (controllers) setpoints to actual conditions to find failed devices.
      - 5) Calculate and report on energy consumption for systems under BMS control.
      - 6) Ensure economizer systems are working to provide optimal free cooling opportunities.
      - 7) Diagnose flow measurement systems to ensure readings are in range of expectations.
      - 8) Categorize faults according to various priorities (energy, comfort, and system maintenance impact).
      - 9) Identify simultaneous heating and cooling in a system and sub system (pre-cool/reheat).
      - 10) Ensure ventilation rates are adequate (testing minimum outdoor air volume settings).
      - 11) Report heating and cooling plant efficiency through efficiency measurement.
      - 12) Optimize air filter replacement by monitoring changes in filter pressure drop.
      - 13) Monitor chiller evaporator and condenser tube bundle pressure drops for degradation in performance.

## 2.5 operator interface / Dedicated Servers



A. Operator Interface / Dedicated Server:

1. Contractor shall furnish 2 new servers to host the operator interface software for the BMS. The new servers shall have the ability to operate in a redundant fashion so that upon the failure of one server the second server continues to operate without any degradation to system performance. The new servers shall be installed at a location to be determined by the Commissioner.
2. Server Hardware Requirements: The server hardware platform shall have the following requirements:
  - a. Processor: Intel Xeon E3-1220 v2, 3.10 GHz, 8M Cache, Turbo, Quad Core/4T processors or approved equal.
  - b. Memory: 8 GB RAM.
  - c. Flash BIOS: BIOS 8MB flash memory for system BIOS
  - d. Storage: CD-RW/DVD Combo
  - e. Hard Drive: SATA 3.0Gb/s: 7200RPM with 8MB DataBurst Cache up to 1.5TB, 10K RPM with 16MB DataBurst Cache up to 300GB, SAS: 15K RPM up to 450GB. CD-RW/DVD Combo
  - f. Network Interface: 2 Onboard Network Adapters
  - g. Audio controller: Integrated High Definition Audio, 24-bit analog-to-digital; 24-bit digital-to-analog stereo conversion
  - h. Monitor: Minimum 19" high definition flat panel display.
  - i. Ports: Eleven USB 2.0: two on front panel, six on back panel, three internal (UDOC) on motherboard; eSATA: one rear; one serial, one parallel; two PS/2; one RJ-45; stereo line-in and headphone line-out on back panel; microphone and headphone connector in front.
  - j. The PC workstation operating system shall be Microsoft Windows 10 Professional, with current Service Pack. Provide all licenses required for operation.
3. Remote Access: Local Area Network installations shall have remote access to the BMS provided for local Intranet. The Commissioner shall provide a connection to the Intranet to be used by the facility.
4. Servers to be powered by emergency power and UPS. UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt Amps needed for panel.

2.6 LOCAL WEB BROWSER / PC Work station

A. Local Web Browser / PC Workstation:

1. Contractor shall furnish PC workstations for local operator interface to the BMS. The quantity and locations shall be as outlined on the BMS riser with exact location to be determined by the Commissioner.
2. PC Workstation Hardware Requirements: The PC workstation hardware platform shall have the following requirements:
  - a. Processor: Dual-core Intel Xeon 3500 series processors or approved equal.
  - b. Memory: 4 GB RAM.
  - c. Flash BIOS: BIOS 8MB flash memory for system BIOS
  - d. Storage: CD-RW/DVD Combo
  - e. Hard Drive: SATA 3.0Gb/s: 7200RPM with 8MB DataBurst Cache up to 1.5TB, 10K RPM with 16MB DataBurst Cache up to 300GB, SAS: 15K RPM up to 450GB. CD-RW/DVD Combo



- f. Network Interface: Integrated Broadcom 5761 Gigabit Ethernet controller with Remote Wake UP and PXE support
  - g. Audio controller: Integrated High Definition Audio, 24-bit analog-to-digital; 24-bit digital-to-analog stereo conversion
  - h. Monitor: Minimum 19" high definition flat panel display.
  - i. Ports: Eleven USB 2.0: two on front panel, six on back panel, three internal (UDOC) on motherboard; eSATA: one rear; one serial, one parallel; two PS/2; one RJ-45; stereo line-in and headphone line-out on back panel; microphone and headphone connector in front.
  - j. The PC workstation operating system shall be Microsoft Windows 10 Professional, with current Service Pack. Provide all licenses required for operation.
- 3. In addition to above monitor furnish a 50" high definition, wall mount, flat panel display to be located in close proximity to one of the PC Workstations. The exact location to be determined by the Commissioner.
  - 4. PC workstation to be configured to only allow access to the BMS system. Access to outside is to be denied. CD drive and USB ports are to be limited to the highest level.
  - 5. PC workstation to be powered by emergency power and UPS. UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt/ Amps needed for panel.
  - 6. Contractor shall include BMS workstation web server for main campus. Contractor is responsible for coordinating with MSKCC's IT department for access.

## 2.7 PORTABLE OPERATOR TERMINAL

### A. Tablet PC Portable Operator's terminal

- 1. The Contractor shall provide 3 tablet portable operator's terminals for programming purposes. The terminal shall be configured as follows:
  - a. Tablet touch screen Personal laptop computer
  - b. Intel Core i5 i5-2467M, 1.6 GHz, Dual-Core
  - c. 4.0 GB - DDR3 SDRAM – Microsoft Windows 10 Professional 64-bit Edition.
  - d. SVGA 1366 x 768 resolution color display
  - e. Complete workstation software packages, including any hardware or software.
  - f. Software registration cards for all included software shall be provided to the Commissioner.
  - g. External power supply/battery charger.
  - h. Wireless network adapter.
- 2. Software
  - a. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
  - b. When used to access first or second tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
  - c. When used to access application specific controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.
  - d. Portable operator terminal shall have ability to wirelessly connect to the BMS network as an operator workstation when customer WiFi network is in place.

## 2.8 BUILDING CONTROLLER

### A. BACnet Devices



1. Network Area Controller (NAC)
  - a. The NAC must provide the following hardware features as a minimum:
    - 1) Communications
      - a) One 10/100 Mb Ethernet Port – RJ-45 connection
      - b) One RS-232 port
      - c) One RS-485 port (up to 57,600 baud)
      - d) Optional internal auto-dial/auto-answer 56K modem.
      - e) All required protocol drivers are included.
    - 2) Inputs/Outputs
      - a) Modular expansion modules for adding hardwired analog and digital inputs and outputs directly to the NAC panel.
    - 3) Battery Backup
      - a) Battery backup provided for all on board functions including I/O.
      - b) Battery is monitored and trickle charged.
      - c) Battery maintains processor operation through power failures for a pre-determined interval, and then writes all data to flash memory, shuts the processor down, and maintains the clock for five years.
      - d) Battery backup is to annunciate a trouble alarm to the BMS if problems occur.
      - e) NAC shall be powered by Uninterruptable Power Supply (UPS). UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt Amps needed for panel.
    - 4) Environment
      - a) Must be capable of operation over a temperature range of 0°C to 55°C.
      - b) Must be capable of withstanding storage temperatures of between 0°C and 70°C.
      - c) Must be capable of operation over a humidity range of 5% to 95% RH, non-condensing
    - 5) Performance
      - a) Supports up to 100 devices.
      - b) All digital outputs shall include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition, each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.
  2. The Network Area Controller (NAC) shall be a fully user-programmable device.
  3. Automation network – The Network Area Controller (NAC) shall reside on the automation network. Each NAC shall support one or more sub-networks of controllers.



4. User Interface – Each Network Area Controller (NAC) shall have the ability to deliver a web based user interface as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
  5. Power Failure – In the event of the loss of normal power, The Network Area Controller (NAC) shall continue to operate for a define period after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software. Flash memory shall be incorporated for all critical controller configuration data.
    - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions.
    - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
    - c. Certification – All controllers shall be listed by Underwriters Laboratories (UL).
- B. Advanced Application Controller
1. Control of AO's and BO's and monitoring of AI's and BI's are permitted on devices that conform to the requirements for the BACnet Advanced Application Controller (B-AAC) as identified in ASHRAE Standard 135. B-AAC's shall be provided with all supporting BACnet services as a local function. The device shall not depend upon any other devices for the functionality of schedule or alarm activities. B-AAC's serving major mechanical systems shall utilize an Uninterruptible Power Supply (UPS). UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt Amps needed for panel
  2. A single piece of equipment shall utilize a single controller. Control functions for a single piece of equipment may not be divided among controllers.
- C. Application Specific Controllers
1. Control of AO's and BO's and monitoring of AI's and BI's are permitted on devices that conform to the requirements for the BACnet Application Specific Controller (B-ASC) as identified in ASHRAE Standard 135. Where B-ASC's are utilized, any supporting NAC or B-AAC must be provided with an Uninterruptible Power Supply (UPS) to avoid any unintentional loss in the support of BACnet services due to a power outage for the NAC while the B-ASC is functional. UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt Amps needed for panel.
- D. Gateways
1. Gateways between BACnet and any other protocols shall not be allowed for this project.
- E. Smart Sensor/Actuator
1. BACnet Smart sensors (B-SS) and actuators (B-SA) shall not be permitted for use on this project. All system I/O must be connected directly to a B-AAC or B-ASC device.
- F. Standalone Un-Interruptible Power Supply
1. Furnish and install a standalone Un-Interruptible Power Supply (UPS) for each network control panel, server, dedicated operator interface PC and advanced application control panels serving each major mechanical system. There shall be a separate UPS for each device. The UPS shall include external batteries, line conditioner, and all other accessories for a complete system. The UPS shall be sized by the controls contractor and submitted to the Commissioner for approval. The UPS shall provide the BMS equipment with un-



interrupted power for a minimum of 15 minutes and shall be sized for 50% spare capacity. The UPS shall be APC, Sola, Exide or approved equal. All wiring between the emergency power source, UPS and BMS equipment panel shall be provided by the Contractor.

2. UPS to be online UPS similar to Liebert GXT3 and sized for proper Volt Amps needed for panel.

## 2.9 SENSORS AND MISCELLANEOUS DEVICES

### A. General - field devices

1. The project that is the subject of this specification may not require all types of hardware listed in this section.
2. Provide field devices for input and output of digital (binary), and analog, signals into BACnet devices. Provide signal conditioning and/or filtering for all field devices as recommended by field device manufacturers, and as required for proper operation of the system.
3. It the responsibility of the building automation contractor to provide equipment as identified in this specification section. This section may identify devices which are not required to be provided in the scope of this project (i.e. The EP transducer is included in this section, but may not be required on a project where all electric controls are found).
4. It shall be this building automation contractor's responsibility to assure that all field devices are compatible with the controllers to be used on the project.
5. Transmitters specified herein are generally 4-20 ma "two-wired" type transmitters, with power for the device expected to be supplied from the transformer powering the controller.
6. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, the building automation contractor shall furnish and install proper device. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
7. Accuracy, as stated in this section, shall include combined effects of non-linearity, non-repeatability and hysteresis.

### B. Temperature Sensors

1. Sensor range: when matched with a/d converter of the controller, sensor range shall provide a resolution of no larger than 0.36°F (unless noted otherwise).
2. Room temperature sensor shall be an element contained within a ventilated cover, suitable for wall mounting. Sensors located in mechanical areas, plenums, garages, or designated institutional locations shall be a flat plate sensor with no possible adjustment. Security screws shall be used in institutional settings as deemed necessary by the Commissioner. The building automation contractor shall coordinate requirements with the Commissioner during the submittal process. Provide an insulated base when used on an outside wall, on an interior wall within 18 inches of an outside wall, or on a wall adjacent to an unconditioned space. The following sensing elements are acceptable:
  - a. Sensing element - platinum RTD, thermistor, or integrated circuit, +/- 0.36°F accuracy at calibration point.
3. Intelligent room sensor with LCD readout
  - a. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow





- service technician access to hidden functions as described in sequence of operation.
- b. Intelligent room sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
  - c. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "off" in unoccupied mode unless a function button is pressed.
  - d. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
  - e. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all air flow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
4. Single point duct temperature sensor shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph (a) below. Sensor probe shall be 300 or 400 series corrosion resistant steel (cres).
- a. Sensing element - platinum RTD, thermistor, or integrated circuit, +/- 0.36°F accuracy at calibration point.
5. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for every three square feet of cooling coil face area. Temperature range as required for resolution indicated in paragraph (a) below.
- a. Sensing element - platinum RTD, thermistor, or integrated circuit, +/- 0.36°F accuracy at calibration point.
6. Liquid immersion temperature sensor shall include stainless steel (or brass for copper piping) thermo well, sensor and connection head for wiring connections.
- a. Sensing element for chilled water applications - platinum RTD, thermistor, or integrated circuit, +/- 0.36°F accuracy at calibration point. Temperature range shall be as required for resolution indicated in paragraph a.
  - b. Sensing element for non-chilled water applications - platinum RTD, +/- 0.2°F (0.2°C) accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F (0.06°C).
7. Outside air temperature and humidity station shall consist of a single device with a ventilated non-metallic sun shield, utility box for terminations, and water tight gasket to prevent water seepage. These devices shall be mounted at least 10 feet above ground level in a north-facing location that is not exposed to the draft from an exhaust fan, cooling tower exhaust, AHU relief air, flue vent from a gas combustion heater, or any source of conditioned air. In the event a suitable wall mounting location cannot be found, the devices may be mounted in an open location provided they are supplied with a housing intended



for mounting in such a location. Temperature range shall be as required for resolution indicated in paragraphs (a) and (b) below.

- a. Sensing element - platinum RTD, thermistor, or integrated circuit, +/- 0.36°F (0.2°C) temperature accuracy at calibration point.
- b. Accuracy (% RH): +/- 3% 0-100% RH at 68°F (20°C), including hysteresis, linearity and repeatability.
- c. Manufacturer: Vaisala (Basis of-Design), or an equivalent product from an approved manufacturer as listed above.

**C. Humidity transmitters**

1. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin polymer film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20ma for percent relative humidity (% RH). Sensors shall have the following minimum performance and application criteria:
  - a. Input range: 0 to 100% RH
  - b. Accuracy (% RH): +/- 3% 0-100% RH at 68°F (20°C), including hysteresis, linearity and repeatability.

**D. Energy Consumption Meter**

1. The energy meter shall consist of digital electronic circuitry and conform to ANSI C12.1 metering accuracy standards and meet UL and CUL specifications as listed in 3111-1.
2. The energy meter system shall consist of a meter and included ct(s) calibrated together as a system with accuracy of +/- 1% from 2 % to 100 % of the rated current over a temperature range of 0-50° C. It shall require no annual recalibration by users in the field.
3. The meter shall derive operating power from its metering connections, and shall not require a separate control power connection and shall automatically correct for CT phase reversal.
4. The energy meter LCD display shall show accumulated KWH on the top half of the display while the bottom half of the display scrolls through amps, voltage, PF, KVAR, KVA, KW and real power. The information and capabilities provided by the energy meter shall include the following:
  - a. Current, per phase & three-phase total
  - b. Voltage, per phase & three-phase total, phase-to-phase & phase-neutral
  - c. Real power (kw), per phase & three-phase total
  - d. Reactive power (kvar), three phase total
  - e. Apparent power (kva), three phase total
  - f. Power factor, per-phase & three-phase total
  - g. Real energy (kwh), three phase total
5. The energy meter shall directly accept any voltage input from 120-480 VAC and be internally isolated to 2500 VAC.
6. The energy meter shall have a N.O. pulse output with selectable pulse output rates of 0.10, 0.25, 0.50, or 1.00 KWH per pulse and a N.C. phase-loss alarm output operating at 100ma @ 24vac/dc. It should be also capable of networking via BACnet MS/TP.
7. The energy meter shall be the H8163 series supplied by Veris industries (Basis of-Design), or an equivalent product from an approved manufacturer as listed above.

**E. Differential pressure sensor, air**



1. The differential pressure sensor for air applications shall provide a current or voltage signal (4-20 Ma, 0-10 VDC, or 0-5 VDC) with an accuracy of +/- 1% fs (including non-linearity, hysteresis, and non-repeatability). Accuracy for pressure sensors used in flow measurement applications shall be +/- 0.5%. Operating temperature range and compensated temperature range shall be as appropriate for the temperature extremes of the environment where it is used and the application it is intended for.

**F. Differential pressure sensor, water**

1. Sensor shall be proportional output, +/- 0.25% full range accuracy, 0 to 100 PSID range (max 250 PSI). Provide Siemens Sitrans, Rosemount (Basis-of-Design), or an equivalent product from an approved manufacturer as listed above.

**G. Fluid flow meters**

1. Provide non-intrusive flow measuring device. Refer to manufacturer for recommendation installation, control and accessories.
2. As an alternative provide magnetic flow meter.
3. The meter must be a clamp-on design with no liquid contact that mounts externally on the pipe. The meter must utilize the transit-time flow measurement technique and employ the use of two microprocessors and have the ability to monitor two independent flow channels simultaneously (second channel optional).
4. The metering electronics must have the ability to operate high temperature flow sensors capable of monitoring liquids at temperatures in excess of 750°F. The meter must also have the ability to employ an alternate Doppler measurement technique for liquids with high air or solid content.
5. The meter must have a transducer encased in stainless steel with an integral armored stainless steel jacketed triax cable. The transducers are to have the ability to be coupled using permanent coupling pads (grease is NOT acceptable). All transducer markings and identification must be laser scribed and solvent resistant. The use of adhesive labels for transducer identification will not be acceptable. All transducers supplied must have a multi-point wet flow calibration certificate accredited from an international standards agency with an accuracy of better than 1%. All calibration and transducer data must reside in a non-volatile memory chip located in the transducer junction box or flow meter.
6. The meter must have the ability to automatically recognize the transducers when connected. Programming of the transducer type into the meter will not be acceptable. The meter must be of a type that requires no zero calibration. The zero calibration must be factory pre-set automatic without the need for zero check/calibration after installation. There must not be any zero drift mechanisms (i.e. temperature change related drift) as the meters cannot be installed with any low-flow cutoff or "dead band".
7. The meter must also provide automatic Reynolds number, liquid sonic velocity compensation, and have built in liquid tables for automatic sound velocity, viscosity, and density settings.
8. The flow meter electronics shall be housed in a NEMA 4X enclosure and must have the ability to indicate flow rate, flow velocity, mass flow, total flow, signal strength, signal quality, liquid sonic velocity, Reynolds regime (laminar/turbulent/transition).



9. The meter must have the ability to have dynamic (automatic) compensation for changes in viscosity and density.
10. The meter shall be capable of outputting multiple 4-20ma, Voltage 0-1v or 0-10v, high precision frequency 0-1kHz or 0-10kHz galvanically isolated, RS-232, RS-484, binary output pulse or alarm for relay total and meter status.
11. The meter shall have the ability to status alarm for conditions of fault, flow direction, sound velocity limit, flow velocity limit.
12. The meter shall have the ability to set the 4-20ma to a settable status condition (i.e. 2ma for an alarm condition).
13. The meter shall have RS-232 output and internal memory with a minimum storage of 100K data points
14. The flow meter shall be a Flexim 7407, Siemens SITRANS, Panametrics (Basis-of-Design), or an equivalent product from an approved manufacturer as listed above.
15. Field start-up and commissioning is to be performed by a factory certified service person. Included is mounting the sensors to the pipe, terminating the sensor wires, programming the meter & providing a startup report.

**H. Airflow Measuring Stations**

1. Airflow measuring stations required to accomplish the specified control sequence shall be furnished under this section but installed by the Contractor's mechanical trade. Airflow measuring stations shall be of heavy gauge metal construction, and shall be furnished with an air straightening section with an open face area of not less than 97%.
2. Each airflow measuring station shall measure airflow by means of a network of static and total pressure sensors factory positioned and connected in parallel to produce an averaged velocity pressure. The measured velocity pressure converted to airflow (CFM) shall have an accuracy of 2% of the full scale throughout the velocity range from 700 to 4,000 FPM when measured under ideal laboratory conditions. The location of stations shall meet manufacturer's guidelines.
3. The maximum resistance to airflow shall not exceed 0.6 times the velocity head. The unit shall be suitable to withstand temperatures up to 250°F.
4. All interconnecting tubing between the air measuring and any remote metering or control shall be furnished and installed by the supplier of the station. A minimum of one static and one total pressure sensor shall be used for every 16 sq. Inches of duct cross sectional area for ducts up to four sq.ft. In cross section. For larger ducts, a minimum of one static and one total pressure sensor shall be used for every 36 sq. Inches of duct cross sectional area.
5. Interconnecting sensor manifolds shall equalize and relate each type of sensor measurement into one total pressure and one static pressure metering port. The permanent system pressure loss created by the unit shall not exceed .15 of a velocity head. Each airflow measuring station shall consist of 16-gauge sheet metal casing and an air straightening section with an open face area not less than 97%. The sheet metal contractor shall install air measuring stations.
6. Provide air monitor Fan-E or equal with an accuracy of + 2%, a turndown of 6 to 1, and no pressure loss across the station.
7. Final locations to be coordinated with sheet-metal contractor and manufacturer to ensure installed actual accuracy meets specifications.



8. Air flow sensing tubes may be mounted in the fan inlet as approved by the manufacturer for AHU applications and shall be piezometer. No other type of fan inlet flow sensor shall be acceptable.

**I. Outdoor Air Volume Measuring Station**

1. Outdoor air volume measuring required to accomplish the specified control sequence shall be furnished and installed under this section. Conventional airflow measuring stations shall not be used for measuring outdoor air intake into an air handling unit.
2. Each outdoor air volume measuring station shall measure airflow by means of an airflow measuring probe specifically designed for the application, matched transducer and monitor. The monitor shall be located between the intake louvers and the outdoor air damper. The quantity of probes must be based on the size of the outdoor air intake opening and must conform to the manufacturer's recommendation.
3. The measured velocity pressure converted to airflow (CFM) shall have an accuracy of 5% of the full scale throughout the velocity range from 200 to 1,000 FPM when measured under ideal laboratory conditions. The location of stations shall meet manufacturer's guidelines.
4. The monitor shall include a built-in display that allows for local indication of all relevant data about the outdoor air. Data can be assessed and viewed by using the 80-character display and intuitive keypad sequences. The display also provides a means to trouble shoot the operation of the hardware. Diagnostic functions monitor the performance of the differential pressure transducer, auto-zero valve, temperature sensors, and transducer heater. Hardware malfunctions are pinpointed and displayed in the alarm list display.
5. Provide TEK-AIR IAQ-TEK or equal.

**J. Current switches**

1. Current switch (input only) shall consist of 0 to 135 a continuous amperage rating, adjustable trip set-point to +/- 1% of range, .1a @ 110 VAC resistive rating. Direct drive motors are permitted to utilize a current switch without an adjustable set point. Non direct-drive motors shall utilize a device with an adjustable set point as well as status and power led indication.
2. Current switch and load control relay (input/output device) shall consist of 0 to 135 a continuous amperage rating current switch, adjustable trip set-point to +/- 1% of range, .1a @ 110 VAC resistive rating. Load control relay shall be capable of 5a @ 240 VAC resistive. The device shall have adjustable trip set point as well as status, power, and relay command status led indication.
3. Current switches for VFD-controlled loads shall be specifically designed for this purpose. A Veris H-934 or approved equivalent device shall be used.

**K. Damper end switch**

1. Damper end switches shall be devices that directly detect the desired position of the damper blades. The switch shall not be a component of the actuator nor shall it be mounted on the damper shaft.
2. All fire/smoke and smoke rated dampers shall be provided with two (2) factory installed damper end switches.
3. All automatic control dampers shall be provided with one (1) factory installed damper end switch.
4. The end switches are specified under another section of this work.



**L. Air Differential Pressure Switch**

1. Air differential pressure switches shall be diaphragm type, die-cast aluminum housing, adjustable set point, with a SPDT switch. Rating shall be a minimum of 5 amps at 120 vac. Switch pressure range shall be suited for the application. Provide Johnson Controls, Dwyer or equal.

**M. Low Temperature Detector (Freeze-Stat)**

1. Provide low temperature detector (freeze-stat) for each chilled water coil located in air handling units. Furnish one detector for each coil section.
2. Low temperature detector (LTD) shall be automatic reset, DPDT type. LTD shall be installed in a serpentine fashion across the coil in the air stream in accordance with the manufacturer's recommendations. Element shall be arranged to lock out the associated fan should the temperature at any point along the sensing element fall below 38 °f for an adjustable time period.

**N. Single Point Leak Detector**

1. Provide Liebert It-410 (Basis-of-Design), or an equivalent product from an approved manufacturer as listed above. The alarm module shall indicate that water has contacted the sensors by actuating two output relays. The relays shall remain activated until the module is reset.

**O. Zone Leak Detector**

1. Provide Liebert It-460 (Basis-of-Design), or an equivalent product from an approved manufacturer as listed above. The alarm module shall indicate that water has contacted the sensors cable by actuating two output relays. The relays shall remain activated until the module is reset.

**2.10 AIR SAMPLING SENSORS**

**A. Carbon Dioxide Sensor**

1. Coordinate with air quality monitoring system.
2. The carbon dioxide detectors shall be catalytic-bead type with a demonstrated resistance to silicones and reduced sulfur compounds. Detectors shall have a minimum life span of three years. The sensors shall have a dual housing with the sensor and transmitter in separate housings, with sensors located up to 50 feet from the transmitter. Housings shall be explosion proof for class 1, Group b, c and d, Division 1 areas. Input power shall be 250ma at 24vdc. Response time shall be less than 5 seconds to final reading, from a step change in gas concentration. Sensor/transmitter repeatability shall be +/- 1% full scale. Transmitter signal shall be 4-20 mA.
3. The detection system shall be Veris model CDE / CWE (Basis-of-Design), or an equivalent product from an approved manufacturer as listed above.
4. Power 24vdc power supply as required from emergency source.

**B. Carbon Monoxide Monitoring and Control System**

1. Coordinate with air quality monitoring system.
2. The sensor/transmitter shall be the MSA model 212376 (Basis of-Design), or an equivalent product from an approved manufacturer as listed above, with a range of 0-200 ppm full scale.



3. The sensor/transmitter shall incorporate a solid-state, semi-conductor type sensor offering a minimum useful life span of 8 years.
4. The sensor/transmitter shall be 3-wire, 4-20 ma design and shall operate on 24vdc. The output of the unit shall be linearized to the full scale range.
5. The transmitter circuitry shall include full temperature and humidity compensation and shall incorporate a purge cycle to periodically heat the semiconductor to a high temperature to allow recovery from interfering gases and high CO concentrations.
6. The response time of the unit, accounting for the purge cycle, shall be 150 seconds or less to 90% of a step change in CO level.
7. The sensor unit shall be provided with a suitable NEMA enclosure for wall mounting in loading dock area and garage area.
8. Provide a green LED for power on, a red LED for sensor failure, a yellow LED for CO warning level reached and a red LED for CO alarm level reached. LEDs shall be visible from the outside of the unit enclosure.
9. Provide a calibration kit (flow system type) including zero gas and test gas. Turn over complete kit to the Commissioner at warranty start date.
10. Power 24vdc power supply as required from emergency source.
11. Provide one sensor/transmitter per 500 square feet of driveway and loading dock.

**C. Methane Monitoring System**

1. Coordinate with air quality monitoring system.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acme (model ST-40)
  - b. MSA
  - c. Honeywell Analytics
  - d. Or approved equal.
3. The methane detector shall be catalytic-bead explosion proof sensor. Detectors shall have a typical life span of two years. The sensors shall have a dual housing with the sensor and transmitter in separate housings, with sensors located up to 50 feet from the transmitter. Housings shall be explosion proof for class 1, group b, c and d, and areas specified in the DDC General Conditions. Input power shall be 250ma at 24vdc. Response time shall be less than 5 seconds to final reading, from a step change in gas concentration. Sensor/transmitter repeatability shall be +/- 1% full scale. Transmitter signal shall be 4-20 ma.
4. Power 24vdc power supply as required from emergency source.
5. Provide methane detection for each gas riser shaft. Provide three sensors per riser or as per manufacturers recommendation, whichever is greater. Submit sensor and electronic transmitter locations for approval.

**2.11 ELECTRIC CONTROL COMPONENTS**

- A. Limit switches (LS): limit switches shall be UL listed, with adjustable trim arm. Limit switches shall be as manufactured by Square "D", Allen Bradley (Basis-of-Design), or an equivalent product from an approved manufacturer as listed above; SPDT or DPDT type.
- B. Control relays: all control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA 1 enclosure.
  1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:



- a. Poles – relays having a single pole or single-throw type shall not be used. Relays shall be double-throw type with a minimum of two poles.
  - b. Relays shall incorporate an LED that indicates when the relay coil is energized.
  - c. Ac coil pull-in voltage range of +10%, -15% or nominal voltage.
  - d. Coil – sealed, with required volt amperes (va) not greater than four (4) va.
  - e. Silver cadmium form c (SPDT) contacts in a dust-proof enclosure, with 8 or 11 pin or spade type plug.
  - f. Pilot light indication of power-to-coil shall be provided for relays installed remotely from the controlling device.
  - g. Relays shall be Allen Bradley - model 700hk, Idec RH-series or approved equal.
2. Relays used for remote start/stop control of motors and shall have a current rating at least 1.5 times full load amps of the load it is controlling. In addition to the relays specified above, the functional devices ribu1c is also permitted for use here.
  3. Relays used for stop/start control shall have low voltage coils (30 Vac or less), and shall be provided with transient and surge suppression devices at the controller interface.
- C. Control transformers: furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be us and CSA listed. Primary and secondary sides shall be fused in accordance with the NEC. Transformer shall be proper size for application, and mounted in minimum Nema 1 enclosure. Each controller device requiring a low voltage power supply to operate shall be provided with a dedicated transformer.
1. Westinghouse, Square “D”, Jefferson or approved equal shall manufacture transformers.
- D. Electric push button switch: switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800t type, as manufactured by Allen Bradley or approved equal.
- E. Pilot light: panel-mounted pilot light shall be oil tight, transformer type, with screw terminals, led type, rated for 24 Vac or 120 Vac. Unit shall be as manufactured by Allen Bradley or approved equal.

## 2.12 NETWORK CONNECTION TOOL

1. Network connection tool shall allow technician to connect a laptop to any ms/tp network or at any ms/tp device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
2. Provide quick connect to ms/tp Lan at each controller. Tool shall be able to adjust to all ms/tp baud rates specified in the BACnet standard.

## 2.13 ELECTRONIC ACTUATORS AND VALVES

- A. Quality Assurance for Actuators and Valves
1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
  2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
  3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
- B. Valves are specified under another specification section of this work.





**C. Execution Details for Actuators and Valves**

1. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.
3. VAV box damper actuation shall be Floating type where possible.
4. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
5. Primary valve control shall be Analog (2-10vdc, 4-20ma).

**D. Actuators for Damper and Control Valves ½" to 6" shall be Electric, provide actuators as follows:**

1. UL Listed Standard 873 shall certify Actuators.
2. NEMA 2 rated actuator enclosures are. Use additional weather shield to protect actuator when mounted outside.
3. 5-year Manufacturer's Warranty. Two-year unconditional + Three-year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
7. A push button gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24Vac and consume 10VA power or less.
9. Conduit connectors are required when specified and when code requires it.

**E. Damper Actuators:**

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
3. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

**F. Valve Actuators ½" to 6"**



1. Control Valves – Refer to section 23 05 23 “Valves for HVAC Piping” for valve requirements.
  2. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail save flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
  3. All zone service actuators shall be non-spring return unless otherwise specified.
  4. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
  5. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
  6. Override handle and gearbox release shall be provided for all non-spring return valve actuators.
- G. Control Dampers.
1. Dampers are specified under another section of this work.
- H. Damper Trade Responsibilities - The following summarizes the trade responsibilities with respect to automatic dampers:
1. Non-Fire or non-Smoke Rated Dampers
    - a. Furnish Damper - HVAC
    - b. Install damper – HVAC
    - c. Furnish Actuator – BMS
    - d. Install Actuator – HVAC
    - e. Provide junction box complete with all relays, wiring, etc. – BMS
    - f. Provide wiring between actuator, end switches, sensors, and junction box – BMS
    - g. Provide wiring from BMS to damper junction box - BMS
    - h. Provide wiring from FAS to damper junction box - N/A
    - i. Furnish 120V main power to elect. Actuators – BMS
    - j. Provide wiring from damper junction box to junction box for interlocked motors, etc. – BMS
    - k. Provide wiring from damper junction box directly to thermostats, etc. – BMS
  2. Fire and/or Smoke Rated Dampers not controlled by Fire Alarm system (FAS)
    - a. Furnish Damper - HVAC
    - b. Install damper – HVAC
    - c. Furnish Actuator – HVAC
    - d. Install Actuator – HVAC
    - e. Furnish and install junction box complete with all relays, wiring, etc. – HVAC
    - f. Provide wiring between actuator, end switches, heat sensors, and junction box – HVAC
    - g. Provide wiring from Central Control System (BMS) to damper junction box – BMS
    - h. Provide wiring from FAS to damper junction box – N/A
    - i. Furnish 120V main power to elect. actuators – BMS
    - j. Provide wiring from damper junction box strip to junction boxes for interlocked motors, etc. – BMS
    - k. Provide wiring from damper junction box directly to thermostats, etc.- BMS
  3. Fire or Smoke Rated Dampers controlled by Fire Alarm system (FAS).



- a. Furnish Damper - HVAC
  - b. Install damper – HVAC
  - c. Furnish Actuator – HVAC
  - d. Install Actuator – HVAC
  - e. Furnish and install junction box complete with all relays, wiring, etc. – HVAC
  - f. Provide wiring between actuator, end switches, heat sensors, and junction box – HVAC
  - g. Provide wiring from Central Control System (BMS) to damper junction box - BMS
  - h. Provide wiring from FAS to damper junction box – Electrical (FAS)
  - i. Furnish 120V main power to elect. Actuators – Electrical
  - j. Provide wiring from damper junction box to junction boxes for interlocked motors, etc. – BMS
  - k. Provide wiring from damper junction box directly to thermostats, etc. – BMS
4. Controls contractor shall have overall responsibility for the complete coordination of the work and the operation of the damper/actuator installation.
  5. In mechanical or electrical rooms 120V power circuits will be provided from an emergency distribution board. These circuits will be terminated in a junction box located in each associated mechanical room and shall be used by the controls contractor to supply local control panels and critical equipment.
  6. These circuits will also be used by the electrical trade to supply dampers, etc., requiring control by the Fire Alarm System. Final connection from the junction boxes to the actuators, end switches and sensors shall be by the mechanical trade.
  7. For dampers not requiring control by the fire alarm system and for other non-critical equipment, obtain power from either the emergency circuits as detailed above or from the motor starter junction box. All wiring shall be by the controls contractor.

I. Butterfly Valve Industrial Actuators

1. Actuators shall be approved under Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
  - a. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1 pH, 60 Hz supply. Two adjustable cam actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
  - b. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
  - c. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
  - d. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.
  - e. The actuator shall be Analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2-10 VDC, 4-20 mA, or adjustable signal as required. Analog



actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.

2. Performance Verification Test
  - a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate which is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
  - b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.
3. Actuator Mounting for Damper and Valve arrangements shall comply with the following:
  - a. Damper Actuators: Shall not be installed in the air stream
  - b. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
  - c. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
  - d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
  - e. Damper mounting arrangements shall comply with the following:
    - 1) The contractor shall furnish and install damper channel supports and sheet metal collars.
    - 2) No jack shafting of damper sections shall be allowed.
    - 3) Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.
  - f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
    - 1) Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
    - 2) Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
    - 3) Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
  - g. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
  - h. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8" wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
  - i. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standoff collars. Sheet metal collars (12" minimum) shall bring each damper



section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

4. Valve Sizing for Water Coil

- a. On/Off Control Valves shall be line size.
- b. Modulating Control Valve Body Size may be reduced at most two pipe sizes from the line size or not less than ½ the pipe size. Size all water coil control valves for the application as follows:
  - 1) Booster-heat valves shall be sized not to exceed 4-9psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
  - 2) Primary valves shall be sized not to exceed 5-15psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
- c. Valve Mounting arrangements shall comply with the following:
  - 1) Unions shall be provided on all ports of two-way and three-way valves.
  - 2) Install three-way equal percentage Characterized Control valves in a mixing configuration with the “A” port piped to the coil.
  - 3) Install 2½ inch and above, Three-Way globe valves, as manufactured for mixing or diverting service to the coil.

2.14 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8” thick sized appropriately to make label easy to read.
- E. When enclosures are installed above accessible ceilings the ceiling grid must be labeled to easily identify enclosure location.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.



- C. Provide a low temperature detector (freeze-stat) for each chilled water coil that has the potential to be exposed to freezing temperatures. Furnish one detector for each coil section.
- D. Provide one heating coil discharge temperature sensor and one heating coil control valve for each separate heating coil.
- E. Provide a discharge temperature sensor for each VAV box with heating coil and utilize Dual Maximum DDC control logic for reheat control.
- F. Chilled water control valves
  - 1. Install chilled water control valves in return piping downstream of cooling coil.
  - 2. Do not install balancing valves, circuit setters or other flow limiting devices.
- G. Cooling coil leaving air temperature sensor
  - 1. Install directly downstream of cooling coil, within 12" of coil face
    - a. No other equipment between coil face and temperature sensor.
    - b. Install sensing element in center of airstream; minimum 8" from each coil edge.
- H. Chilled water temperature sensor
  - 1. Install immersion temperature sensor well in CHWR piping downstream of cooling coil prior to branch isolation valve.
  - 2. Install in a full flow location (avoid T fittings, elbows, etc.).
- I. Chilled water differential pressure sensor
  - 1. Install directly across the hydraulically most remote control valves as identified in the hydraulic model.
  - 2. Install taps with manual isolation valves for service maintenance.
  - 3. Provide venting and equalizing capability (can be included with sensor manifold)
  - 4. Install taps horizontally in piping to minimize air and sediment affecting sensor.

### 3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from the Commissioner prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

### 3.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock, line and low voltage and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26 and all national, state and local electrical codes.



- B. All wiring in Mechanical Equipment Rooms, communications or electrical closets shall be in approved raceways (cable tray, conduit, EMT, etc.). Other open wiring strung above ceilings shall be plenum rated cable, bundled together and protected from mechanical damage. Wiring within drywall cavities or enclosures or beneath raised floor construction shall be in conduit. Wiring shall be independently supported from the building structure with bridal rings and clips. The supporting of wiring from mechanical ductwork, piping or hangers is not acceptable.
- C. Cables for 120/24 volt AC. wiring, communications wiring and low level signal wiring (i.e., 4-20 mA analog) shall always be run in separate raceways.
- D. Use liquid tight flexible metal conduit, ½ inch minimum size, for making connections at instruments and devices mounted on piping or vessels or on equipment subject to vibration.
- E. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- F. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the City of New York prior to rough-in.
- G. Provide auxiliary pilot duty relays on motor starters as required for control function.
- H. Power used for control and instrumentation shall be taken from panelboards connected to the emergency power distribution system. Wiring and raceway materials and installation for ATC system power requirements shall be furnished under this Section.
- I. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).
- J. Install all line voltage wiring, concealed or exposed, in conduit in accordance with the Division 26 specifications, NEC and local building code.
- K. All Primary Network wiring throughout the building shall be run in conduit. Terminal equipment sensors and the secondary network wiring may be run in plenum rated cable above accessible hung ceilings. Plenum cable shall be run parallel to building lines and supported from the building structure (not from duct, pipe or associated hangers) with bridle rings.
- L. Where conduit is required, it shall be steel Electric Metallic Tubing (EMT), except that it shall be Rigid Galvanized Steel (RGS) conduit where located outdoors, is exposed to mechanical damage or is intended for embodiment in concrete.
- M. Conduit runs which extend from the interior to the exterior of a building shall be sealed to prevent the circulation of air. This shall be accomplished by the installation of sealing fittings.
- N. All wires terminating at each field device, terminal box, field equipment cabinet, DDC control unit, or any other terminals, shall be identified using Brady clip sleeve type nonmetallic wire markers or equivalent. The identification shall be consistent with the tagging indicated on the approved shop drawings. The same identification code shall be carried through from the field device to the final termination point. After identification is complete, the wire markers shall be anchored using a single layer of non-yellowing clear polymer tape.



- O. Wires shall be terminated with insulated spade type lugs on screw terminals. Soldered connections shall only be made at instruments where no other means of termination is practical.
- P. Perform continuity testing for all wiring installed.
- Q. Control raceways shall not be hung from electrical raceways or attached to ceiling grid hanger wires.
- R. Percent fill of conduit, EMT or IMC shall not exceed Code maximum, regardless of service.
- S. No 300 volt insulated wiring shall terminate within or occupy any enclosure containing conductors operating at a voltage greater than 300 volts. This particularly applies to any analog or digital I/O wiring entering 460-volt motor starter enclosures or motor control centers.
- T. Use of tie wraps for supporting conduit, wire, cable, etc., will not be permitted.

### 3.5 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays
  - 1. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use. Provide outside air temperature indication on all system displays associated with economizer cycles.
  - 2. Each major system display shall link the associated “As Built” control flow drawing and sequence of operations to the system graphic for easy reference.
- C. Run Time Totalization
  - 1. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trend Log
  - 1. All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm
  - 1. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per the Commissioner’s requirements.
- F. Database Save
  - 1. Provide back-up database for all stand-alone application controllers on disk.

### 3.6 TESTING, CALIBRATING, AND COMMISSIONING

- A. After completion of the installation of work in this Section, test, regulate, and adjust system equipment, controllers, alarms, thermostats, humidistats, automatic control valves, automatic damper motors, and related system accessories, each entire automation system, including





- interconnections with the building life safety system, and place these items in complete and satisfactory operating condition.
- B. Furnish labor and test apparatus required to calibrate and prepare for service instruments, controls and accessory equipment furnished under this Section. This work includes: Zero, span and range calibration checks of instruments and accessories, both field and panel mounted. In addition, the Vendor shall check actuators, control valves and automatic dampers, to insure proper action, stroke each actuator valve and automatic damper, and make necessary adjustments for stem and blade travel.
  - C. Furnish labor and test apparatus required to check the operation of control loops, set points and interlocks, as well as electronic equipment. The Contractor shall test every input/output point for proper performance through the entire system and maintain accurate test records for each point throughout the testing cycle and thereafter. Commissioner reserves the right to inspect those test records at any time and also to witness any of the point tests he deems appropriate. Testing shall be witnessed and accepted by the Commissioner.
  - D. Upon completion of the testing and calibration and in the presence of the Commissioner conduct an inspection of the control system and perform such tests that will be required to determine that contract obligations have been fulfilled. Notify the Commissioner two (2) weeks in advance of readiness to make such tests.
  - E. For site tests, the Contractor shall submit a test plan and commissioning plan for each system (i.e., air conditioning system, exhaust fans, pumps, chillers, cooling towers, etc.) for review by the Commissioner. After review of the plan, the Contractor shall prepare and submit a detailed test procedure for review. The test procedure shall also include reference to the Specification Section and Paragraph with which each test is intended to demonstrate compliance, together with the criteria for acceptance or rejection. The site system test, conducted by the Contractor in accordance with the test procedures and project schedules, and witnessed by the Commissioner shall be a comprehensive test of the system to demonstrate that all aspects of the hardware and software are in conformance with the Specification requirements. The system test shall include testing of all workstations so as to demonstrate no substantial degradation of performance of their functions as buildings, blocks, and workstations are added to the system. The Commissioner shall be notified at least five (5) working days prior to any testing and shall have the option of witnessing any and all tests.
  - F. Minimum validation and sign-off requirement (on all work stations) shall be as follows:
    - 1. Run samples of specified reports and trends.
    - 2. Execute menu tree.
    - 3. Display all required graphics.
    - 4. Execute digital and analog commands via mouse and keyboard.
    - 5. Demonstrate data entry/point modification/programming.
    - 6. Demonstrate program downloading.
    - 7. Demonstrate program uploading.
    - 8. Demonstrate control loop execution and stability.
    - 9. Demonstrate specified diagnostics.
    - 10. Demonstrate scan, update and alarm response.
    - 11. Execute all-points summary.
    - 12. Execute communication status checks.
  - G. The guarantee period shall not start until systems in this Section have been approved and accepted by the Commissioner, as detailed in the previous paragraphs, at which time the Commissioner will accept, in writing, the system of this Section in its entirety. This does not



preclude the beneficial use by the City of New York of any portion of the system prior to final acceptance of the whole system.

- H. During the guarantee period, the Vendor shall test the system under varying seasonal conditions to ensure that all operational sequences, as specified, are performed correctly. This shall include at least three additional visits after initial Commissioner acceptance. Where necessary, the Vendor shall make programming adjustments and instrument calibrations at no expense to the City of New York.
- I. After control devices have been initially commissioned (i.e. calibrated, tested and signed off), each BMS program shall be put on line and commissioned. The contractor shall, in the presence of the City of New York demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracies. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and retested.
- J. Demonstration of DDC controller operational qualification shall include signed program commissioning documents.
  - 1. Program commissioning documents shall include: Provide a report including all DDC programs resident in the BMS system as a table of contents.
  - 2. Provide a report including all DDC programs resident in the BMS system as a table of contents.
  - 3. Provide the sequence of operations for each DDC program
  - 4. Follow the sequence of operations with a print out of the DDC program. Include comment statements in the DDC program referring to the sequence of operations.
  - 5. For each control loop in the sequence of operation, include a verification grid inclusive of indication of program pass/fail, date, technician initials the Commissioner and commissioning agent's initials, date.
    - a. Trend inputs, outputs, and setpoint of each control loop.
    - b. Include a graphical trend report indicating verification of loop tuning.
    - c. For each action due to change in HVAC equipment operation mode, safety cutout, operator override, etc., include a verification grid inclusive of indication of program pass/fail, date, technician initials, the Commissioner's and commissioning agent's initials, date.
- K. After control devices have been initially commissioned (i.e. calibrated, tested and signed off), each BMS program shall be put on line and commissioned. The contractor shall, in the presence of the Commissioner demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracies. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and retested.
- L. Demonstration of DDC controller operational qualification shall include signed program commissioning documents. Program commissioning documents shall include:
  - 1. Provide a report including all DDC programs resident in the BMS system as a table of contents.
  - 2. Provide the sequence of operations for each DDC program
  - 3. Follow the sequence of operations with a print out of the DDC program. Include comment statements in the DDC program referring to the sequence of operations.



4. For each control loop in the sequence of operation, include a verification grid inclusive of indication of program pass/fail, date, technician initials, the City of New York, and commissioning agent's initials, date.
5. Trend inputs, outputs, and setpoint of each control loop.
6. Include a graphical trend report indicating verification of loop tuning.
7. For each action due to change in HVAC equipment operation mode, safety cutout, operator override, etc, include a verification grid inclusive of indication of program pass/fail, date, technician initials, the Commissioner and commissioning agent's initials, date.
8. Demonstration of ASC terminal unit controller operational qualification shall include signed digital terminal box commissioning documents.

**M. Digital Terminal Box Commissioning**

1. Perform digital terminal box commissioning composed of commanding terminal box airflow control dampers and reheat valves gradually between 0 and 100% open and recording feedback
2. Each point shall be recorded. Controlled variable outputs and sensor feedback input points shall be recorded in a list format.
3. Systems shall be given a pass or fail recommendation by the Contractor based upon empirical data gathered by the digital terminal box commissioning program. Contractor shall remediate box control deficiencies and retest repaired boxes. Successful digital terminal box commissioning reports shall be submitted to the Commissioner.

**3.7 CHECKOUT**

- A. Prior to beginning testing and acceptance, the Contractor shall submit a testing procedure for review and approval.
- B. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- C. All testing listed herein shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Commissioner is notified of the system demonstration.
- D. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
- E. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.'
- F. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.
- G. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
- H. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.



- I. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
- J. Alarms and Interlocks:
  - 1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  - 2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
  - 3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- K. Contactor shall supply to the Commissioner all certified testing documentation from its vendors, subcontractors, suppliers and/or distributors as part of submittals and closeout documentation.

### 3.8 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. The Commissioner shall provide phone line for this service for 1 year or as specified.
- D. Provide Commissioner with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

### 3.9 checkout & testing

- A. Prior to beginning testing and acceptance, the Contractor shall submit a testing procedure for review and approval.
- B. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- C. All testing listed herein shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Commissioner is notified of the system demonstration.
- D. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
- E. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
- F. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.
- G. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.



- H. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.
- I. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
- J. Alarms and Interlocks:
  - 1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  - 2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
  - 3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- K. Contactor shall supply to the Commissioner all certified testing documentation part of submittals and closeout documentation.

### 3.10 DEMONSTRATION AND ACCEPTANCE

- A. Demonstration:
  - 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests.
  - 2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" section of this specification. Commissioner will be present to observe and review these tests. The Commissioner shall be notified at least 10 days in advance of the start of the testing procedures.
  - 3. The demonstration process shall follow that approved checklists and forms submitted shall be completed for all systems as part of the demonstration.
  - 4. The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure. modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.
  - 5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
  - 6. Demonstrate compliance with Sequences of Operation through all modes of operation.
  - 7. Demonstrate complete operation of Operator Interface.
  - 8. Additionally, the following items shall be demonstrated:
    - a. DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable



- values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
- b. Demand limiting (if implemented) The Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
  - c. Demand limiting (if implemented) The Contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
  - d. Optimum Start Stop (if implemented). The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
  - e. Interface to the building fire alarm system (if implemented).
9. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Commissioner. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
  10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

**B. Acceptance**

1. All tests described in this specification shall have been performed to the satisfaction of the Commissioner to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Commissioner. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: Submittals
3. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
4. Testing procedures for the control system shall be based on ASHRAE standards 135 and 135.1 and that the components were tested to BACnet International, BACnet Testing Laboratories standards.
5. All testing listed herein shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Commissioner is notified of the system demonstration.
6. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

**3.11 DEMONSTRATION**

- A. Provide systems demonstration under provisions of Section 23 08 00 "Commissioning of HVAC".
- B. Demonstrate complete operating system to Commissioner.
- C. Provide certificate stating that control system has been tested and adjusted for proper operation.

**END OF SECTION 23 09 00**

**SECTION 23 09 05****SEQUENCES OF OPERATION FOR HVAC CONTROLS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 23 "Valves for HVAC Piping"
- D. Section 23 05 48 "Vibration Isolation, Seismic and Wind Restraints for HVAC Components"
- E. Section 23 05 93 "Testing, Adjusting and Balancing"
- F. Section 23 08 00 "Commissioning of HVAC Work"
- G. Section 23 09 00 "HVAC Instrumentation and Controls"
- H. Section 23 34 16 "Damper"
- I. This section is a part of each Division 23 00 00 section.

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.3 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.4 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.5 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

PART 2 - SEQUENCES OF OPERATION

2.1 GENERAL

- A. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.
- B. BACnet Object List
- C. The following points as defined for each piece of equipment are designated as follows:
  - 1. Binary Out (BO) - Defined as any two-state output (start/stop) (enable/disable), etc.
  - 2. Binary In (BI) - Defined as any two-state input (alarm, status), etc.
  - 3. Analog In (AI) - Defined as any variable input (temperature) (position), etc.
  - 4. Analog Out (AO) - Defined as any electrical variable output. 0–20mA, 4–20mA and 0–10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.
- D. All set points referenced in this section are subject to change and shall be adjustable from the BMS Operator Interface.
- E. Refer to separate BMS Points List for the complete listing of DDC points.
- F. All fan and pump Variable Frequency Drives (VFD) shall be furnished with a BACnet network communications card for serial interface to the BMS. The contractor shall provide network interface and all programming to monitor and control all points from the VFD's to the BMS. Communication interface shall be via BACnet MS/TP.
- G. In addition to the network interface each VFD shall be hardwired to the DDC controller for the following points:
  - 1. Start/Stop
  - 2. Status (Pressure switch or current switch)
  - 3. VFD Speed Control
  - 4. VFD Lock Out





- H. All pumps shall be monitored by a differential pressure switch piped across the pump for positive status indication to the BMS.
- I. All fans shall be monitored by a current switch for positive status indication to the BMS.
- J. Global DDC Points to be provided for the BMS:
  - 1. Outside Air Temperature
  - 2. Outside Air Humidity
  - 3. Outside Air CO2

## 2.2 EXHAUST FANS – CONSTANT VOLUME (Toilet Exhaust Fans)

- A. General:
  - 1. The system consists of a constant volume supply exhaust fan.
  - 2. All dampers for all fans shall be proved open/closed (via end switches) prior to starting/stopping fans.
- B. System Off:
  - 1. When the system is off, the exhaust damper shall be closed and the fan shall be off.
- C. System Start / Run:
  - 1. On a fan start command from the BMS, exhaust fan shall start.
- D. System Stop:
  - 1. When the system is called to stop, the system shall revert to the “Off” state as described above.

## 2.3 EXHAUST FANS – VARIABLE VOLUME

- A. General:
  - 1. The system consists of a Variable volume exhaust fan, exhaust damper with end switch, and a pressure transmitter.
  - 2. Pressure transmitter shall be wired directly into the VFD.
  - 3. VFD shall be UL listed. VFD's internal PID loop shall be utilized for fan speed control.
  - 4. All dampers for all fans shall be proved open/closed (via end switches) prior to starting/stopping fans.
- B. System Off:
  - 1. When the system is off, the exhaust damper shall be closed and the fan shall be off.
- C. System Start:
  - 1. On a fan start command from the BMS system, exhaust damper shall open and when it's end switch proves open, exhaust fan shall start.
- D. System Run:



1. Pressure transmitter shall modulate fan VFD speed to maintain required static pressure setpoint.

E. System Stop:

1. When the system is called to stop, the system shall revert to the “Off” state as described above.

## 2.4 REFRIGERANT MONITORING & EXHAUST SYSTEM – 2 SPEED

A. General:

1. The system consists of a 2 speed exhaust fan, exhaust damper with end switch, and a refrigerant leak detection system.
2. Contractor shall provide local control of the exhaust fan which shall cycle on and off to maintain the space temperature at or below 80°F (adj.). Provide a temperature sensor and annunciate an alarm to the BMS if the space temperature goes above the high alarm set point.
3. Contractor shall provide a complete installation of a refrigerant leak detection system including a main control panel, sensors, audible/visual alarm devices and emergency break glass switches. This system shall be linked to the BMS for alarm annunciation.
4. Refrigerant Leak Detection is specified under another section of this work.
5. When a refrigerant leak is detected, the exhaust fan shall start and the leak detection system shall activate the local alarm and transmit the alarm to the BMS. Provide an alarm horn, strobe light and silence switch for local annunciation at each entrance to the chiller room, above the break glass switch.
6. Break-glass stations shall be located at the outside of each door to the MER and shall initiate a shutdown for the chiller plant: shutting down all chillers, pumps, cooling towers and closing all isolation valves. A critical alarm shall be sent to the BMS.
7. An audio / visual alarm shall be wired to the refrigerant leak detection system.
8. Refrigerant sensors shall be wired directly to the refrigerant leak detection system.

B. System Off:

1. When the system is off, the exhaust damper shall be closed and the fan shall be off.

C. System Start:

1. On a fan start command from the refrigerant leak detection system, exhaust damper shall open and when it's end switch proves open, exhaust fan shall start.
2. Although System Start sequences have been given here, the intent of these systems is 24/7 operation and these sequences are only applicable during startup.

D. System Run:

1. System shall run in the lower speed 24/7 to ventilate the chiller MER.
2. On a signal from the refrigerant leak detection system, Audio / Visual Alarm shall engage, exhaust fan shall ramp up to the higher speed.

E. System Stop:

1. When the system is called to stop, the system shall revert to the “Off” state as described above.



## 2.5 CHILLED WATER AND CONDENSER WATER SYSTEMS

### A. General:

1. The system consists of a primary and secondary loop. The primary loop consists of (1) free-cooling plate & frame heat exchangers, two water-cooled centrifugal chillers, two variable volume primary chilled water pumps, and one chilled water differential pressure bypass valve. The primary loop serves chilled water to Fan Coil Units & the C3 level Air Handling Units. The secondary loop consists of two plate & frame heat exchangers, two variable volume secondary chilled water pumps, and one chilled water differential pressure bypass valve. The secondary loop serves chilled water to activate the chilled beams.

### B. Chillers (CH-1, 2) / Chilled Water System (CHWP--1, 2)

1. The contractor shall furnish BACnet DDC controls for monitoring and control of the chiller and chilled water system. The contractor shall connect the DDC controller to the BMS network for point monitoring and control. The operator shall have the ability to select CHW pump lead/lag and pump manual/auto operation from switches mounted on the face of the local control panel. Indicator lights on the face of the panel shall indicate pump running status for each pump. A local alarm with audible/visual indication and silence switch shall also be mounted on the face of the panel. Local alarms annunciated shall be pump fail and CHW high temperature alarm.
2. The controls provided by the manufacturer of the chillers shall operate to maintain its programmed chilled water set point. The set point shall be adjustable from the BMS system through a 4-20 milliamp analog output signal. Start/stop and status shall also be hardwired points to the BMS system control panel.
3. Chiller monitoring shall be via a two-wire BACnet interface to the chiller manufacturer's microprocessor controller (Approximately 50 points). The chiller control panel shall be furnished with a BACnet interface for communication to the BMS. Chiller manufacturer to provide chiller network communication card. The contractor shall provide network interface and all programming to monitor and control all points from the chillers to the BMS.
4. The contractor shall furnish, install, and wire all devices necessary for a complete operational chilled water system including but not limited to miscellaneous interlock and control wiring for chillers, refrigerant compressors, pumps, flow switches, etc. The contractor shall mount and wire all components furnished by the chiller manufacturer that are not factory installed. Coordinate requirements with the chiller manufacturer.
5. Chillers shall start through a manual command from the BMS. Upon a need for chilled water, the chiller shall be manually enabled through the BMS after the lead chilled water and condenser water pumps are started and the necessary isolation and switchover valves have been properly positioned. The enabled chiller CHW and CW isolation valves shall open and prove open through operator mounted limit switches indicating valve position. Once the isolation valves are opened, the lead chilled water pump shall start and slowly ramp up to speed control set point. Refer to the Condenser Water System for further detail on condenser water control. Once started, the chiller shall stay on for a minimum time, determined by the chiller manufacturer.
6. The Central Plant Energy Control System (CPECS) shall monitor and control all mechanical equipment and instrumentation, through the BMS, that are directly involved in the production and distribution of chilled water (CHW) including the compressors, chillers, cooling towers, pumps and valves located in the central chilled water plant. The CPECS shall continuously and automatically optimize the plant energy usage using adaptive control methodology, data correlation and real time self-calibrating data feedback loops that continually adjusts logic in accordance with actual system conditions such as chiller approach, pumping efficiency and cooling tower performance, as measured in KW per



- ton of cooling. The CPECS will also monitor and control the air handler (as shown on drawings).
7. The Chilled Water Plant operation will be performed through the BMS via manual commands by the plant operations personnel. Advisory messages shall be posted through the BMS to alert operations personnel on when additional chillers, cooling towers, chilled water pumps and condenser water pumps should be enabled and disabled in order to meet the current demand in the most efficient manner.
  8. When an additional chiller is enabled, the CHW and CW isolation valves shall open and prove open through operator mounted limit switches indicating valve position. When a chiller is disabled the chiller CHW and CW isolation valves shall close after flow is no longer required by the machine.
  9. The CHW pump VFD speed shall be controlled automatically through the BMS to maintain the chilled water system differential pressure at set point. A differential pressure sensor and pressure bypass valve shall be located just prior to the last load on the circuit. The sensor shall be wired to the same controller that controls the pump VFD and bypass valve. The pump VFD shall be controlled to maintain the minimum chilled water system differential pressure set point and shall also maintain the chiller flow requirements. The minimum flow set point shall vary and shall be determined by the quantity of chillers or heat exchangers enabled. When the pump VFD is running at the minimum flow required and system pressure is too high the pressure bypass valve shall modulate to maintain the system pressure at set point.
  10. For each set of pumps one pump is primary and the other is stand-by. Provide staging control of the pumps so if the primary pump fails, lock it out and start the stand-by pump. An alarm shall be annunciated to the BMS. Rotate the primary and stand-by pumps on a regular schedule (adj.) to equalize runtime.
  11. The BMS shall monitor the water flow meter located in the chilled water supply pipe to each chiller. The water flow meter along with the matched pair of temperature sensors located on the chillers chilled water supply and return lines shall be used to calculate BTU.
  12. The BMS shall monitor the water flow meter located in the supply pipe for the chilled water system. The water flow meter along with the matched pair of temperature sensors located on the chilled water system supply and return lines shall be used to calculate BTU.

## 2.6 CONDENSER WATER SYSTEM

### A. Cooling Towers (CT-1, 2, 3) / Condenser Water System (CWP-1, 2)

1. The contractor shall furnish BACnet DDC controls for monitoring and control of the cooling towers and condenser water system. The contractor shall connect the DDC controller to the BMS network for point monitoring and control. The operator shall have the ability to select CW pump lead/lag and pump manual/auto operation from switches mounted on the face of the local control panel. Indicator lights on the face of the panel shall indicate pump running status for each pump. A local alarm with audible/visual indication and silence switch shall also be mounted on the face of the panel. Local alarms annunciated shall be pump fail and CW high temperature alarm.
2. The contractor shall provide all low voltage control electrical installation and wiring for makeup water system, sand filtration system, low water alarm, high water alarm, pan heater and low temperature controls, vibration controls, water treatment system, etc. Refer to the cooling tower specifications for details.
3. Basin heaters shall cycle as required to maintain a minimum water temperature and to prevent freezing. Under no load conditions, the system pumps shall de-energize and the starter interlock shall energize the heater circuit. All active fans shall be cycled during cold weather operation to avoid long periods of idle operation, and subsequent possibility of ice build-up. Basin heaters shall be inhibited when a low water condition exists. A low



- or high water level condition shall be annunciated to the BMS. A basin water temperature sensor shall annunciate high and low temperature alarms to the BMS.
4. Cooling tower vibration switches shall stop the fan through a local hardwired interface when vibration exceeds set point. Monitor each switch and annunciate alarms to the BMS.
  5. The Central Plant Energy Control System (CPECS) shall monitor and control all mechanical equipment and instrumentation, through the BMS, that are directly involved in the production and distribution of chilled water (CHW) including the compressors, chillers, cooling towers, pumps and valves located in the central chilled water plant. The CPECS shall continuously and automatically optimize the plant energy usage using adaptive control methodology, data correlation and real time self-calibrating data feedback loops that continually adjusts logic in accordance with actual system conditions such as chiller approach, pumping efficiency and cooling tower performance, as measured in KW per ton of cooling. The CPECS will also monitor and control the air handler (as shown on drawings).
  6. The Chilled Water Plant operation will be performed through the BMS via manual commands by the plant operations personnel. Advisory messages shall be posted through the BMS to alert operations personnel on when additional chillers, cooling towers, chilled water pumps and condenser water pumps should be enabled and disabled in order to meet the current demand in the most efficient manner.
  7. When a cooling tower is enabled, the sump and spray valves shall open and prove open through operator mounted limit switches indicating valve position. When a cooling tower is disabled the sump and spray valves shall close.
  8. The CW pump VFD speed shall be controlled automatically through the BMS to maintain the recommended condenser water flow set point as measured by the condenser water flow meter. The flow set point shall vary and shall be determined by the quantity of chillers or heat exchangers enabled.
  9. For each set of pumps one pump is primary and the other is stand-by. Provide staging control of the pumps so if the primary pump fails, lock it out and start the stand-by pump. An alarm shall be annunciated to the BMS. Rotate the primary and stand-by pumps on a regular schedule (adj.) to equalize runtime.
  10. The CW supply temperature shall be maintained by enabling and staging the cooling towers and cooling tower fans. The enabling of the towers shall be done manually by the plant operations personnel via an advisory message through the BMS. Once a tower has been enabled the tower fans shall be controlled automatically through the BMS to maintain the desired condenser water supply temperature set point.
  11. The BMS shall monitor the water flow meter located in the condenser water supply pipe to each chiller. The water flow meter along with the matched pair of temperature sensors located on the chillers condenser water supply and return lines shall be used to calculate BTU.
  12. The BMS shall monitor the water flow meter located in the condenser water supply pipe for the condenser water system. The water flow meter along with the matched pair of temperature sensors located on the condenser water system supply and return lines shall be used to calculate BTU.

**B. Economizer (Free Waterside Cooling) Heat Exchanger (HX-1)**

1. The contractor shall furnish BACnet DDC controls for monitoring and control of the economizer heat exchanger. The contractor shall connect the DDC controller to the BMS network for point monitoring and control.
2. The economizer heat exchanger shall be used for free cooling and shall be activated whenever any mechanical equipment requiring chilled water is operating and the outside wet bulb temperature is below set point. The Central Plant Energy Control System (CPECS) shall indicate when the plant personnel shall enable the PHX via an advisory sent through the BMS.



3. When the PHX is enabled the heat exchanger CHW and CW isolation valves shall open and prove open through operator mounted limit switches indicating valve position. When a PHX is disabled the PHX CHW and CW isolation valves shall close.
4. Control cooling towers to maintain set point. The calculated set point shall be the sum of the tower approach temperature and outside wet bulb. If the calculated set point is above chilled water temperature requirements, the chillers shall be enabled and PHX shall be disabled. If the calculated set point is equal to or below the chilled water temperature requirements, the PHX shall be enabled.
5. In the switch over from free cooling to mechanical cooling, the condenser water supply temperature shall be allowed to reach a minimum temperature of 60° F (adj.) prior to enabling mechanical cooling.
6. The BMS shall track the run time of the economizer heat exchanger and shall totalize the time on a monthly basis. The run time shall be based on the time the isolation valves are open to the heat exchangers.
7. The BMS shall monitor the water flow meter located in the condenser water supply pipe to the PHX. The water flow meter along with the matched pair of temperature sensors located on the PHX condenser water supply and return lines shall be used to calculate BTU.
8. The BMS shall monitor the water flow meter located in the chilled water supply pipe to the PHX. The water flow meter along with the matched pair of temperature sensors located on the PHX chilled water supply and return lines shall be used to calculate BTU.

## 2.7 HOT WATER SYSTEM

### A. General

1. Hot Water system consists of three condensing boilers, two variable speed primary hot water pumps, two variable speed primary hot water pumps, and a differential pressure bypass valves. The system serves hot water to Air Handling Units on C-3 level, perimeter radiation, fan coil units & chilled beams throughout the building.
2. Boilers will be provided with their manufacturer's PLC control package which shall stage and control boilers fire rate to maintain proper loop temperature set point. The boiler master control panel shall be furnished with a BACnet interface for communication to the BMS. The contractor shall provide an interface and all programming to monitor and control all points from the boilers to the BMS.
3. Refer to Section 23 51 01 – BOILER DRAFT CONTROL SYSTEM for additional requirements.
4. The hot water system will consist of both a primary hot water system (serving the AHU pre-heat coils, reheat coils, perimeter radiation).
5. The boiler master control panel shall be furnished with a BACnet interface for communication to the BMS. The contractor shall provide an interface and all programming to monitor and control all points from the boilers to the BMS.
6. The contractor shall install all field wiring required for boiler operation that cannot be factory installed.
7. The contractor shall furnish and install BACnet DDC controls for automatic stand-alone control of both the primary and secondary hot water system. The DDC controls shall be connected to the BMS for remote monitoring and control. The operator shall have the ability to select HW pump lead/lag and pump manual/auto operation from switches mounted on the face of the local control panel. Indicator lights on the face of the panel shall indicate pump running status for each pump.
8. A local alarm with audible/visual indication and silence switch shall also be mounted on the face of the panel. Local alarms annunciated shall be pump fail and HW high temperature alarm.

### B. Primary Hot Water System



1. An outside air temperature interlock or manual command through the BMS shall enable the primary hot water system.
  2. When enabled to run, the lead boiler isolation valve shall open through a hardwire connection to the boiler control panel. Once the valve is open the lead primary hot water system pump shall start and slowly ramp up to speed control set point. A water flow meter shall provide positive flow indication to the boiler panel and once flow is proven the boiler shall fire. The boiler controls shall maintain the hot water supply temperature at set point (140°F adj.). When an additional boiler is enabled the associated isolation valve shall be opened prior to enabling boiler.
  3. A differential pressure sensor shall be located just prior to the last load on the circuit. The sensor shall be wired to the same controller that controls the pump VFD and bypass valve. The pump VFD shall be controlled to maintain the hot water system differential pressure set point. If the pump is operating at the minimum VFD speed and the differential pressure is above set point, the differential pressure bypass valve shall modulate open to maintain set point.
  4. For each set of pumps one pump is primary and the other is stand-by. Provide staging control of the pumps so if the primary pump fails, lock it out and start the stand-by pump. An alarm shall be annunciated to the BMS. Rotate the primary and stand-by pumps on a regular schedule (adj.) to equalize runtime.
  5. The BMS shall monitor the water flow meter located in the supply pipe for the primary hot water system. The water flow meter along with the matched pair of temperature sensors located on the hot water system supply and return lines shall be used to calculate BTU.
- C. The temperature control valves shall maintain the primary hot water supply temperature at set point. The set point shall be adjustable and shall be reset by outside air temperature as follows:

Outside Air Temperature	Set Point
50°F	110°F
30°F	130°F
0°F	140°F

- D. The temperature control valves shall maintain the secondary hot water supply temperature at set point. The set point shall be adjustable and shall be reset by outside air temperature as follows:

Outside Air Temperature	Set Point
50°F	100°F
30°F	110°F
0°F	120°F

- E. The BMS shall monitor the water flow meter located in the supply pipe for the secondary hot water system. The water flow meter along with the matched pair of temperature sensors located on the hot water system supply and return lines shall be used to calculate BTU.

## 2.8 AIR SYSTEMS

- A. General



1. Interlock all associated dampers to open/close with fan start/stop.
2. BMS shall monitor the fan status via a current switch and shall track run times when fan is in operation. If the fan fails to operate an alarm shall be annunciated at the BMS and dampers shall be indexed to their normal off positions.
3. For fans greater than 2,000 CFM, provide a high discharge static pressure switch if dampers are located upstream of the fan and/or a low static pressure switch if dampers are located downstream of the fan to prevent mechanical damage if a damper fails to open. The switch shall stop the fan when duct pressure exceeds design. The fan shall remain off until the pressure switch is reset.
4. Duct smoke detector shall stop the fan upon the presence of smoke through a signal from the fire alarm system. The Fire Alarm System shall stop all fans greater than 2000 CFM through a hard wired safety circuit in the fan starter/VFD and signal the BMS when a fire alarm is present.
5. Fire/smoke dampers shall be wired back to the associated fan so that the dampers open/close with fan start/stop. Where dampers are located just up or down stream from the fan, the damper shall open and prove open via a damper mounted end switch prior to starting the fan motor. All fire/smoke dampers shall be monitored through the BMS for damper open/close status.
6. BMS shall control heating coil freeze protection pumps so that the pump is commanded on whenever the outdoor air temperature falls below 42°F (adj.). The pump shall run continuously until the outdoor air temperature rises 2°F above the set point at which the pump was commanded on.
7. Dirty filter status shall be monitored by a differential pressure transmitter and the alarm indication shall be through DDC high analog alarm limit set point.
8. Each individual supply, return and exhaust fan in all the air-handling units' fan arrays and lab exhaust fan array shall be provided with an integral back flow prevention device (damper) that prohibits recirculation of air in the event that a fan or multiple fans become disabled or are not operating

## 2.9 VARIABLE AIR VOLUME ENERGY RECOVERY UNIT

A. These sequences are for system AHU-C-1, 1-1, 2-1

B. General

1. The contractor shall furnish BACnet DDC controls for monitoring and control of the air handling unit and associated exhaust fan. The contractor shall connect the DDC controller to the BMS network for point monitoring and control.
2. The unit consists of a minimum and maximum modulating outside air intake damper, a modulating return damper, a modulating spill air damper, a backdraft damper, a pre-filter and final filter section, a hot water heating coil and freeze protection pump, a chilled water cooling coil, a humidifier control valve and humidifier summer / winter isolation valve, an array of three variable volume supply air fans and a variable volume return air fan. Units are equipped with air flow measuring stations on the outside air, return air, & supply air. Units are providing conditioned air for VAV boxes
3. The contractor shall furnish all necessary controls to accomplish the sequence of operation as described below.

C. System Off

1. When the system is off, the outside air and spill air dampers are closed. The return air damper is open. The heating coil control valve is under control of its discharge temperature sensor to maintain the plenum temperature of 50 degrees whenever the outside air temperature is less than 40 degrees. The supply and return fans are off. The CHW cooling coil valve shall be closed. The Humidifer Control Valve Shall be closed.





2. All safeties shall be fully operation when the system is off.

**D. System Start**

1. The AHU shall be started through the BMS by a manual command or automatically and remotely from the BMS based upon the time of day, operator command, or other programmed parameters.
2. Upon a command to start all associated fire/smoke dampers shall open, the minimum outside air damper shall open to the airflow set point and the exhaust and return air dampers shall be modulated to their corresponding positions.
3. Supply fan isolation dampers shall be opened and shall prove open through a damper mounted end switch prior to fan start. This shall be hard wired to the fan VFD safety circuit so that if the damper is not in the open position while the fan is running the fan shall stop.
4. The return fan shall be interlocked to run whenever the supply fan is running.
5. The supply and return fans shall slowly ramp up to speed control set point and shall run continuously. The supply fan variable speed drive shall be controlled to maintain the supply static pressure set point, as sensed at a point 2/3 downstream of the supply fan. The return fan variable speed drive shall be controlled to maintain a constant air volume differential as measured by the supply and return airflow measuring stations, to maintain positive pressurization of the space.
6. The heating coil valve shall be controlled in sequence with the cooling coil valve and economizer dampers to maintain discharge air set point (55°F adj.) as reset by return air temperature.

**E. System Run**

1. The supply and return fans shall start on a slow speed and gradually ramp up to attain setpoint.
2. A temperature sensor located in the mixed air shall through the BMS modulate the variable outside air, return air dampers in unison, and spill air damper as required to maintain its setpoint, initially 55 degrees (adjustable). Provide a return air and outside air humidity sensor to allow enthalpy overcall of the mixed air control loop.
3. Provide a CO2 sensor in each space to monitor carbon dioxide. Demand Control Ventilation Mode shall be initiated whenever the CO2 level is detected to be in excess of 1000 PPM. When initiated, the supply fan speed shall increase and the mixed air temperature control loop will be overridden and the outside air and return air dampers shall position to allow more outside air into the system. The DCV mode will seek to maintain a differential of 570 PPM, when the space CO2 measurements drop to 800 PPM, DCV mode will terminate.
4. Refer to Section 23 09 11 "Air Quality Monitoring System" for additional requirements.
5. A temperature sensor located in the fan discharge shall through the BMS modulate the heating coil control valve in sequence with the cooling coil control valve without overlap as required to maintain its setpoint. When favorable outside air conditions are sensed, the BMS shall reset the mixed air temperature control loop to affect the first stage of cooling.
6. A humidity sensor located in the fan discharge shall through the BMS modulate the humidifier control valve as required to maintain its setpoint initially set at 45% (adj). The humidifier summer / winter isolation valve shall be open in the heating season and closed in the cooling season.
7. Economizer dampers shall be enabled to provide free cooling when the AHU is in the cooling mode and the outside air enthalpy is less than the air handling unit return air enthalpy. The outside air and exhaust dampers shall modulate open and return air damper shall modulate closed. The chilled water coil shall be enabled as necessary to



maintain temperature set point if the outdoor air damper is open 100% and the unit cannot maintain the discharge temperature set point.

8. Humidification: The space humidity levels shall be maintained at a minimum of 40% RH (adj.). If the humidity level approaches the low limit set point the humidifier shall be enabled by opening the steam isolation valve and controlling the humidity control valve to maintain the supply humidity set point of 75% RH (adj.). The humidifier shall continue to operate until all of the space humidity levels have risen 3% RH (adj.) above the low limit set point. The high humidity limit shall be located downstream from the humidifier and shall disable the humidifier through a hardwired interlock if the high humidity level of 85% RH (adj.) is exceeded.
9. De-humidification: The space humidity levels shall be maintained at a maximum of 60% RH (adj.). If the humidity level approaches the high limit set point, the cooling coil valve shall modulate open to maintain the discharge air humidity set point subject to a supply air temperature low limit of 50°F (adj.). The dehumidification cycle shall continue until all of the space humidity levels have dropped 3% RH (adj.) below the high limit set point.
10. When the unit is indexed off, all fans shall stop, the associated fire smoke dampers shall close, the outside air and exhaust air dampers shall close and the return air
11. A duct static pressure sensor mounted in the supply duct will through the BMS vary the speed of the supply fan as required to maintain system static pressure at setpoint (determined at balancing).
12. An air flow sensor mounted in the inlet of the supply fan shall measure the volume (CFM) of the supply air. This value shall be used to establish the setpoint for the return fan. An air flow sensor mounted in the inlet of the return fan shall measure the volume (CFM) of the return air. The BMS shall then adjust the speed of the return fan so that the return volume is 10% less than the supply volume for pressurization control.

**F. Unoccupied Mode**

1. When the system is shut down (not due to a safety trip shutdown), it will revert to the status described above in "System Off". If the average space temperature exceeds the summer or winter setback temperature, the system will start and operate in 100% recirculation, on cooling or full heating until the average space temperature is brought to occupied mode setpoint, at which time the unit will stop.

**G. System Stop**

1. When the system is called to stop, the system shall revert to the "Off" state as described above.

**H. Safeties**

1. A freezestat with its element serpentine across the face of the cooling coil will stop the supply fan and return fan, close the outside air and return air dampers, open the heating coil control valve 100% and activate a critical alarm at the BMS. The freezestat shall be the manually reset type. The freezestat shall start the freeze protection pump.
2. A smoke detector located in the supply fan discharge and a second smoke detector located in the return air shall stop the supply fan and return fan through the fire alarm system if the products of combustion are sensed.
3. A differential pressure switch with indicator gauge installed across the filter shall indicate whenever the filter is obstructed and initiate a non-critical alarm at the BMS.
4. Static pressure sensors located on the inlet and discharge of the supply fan and return fan shall stop the supply and return fans and sound an alarm at the BMS if the fan suction pressure or discharge pressure exceeds the setting of the respective sensor. Pressure sensors shall be hard-wired to the respective fan start circuit.



5. BMS shall monitor differential pressure sensor across the energy recovery wheel and generate maintenance alarm if it's setpoint is exceeded.
6. A high humidity limit sensor mounted in the supply fan discharge shall close the humidifier control valve (in heating season) and open the cooling coil control valve (in cooling season) 100% until the discharge humidity levels return to normal.

#### 2.10 2-PIPE FAN COIL UNITS

- A. The fan coil units are 2-pipe cooling only units, controlled by a networked space thermostat to maintain space temperature at setpoint. The BMS shall monitor space temperature and generate and alarm if the space temperature deviates more than 2 degrees from setpoint.
- B. The contractor shall furnish BACnet DDC controls for monitoring and control of each fan coil unit. The contractor shall connect the DDC controller to the BMS network for point monitoring and control.
- C. A space temperature sensor shall control the supply fan and cooling coil valve.
- D. When the room temperature is below the cooling set point, the cooling valve shall be closed and the fan shall be off. On a rise in room temperature above the cooling set point the cooling coil valve shall open and the fan shall start.
- E. An alarm shall be sent to the BMS if the space temperature rises above the high alarm limit set point.
- F. The contractor shall furnish and install a leak detector in the auxiliary drip pan. Upon detection of a high water condition the fan shall stop and the chilled water valve shall close and an alarm shall be annunciated to the BMS.
- G. A temperature sensor mounted in the discharge duct shall monitor the discharge temperature at the BMS.
- H. A leak detector mounted in the auxiliary drain pan shall initiate an alarm at the BMS.
- I. Modulate the chilled water control valve to maintain space cooling set point.
- J. A pressure sensor mounted across the filter shall initiate an alarm at the BMS when the filter becomes loaded.

#### 2.11 4-PIPE FAN COIL UNITS

- A. The fan coil units are 4-pipe cooling and heating units, controlled by a networked space thermostat to maintain space temperature at setpoint. The BMS shall monitor space temperature and generate and alarm if the space temperature deviates more than 2 degrees from setpoint.
- B. The contractor shall furnish BACnet DDC controls for monitoring and control of each fan coil unit. The contractor shall connect the DDC controller to the BMS network for point monitoring and control.
- C. A space temperature sensor shall control the supply fan and cooling and heating coil valves.
- D. When the room temperature is between the occupied heating and cooling set points (inside of the bias), the fan shall be off and the heating and cooling valves shall be closed. On a rise in



room temperature above the cooling set point the fan shall start and the cooling valve shall modulate open, and the heating valve shall remain closed. On a drop in room temperature below the heating set point, the fan shall start and the heating valve shall modulate open, and the cooling valve shall remain closed. The same shall occur for the unoccupied heating and cooling set points when the system is indexed to the unoccupied mode through the BMS time schedule.

- E. An alarm shall be sent to the BMS if the space temperature rises above the high alarm limit set point or falls below the low limit set point.
- F. The contractor shall furnish and install a leak detector in the auxiliary drip pan. Upon detection of a high water condition the fan shall stop and the chilled water valve shall close and an alarm shall be annunciated to the BMS.
- G. A temperature sensor mounted in the discharge duct shall monitor the discharge temperature at the BMS.
- H. A leak detector mounted in the auxiliary drain pan shall initiate an alarm at the BMS.
- I. Modulate the chilled water and hot water control valves to maintain space set point.
- J. A pressure sensor mounted across the filter shall initiate an alarm at the BMS when the filter becomes loaded.

## 2.12 HEATING & VENTILATING UNIT

### A. General

- 1. The unit consists of an outside air intake damper, one filter section, hot water heating coil with freeze protection pump, freezestat, and variable speed supply fan.
- 2. These units serve heated ventilation air to mechanical spaces.
- 3. The contractor shall furnish all necessary controls to accomplish the sequence of operation as described below.

### B. System Off

- 1. When the system is off, the outside air damper is closed. The heating control valve is under control of its discharge temperature sensor to maintain the plenum temperature of 50 degrees whenever the outside air temperature is less than 40 degrees. The supply fan is off. The chilled water cooling coil control valve shall be closed.
- 2. All safeties shall be fully operational when the system is off.

### C. System Start

- 1. The supply fan shall be started manually at the VFD or automatically and remotely from the BMS based upon the time of day, operator command, or other programmed parameters. When the supply fan is started the system shall come under control.
- 2. When the supply fan is called to start the outside air damper shall open. When all interlocked dampers have proven open 100% via damper actuated end switches, the supply fan will start. The supply fans will start on a slow speed and gradually ramp up to attain setpoint.
- 3. Although System Start sequences have been given here, the intent of these systems is 24/7 operation and these sequences are only applicable during startup.

D. System Run

1. A temperature sensor located in the fan discharge shall through the BMS modulate the heating coil control valve as required to maintain its discharge setpoint.

E. System Stop

1. When the system is called to stop, the system shall revert to the “Off” stat as described above.

F. Monitoring, Safeties, & Alarms

1. A freezestat with its element serpentine across the face of the cooling coil will open the heating coil control valve 100% and activate a critical alarm at the BMS. The freeze protection circulating pump shall be started. The freezestat shall be the manually reset type.
2. A smoke detector located in the supply fan discharge shall stop the supply fan through the fire alarm system if the products of combustion are sensed.
3. A differential pressure switch with indicator gauge installed across the filters shall indicate whenever the filter is obstructed and initiate a non-critical alarm at the BMS.

## 2.13 FIN-TUBE RADIATOR

- A. The contractor shall furnish, install and wire DDC controls for local control of each finned tube radiator and connect to the BMS for remote monitoring and control. Contractor shall provide all required field wiring of controls that cannot be factory installed for proper unit operation.
- B. Provide Automatic, Pressure-Independent, Flow/Pressure Control Valves to control finned tube elements as indicated on the plans. Refer to Section 23 05 23 “Valves for HVAC Piping” for additional details.
- C. The BMS shall control in sequence the heating coil control valve in the 4-pipe chilled beams and the fin-tube radiator control valve in each zone.
- D. The BMS shall monitor space temperature via a wall mounted temperature sensor.
- E. There shall be a base cooling setpoint of 72 deg F and a base heating setpoint of 70 deg F.
- F. Upon a drop in room temperature below the occupied heating temperature setpoint, the perimeter radiation hot water control valve will modulate open to maintain occupied space temperature setpoint of 70 deg F (adjustable). Upon a further drop in temperature below the setpoint, the chilled beam hot water valve will modulate open to maintain the occupied space temperature setpoint of 70 deg F (adjustable). As the room temperature rises the hot water valve in reverse order will modulate closed.

## 2.14 HOT WATER CABINET UNIT HEATER

- A. The contractor shall furnish, install, and wire a control valve to control the cabinet unit heater. The thermostat shall be integral to the unit. On a fall in space temperature below set point, the thermostat shall open the valve and energize the unit fan. On a rise in space temperature, the fan shall be de-energized and the valve shall close.
- B. A pipe-mounted electric aqua-stat shall lock out the fan if hot water is not available.



- C. Cycle the 2-position hot water control valve to maintain space heating set point.
- D. Controls shall be standalone and not connected to the BMS.

## 2.15 CRAC (COMPUTER ROOM AIR CONDITIONING) UNIT

### A. General

- 1. The requirements of this sequences shall apply to all equipment designated as CRAC & CRAH.
- 2. CRAC units shall be provided with their manufacturer's DDC controller which shall manage all aspects of CRAC equipment operation and sequencing. BMS shall have a communication interface with CRAC control package. The control valve shall be provided by the contractor and field installed but shall be wired back to the CRAC local controller.

### B. Safeties

- 1. A spot type leak detector shall be installed in the CRAC unit auxiliary drain pan and shall be wired directly to solenoid isolation valves on the supply and return piping to the unit. The leak detector shall also initiate an alarm at the BMS.

## 2.16 CONDENSER WATER SYSTEM

### A. Cooling Towers (CT-1, 2) / Condenser Water System (P-4, 5)

- 1. The contractor shall furnish BACnet DDC controls for monitoring and control of the cooling towers and condenser water system. The contractor shall connect the DDC controller to the BMS network for point monitoring and control. The operator shall have the ability to select CW pump lead/lag and pump manual/auto operation from switches mounted on the face of the local control panel. Indicator lights on the face of the panel shall indicate pump running status for each pump. A local alarm with audible/visual indication and silence switch shall also be mounted on the face of the panel. Local alarms annunciated shall be pump fail and CW high temperature alarm.
- 2. The contractor shall provide all low voltage control electrical installation and wiring for makeup water system, sand filtration system, low water alarm, high water alarm, pan heater and low temperature controls, vibration controls, water treatment system, etc. Refer to the cooling tower specifications for details.
- 3. Basin heaters shall cycle as required to maintain a minimum water temperature and to prevent freezing. Under no load conditions, the system pumps shall de-energize and the starter interlock shall energize the heater circuit. All active fans shall be cycled during cold weather operation to avoid long periods of idle operation, and subsequent possibility of ice build-up. Basin heaters shall be inhibited when a low water condition exists. A low or high water level condition shall be annunciated to the BMS.
- 4. Cooling tower vibration switches shall stop the fan when vibration exceeds set point. Monitor each switch and annunciate alarms to the BMS.
- 5. The Central Plant Energy Control System (CPECS) shall monitor and control all mechanical equipment and instrumentation, through the BMS, that are directly involved in the production and distribution of chilled water (CHW) including the compressors, chillers, cooling towers, pumps and valves located in the central chilled water plant. The CPECS shall continuously and automatically optimize the plant energy usage using adaptive control methodology, data correlation and real time self-calibrating data feedback loops that continually adjusts logic in accordance with actual system conditions such as chiller approach, pumping efficiency and cooling tower performance, as measured in KW per



ton of cooling. The CPECS will also monitor and control the air handler (as shown on drawings).

6. The Chilled Water Plant operation will be performed through the BMS via manual commands by the plant operations personnel. Advisory messages shall be posted through the BMS to alert operations personnel on when additional chillers, cooling towers, chilled water pumps and condenser water pumps should be enabled and disabled in order to meet the current demand in the most efficient manner.
7. When a cooling tower is enabled, the sump and spray valves shall open and prove open through operator mounted limit switches indicating valve position. When a cooling tower is disabled the sump and spray valves shall close.
8. The CW pump VFD speed shall be controlled automatically through the BMS to maintain the recommended condenser water flow set point as measured by the condenser water flow meter. The flow set point shall vary and shall be determined by the quantity of chillers or heat exchangers enabled. When there is more than one pump operating, both pumps shall operate at the same VFD speed set point.
9. There are two primary pumps and one standby pump. Provide staging control of the pumps so if a primary pump fails, the BMS controls shall lock it out and start the standby pump. An alarm shall be annunciated to the BMS. Advisory message shall be sent through BMS to rotate the primary and stand-by pumps on a regular schedule (adj.) to equalize runtime.
10. The CW supply temperature shall be maintained by enabling and staging the cooling towers and cooling tower fans. The enabling of the towers shall be done manually by the plant operations personnel via an advisory message through the BMS. Once a tower has been enabled the tower fans shall be controlled automatically through the BMS to maintain the desired condenser water supply temperature set point.

**B. Economizer Heat Exchanger (HX-1)**

1. The contractor shall furnish BACnet DDC controls for monitoring and control of the economizer heat exchangers. The contractor shall connect the DDC controller to the BMS network for point monitoring and control.
2. The economizer heat exchanger shall be used for free cooling and shall be activated whenever any mechanical equipment requiring chilled water is operating and the outside wet bulb temperature is below set point. The Central Plant Energy Control System (CPECS) shall indicate when the plant personnel shall enable the HX via an advisory sent through the BMS.
3. When the HX is enabled the enabled heat exchanger CHW and CW isolation valves shall open and prove open through operator mounted limit switches indicating valve position. When a HX is disabled the HX CHW and CW isolation valves shall close.
4. Control cooling towers to maintain set point. The calculated set point shall be the sum of the tower approach temperature and outside wet bulb. If the calculated set point is above chilled water temperature requirements, the chillers shall be enabled and EHX shall be disabled. If the calculated set point is equal to or below the chilled water temperature requirements, the EHX shall be enabled.
5. In the switch over from free cooling to mechanical cooling, the condenser water supply temperature shall be allowed to reach a minimum temperature of 60° F (adj.) prior to enabling mechanical cooling.
6. The BMS shall track the run time of the free cooling heat exchanger and shall totalize the time on a monthly basis. The run time shall be based on the time the isolation valves are open to the heat exchangers.

**2.17 MISCELLANEOUS SYSTEMS**

**A. Boiler Room**



1. Combustion supply air fan shall be hardwired interlocked to the boiler/burner control so that ventilation is proven prior to firing any burners.
2. All associated dampers shall be interlocked to open/close with fan operation.
3. Contractor shall provide carbon monoxide (CO) and natural gas (CH<sub>4</sub>) sensors that shall control the boiler room exhaust fan to maintain a maximum CO/CH<sub>4</sub> set point. Sensor quantity and location shall provide full area coverage for the approved CO/CH<sub>4</sub> sensor as recommended by the sensor manufacturer. When preset limits of natural gas (CH<sub>4</sub>) or carbon monoxide (CO) are exceeded, the following shall occur.
  - a. CO - When any CO sensor detects a low limit level of 25 PPM (adj.), the exhaust fan shall start and run after associated dampers open. The fan shall run for a minimum time of 5 minutes (adj.) after the CO level falls below the low limit set point to prevent excessive cycling of the fan. If the CO level exceeds the high alarm limit set point of 200 PPM (adj.) a local alarm shall annunciate the condition (audible and visual alarms) and an alarm shall be annunciated to the BMS.
  - b. CH<sub>4</sub> - When the space CH<sub>4</sub> level reaches the low limit set point of 25% LEL (adj.), the exhaust fan shall start and run and a local alarm shall annunciate the condition (audible and visual alarms) and an alarm shall be annunciated to the BMS. The fan shall run for a minimum time of 5 minutes (adj.) after the CH<sub>4</sub> level falls below the low limit set point to prevent excessive cycling of the fan. If the CH<sub>4</sub> level exceeds the high alarm limit set point of 50% LEL (adj.) a local alarm shall annunciate the condition (audible and visual alarms), a second alarm shall be annunciated to the BMS and a relay output of the condition and shall simultaneously initiate the following:
4. Shutdown all equipment including boilers and burners irrespective of mode of operation.
5. Close the gas safety shut off valve feeding the, boilers and domestic hot water heaters.
6. Break glass switches shall be wired such that all boilers and domestic hot water heaters shall be shut down when glass is broken. The BMS will monitor break glass switch position. If an emergency occurs, the boiler control panel will initiate a shutdown for the boiler plant: shutting down all pumps and closing all isolation valves. A critical alarm will be issued to the BMS.
7. Provide an alarm horn, strobe light and silence switch at each entrance to the boiler room, above the break glass switch. Alarm to activate when gas leak occurs. Horn shall be silenced from switch and strobe shall continue to operate until condition is cleared.

## 2.18 MISCELLANEOUS SYSTEMS

### A. Hot Water Unit Heater / Cabinet Unit Heater

1. The contractor shall furnish and install all devices for local control. The space thermostat shall start/stop the unit heater and open/close the two-position hot water coil valve to maintain an adjustable room temperature set point.
2. An aquastat shall stop the unit when hot water is not available.

### B. Electric Air Curtain

1. Contractor shall wire air curtain controls that are furnished with the unit for local control.
2. Field-Installed Thermostat
3. Automatic Door Switch: Combination roller-plunger type installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
4. Three-Speed Switch: Manually activates, deactivates, and controls air-curtain fan speed.
5. Three-Delay Relay: Factory installed and adjustable to allow air curtain to operate from 0.5 seconds to 10 hours.





6. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, terminal strip, and NEMA 250, Type 1 enclosure with door-mounted hands-off-auto switch.

C. Heat Trace

1. The BMS shall monitor a common alarm contact from each heat trace control panel.
2. The contractor shall provide CT's on each Heat Trace circuit to monitor status at the front end.
3. The BMS shall annunciate an alarm if outside air temperature falls below 40°F and the heat trace system has not activated.

D. Sump Pit and Sewage Ejector

1. The contractor shall monitor each sump pit and sewage ejector for high water condition.

E. Domestic Hot Water

1. The contractor shall monitor the supply water temperature off of each domestic hot water heater and annunciate a high temperature alarm if the analog limit is exceeded.

F. Fuel Oil System

1. Install and wire all fuel oil level sensing equipment for fuel oil tanks. Install and wire all fuel oil leak sensing equipment for tanks and containment piping. Fuel oil leak and level panels shall be installed in the fuel oil pump areas.
2. Install and hard wire interlock between the generator start and generator fuel oil pump start.
3. Install fuel oil tank level sensors in fuel oil storage tank. Provide all power and control wiring as required.
4. Install fuel oil tank overfill alarm at tank. Provide all power and control wiring as required.
5. Install fuel oil tank overfill alarm light and horn at tank fill connection on loading dock. Strobe light shall be activated whenever tank level exceeds 95% of capacity. Alarm horn shall be activated whenever tank level exceeds 99% of capacity. Install key operated silence switch and key operated alarm light disable switch at tank fill connection.
6. Provide monitoring of fuel oil system from BMS per the points listed on the BMS Point List.

G. Emergency Generator

1. The BMS shall monitor points for the emergency generator through a network serial interface provided as part of the emergency generator controls package.
2. Contractor shall provide actuators and control wiring for two motorized dampers, one for each generator. Each damper will require 2 actuators for a total of 4.

H. Damper Actuators Serving Emergency Generators

1. Actuators used with emergency generator dampers shall be electrically activated spring-return type with 15 second travel time to fail open. Actuators' torque requirements shall be 175 lb-in for holding and spring return and 475 lb-in for stall maximum. Each actuator shall be suitable for smoothly positioning a 25 square foot damper. Actuators to be mounted outside of air stream. Temperature rating shall be -40°F to 130°F. Actuator power shall be 120 VAC. Actuator shall be manufactured by Honeywell Model MS4120F series or as approved by the Commissioner.



- I. Automatic Transfer Switch
  - 1. The BMS shall monitor points for the ATS through a network serial interface provided as part of the ATS controls package.
- J. Uninterruptible Power Supply
  - 1. The BMS shall monitor points for the UPS through a network serial interface provided as part of the UPS controls package.
- K. Electric Power Meter
  - 1. The Contractor shall furnish and install electric power meters to monitor power where shown on the plans. Refer to the electrical plans for quantity and locations.
  - 2. Power meters shall connect to the BMS via BACnet interface and all point data made available through the BMS.
- L. Miscellaneous Points
  - 1. The contractor shall monitor the miscellaneous points as listed in the BMS Points List. Contractor shall furnish any field devices required to monitor the points as listed.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

**END OF SECTION 23 09 05**

**SECTION 23 11 13****FACILITY FUEL-OIL PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".
- F. Section 23 31 20 "Fire-Resistive Duct-Pipe Insulation and Enclosure.
- G. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes fuel-oil distribution systems including, but not limited to the following:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping and tubing joining materials.
  - 3. Piping specialties.
  - 4. Valves.
  - 5. Fuel-oil storage tank piping specialties.
  - 6. Fuel oil transfer pumps.
  - 7. Fuel oil day tank and accessories - day tank system
  - 8. Fuel maintenance system.
  - 9. Controls
  - 10. Liquid-level gage system.
  - 11. Leak-detection and monitoring system.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"



- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints And Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 DEFINITIONS**

- A. AST: Aboveground storage tank.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- E. UST: Underground storage tank.

**1.6 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure Ratings: Except where indicated otherwise, minimum pressure requirements are as follows:
  1. Oil Piping and Fittings: 150 psig
  2. Underslab, containment conduit piping: 175 psig

**1.7 SEISMIC AND WIND LOAD DESIGN**

- A. This project is located within a seismic and wind zone requiring special provisions for the support and restraint of equipment, components and piping in the event of earthquake or wind conditions.
- B. Seismic Performance: Field-installed support attachments for fuel oil piping system, including fuel oil pumps shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  1. The term "withstand" means "the complete system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."



- C. Engineering Services: Design seismic restraints and wind restraints for the fuel oil piping system, pipe connections, connecting piping supports, fuel oil pumps, generators, ASTs, and equipment, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of New York, using performance requirements and design criteria indicated under another section of this work.
- D. Provide Seismic Qualifications Certification that the fuel oil system, accessories and components will withstand the seismic and wind forces as defined under another section of this work. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. The term "withstand" means "the fuel oil system will remain in place without separation of any parts from the device when subjected to the seismic or wind forces specified and the will be fully operational after the seismic event."
  - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. It is the intent to keep all HVAC building system components in place during a seismic or wind event and operational after the seismic event.
- F. It shall be understood that the requirements for the seismic and wind restraints and vibration control as specified herein are complementary to requirements delineated elsewhere under other sections of this work for the support, fastening and isolating of equipment work. Nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this and other related sections.

#### 1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.9 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 1. Piping specialties.
  - 2. Valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 3. Fuel-oil storage tank accessories.
  - 4. Fuel-oil storage tank piping specialties.
  - 5. Conduit containment piping system
  - 6. Fuel-oil transfer pumps.
  - 7. Fuel maintenance system.
  - 8. Liquid-level gage system.
  - 9. Leak-detection and monitoring system.
- B. Shop Drawings: For facility fuel-oil piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.



- C. Engineering Services Submittal: For fuel-oil piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of New York responsible for their preparation to be submitted to Commissioner for review and approval.
    - 1. Detail fabrication and assembly of anchors and seismic restraints.
    - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
    - 3. Detail fabrication and assembly of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to building structure.
  - D. Coordination Drawings: Plans and details, drawn to scale, on which fuel-oil piping is shown and coordinated with other installations, using input from installers of the items involved.
  - E. Qualification Data: For qualified professional engineer.
  - F. Seismic Qualification Certificates: For ASTs, pumps, accessories, and components, from manufacturer.
    - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - G. Brazing certificates.
  - H. Welding certificates.
  - I. Field quality-control reports.
  - J. Warranty: Sample of special warranty.
  - K. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.
  - L. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - 1. Drive Belt: One for each belt-driven pump.
- 1.10 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
  - B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - C. Steel Support Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - D. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.



- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
- G. Comply with requirements of the EPA and of New York City Department of Buildings and New York City Department of Environmental Protection. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

#### 1.11 FACTORY TESTING

- A. Prior to shipment, the manufacturer shall test all "packaged" assemblies.
- B. Electrical components shall be functionally tested with all instruments and controls.
- C. Pump sets shall be fully tested prior to shipment. Testing shall include both a pressure and vacuum testing period. Following the pressure and vacuum tests the pump set shall be given a full operational test. The pump shall be connected to a fuel oil supply and return. The pump set shall be operated normally.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.
- D. Store PE pipes and valves protected from direct sunlight.

#### 1.13 PROJECT CONDITIONS

- A. Interruption of Existing Fuel-Oil Service: Do not interrupt fuel-oil service to facilities occupied by The City of New York or others unless permitted under the following conditions and then only after arranging to provide temporary fuel-oil supply according to requirements indicated:
  - 1. Notify The Commissioner no fewer than three days in advance of proposed interruption of fuel-oil service.
  - 2. Do not proceed with interruption of fuel-oil service without Commissioner's written permission.

#### 1.14 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

#### 1.15 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of fuel-oil storage tanks and flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.



1. Storage Tanks:
  - a. Failures include, but are not limited to, the following when used for storage of fuel oil at temperatures not exceeding 180 deg F:
    - 1) Structural failures including cracking, breakup, and collapse.
    - 2) Corrosion failure including external and internal corrosion of steel tanks.
  - b. Warranty Period: 30 years from date of Substantial Completion.
2. Flexible, Double-Containment Piping and Related Equipment:
  - a. Failures due to defective materials or workmanship for materials installed together, including piping, dispenser sumps, entry boots, and sump mounting adapters.
  - b. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

- 2.1 MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following:

- A. Gate, Globe, and Check Valves:
  1. Conbraco Industries, Inc.; Apollo Div.
  2. Grinnell Corp.
  3. Milwaukee Valve Co., Inc.
  4. Stockham Valves & Fittings, Inc.
  5. Or approved equal.
- B. Ball and Butterfly Valves:
  1. DeZurik.
  2. Neles-Jamesbury, Inc.
  3. Milwaukee Valve Co., Inc.
  4. Or approved equal.
- C. Fuel Oil Transfer Pumps:
  1. Preferred Utilities Manufacturing Corp.
  2. Viking Pump, Inc.
  3. Webster Heating.
  4. Or approved equal.

## 2.2 PIPES, TUBES, AND FITTINGS

- A. All piping shall be provide with ground joint unions at piece of apparatus to facilitate connecting and disconnecting.
- B. All horizontal fuel oil piping within the building or outside the building shall be installed in a minimum 10 gauge containment conduit and completely encased with an approved 2-hour (minimum) fire resistive enclosure. All vertical fuel oil piping shall also be installed in a 10 gauge conduit and run within a masonry or concrete shaft.
- C. Fire Resistive enclosure is specified under section 23 31 20 "Fire-Resistive Duct-Pipe Insulation and Enclosure".





- D. All piping shall be steel with welded fittings (galvanized pipe and fittings are not permitted).
- E. Victaulic piping or fittings are not permitted.
- F. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type S, Grade B.
  - 1. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
  - 2. Unions: ASME B16.39, Class 300, malleable iron with brass-to-iron seat, ground joint, and threaded ends conforming to ASME B1.20.1.
  - 3. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 300, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
    - e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

## 2.3 DOUBLE-CONTAINMENT PIPE AND FITTINGS

- A. Containment piping shall be steel with welded fittings (galvanized pipe and fittings are not permitted).
  - 1. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

## 2.4 PIPE INSULATION

- A. As specified under another section.

## 2.5 JOINING MATERIALS

- A. Common Joining Materials: Refer to Section 23 05 00 "Common Requirements for HVAC Work" for joining materials not included in this Section.
- B. Gaskets for Flanged Joints: Full faced for cast-iron flanges and ring type for steel flanges. Select materials that suit service of piping in which gasket is installed and is not detrimentally affected by chemical and thermal conditions of fuel oil.

## 2.6 PIPING SPECIALTIES

- A. Pipe Connectors: UL 567, swivel or compression type for connection to equipment.
- B. Strainers: Y pattern, full size of connecting piping. Include stainless-steel screens with 3/64-inch perforations, except where other screens are indicated.
  - 1. Pressure Rating: 300-psig WOG working pressure.
  - 2. 2-Inch NPS and Smaller: Bronze body.
  - 3. 2-1/2-Inch NPS and Larger: Cast-iron body.
  - 4. Screwed screen retainer with centered blow-down and pipe plug.
- C. Flexible Connectors: Comply with UL 567.



1. Metallic Connectors:

- D. Basket Strainers: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection, flanged ends.

1. Pressure Rating: 300-psig WOG working pressure.

- E. T-Pattern Strainers: malleable iron with removable access coupling and end cap for strainer maintenance.

1. Pressure Rating: 300-psig WOG working pressure.

F. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Pressure Rating: 300-psig WOG working pressure.
4. Maximum Operating Temperature: 225 deg F.

2.7 VALVES

- A. General: All valves shall be rated for a minimum of 350 psig WOG working pressure.
- B. Valves shall be as specified under another section of Division 23.

2.8 SPECIALTY VALVES

- A. Oil Safety Valves: UL listed for flammable or volatile liquids, 350-psig working pressure, and 550 deg F operating temperature. Include ASTM B 61 bronze body, bronze bases and discs; and field-adjustable, cadmium-plated, carbon-steel springs; factory set at 20 percent above operating pressure; and threaded ends conforming to ASME B1.20.1.
- B. Provide and install on the tank suction stub a bronze, 1-1/2" Double Poppet Foot Valve, with lapped-in seat, double guided poppet stems and 20 mesh monel screen. Double Poppet Foot Valve shall be as supplied by Preferred Utilities Manufacturing Corporation, Model Type 22. The foot valve shall come with a 233-FV foot valve extractor fitting which shall allow for easy access to and repair of the foot valve. The 233-FV foot valve extractor fitting shall come with an extractor wrench of the appropriate size.
- C. Pressure Relief Valves: Comply with UL 842.
- D. Emergency Shutoff Valves: Comply with UL 842.

2.9 FUEL OIL TRANSFER PUMPS AND PIPING

- A. Provide and install a factory assembled, "packaged" Automatic Duplex Fuel Oil Transfer system to ensure a reliable supply of fuel oil to the generator fuel oil day tank. System to be factory fabricated, tested and certified as a complete unit. Field assembly of units are not acceptable.
- B. Provide a complete duplex fuel oil pump and piping system with a PLC based control system for monitoring and control as scheduled and detailed on drawings. The set shall be piped and wired, with components mounted on a steel base support fabricated of 1/4" steel plate with 4" steel side rails continuously welded to the base. The base support to be fabricated with 2-3/4" overflow containment lip and base shall extend beyond any fitting, valve, pump, strainer or selector valve. Any fuel leaking from any component, fitting or packing in the system shall be



contained by this baseplate. Base shall be grouted and anchored in the field to the housekeeping pad to minimize vibration and movement.

- C. In the Rupture Basin through a 3/4" welding boss, shall be a Preferred Utilities Manufacturing Corporation RBS switch for leak detection. Switch shall be redundantly sealed against vapors and fluids, be lever float operated and magnetically actuated. Wiring enclosure shall be cast aluminum and constructed to NEMA 4 standards. Visual and audible alarm and annunciation for the pump set rupture basin shall be located on the pump set control cabinet. Provide a 2" plugged drain connection in the Rupture Basin.
- D. Description: UL 343, single-stage, internal-gear, positive-displacement, rotary type. Include foot-mounted, cast-iron housing; steel gears; bronze bearings; steel shaft; mechanical seals; built-in pressure relief bypass; steel base; and drive coupling.
  - 1. Drive: Direct drive, close coupled.
- E. Motor: Split phase for single-phase motors; capacitor start, induction run, totally enclosed for 3-phase motors.
- F. The pumps shall be connected to the piping in the set through stainless steel flexible metallic metal jackets, and the pump and motor assemblies shall be mounted to the base plate via elastomeric vibration isolators. Pumps and motors shall be mounted on a structural steel channel and equipped with flexible coupling and full OSHA approved coupling guard. Pumps and motors shall be removable for ease of maintenance.
- G. Flexible coupling general: The pumps shall be connected to the motor by an elastomeric jaw type flexible coupling that does not require lubrication. The coupling wear member shall be replaceable without disturbing the alignment of either the pump or motor. Sizing of the flexible coupling shall be based on motor horsepower and rpm. Materials of construction: The coupling body shall be sintered iron and case iron. The elastomeric wear member shall be NBS rubber.
- H. Provide a time delayed flow sensing switch on the discharge of the pumpset to bring on the lag pump should the lead pump fail to maintain flow in the loop. Switch will be wired back to the main control cabinet for alarm and annunciation.
- I. The PLC based control system shall be housed in a cabinet, NEMA 4 construction, factory wired.
- J. Furnish and install a complete system of piping with all necessary valves between the system components. Provide a swing check valve and gate valve at the pump inlet. Provide approved anti-syphon valve at high points of suction line. Install fusible link valve on oil supply immediately adjacent to point where pipe enters generator room in accessible location. Valve shall have provision to close manually (Preferred or equal). Install whatever additional valves may be required by local or state regulations.

## 2.10 FUEL OIL GENERATOR "BELLY" TANK AND ACCESSORIES

- A. See Generator Specification in Division 26.
- B. Tank connections shall include: fuel inlet, required vent openings, manual fill, tank level sensor, 2 inlets for engine supply, and 2 outlets for engine return. All piped with reinforced, welded pipe adapters. Fuel fill, inlet and return must be supplied with factory installed drop tubes to prevent surging and foaming in the tank.



- C. Tank Level Controller. Level Controls shall have five (5) float operated switches rated at 100 watts and factory installed in the day tank. Levels of control: emergency high-level alarm and total pump shutdown (90% capacity), pump off (80% capacity), pump on (50% capacity), and emergency low-level secondary pump on and annunciation (40% capacity) and 10% Engine shutdown (direct to engine panel). Unit shall be suitable for pressures to 150 psi, and shall be made entirely of non-ferrous material. Electrical connections shall be contained in a factory installed weatherproof junction box.
- D. Vent Sensor. Provide and factory install a leak detector for alarming and fuel supply pump shut down via detection of oil in the vent line. Unit to be lever float operated and magnetically actuated with redundant vapor and fluid provisions. Electrical connections shall be contained in a factory installed weatherproof junction box.
- E. Tank Leak Sensor. Provide and factory install a rupture basin leak detector for alarming and fuel supply pump shut down. Electrical connections shall be contained in a factory installed NEMA 4X weatherproof junction box.

## 2.11 OIL FILL LINES & VENT TERMINALS

- A. Vent pipe line shall be provided from the fuel oil storage tank to the required height within building construction and shall terminate with a vent to atmosphere. set. Fitting shall be one piece. Each oil tank vent pipe terminal shall be provided with a weatherproof vent head the approved equal of "Preferred Junior Vent Protector with Screens."
- B. Fuel oil fill line shall be provided from the fuel oil storage tank within the building property line terminating with a fill box. Fuel oil fill box shall be EPA and local code approved. Fuel oil fill box shall include cover and spill containment cap. Provide remote overfill alarm bell and light with tank mounted sensor. Fuel oil fill box shall be manufactured by EBW or approved equal.
- C. Provide and install where shown on the drawings a Preferred Utilities Model 3 Sidewalk Fill Station per NFPA 31 Standard for the Installation of Oil Burning Equipment. The Fill Station is designed for below grade installation with flush mounting on horizontal surfaces.
- D. The Model 3 Sidewalk fill station body shall be made from heavy-duty carbon steel with welded body and painted for corrosion resistance. The fill station shall include a gasket equipped water-tight carbon steel Highway-20 rated cover held down with recessed screw heads. It shall also include an integral recessed handle for easy cover removal. The steel cover has a Buna-N gasket and recessed head bolts.
- E. The fill line shall enter the fill station through a boot connection. Boot connection shall be flexible for extreme temperature conditions that may affect piping expansion. Integral to the fill station shall be a hand pump for evacuation of spilled media. The spill container holds a minimum of 15 gallons of spilled fuel. A hose is provided so that clean oil can be pumped into the fill pipe. Contaminated oil or water can be pumped into a bucket for safe removal.
- F. Internally mounted in the fill station shall be an audible/visual overfill alarm system for single tank installations to be activated by a High Level Switch. The station shall consist of an "Overfill Alarm" light, alarm horn, "Alarm Silence" push button and a digital readout of tank contents in US gallons. All wiring shall be in Liquid-Tite waterproof flexible conduit. The alarm light and horn shall be automatically silenced in 90 seconds or instantly silenced with the operator depresses the "Alarm Silence" button. The digital display shall flash during a high level condition.
- G. Provide permanently mounted and prominently displayed inside the Fill Station a durable nameplate displaying the main oil storage tanks inventory capacity in US gallons. For the fill



line connection, include a composite top-seal, tight fill adapter and lockable fill cap. The system shall include a preferred FA-S caution sign.

- H. The fill and vent terminal shall be provided with approved identification indicating the tank number with which it is connected.

## 2.12 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for fuel oil.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.13 SPECIALTY VALVES

- A. Mechanical Leak Detector: Comply with UL 842.
  - 1. Listed and labeled for fuel-oil service by an NRTL acceptable to New York City Department of Buildings.
  - 2. Body: ASTM A 126, cast iron.
  - 3. O-Rings: Elastomeric compatible with fuel oil.
  - 4. Piston and Stem Seals: PTFE.
  - 5. Stem and Spring: Stainless steel.
  - 6. Piston Cylinder: Burnished brass.
  - 7. Indicated Leak Rate: Maximum 3 gph (3 mL/s) at 10 psig (69 kPa).
  - 8. Leak Indication: Reduced flow.

## 2.14 FUEL OIL MANAGEMENT CONTROL SYSTEM

- A. Provide a Fuel Oil Management system housed in a Control Cabinet mounted on the fuel oil pump set. The control cabinet shall be completely pre-wired, factory programmed and tested to ensure job site reliability. The pump set and control cabinet shall be the product of a single manufacturer for single source responsibility.
- B. Description: Factory fabricated and wired fuel maintenance system for fuel-oil filtration; with enclosure, filter, fuel-oil pump, and controls; FMG approved, listed, and labeled by an NRTL acceptable to New York City Department of Buildings.
  - 1. Enclosure: NEMA 250, Type 3R, painted steel containing pumps, filters, accessories, and controls. Hinged door on the front of enclosure.
  - 2. Pump: Comply with HI M109, steel-gear-with-crescent, positive-displacement, direct-coupled, rotary-type.
  - 3. Materials: Cast-iron housing; bronze bearings; steel shaft; mechanical seals; and built-in, pressure relief bypass valve.
  - 4. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified under another section of this work.
    - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
    - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  - 5. Piping: Steel with wrought-steel fittings and welded joints.
  - 6. Multistage Filter: Spin-on, replaceable types.



- a. Stage 1: 100-mesh strainer.
  - b. Stage 2: Centrifuge to separate particulates and water from oil.
  - c. Stage 3: Coalescing water and particulate filter.
  - d. Stage 4: 30-micron particulate removal.
  - e. Stage 5: 10-micron particulate removal.
  - f. Stage 6: Minimum 99.5 percent water removal with see-through bowl and water-sensor probe.
  - g. Stage 7: 1.5-micron particulate removal.
7. Programmable Logic Controller:
- a. Alarm on maximum 15-in. Hg vacuum at pump suction indicating plugged filter.
  - b. Alarm on high water level in filter.
  - c. Alarm leak in enclosure.
  - d. Touch screen; with minimum 2-line, 20-character, backlit, LCD display.
  - e. Controller strip heater with thermostat.
8. Interface with automatic control system is specified in Section 23 09 00 "HVAC Instrumentation and Controls" to control and indicate the following:

#### 2.15 LIQUID-LEVEL GAGE SYSTEM

- A. Provide and install a Storage Tank Liquid Level Management System. Third party tested 0.1 gph In-Tank and or external 0.2 gph Out-of-Tank Detection capabilities which meet and exceed the current standard EPA required protocols. Console shall include integral printer.
- B. Description: Calibrated, liquid-level gage system complying with UL 1238 with probes or other sensors and remote annunciator panel.
- C. Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.

#### 2.16 LEAK-DETECTION AND MONITORING SYSTEM

- A. Provide fuel oil leak detector that shall be float operated, suitable for #2 oil to 150 psi. It shall have brass and Buna N wetted parts. Switch shall be hermetically sealed and fully isolated from contents and external atmosphere. Electrical connections shall be made externally to the tank in an explosion-proof head assembly approved by UL for Class 1, Group D applications.
  1. Provide dry contact input to the BMS.
- B. Cable and Sensor System: Comply with UL 1238.
  1. Calibrated, leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil storage tanks and fuel-oil piping.
  2. Include fittings and devices required for testing.

#### 2.17 FUEL OIL

- A. Fuel Oil: ASTM D 396, Grade No. 2.

#### 2.18 LABELING AND IDENTIFYING



- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, continuously inscribed with a description of utility.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine roughing-in for fuel-oil piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 PREPARATION

- A. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

#### 3.4 INDOOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Verify final equipment locations for roughing-in.
- I. Prohibited Locations:
  - 1. Do not install fuel-oil piping in or through circulating air ducts, ventilating ducts, or dumbwaiter or elevator shafts.
  - 2. Do not install fuel-oil piping in solid walls or partitions.
- J. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- K. Connect branch piping from top or side of horizontal piping.



- L. Install unions in pipes 2" and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- M. Do not use fuel-oil piping as grounding electrode.
- N. Install Y-pattern strainer on inlet side of fuel-oil pump.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

### 3.5 VALVE INSTALLATION

- A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.
- B. Install valves in accessible locations.
- C. Protect valves from physical damage.
- D. Install metal tag attached with metal chain indicating fuel-oil piping systems.
- E. Install oil safety valves at inlet of each oil-fired appliance.
- F. Install pressure relief valves in distribution piping between the supply and return lines.
- G. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.
- H. Install manual air vents at high points in fuel-oil piping.
- I. Install emergency shutoff valves at dispensers.

### 3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Bevel plain ends of steel pipe.





2. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
- G. Flared Joints: Comply with SAE J513. Tighten finger tight, then use wrench according to fitting manufacturer's written recommendations. Do not overtighten.

### 3.7 FUEL-OIL PUMP INSTALLATION

- A. Transfer Pumps:
  1. Install pumps with access space for periodic maintenance including removal of motors, impellers, and accessories.
  2. Set pumps on and anchor to concrete base.
- B. Install two-piece, full-port ball valves at suction and discharge of pumps.
- C. Install mechanical leak-detector valves at pump discharge.
- D. Install Y-pattern strainer on inlet side of simplex fuel-oil pumps.
- E. Install check valve on discharge of simplex fuel-oil pumps.
- F. Install suction piping with minimum fittings and change of direction.
- G. Install vacuum and pressure gage, upstream and downstream respectively, at each pump to measure the differential pressure across the pump.

### 3.8 FUEL MAINTENANCE SYSTEM INSTALLATION

- A. Install suction line, with foot valve, at one end of storage tank, 1 inch from the bottom of tank.
- B. Install return line at the opposite end of storage tank from suction line.

### 3.9 LIQUID-LEVEL GAGE SYSTEM INSTALLATION

- A. Install liquid-level gage system. Locate panel inside building where indicated.

### 3.10 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

- A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.
  1. Single-Wall, Fuel-Oil Storage Tanks: Install probes as indicated.
  2. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor cable probes in interstitial space of double-containment piping.
  3. Install liquid-level gage.

### 3.11 CONNECTIONS



- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Install unions, in piping 2" and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- C. Install flanges, in piping 2-1/2" and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- D. Connect piping to equipment with ball valve and union. Install union between valve and equipment.
- E. Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for service access.

### 3.12 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
  - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
  - 2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 7. Use 3000-psi, 28-day, compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete."

### 3.13 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:
    - a. Fuel-Oil Distribution Piping: Minimum 75 psig for minimum 90 minutes.
    - b. Fuel-Oil, Double-Containment Piping:
      - 1) Carrier Pipe: Minimum 75 psig for minimum 60 minutes.



- 2) Containment Conduit: Minimum 75 psig for minimum 60 minutes.
    - c. Suction Piping: Minimum 20-in. Hg for minimum 90 minutes.
    - d. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 15 psig.
  2. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of New York City Department of Buildings.
  3. Test liquid-level gage for accuracy by manually measuring fuel-oil levels at not less than five different depths while filling tank and checking against gage indication.
  4. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.
  5. Start fuel-oil transfer pumps to verify for proper operation of pump and check for leaks.
  6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  7. Bleed air from fuel-oil piping using manual air vents.
  - D. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.
  - E. Prepare test and inspection reports.
- 3.14 DEMONSTRATION
- Engage a factory-authorized service representative to instruct The City of New York's service operators to adjust, operate, and maintain liquid-level gage systems, leak-detection and monitoring systems, fuel-oil pumps.

**END OF SECTION 23 11 13**



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## **SECTION 23 13 13**

### **UNDERGROUND FUEL STORAGE TANKS AND FUEL SYSTEMS**

#### **PART 1 – GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the City of New York Standard Construction Contract.

##### **1.2 SUMMARY**

- A. Section includes underground fuel storage tanks, motor fuel dispensing systems, and related pumps, systems, alarms, and equipment.

##### **1.3 RELATED WORK SPECIFIED ELSEWHERE**

- A. Earthwork: Section 31 00 00 "Earthwork".
- B. Cast-In Place Concrete: 03 30 00 "Cast-in-Place Concrete".
- C. Common Requirements for Electrical Work: Section 26 05 00 "Common Requirements for Electrical Work".
- D. Low-Voltage Electrical Power Conductors and Cables: Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".
- E. Raceway and Boxes for Electrical Systems: Section 26 05 33 "Raceway and Boxes for Electrical Systems".
- F. Underground Ducts and Raceways for Electrical Systems: Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems".
- G. Panelboards: Section 26 24 16
- H. Wiring Devices: Section 26 27 26

##### **1.4 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – Construction Waste Management and Disposal
  - 2. Section 01 81 13 – Sustainable Design Requirements for LEED Buildings
  - 3. Section 01 81 19 – Indoor Air Quality Requirements for LEED Buildings



- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.6 REFERENCES

- A. NFPA 30 - Flammable and Combustible Liquids Code.
- B. NFPA 30A - Automotive and Marine Service Station Code.
- C. Underwriters Laboratories (UL) Standard for Safety 1316 Glass-Fiber--Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures.
- D. NFPA 70 - National Electric Code.
- E. API 1615 - Installation of Underground Liquid Storage Systems.
- F. Underwriter's Laboratories (UL).
- G. ETL Testing Laboratories (ETL).
- H. Factory Mutual Engineering and Research (FM).
- I. NYS Department of Environmental Conservation Regulations.
- J. US Environmental Protection Agency Regulations.

1.7 DEFINITIONS

- A. Motor Fuel Dispensing System: Fuel storage tank, leak containment and detection for tank and underground piping, overfill prevention, high level alarm, gage system, remote pump, dispenser, optional automated fuel management system, and automated fire extinguishing system with manual backup operation (unleaded gasoline systems only).

1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.9 SUBMITTALS

- A. Submittals Package: Submit the Product Data, and Quality Control Submittals specified



below at the same time as a package.

- B. Product Data: Catalog sheets, specifications, illustrations, wiring diagrams, CARB Stamp (where applicable), and installation instructions for each item specified for each type of system.
  - 1. Factory Test Certificate: For each fuel storage tank.
  - 2. Final test procedure documentation.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Qualifications:
  - 1. Contractor: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening, have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
  - 2. Manufacturer: The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years."
- C. Listings: Components of the system(s) for which Underwriters' Laboratories, Inc. (UL) provides product listing service, shall be listed and bear the listing mark.
- D. Regulatory Requirements:
  - 1. Systems for storing diesel fuel or unleaded gasoline for motor fuel dispensing systems shall comply with the applicable requirements of UL 58, NFPA 30 and NFPA 30A.
  - 2. New York State Department of Environmental Conservation Bulk Storage Regulations 6 NYCRR Parts 612, 613, and 614.
  - 3. New York State Department of Environmental Conservation Petroleum and Volatile Organic Liquid Storage and Transfer 6 NYCRR Part 229.
  - 4. New York State Department of Environmental Conservation Dispensing Site and Transport Vehicles 6 NYCRR Part 230.
  - 5. New York City Administrative Code, Title 27, and applicable New York City Fire Department Rules and Regulations.
- E. Company Field Advisor:
  - 1. Secure the services of a Company Field Advisor of the manufacturer of the leak and overfill monitoring system for a minimum of 8 hours for the following:
    - a. Inspect installation and witness initial startup of the system.
    - b. Instruct the City of New York's service operators in the operation and service of the system (minimum of two 2-hour instruction sessions). Schedule instruction sessions with the Commissioner.
  - 2. Secure the services of a Company Field Advisor of the manufacturer of the fuel management system for a minimum of 8 hours for the following:



- a. Inspect installation and witness initial startup of the system.
- b. Instruct the City of New York's service operators in the operation and service of the system (minimum of two 2-hour instruction sessions). Schedule instruction sessions with the Commissioner.

#### 1.11 WARRANTY

- A. Fiberglass Tanks: Thirty-year manufacturer's warranty for each tank, starting on the day of substantial completion.

#### 1.12 PROVISION OF TOOLS

- A. Special Tools to be provided by Contractor:
  1. One stick gage and two calibration charts for each fuel tank.
  2. Two tools for each type and size vandal resistant fastener.
  3. Two lifting arms for composite type manhole frames and lids.

### PART 2 – PRODUCTS

#### 2.1 FIBERGLASS FUEL STORAGE TANKS

##### A. Tank Capacities

1. 6,000-gallon regular gasoline tank
2. 4,000-gallon diesel tank

##### B. Manufacturers:

- a. Containment Solutions
- b. Xerxes Fiberglass Tanks
- c. Or approved equal

##### C. Features:

1. Double wall fiberglass reinforced plastic (FRP) underground storage tanks with a primary (internal) tank and a secondary (external) tank.
2. Interstitial space between the primary and secondary tank walls to allow for the free flow and containment of all leaked product from the primary tank, and the insertion of a monitoring device at bottom of the secondary tank.

##### D. Design Criteria:

1. UL labeled for underground service in accordance with UL-1316 Construction Standard for Glass-Fiber-Reinforced Plastic Underground Storage Tanks and conforming to 2014 New York City Construction Codes.
2. Internal Load: Primary and secondary tanks shall withstand air pressure test as recommended by tank manufacturer to meet 2014 New York City Construction Codes. Maximum test pressure as recommended by tank manufacturer.
3. Internal and external tanks shall be factory vacuum tested to assure structural integrity.
4. Surface Loads: H-20 axles loads when properly installed according to current manufacturer's installation instructions.
5. External Hydrostatic Pressure: 7 feet of overburden with the hole fully flooded.





6. Tanks capable of supporting accessory equipment such as drop tubes, submersible pumps and ladders when installed according to tank manufacturer's recommendations and limitations.
7. Vent primary and secondary tanks to atmospheric pressure. The tanks are not designed as pressure vessels.

**E. Product Storage:**

1. Tanks capable of storing gasoline, gasohol, 100 percent ethanol or methanol, jet fuel, diesel fuel, AV gas, kerosene, and potable water at ambient underground temperature, fuel oil at temperatures not to exceed 150 degrees F, and fuels with a specific gravity up to 1.1.

**F. Construction:**

1. Materials (Primary and Secondary Tanks): Isophthalic polyester resin and glass fiber reinforcement.
2. Manway:
  - a. Above liquid level type with 22-inch minimum inside diameter. Provide one manway on tanks.
  - b. Bolted cover with UL listed gasket and welded threaded openings of number and sizes required. Secure nuts or heads of bolts to the underside of the flange.
  - c. Protect threads on bolts during transit and installation.
3. Containment Sump Mounting Collar: Sized to accept 42-inch fiberglass containment sump.
4. Monitor Fittings: 4-inch NPT fitting.
5. Gage/Deflector Plates (Under Manways and Fitting Openings): Steel.

**G. Containment Sump: Flat sided type with watertight lids, 42-inch dia., by fiberglass tank manufacturer.**

1. Construction: Same material as the tank.
2. Bonding Kit: As recommended by fiberglass tank manufacturer.

**H. Tank Hold-Down Device:**

1. Hold-Down Strap (By Tank Manufacturer): Fiberglass reinforced plastic, pre-shaped to fit the tank contour. The quantity and location of hold down straps shall be as recommended by tank manufacturer.
2. Eye Bolt: Cadmium plated ASTM A 36 steel, eye on one end, and the other threaded and fitted with an 1/4" x 4" square steel plate, structural nut and washer. Rod length as required for proper anchoring into the concrete mat.
3. Wire Rope: Improved plow steel, 6 x 19 strand, galvanized, fiber core, minimum tensile strength 12500 pounds.
4. Wire Rope Clamps: Cadmium plated for corrosion resistance.

**I. Tank Identification: Permanent stencils, labels, or plates mounted on tanks, and include the following information:**

1. Manufacturer's statement that tank conforms to Bulk Storage Regulation 6 NYCRR Part 614.



2. Standard of Design by which tank was manufactured.
3. List of products and additives which may be permanently stored in the tank.
4. Year in which tank was manufactured.
5. Unique identification number.
6. Dimensions, design, working capacity, and tank model number.
7. Name of tank manufacturer.

J. Flanged Manway: One required.

1. Ring Pattern (Tanks with Mounting Collar): One ring pattern for mounting cover plate.

## 2.2 CONTAINMENT SUMP

A. Fiberglass Containment Chamber (watertight):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Containment Solutions
  - b. OPW two-piece sump
  - c. Franklin Fueling System
  - d. Or approved equal.
2. Minimum I.D.: 42 inches.
3. Watertight cover lid.
4. Manway Mounting Kit- Subject to compliance with requirements, provide products by one of the following:
  - a. Containment Solutions EZ-fit adhesive (Basis-of-Design)
  - b. Franklin Fueling System
  - c. OPW
  - d. Or approved equal.
5. Entry Fitting and Test Boot with Air Stem:
  - a. Smith Fibercast or an equivalent product from an approved manufacturer listed above (entry boots), and Franklin Fueling System or an equivalent product from an approved manufacturer listed above (test boots).
6. Containment chamber shall seal watertight to the tank and secondary containment system.

## 2.3 FLUSH MOUNT WATERTIGHT ACCESS LID ASSEMBLY (AT GRADE)

- A. Manufacturers - Subject to compliance with requirements, provide products by one of the following:
1. Containment Solutions
  2. Franklin Fueling System
  3. OPW
  4. Or approved equal.
- B. Cover: Fiber reinforced composite type complying with DOT H-20 load requirements, and identified with API color coding, and fuel identification plate, minimum 44-inch dia.



- C. Skirt: 1/4 inch rolled steel angle iron ring welded to 14 gage steel skirt with galvaneel finish, and provisions to secure cover to skirt ring with vandal resistant fasteners.
- D. Slide Action Handle: Allows cover removal from a standing position.

## 2.4 TANK ACCESSORY PACKAGE

### A. Tank Fill Assembly:

- 1. Cover: Waterproof, hinged, locking type.
- 2. Shell: Durable polyethylene, or fiberglass shell with plastic or cast-iron base.
- 3. Cover Lid Manhole: Plastic or steel skirt with composite manhole cover complying with DOT H-20 load requirements.
- 4. Drain valve.
- 5. Top Seal Fill Pipe Cap: Subject to compliance with requirements, provide products by one of the following:
  - a. Diesel – OPW Model 634TT-7085-EVR
  - b. Regular Unleaded – OPW Model 634TT-7085-EVR
  - c. Stage I Vapor Recovery – OPW Model 1711T-7085-EVR
  - d. Or approved equal.
- 6. Top Seal Fill Pipe Swivel Adapter: Subject to compliance with requirements, provide products by one of the following:
  - a. Diesel – OPW Model 61SALP
  - b. Regular Unleaded – OPW Model 61SALP
  - c. Stage I Vapor Recovery – OPW Model 61VSA-1020-EVR
  - d. Or approved equal.
- 7. Below Grade Spill Containment Assembly: Subject to compliance with requirements, provide products by one of the following:
  - a. Diesel – OPW Model 1C-31532D, 15-Gallon Double -Wall Unit
  - b. Regular Unleaded – OPW Model 1C-31532D, 15-Gallon Double -Wall Unit
  - c. Stage I Vapor Recovery – OPW Model 1C-3132P, 5-Gallon Double -Wall Unit
  - d. Or approved equal.
- 8. Fill Limiting Valve: Subject to compliance with requirements, provide products by one of the following:
  - a. Diesel – OPW Model 71SO-4000
  - b. Regular Unleaded – OPW Model 71SO-420C
  - c. EMCO A1100
  - d. Or approved equal.
  - e. Any hydraulic shock resulting from valve operation shall be minimal to prevent damage to the delivery hose.

- B. Nameplate Holders: Corrosion resistant steel plates and straps (4 inch) with vandal resistant fasteners;



1. OPW 107
2. EBW 787
3. Wifco
4. Or approved equal.

C. Fill Port Nameplate:

1. Construction: Minimum 1/8-inch-thick two color laminated plastic engravers stock with the following items engraved in contrasting symbol and background colors conforming to the American Petroleum Institute (API) color coding for the fuel type, and consistent with facility fuel supplier's marking.
  - a. Manufacturer's statement that tank conforms to Bulk Storage Regulation 6 NYCRR Part 614.
  - b. Standard of Design by which tank was manufactured.
  - c. List of products and additives which may be permanently stored in tank.
  - d. Year in which tank was manufactured.
  - e. Unique identification number.
  - f. Dimensions, design, working capacity, and tank model number.
  - g. Name of tank manufacturer.
  - h. Date of tank installation.
  - i. API color symbol.
  - j. Installers name.

D. Padlock: Bronze, 2-1/8" wide covered laminated steel 5-pin tumbler, boron alloy shackle, and keyway protection.

1. Key all locks alike.

E. Stick Gage: Hardwood, calibrated in 1/8-inch increments.

F. Manhole for Leak Monitor System: H-20 loading, 18-inch diameter cast iron body, minimum 18-inch steel skirt and cover secured with minimum of 2 cap screws;

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. OPW 6110-18WT,
  - b. Morrison Bros. 418TM (18 inch dia.)
  - c. EBW MW-1800.
  - d. Or approved equal.

## 2.5 UNLEADED GASOLINE TANK INSTALLATION PACKAGE

A. Vent (Unleaded Gasoline Tanks): Composite body, pressure-vacuum vent type, CARB and EVR certified, designed to direct vapors upward. Fitting relief valve shall be set for 3 inches water column pressure and 8 inches water column vacuum;

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Oemco Model No. 412,
  - b. OPW 623V, EBW 802,
  - c. Morrison Bros. 749,



- d. Or approved equal.
- B. Remote Pump: Single phase 2 HP, 208/230 VAC; with control box and mechanical line leak detector. Subject to compliance with requirements, provide products by one of the following:
  - 1. F.E. Petro IST-VS2
  - 2. Red Jacket P75T-X (quick set finial)
  - 3. Or approved equal.
- C. Mechanical Line Leak Detector: Subject to compliance with requirements, provide products by one of the following:
  - 1. F.E. Petro STP-MLD
  - 2. Red Jacket FX-1V,
  - 3. Or approved equal.
- D. Extractor fitting (for tank testing): Subject to compliance with requirements, provide products by one of the following:
  - 1. Universal V421,
  - 2. OPW 233,
  - 3. EBW 300 Series,
  - 4. Morrison Bros. 560,
  - 5. Or approved equal.
  - 6. Cap: EVR certified; OPW 1711T-7085-EVR, or EBW 304 Series.
  - 7. Adapter: EVR certified; OPW 61VSA-1020-EVR, or Franklin SWV-101-B.
- E. Manual Shutoff Valve: Steel ball valve, 1 1/2-inch size. Subject to compliance with requirements, provide products by one of the following:
  - 1. Jomar T-2000, Morrison Bros. 6191BSS (stainless steel) (Basis-of-Design),
  - 2. McMaster-Carr 46495K25
  - 3. Morrison Bros.
  - 4. Or approved equal.
- F. Drop Tube: Subject to compliance with requirements, provide products by one of the following:
  - 1. OPW model 61T-SS-0412 (Basis-of-Design)
  - 2. Franklin
  - 3. EBW
  - 4. Or approved equal.

## 2.6 DIESEL MOTOR FUEL TANK INSTALLATION PACKAGE

- A. Vents (Diesel Motor Fuel Tanks): Aluminum body and cover, open type 30 or 40 mesh brass screen, and rain shield, designed to direct vapors upward;
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. OPW 23;
    - b. EMCO Wheaton A4103,
    - c. Morrison Bros. 354,



- d. EBW 800 series,
  - e. Or approved equal.
- B. Remote Pump: Single phase 3/4 HP, 208/230 Vac; with control box and mechanical line leak detector;
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. F.E. Petro IST-R-VS2-VL1
    - b. Red Jacket P75 T-X (quick set finial).
    - c. Or approved equal.
  - 2. Mechanical Line Leak Detector: Subject to compliance with requirements, provide products by one of the following:
    - a. F.E. Petro STP-MLD-D
    - b. Red Jacket FX-1DV,
    - c. Or approved equal.
- C. Manual Shutoff Valve: Brass, full port ball valve, 1 1/2-inch size,
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jomar T-100NE,
    - b. Morrison Bros. 691B,
    - c. McMaster-Carr 47865K27,
    - d. Or approved equal.

## 2.7 DIESEL TANK INSTALLATION PACKAGE

- A. Vents (Diesel Motor Fuel Tanks): Aluminum body and cover, open type 30 or 40 mesh brass screen, and rain shield, designed to direct vapors upward;
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. OPW 23;
    - b. EMCO Wheaton A4103,
    - c. Morrison Bros. 354,
    - d. EBW 800 series,
    - e. Or approved equal.
- B. Foot Valve Extractor Assembly:
  - 1. Pipe Cap: Die cast zinc, steel cross bar, (4 inch); Subject to compliance with requirements, provide products by one of the following:
    - a. OPW 116,
    - b. Morrison Bros. 578,
    - c. EBW 320 series.
    - d. Or approved equal.



2. Foot Valve: Double poppet type with bronze body and poppet, metal to metal seat, 8 or 24 mesh galvanized brass screen, and extension legs; Subject to compliance with requirements, provide products by one of the following:
  - a. OPW 92,
  - b. Morrison Bros. 335A,
  - c. EBW 50 thru 201 series,
  - d. Or approved equal.
3. Extractor Fitting: Cadmium plated cast iron body with bronze cap and chromed tanned leather gasket; Subject to compliance with requirements, provide products by one of the following:
  - a. OPW 233,
  - b. Morrison Bros. 560,
  - c. EBW 320 series.
  - d. Or approved equal.
- C. Locking Pipe Cap with Adapter (Fuel Oil and Diesel Fuel for Diesel Generators): Cast iron collar and cap with buna gasket (3 inch);
- D. Cap and Adaptor: Subject to compliance with requirements, provide products by one of the following:
  1. OPW 634TE-7085 cap with OPW 633T-8076 adapter,
  2. Morrison Bros. 178 cap with Morrison Bros. 305 adapter,
  3. EBW 779-200-01 cap with 778-302-01 adapter,
  4. Or approved equal.
- E. Riser: Standard weight galvanized steel pipe with 150 lb galvanized malleable iron fittings, and threaded joints with thread sealant.
- F. Drop Tube – Subject to compliance with requirements, provide products by one of the following:
  1. OPW model 61T-SS-0206 (Basis-of-Design)
  2. Franklin
  3. EBW
  4. Or approved equal.

## 2.8 DISPENSER ISLAND FACIA

- A. Type: 2 inch rolled top edge, welded anchor clips and bottom return edge.
  1. Material: 12 gage stainless steel.
  2. Overall Height: 13 inches.
  3. Radius: Standard.

## 2.9 DISPENSER SUMP

- A. Type: One-piece Polyethylene with stabilizer bar kits for shear valves, and rain lip;
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



1. OPW, Model DS-1928 (Basis-of-Design)
2. APT LM Series,
3. Morrison
4. Or approved equal.

## 2.10 SAFETY SERVICE VALVE

- A. Type: Double poppet valve, normally open, designed to automatically shut down fuel delivery to the pump upon impact or in the event of fire;
1. Fusible Link Melting Temperature: 160 degrees F.
  2. Valves: Subject to compliance with requirements, provide products by one of the following:
    - a. Universal Valve 521,
    - b. EMCO Wheaton A60-003,
    - c. EBW 662,
    - d. OPW 10BFP5726,
    - e. Or approved equal.

## 2.11 FUEL DISPENSER

- A. Types and manufacturers:
1. Dual Hose, Non-blending, Single Product Type Dispenser: 1-grade, 2-sided, 1 hose per side with hose with swivel fittings on each end, breakaway fitting, light, pulser, and high hose retractor; 115/230 VAC.
    - a. Wayne G6202D-2GJK/W1 (Basis-of-Design),
    - b. Gasboy,
    - c. Veeder-Root,
    - d. Or approved equal.
- B. Nozzles:
1. Standard Nozzle:
    - a. OPW 11B (Basis-of-Design),
    - b. Gasboy,
    - c. Veeder-Root,
    - d. Or approved equal
  2. Diesel Nozzle:
    - a. "Husky" XS Series, Model No.: 159507 (Basis-of-Design),
    - b. Gasboy,
    - c. Veeder-Root,
    - d. Or approved equal.
  3. Diesel Nozzle Swivel:
    - a. "Husky" Model No.: HS-0350 (Basis-of-Design),
    - b. Gasboy,





- c. Veeder-Root,
- d. Or approved equal.

**C. Hoses:**

- 1. Diesel Fuel Hose – One-inch dia, minimum 16 feet long:
  - a. "Goodyear" Flexsteel, Model No.: GY-532-327-120-23769
  - b. "Flex-Ever" Hardwall Dispense Hose 7280-1002A Series
  - c. "Husky"
  - d. Or approved equal.
- 2. Diesel Breakaway Valve:
  - a. "Husky" Model No.: HS-3360,
  - b. "OPW" 66RN,
  - c. "Parker",
  - d. Or approved equal.
- 3. Diesel Whip Hose:
  - a. "Goodyear" Flexsteel, Model No.: GY-532-327-120-00169,
  - b. "Flex-Ever"
  - c. Husky,
  - d. Or approved equal.
- 4. Unleaded Gasoline Hose: 3/4-inch dia, minimum 16 feet long:
  - a. "Goodyear" Flexsteel, Model No.: GY-532-327-120-23769,
  - b. "Flex-Ever" Hardwall Dispense Hose 7280-752A Series,
  - c. Husky
  - d. Or approved equal.

**D. Dispenser Accessories:**

- 1. Totalizer.
- 2. Gasoline filter as recommended by the manufacturer,
- 3. Double swivel fitting.
- 4. Pulser.
- 5. Fuel Filters: As manufactured by Cim-Tek, Parker or approved equal, for each required fuel type and environmental conditions.
- 6. Hose Mast Assembly: Wayne 889918-001, OPW or approved equal.
- 7. Hose Mast Vapor Recovery Clamp: Wayne 890898-001, OPW or approved equal.
- 8. Balance Adapter: OPW 38CS-0380, or approved equal.

**E. Cabinet and Frame:**

- 1. All stainless-steel construction.

**F. Mark dispensers with a warning sign reading "NO SMOKING - TURN OFF ENGINE - DO NOT DISPENSE GASOLINE INTO UNAPPROVED CONTAINERS".**

**2.12 TANK GAGING, LEAK AND OVERFILL MONITOR SYSTEM**



- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Veeder Root Inc., Simsbury, CT, (800) 873-3313. (Basis-of-Design)
  - 2. OPW, Hotchkins, IL, (708) 465-4200.
  - 3. Pneumercator Co., Inc., Farmingdale, NY, (516) 293-8450.
  - 4. Intelligent Controls Inc., Saco, ME, (800) 225-9787.
  - 5. OMNTEC/Electro Levels Mfg. Co., Ronkonkoma, NY, (516) 467-5787.
  - 6. Or approved Equal.
- B. Type: Continuous operation tank gaging, leak detection and overfill monitor system for double wall storage tanks, double wall product piping, and containment sumps.
  - 1. Systems shall have system test capability, and shall be UL listed and/or FM approved.
- C. Alarm Monitor Panels: Locate panel inside nearest appropriate building as shown on design plans.
  - 1. The alarm panel shall visually indicate the following:
    - a. Status of each tank's interstitial space.
    - b. Status of each containment system.
    - c. Status of high level sensor set at 95 percent of tank operating capacity (on or off). When sensor is tripped, audio alarm shall be activated and be audible at fill port location.
- D. Non-Discriminating Leak Sensors:
  - 1. Detects leaks in the following:
    - a. Interstitial space between tank walls.
    - b. Piping system which drains into containment sump.
  - 2. Sensors: Non-discriminating type not sensitive to condensation forming on the sensor surface, or dripping across the sensor surface.
- E. Magnetostrictive Gage Probe:
  - 1. Includes temperature sensors, and both product and water floats capable of sensing product level to nearest 0.001 inch.
  - 2. Upon demand, the system shall indicate water level, product level, and average product temperature.
  - 3. System shall sense and alarm leakage rates greater than 0.2 gal/hr.
- F. Instrumentation Control Cable: Connect probe and sensor to alarm monitor panel, as recommended by manufacturer of leak and overfill monitor system.
- G. Audible Overfill Alarm Device: Weatherproof, surface mounted basic grille type, 120 VAC as manufactured by tank gaging, leak detection and overfill monitor system manufacturer.
- H. Overfill Alarm Device Sign: Constructed of 1/8-inch-thick two color laminated plastic engravers stock, with the words "OVERFILL ALARM DEVICE" engraved in white on red background. Size sign and lettering for easy reading from ground level.



- I. Printer: As recommended by system manufacturer. If printer is thermal type provide 6 rolls of thermal paper at each location.

## 2.13 FUEL MANAGEMENT SYSTEMS

- A. Stand alone, magnetic stripe card activated, self-contained, island mounted type capable of 24-hour monitoring, and accepted and readily utilized by NYPD.
  1. Systems - Subject to compliance with requirements, provide products by one of the following:
    - a. FCT-XT Fuel Control Terminal by E.J. Ward, 8801 Tradeway, San Antonio, TX 78217, (210) 824-7383, [www.ejward.com](http://www.ejward.com).
    - b. FuelMaster 2500 System by Syn-Tech Systems, Inc., 100 Four Points Way, Tallahassee, FL 32305, (800) 888-9136, [www.marketing@syntech-fuelmaster.com](mailto:www.marketing@syntech-fuelmaster.com).
    - c. K800 Fuel Control System by OPW, 6900 Santa Fe Drive, Hodgkins, IL 60525, (708) 485-4200, [www.opwglobal.com](http://www.opwglobal.com).
    - d. Or approved equal.
  2. Features:
    - a. Microprocessor:
      - 1) Capable of reprogramming without changing hardware and communicates with communication controller by internal network or by dial-up phone lines.
    - b. Keypad: Heavy duty, alpha-numeric membrane type with separate key for each letter (no shift or function keys required).
    - c. Display: Backlit LCD with contrast adjustment that is highly visible and easy to read in total darkness or direct sunlight.
    - d. Dispenser selection controlled thru system logic by vehicle and/or operator card data.
    - e. Programmable to limit delivery by card or vehicle identification.
    - f. Audible "Card Left in Reader" alarm.
    - g. Capable of recording and storing transaction data including operator vehicle, quantities, day and time, odometer reading; and printing this information on demand.
    - h. Interfaces with fuel dispensers, tank monitoring equipment, and capable of data transfer via modem to facility computers.
    - i. Storage capacity with battery backup for minimum 500 transactions.
    - j. Transient protection on AC power input and modem communication.
    - k. Manual system override switches.
    - l. Weatherproof Cabinet and Stand: Powder coated steel construction.
    - m. Capable of reconciliation reporting.
    - n. Maximum Operating Temperature: -40 degrees F to 122 degrees F.

## 2.14 FASTENERS

- A. Vandal Resistant Fasteners: Stainless steel, Allen or Torx head, both with center post.

## 2.15 DIESEL FILTRATION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



1. Diesel Pure DP200 (Basis-of-Design)
2. Donaldson
3. WASP PFS
4. Or approved equal.

**B. System requirements:**

1. Furnish and install a factory assembled and tested system capable of continuously filtering and de-watering stored Ultra Low Sulphur Diesel (ULSD) and ULSD blended biodiesel fuel. Coalesce and remove both free-standing water and saturated/emulsified water from the fuel. The factory filter must be SAE J1488 ver. 2010 certified to effectively remove emulsified water to at least 95% efficiency with ULSD and ULSD blended to a minimum of B15 (an IFT or Interfacial tension of 15Nm/m).
2. All system components shall be Class 1, Division 1 rated.
3. The System will have been certified to effectively remove emulsified water to at least 95% efficiency with ULSD and ULSD blended to a minimum of B15 (an IFT or Interfacial tension of 15Nm/m) while operating at 90psii operating pressure with fuels up to B20
4. The systems shall filter and treat the entire contents of one main tank by circulating the complete volume every 8-10 hours of system operating time. Oily water removed from the fuel shall be able to be drained off, filtered to less than 10ppm and stored in a corrosion proof container until disposal can be arranged.
  - a. The fuel quality monitoring control and management system shall be integrated with each main fuel oil transfer pump control system contained in separate NEMA 3R cabinet. The control system cabinet shall contain (as a minimum) the following devices:
  - b. A Programmable Logic Controller (PLC) or programmable relay to control and manage system functions as described herein to monitor the performance and integrity of the fuel maintenance system and to alert service staff to drain excessive water in filter canister, a fuel leak in the unit, motor overload, or to notify a required filter change.
  - c. The following alarm points shall send an alarm notice and illuminate an alarm indicating light which shall remain lit until the alarm is acknowledged and cleared:
    - 1) Failure during Flow Test.
    - 2) Excess Water in Fuel Canister.
    - 3) 'Filter Dirty' Alarm.
    - 4) Leakage into System Drip Tray Alarm.
    - 5) Motor overload.
    - 6) Anti-siphon solenoid valve control - When the lowest piping inside the filtration cabinet is below the top of the fuel tank, anti-siphon solenoid valves must be installed on both the supply and the return lines to the filtration unit.
    - 7) Two-way communication with Veeder Root Console, or approved manufacturer console by an approved manufacturer listed above.
5. Water detection sensor -The presence of water in the tank can be used as a trigger to run a filtration cycle.
  - a. All of the components shall be factory mounted on a structural steel backing panel with integral 2.5-inch-high steel containment lip, seam welded to form a



leak-tight drip tray. Base shall extend beyond any fitting, valve, pump or strainer to assure that a fuel leak from any component, fitting, or packing in the system shall be contained within the pan. The same steel base and containment tray shall be used to support the fuel transfer pumping and straining system described elsewhere in this Specification.

- 1) The suction fuel lines from the fuel filtration system shall extend to the lowest point of the diesel tank so that any water accumulating from leakage, contaminated fuel delivery, or condensation will be drawn into the filter and dewatering system. The fuel pick-up line should be within 2 inches of the bottom of the tank, cut on a 45-degree angle, and should not make contact with the tank bottom. This fuel pick-up line should be located as close to one end of the tank as possible. The fuel pick-up line should be a solid material that meets 2014 New York City Construction Codes and a minimum of one-inch ID. Pipe will be Brugg Flexwell, entry boots ZJI petroseal filled, UV rated, or approved equal.
  - 2) The fuel return line from the fuel filtration system must be installed at the opposite end of the tank to where the fuel pick-up line is located. The return line must just barely penetrate far enough into the tank so as to minimize fuel siphoning back into the fuel filtration system. The fuel return line should be a solid material that meets 2014 New York City Construction Codes and a minimum of one-inch ID. Pipe will be Brugg Flexwell, entry boots ZJI petroseal filled, UV rated, or approved equal.
  - 3) The fuel filtration canister shall be a pressure vessel fabricated out of solid stainless steel and be capable of obtaining an ASME "U" stamp. Vessel must be built in a certified shop in accordance to code and be capable of certification, if required. No component of the fuel filtration system shall be constructed of plastic, polycarbonate or any other material that will not withstand regulated or specified heat and fire ratings.
  - 4) The stainless-steel filter canister shall have a removable, gasketed VITON "O" ring top, and be fitted with an integral water containment sump with a certified intrinsically safe electronic water detector. The electronic water sensor in the fuel canister must be CE certified to be intrinsically safe. The stainless-steel fuel canister shall be a pressure vessel manufactured in a U-stamp ASME certified shop. It shall be engineered and tested to hold replaceable SAE J1488 ver. 2010 certified coalescing fuel filters. These filters must have a greater than 95 percent efficiency rating from SAE for removing emulsified and saturated water from ULSD and ULSD blended with biodiesel to an interfacial tension (IFT) of 15 mN/m.
- b. The replaceable SAE J1488 ver. 2010 filter must also filter particulate to a 0.2 sub-micron level.

## PART 3 – EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION



A. Testing Prior to Installation:

1. Before placing the tank into its excavation, plug all openings and pressure test tank in accordance with manufacturer's printed test instructions, unless otherwise specified.
2. Tanks should not be pressurized beyond manufacturer's specified limits. The tank must hold the test pressure for 30 minutes.
3. Check fitting connections, and seams in outermost tank by applying a soap suds solution.
4. Reject any leaking tanks.

3.3 INSTALLATION

- A. Install the Work of this section in accordance with the item manufacturer's printed installation instructions, unless otherwise shown or specified.

3.4 FUEL STORAGE TANKS

- A. Lower tank carefully into the excavation using lifting lugs provided on the tank. Set the tank on a full length concrete slab covered with a 12-inch layer of pea gravel.
- B. Do not use chocks or saddles to support or block the tank in position.
- C. Install tank anchoring devices to secure tank firmly in place.
- D. Do not place fuel into tank until backfilling is completed.
- E. Plug and seal all unused openings in containment sump.

3.5 TANK ACCESSORIES

- A. Fuel Identification: Attach laminated plastic nameplate to each tank fill pipe to identify the fuel in the tank.
- B. Tank Identification: Affix tank identification stencil, label, or plate permanently to tanks and fill ports.
- C. Install padlocks on all lockable caps on fill and vapor recovery piping.
- D. Terminate vent lines with vent caps.
- E. Overfill Alarm Device Sign: Mount sign adjacent to alarm device in a location that is easily readable from ground level.
- F. Vent Caps:
1. Install vent caps at end of vent piping minimum of 12 feet above finished grade.

3.6 FIELD QUALITY CONTROL

- A. All Tank & Piping Testing and Inspection shall be in accordance with NYCFD/NYSDEC standards and regulations.

3.7 ALARMS



- A. The high-level sensor shall be set to trip the system at 90% of full tank capacity. The visual and audible alarm devices shall be seen and heard from the fill port location.

**END OF SECTION 23 13 13**



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## **SECTION 23 21 13**

### **HVAC PIPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- A. Section 23 05 00 "Common Requirements for HVAC Work".
- B. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- C. Section 23 05 93 "Testing, Adjusting and Balancing".
- D. Section 23 09 00 "HVAC Instrumentation and Controls".
- E. This section is a part of each Division 23 00 00 section.

##### **1.2 SUMMARY**

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the HVAC piping systems including, but not limited to the following:
  - 1. Hot-water heating piping.
  - 2. Chilled water piping.
  - 3. Condenser-water piping.
  - 4. Makeup-water piping.
  - 5. Condensate-drain piping.
  - 6. Blowdown-drain piping.
  - 7. Air-vent piping.
  - 8. Safety-valve-inlet and -outlet piping.
  - 9. Pipe and fittings.
  - 10. Strainers.
  - 11. Safety valves.
  - 12. Pressure-reducing valves.
  - 13. Thermostatic air vents and vacuum breakers.
- B. Additional refrigerant piping requirements are specified under another section of this work.
- C. Utility Company steam and condensate piping and installation requirements, including but not limited to piping, fittings, traps, pressure-reducing valves, flash tanks, etc. are specified under another section of this work.
- D. Low pressure and high-pressure steam and condensate piping and installation requirements including but not limited to piping, fittings, traps, pressure-reducing valves, flash tanks, etc. are specified under another section of this work.



### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### 1.5 DEFINITIONS

- A. HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.
- B. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

### 1.6 HVAC PIPING SYSTEM PERFORMANCE REQUIREMENTS

- A. Refer to Section "Common Requirements for HVAC Work" for minimum working pressures and temperatures for the Water, Steam and Condensate systems.

### 1.7 REFERENCE STANDARDS

- A. ANSI/ASME B31.9 Building Services Piping
- B. ANSI/ASME B 31.1 Power Piping
- C. ANSI B16.4
- D. ANSI B16.3
- E. ANSI B16.9; ASTM A-234
- F. ANSI B16.11
- G. ASTM B32; ANSI B16.22



H. ASTM A105; ANSI B16.5

I. ANSI B16.18

J. ANSI B16.1

K. ASTM A197

L. ASME B16.39

## 1.8 SUBMITTALS

A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

B. Product Data: Provide manufacturer's Literature and data for the following:

1. Pipe and equipment supports
2. Pipe and tubing, with specifications, class or type and schedule, complete with mill reports.
3. Pipe fittings, including miscellaneous adapters and special fittings
4. Flanges, gaskets and bolting
5. Strainers
6. Flexible connectors for water service
7. Pipe alignment guides
8. Expansion joints
9. Expansion compensators
10. Dielectric Fittings
11. All specified hydronic system components
12. Water flow measuring devices
13. Gauges
14. Thermometers and test wells
15. Seismic bracing details for piping
16. Factory pre-insulated piping components and installation instructions
17. Pipe fittings and mechanical couplings, if used, for preinsulated chilled water piping
18. Anchors and thrust blocking for preinsulated chilled water piping
19. Pressure-seal fittings.
20. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
21. Pressure reducing and safety valve.
22. Steam trap.
23. Air vent and vacuum breaker.
24. Flash tank.
25. Meter
26. Air control devices.
27. Hydronic specialties.

C. Shop Drawings: Submit the following:

1. Piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, flash tank assemblies, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
2. Piping Shop Standards and specifications, including but not limited to, materials, fittings, joint construction and sealing, fabrication, assembly, and spacing of hangers and supports.



3. Mill Certificates
4. Hangers and supports, including methods for pipe and building attachment, seismic restraints, and vibration isolation.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

## 1.9 QUALITY ASSURANCE

A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."

B. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been properly instructed to join piping with pressure-seal pipe couplings and fittings.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. ASME Compliance: Comply with ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping," for materials, products, and installation.

F. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

G. All equipment and material to be provided for this project shall be UL or ETL listed, in accordance with the requirements of the New York City Department of Buildings.

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Unless specified otherwise, all steel piping shall be Type ASTM-A-53-Grade B seamless or ERW. Furnace butt weld pipe is not acceptable.

B. All pipe shall be of the domestic manufacture, delivered to the job properly primed and marked and supplied with the interior surfaces clean and rust free. Each end to be capped. Piping found to be in violation of this specification may be required to be removed from the job site, at the sole discretion of the Commissioner, whether or not already installed. Mill certifications from the pipe supplier shall be provided as part of the shop drawing submission.

C. Grooved piping is NOT permitted.



- D. Type “M” copper tubing is not permitted.
- E. Open water systems are defined as systems in which the atmosphere is in direct contact with water in piping system (i.e. via an open cooling tower, etc.).
- F. Secondary water branches shall be shop fabricated. Steel branches shall be shop fabricated complete with valve and accessory fittings and suitable for welding to risers without further work. Copper branches similarly shall be shop fabricated with all accessories suitable for ready attachment to unit and steel branches.
- G. All vertical riser piping (regardless of service or size) shall be either brazed or welded.

## 2.2 DIELECTRIC FITTINGS

- A. For all systems, provide dielectric fittings to isolate joined dissimilar materials to prevent galvanic action and stop corrosion. Fittings shall be of the non-reducing type, which shall be suitable for the system fluid, pressure, and temperature and shall not restrict the flow.
- B. Brass valves are not an acceptable substitute for a dielectric fitting.
- C. For factory fabricated equipment, manufacturer shall submit method of compliance or exceptions (if applicable) in writing as part of the shop drawings submission for review by the Commissioner.
- D. It is the intent of this section that all system components (equipment connections, piping, etc.), whether they are field installed or factory fabricated, shall comply with these requirements.
- E. Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain and weld-neck end types that match piping system materials.
- F. Insulating Material: Suitable for system fluid, pressure, and temperature, does not restrict flow.

## 2.3 COPPER TUBE AND FITTINGS

- A. Fittings for copper tubing shall be Chase Sweat Fittings, Mueller Brass Co’s “Streamline” solder fittings or “Arco” wrought-copper fittings.
- B. Type “M” copper tubing is not permitted.
- C. “T-Drill” type fittings are NOT acceptable.
- D. All copper tubing shall be not less than 99.9 percent pure copper. Tubing shall conform to ASTM B88.
- E. Hard Drawn-Copper Tubing: ASTM B 88, Type K.
- F. Wrought-Copper Fittings: ASME B16.22, ASTM-B-32
- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anvil International, Inc.
  - 2. S. P. Fittings; a division of Star Pipe Products.
  - 3. Ferguson
  - 4. Or approved equal.



## 2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness. Temperature and Pressure ratings shall be as specified in Section COMMON REQUIREMENTS FOR HVAC WORK.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150 and 300. Temperature and Pressure ratings shall be as specified in Section “Common Requirements for HVAC Work.”
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 Temperature and Pressure ratings shall be as specified in Section “Common Requirements for HVAC Work.”
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300. Temperature and Pressure ratings shall be as specified in Section “Common Requirements for HVAC Work.”
- E. Weld End Fittings: ASTM A-234, ASME B16.9; Classes 150, 250, and 300. Temperature and Pressure ratings shall be as specified in Section “Common Requirements for HVAC Work.”
- F. Socket Weld Fittings: ASME B16.11; Classes 150, 250, and 300. Temperature and Pressure ratings shall be as specified in Section “Common Requirements for HVAC Work.”
- G. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250; raised ground face, and bolt holes spot faced. Temperature and Pressure ratings shall be as specified in Section “Common Requirements for HVAC Work.”
- H. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- I. Welded Flanges ASTM-A105, ANSI B16.5
- J. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt-welding.
  - 3. Facings: Raised face.
- K. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt-welding.
  - 3. Facings: Raised face.
- L. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.
- M. Stainless-Steel Bellows, Flexible Connectors:
  - 1. Body: Stainless steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
  - 2. End Connections: Threaded or flanged to match equipment connected.
  - 3. Performance: Capable of 3/4-inch misalignment.
  - 4. CWP Rating: As specified in Section “Common Requirements for HVAC Work.”  
Maximum Operating Temperature: 250 deg F.



## 2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.6 VALVES

- A. Valves shall be as specified under Section 23 05 23 "Valves for HVAC Piping".
- B. Automatic Temperature Control Valve Actuators, and Sensors: Comply with requirements specified in Section "HVAC Instrumentation and Controls."

## 2.7 STRAINERS

- A. There shall be approved strainers in the inlet connections to each bucket or combination float and thermostatic steam trap, each water feeder and make-up connection, each water regulating valve, each pump, each vent and each valve. The intention is to protect, by strainers, all apparatus of an automatic or manual character whose proper functioning would be interfered with by dirt on the seat, or by scoring of the seat.
- B. All strainers in waterlines (including all pump inlets) and in steam lines shall be Y-pattern, set in a horizontal (or vertical downward) run of pipe. Where this is not feasible, strainers may be of the enlarged cross-section type. Strainers shall be arranged so as not to "trap" pipes and to facilitate disconnection and opening up for cleaning. Unless otherwise indicated, strainers shall be line size.
- C. Provide approved valved and capped dirt blow off connection for each strainer.
- D. All strainers shall be provided with flanged covers for screen removal in lieu of screwed covers for screen removal wherever obtainable.



- E. All strainer screens 6" and above shall be reinforced for the operating conditions.
- F. Y-Pattern Strainers:
  - 1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for strainers 2" and smaller; flanged ends for strainers 2-1/2" and larger.
  - 3. Strainer Screen: Stainless-steel mesh strainer, and stainless steel basket - perforated (1/32" for steam and condensate and for water: 1/16" for sizes up to 3" and 1/8" for sizes above 4")
  - 4. Tapped blowoff plug.
  - 5. CWP Rating: 300-psig working steam pressure.
- G. Basket Strainers:
  - 1. Body: ASTM A 126, Class B high-tensile cast iron, with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for strainers 2" and smaller; flanged ends for strainers 2-1/2" and larger.
  - 3. Strainer Screen: Stainless steel, mesh strainer, and perforated (1/32" for steam and condensate and for water: 1/16" for sizes up to 3" and 1/8" for sizes above 4") stainless-steel basket.
  - 4. CWP Rating: 300-psig working steam pressure.
- H. T-Pattern Strainers:
  - 1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
  - 2. End Connections: Threaded ends for strainers 2" and smaller; flanged ends for strainers 2-1/2" and larger.
  - 3. Strainer Screen: 60-mesh startup strainer, and perforated (1/32" for steam and condensate and for water: 1/16" for sizes up to 3" and 1/8" for sizes above 4") stainless-steel basket.
  - 4. CWP Rating: 250 psig working steam pressure.

## 2.8 FLASH TANKS

- A. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 300-psig rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs. As specified in Section "Common Requirements for HVAC Work."

## 2.9 SAFETY VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong International, Inc.
  - 2. Kunkle Valve; a Tyco International Ltd. Company.
  - 3. Spirax Sarco, Inc.
  - 4. Watts Water Technologies, Inc.
  - 5. Or approved equal.
- B. Disc Material: Forged copper alloy.





- C. End Connections: Threaded inlet and outlet.
- D. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
- E. Pressure Class: 150.
- F. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
- G. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

## 2.10 CAST-IRON SAFETY VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong International, Inc.
  - 2. Kunkle Valve; a Tyco International Ltd. Company.
  - 3. Spirax Sarco, Inc.
  - 4. Watts Water Technologies, Inc.
  - 5. Or approved equal.
- B. Disc Material: Forged copper alloy with bronze nozzle.
- C. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
- D. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
- E. Pressure Class: 150.
- F. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
- G. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
- H. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

## 2.11 PRESSURE-REDUCING VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong International, Inc.
  - 2. Hoffman Specialty; Division of ITT Industries.
  - 3. Leslie Controls, Inc.
  - 4. Spence Engineering Company, Inc.
  - 5. Spirax Sarco, Inc.
  - 6. Or approved equal.
- B. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.



- C. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.
- D. Body: Cast iron.
- E. End Connections: Threaded connections for valves 2" and smaller and flanged connections for valves 2-1/2" and larger.
- F. Trim: Hardened stainless steel.
- G. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.
- H. Gaskets: Non-asbestos materials.

## 2.12 AIR CONTROL DEVICES

### A. Expansion Tanks:

- 1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- 2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
- 3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
- 4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch diameter gage glass, and slotted-metal glass guard.

### B. Diaphragm-Type Expansion Tanks:

- 1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- 2. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
- 3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

## 2.13 SEPARATORS

- A. Maximum Working Pressure: As specified in Section 230500 "Common Requirements for HVAC Work."
- B. Maximum Operating Temperature: Up to 300 deg F.
- C. Tangential-Type Air Separators:
  - 1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
  - 2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.



3. Tangential Inlet and Outlet Connections: Threaded for 2" and smaller; flanged connections for 2-1/2" and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.
6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bell & Gossett Type RL
  - b. Armstrong,
  - c. Amtrol,
  - d. Taco,
  - e. Or approved equal.

**D. In-Line Air Separators:**

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Cartridge type impingement filter, with replaceable 100 micron or 300 micron filter media. Size and capacity shall be as indicated on drawings.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bruner,
  - b. Culligan,
  - c. Cuno,
  - d. Dollinger,
  - e. Honeywell,
  - f. Or approved equal.

**E. Air Purgers:**

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: As specified in Section "Common Requirements for HVAC Work."

**F. Coalescing Separator:**

1. Provide coalescing type air and dirt separator of size and location as indicated on the drawings. Separator shall include separate air chamber for air removal and lower vessel extension for dirt separation.
2. Separator shall be steel fabricated with ANSI B16.5 flange connections and rated for 150 psig design pressure. Separator shall include internal copper coalescing medium and stainless steel collector tube.
3. Separators shall include manufacturer's integral high capacity air vent or cast iron air vent as specified herein. Separator shall also include manufacturers side tap valve to facilitate system filling and bottom drain connection with ball valve drain.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Spirotherm (Spirovent Dirt HV),
  - b. LAKOS,
  - c. Griswold Controls
  - d. Bruner
  - e. Honeywell



f. Or approved equal.

G. Centrifugal SOLID Separator:

1. Provide centrifugal solids separator, with efficiency of 98% to 40 microns, as scheduled and detailed on drawings. Body shall be steel, ASME stamped for 125 psig, with flanged connections and factory painted exterior. Provide 4"x6" cleanout for lower section, and flanged upper dome for easy maintenance access.
2. Provide automatic recovery tank with bag filter (solids collection vessel) as scheduled and detailed. Controlled continuous flow, 25 micron solids collection bag, 600 cubic inches capacity, manual isolation valves, sight glass for flow verification and differential pressure switch, Annunciator in an independent junction box, contacts rated for 4 amps at 115 volts, set at 10 psid with a range of 4 to 25 psid.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. LAKOS,
  - b. Griswold Controls
  - c. Bruner
  - d. Honeywell
  - e. Or approved equal.

2.14 HVAC PIPING SPECIALTIES

A. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: As specified in Section "Common Requirements for HVAC Work."
5. Maximum Operating Temperature: 250 deg F.

B. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: As specified in Section "Common Requirements for HVAC Work."
5. Maximum Operating Temperature: 250 deg F.

C. Expansion fittings and loops are specified under another section of this work.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

A. Refer to DDC General Conditions for execution requirements.

3.2 PIPING APPLICATIONS

A. Piping materials, components and installation shall be capable of withstanding the minimum system working pressure and temperature as specified under Section "Common Requirements for HVAC Work."



- B. Grooved piping is not permitted
- C. Type "M" copper tubing is not permitted.
- D. For all systems, provide dielectric fittings to isolate joined dissimilar materials to prevent galvanic action and stop corrosion. Fittings shall be of the non-reducing type, which shall be suitable for the system fluid, pressure, and temperature and shall not restrict the flow.

### 3.3 PIPING MATERIALS

#### A. LP Steam Piping Applications

- 1. LP Steam and condensate Piping is specified under another section of this work.

#### B. HP Steam Piping Applications

- 1. HP Steam and condensate Piping is specified under another section of this work.

#### C. Hot Water Piping

- 1. Hot-water heating piping 2-1/2" and smaller, shall be Schedule 40 steel pipe; ASTM – A53, Grade B, Seamless. cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints. Brazed Type "K" copper is also acceptable.
- 2. Hot-water heating piping, 3" and larger, shall be Schedule 40 steel pipe, ASTM – A53, Grade B, Seamless wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded joints.

#### D. Chilled Water Piping Applications

- 1. Chilled-water piping 2-1/2" and smaller shall be Schedule 40 steel pipe; ASTM-A53, Grade B, seamless, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints. Brazed Type "K" copper is also acceptable.
- 2. Chilled-water piping, aboveground, 3" and larger, shall be Schedule 40 steel pipe, ASTM – A53, seamless, wrought-steel fittings and forged-steel flanges and flange fittings, and welded and flanged joints.

#### E. Condenser Water Piping Applications

- 1. Condenser-water piping, aboveground, 2-1/2" and smaller shall be Schedule 40 steel pipe, ASTM – A53, seamless; malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints. Brazed Type "K" copper is also acceptable.
- 2. Condenser-water piping, aboveground, 3" and larger shall be Schedule 40 steel pipe, ASTM-A53, seamless, wrought-steel fittings and forged-steel flanges and flange fittings, and welded and flanged joints.
- 3. Condenser-water piping installed belowground and within slabs shall be Type K (A), annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

#### F. Ancillary Piping Applications

- 1. Makeup-water piping installed aboveground shall be Type L (B), hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- 2. Makeup-Water Piping Installed belowground and within Slabs: Type K, hard drawn temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest



- possible joints.
3. Condensate-Drain Piping: Type L, hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
  4. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

G. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K (A), annealed-temper copper tubing with soldered joints.

H. Safety-Valve-Inlet and - Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

I. Vacuum-Breaker Piping: Outlet, same as service where installed.

J. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

### 3.4 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

### 3.5 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.



- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system pressures specified in section "Common Requirements for HVAC Work."
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation, insulation covers and servicing of valves.
- L. Install drains, consisting of a tee fitting, ¾" ball valve, and short ¾" threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- N. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- O. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- P. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- Q. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- R. Install valves according to Section "Valves for HVAC Piping."
- S. Install unions in piping, 2" and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- T. Install flanges in piping, 2-1/2" and larger, adjacent to valves, at final connections of equipment and elsewhere as indicated.
- U. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install ¾" nipple and ball valve in blowdown connection of strainers 2" and larger. Match size of strainer blowoff connection for strainers smaller than 2".
- V. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in another section of this work.
- W. Identify and label piping as specified under another section of this work.
- X. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
  - 1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
  - 2. Size drip legs same size as main. In steam mains 6" and larger, drip leg size can be reduced, but to no less than 4".
- Y. Flash Tank:



1. Pitch condensate piping down toward flash tank.
2. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
3. Install thermostatic air vent at tank top.
4. Install safety valve at tank top.
5. Install full-port ball valve, and swing check valve on condensate outlet.
6. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
7. Install pressure gage on low-pressure steam outlet.

### 3.6 SAFETY VALVE INSTALLATION

- A. Install safety valves according to ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping."
- B. Pipe safety-valve discharge without valves to atmosphere outside the building.
- C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
- D. Install exhaust head with drain to waste, on vents equal to or larger than 2-1/2 ".

### 3.7 HANGERS AND SUPPORTS

- A. Piping support must account for expansion and contraction, vibration, dead load of piping and its contents and seismic bracing requirements.
- B. Hangers, supports, anchor devices and seismic restraints are specified in Section "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components."
- C. Install the following pipe attachments:
  1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
  1. 3/4" through 1-1/4" - Maximum span, 7 feet; minimum rod size, 3/8 inch.
  2. 1-1/2": Maximum span, 9 feet; minimum rod size, 3/8 inch.
  3. 2": Maximum span, 10 feet; minimum rod size, 3/8 inch.
  4. 2-1/2": Maximum span, 11 feet; minimum rod size, 1/2 inch.
  5. 3": Maximum span, 12 feet; minimum rod size, 1/2 inch.
  6. 3-1/2": Maximum span, 13 feet; minimum rod size, 1/2 inch.
  7. 4": Maximum span, 14 feet; minimum rod size, 5/8 inch.
  8. 5": Maximum span, 16 feet; minimum rod size, 5/8 inch.
  9. 6": Maximum span, 17 feet; minimum rod size, 3/4 inch.
  10. 8": Maximum span, 19 feet; minimum rod size, 3/4 inch.





11. 10": Maximum span, 22 feet; minimum rod size, 7/8 inch.
12. 12": Maximum span, 23 feet; minimum rod size, 7/8 inch.
13. 14": Maximum span, 25 feet; minimum rod size, 1 inch.
14. 16": Maximum span, 27 feet; minimum rod size, 1 inch.
15. 18": Maximum span, 28 feet; minimum rod size, 1 inch.
16. 20": Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

- E. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. 3/4": Maximum span, 5 feet; minimum rod size, 3/8 inch.
2. 1": Maximum span, 6 feet; minimum rod size, 3/8 inch.
3. 1-1/2": Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2": Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/2": Maximum span, 9 feet; minimum rod size, 1/2 inch.
6. 3": Maximum span, 10 feet; minimum rod size, 1/2 inch.

- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.8 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and



procedure, and brazed joints.

- K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

### 3.9 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators 2" and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
  - 1. Install tank fittings that are shipped loose.
  - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

### 3.10 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. For terminal reheat coils, install control valves in return line close to connected equipment.
- D. Install traps and control valves in accessible locations close to connected equipment.
- E. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- F. Install vacuum breakers downstream from control valve, close to coil inlet connection.
- G. Install a drip leg at coil outlet.
- H. Install ports for pressure gages and thermometers at coil inlet and outlet connections.

### 3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and



inspect components, assemblies, and equipment installations, including connections.

- B. Prepare piping according to ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping," and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
  2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  3. Flush piping systems with clean water; then remove and clean or replace strainer screens.
  4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- C. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  3. Isolate expansion tanks and determine that hydronic system is full of water.
  4. All piping systems shall be tested to a hydrostatic pressure at least 1-1/2 times the maximum operating pressure (but not less than 125 psig) for a sufficiently long time, but not less than 4 hours, without losing pressure, to detect all leaks and defects. Where necessary, piping shall be tested in sections to permit the progress of the job.
  5. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  7. Prepare written report of testing.
- D. Prepare written report of testing.
- E. Perform the following before operating the system:
1. Open manual valves fully.
  2. Inspect pumps for proper rotation.
  3. Set makeup pressure-reducing valves for required system pressure.
  4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  5. Set temperature controls so all coils are calling for full flow.
  6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  7. Verify lubrication of motors and bearings.

**END OF SECTION 23 21 13**



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**SECTION 23 21 23****HVAC PUMPS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 13 "Motors for HVAC Equipment".
- E. Section 23 05 15 "Variable Frequency Motor Drives".
- F. Section 23 05 23 "Valves for HVAC".
- G. Section 23 21 13 "HVAC Piping".
- H. Section 23 22 13 "Steam and Condensate Heating Piping".
- I. This Section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. In-line centrifugal pumps.
  - 2. End-suction centrifugal pumps.
  - 3. Horizontal split-case pumps
  - 4. Duplex condensate pump units.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile



Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings” where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCE STANDARDS**

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references and where noted within this Division of work.

- 1. ANSI/UL 778 – Motor Operated Water Pumps

**1.6 DEFINITIONS**

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

**1.7 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Pump Pressure Ratings: As described in section 23 05 00 “Common Requirements for HVAC Work,” but at least equal to system’s maximum operating pressure at point where installed, but not less than 250 psi. Factory test at 1.5 times working pressure.
- B. Water Temperature: Pump to comply with specific application.
- C. Mounting: As described in section 23 05 48 “Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components”.
- D. Pumps shall be selected to operate at or near their point of peak efficiency thus allowing for operation at capacities of approximately 25% beyond design capacity. In addition, the design impeller diameter shall be selected so that the design capacity of each pump (GPM and TDH) shall not exceed 90% of the capacity obtainable with maximum impeller diameter at the design speed for that model.
- E. Rising Curve: Pump characteristic curve shall rise continuously from maximum capacity to shut-off, with shut-off head minimum 10 percent greater than the design head, except for double suction pumps to shut-off head shall be 20 percent greater than the design head.
- F. Working Pressure: Construct pumps for the working pressure in pounds per square inch as specified under another section of this work.



- G. Each pump shall be thoroughly cleaned and painted with (1) coat of machinery enamel prior to shipment.
- H. The manufacturer shall include a set of installation instructions with the pumps at the time shipment.

#### 1.8 SEISMIC AND WIND LOAD DESIGN

- A. This project is located within a seismic and wind zone requiring special provisions for the support and restraint of equipment, components and piping.
- B. Fabricate pumps, mounting frames and attachments and other section components with restraints to withstand seismic forces defined under another section of this work.
- C. Provide manufacturer's Seismic Qualifications Certification that the pumps, controllers, accessories and components will withstand seismic forces as defined under another section of this work. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outlined Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchoring provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

#### 1.9 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.10 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
  - 2. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH information.
- C. Product Certificates from Pump manufacturer certifying accuracies under specified operating conditions and compliance with specified requirements.
- D. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

#### 1.11 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."



- B. Alignment: Base mounted pumps shall be aligned by qualified millwright and alignment certified.
- C. Source Limitations: Obtain Hydronic pumps through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- E. Regulatory Requirements: Comply with provisions of the following:
  - 1. UL Compliance: Comply with UL 778 for motor-operated water pumps.
  - 2. ASME B31.9 "Building Services Piping" for piping materials and installation.
  - 3. Hydraulic Institute's "Standards for Centrifugal, Rotary & Reciprocating Pumps" for pump design, manufacture, testing, and installation.
  - 4. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.
  - 5. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
  - 6. NFPA 70 "National Electric Code" for electrical components and installation.
- F. Single-Source Responsibility. Obtain each category of pumps from a single-source and by a single manufacturer. Include responsibility and accountability to answer questions and resolve problems regarding compatibility, installation, performance and acceptance of pumps.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

#### 1.13 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

### PART 2 - PRODUCTS

#### 2.1 PUMPS, GENERAL

- A. General: Factory assembled and tested.
- B. Base-Mounted Pumps: Include pump casings that allow removal and replacement of impellers without disconnecting piping.
- C. Types, Sizes, Capacities, and Characteristics: As specified.





- D. To insure cavitation-free operation, each pump's NPSH requirement must be low enough to permit stable, continuous operation at 120% or greater of best efficiency point.
- E. Provide premium efficient motors.
- F. Motor kW ratings shown on the schedule are minimum acceptable and have been sized for continuous operation without exceeding full load nameplate rating over the entire pump curve, exclusive of motor service factor.
- G. Pumps shall be hydrostatically tested to 150% of the maximum pump working pressure.
- H. The pump and motor shall be mounted and aligned at the pump manufacturer's factory on a common baseplate. Final alignment shall be made, on site, after the pump is installed and brought to operating temperature.
- I. For all pumps, provide a flushing line from the discharge volute to the flush seal cap. Provide an abrasive separate in the flushing line. See Details.
- J. Furnish single, multiple, or variable-speed, premium efficiency motors, with type of enclosures and electrical characteristics indicated and as specified under another section of this work. Include built-in thermal-overload protection and grease-lubricated ball bearings. Select each motor to be non-overloading over full range of pump performance curve.
- K. Factory Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.
- L. Manufacturer's Preparation for Shipping: Clean flanges and exposed machine metal surfaces and tear with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

## 2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong
  - 2. Bell & Gossett; Div. of ITT Industries.
  - 3. PACO Pumps.
  - 4. Peerless Pump; a Member of the Sterling Fluid Systems Group.
  - 5. Taco, Inc.
  - 6. Weinman; Div. of Crane Pumps & Systems.
  - 7. Or Approved Equal.
- B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, radially split case design, close-coupled, in-line pump, designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump shall be rated for 250-psig minimum working pressure and a continuous water temperature of 250 deg F.
- D. Pump Construction:
  - 1. Casing: Radially split, ductile iron, with suction and discharge flanges of the same size for piping connections, located on a common center line 180 degrees apart for mounting



- in the pipe line. Drain plug in bottom of volute and threaded gage tapings at inlet and outlet.
2. Flanges shall be ANSI rated drilling for pump rated working pressure.
  3. Pumps shall include a volute type casing suction branch to minimize pumping noise.
  4. Impeller: ASTM B 584, cast bronze; single suction, statically and dynamically balanced, enclosed, overhung and keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
  5. Pump Shaft and Sleeve: Ground and polished stainless steel shaft with bronze sleeve and integral thrust bearing. Include flinger on motor shaft between motor and seals to prevent liquid that leaks past pump seals from entering motor bearings.
  6. Wearing Rings: Replaceable, bronze casing ring.
  7. Mechanical Seal: Single balance, Mechanical Type, suitable for 250 degrees F, with all metal parts to be 316 stainless steel Viton elastomers and tungsten carbon and seat carbon washer.
  8. A flush line shall be provided between the pump discharge and the flush connection on the seal face to supply a source of water to the seal face. For open type water systems, provide an abrasive separator in the flush line to insure clean water.
  9. Pump Bearings: Oil lubricated, thrust type.
  10. Motor: Direct mounted to pump casing. Include lifting and supporting lugs in top of motor enclosure. Motor shall be as specified under another section of this work."

## 2.3 END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
1. Armstrong
  2. Bell & Gossett; Div. of ITT Industries.
  3. PACO Pumps.
  4. Peerless Pump; a Member of the Sterling Fluid Systems Group.
  5. Taco, Inc.
  6. Weinman; Div. of Crane Pumps & Systems.
  7. Or approved equal.
- B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, end-suction pump, designed for installation with pump and motor shafts mounted horizontally.
- C. Rate pump for 250-psig minimum working pressure and a continuous water temperature of 250 deg F.
- D. Pump Construction:
1. Casing: Radially split, ductile iron, with threaded gage tapings at inlet and outlet, and flanged connections. Discharge nozzle shall be capable of being swiveled through any of three positions for greater flexibility of application. A separate suction cover shall be bolted to the casing and aligned with a machined locked fit. Openings shall be provided for priming, venting, draining and for suction and discharge gauge connections.
  2. Suction and discharge connections shall be flanged, ANSI suitable for working pressures scheduled on the drawings, flat faced.
  3. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
  4. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  5. Bearings: Provide regreasable ball bearings with 50,000-hour life, rated L10 and dust-sealed.



6. Seals: Hot water pump shall be provided with mechanical seals of carbon ring, Viton Elastomer and ceramic stationary seats. Condenser water and chilled water shall be provided with mechanical seals of carbon ring Buna elastomer and ceramic stationary seat.
7. Provide a flushing line from the discharge volute to the flush seal cap. For condenser water (or open water system) pumps, provide an abrasive separate in the flushing line.
8. Wearing Rings: Replaceable, bronze casing rings to maintain proper running clearances and minimize leakage between suction and discharge side of casing.
9. Motor: Direct mounted to pump casing. Include supporting legs as integral part of motor enclosure. Motor shall be sized for non-overloading over full characteristic curve of the pump. Motors shall be close coupled type. Motor shall be as specified under another section of this work."

#### 2.4 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Armstrong
  2. Bell & Gossett; Div. of ITT Industries.
  3. PACO Pumps.
  4. Taco, Inc.
  5. Weinman; Div. of Crane Pumps & Systems.
  6. Or approved equal.
- B. Description: Horizontally mounted, factory assembled and tested, centrifugal, overhung-impeller, separately coupled, end-suction pump designed for base mounting, with pump and motor shafts horizontal. Rate pump for 250-psig minimum working pressure and a continuous water temperature of 250 deg F.
- C. Pump Construction:
  1. Casing: Radially split, ductile iron, with threaded gage tappings at inlet and outlet, and flanged connections. Discharge nozzle shall be capable of being swiveled through any of three positions for greater flexibility of application. A separate suction cover shall be bolted to the casing and aligned with a machined locked fit. Openings shall be provided for priming, venting, draining and for suction and discharge gauge connections.
  2. Suction and discharge connections shall be flanged, ANSI suitable for working pressures scheduled on the drawings, flat faced.
  3. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
  4. Shaft and Sleeve: A replaceable bronze shaft sleeve shall be furnished to cover the wetted area of the shaft extending through the seal box. The shaft shall be high strength S.A.E. 1045 steel accurately machined and of sufficient size to transmit the maximum horsepower and loading from the impeller to the bearing impeller at the maximum allowable operating speed. Shaft shall be furnished with a deflector between the casing and bearing frame to prevent leakage of the fluid into the bearings.
  5. Bearings: Provide greasable ball bearings with 50,000-hour life, rated L10 and dust-sealed.
  6. Wearing Rings: Replaceable, bronze casing rings to maintain proper running clearances and minimize leakage between suction and discharge side of casing.
  7. Seals: Hot water pumps shall be provided with mechanical seals which shall be stainless steel with a rotating face of babbitt filled carbon and a stationary face of tungsten carbide, balanced type designed for 250 degrees F.



8. Condenser water and chilled water shall be provided with mechanical seals of carbon ring Buna elastomer and ceramic stationary seat.
9. Provide a flushing line from the discharge volute to the flush seal cap.
10. For condenser water pumps, provide an abrasive separate in the flushing line. For pumps with working pressures above 150 PSIG, mechanical seals shall be stainless steel with a rotating face of babbitt filled carbon and a stationary face of tungsten carbide, balanced type designed for 250 degrees F.
11. Motor: Motor shall be sized for non-overloading over full characteristic curve of the pump. Motor: Direct mounted to pump casing. Include supporting legs as integral part of motor enclosure. Motors shall be close coupled type. Motor shall be as specified under another section of this work.
12. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
13. Flexible Coupling: For pumps with variable speed drives or constant speed over 40 HP, provide Falk Type "T" Steel with coupling guard. For constant speed pumps with motors less than 40 HOP, Woods type will be permitted/
14. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
15. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor. Grind welds smooth before application of factory finish. Field drill motor mounting holes for field installed motors.
16. Motor: Motor: secured to mounting frame, with adjustable alignment. Motor shall be sized for non-overloading over full characteristic curve of the pump. Motor shall be as specified under another section of this work."

## 2.5 HORIZONTAL SPLIT-CASE PUMPS

- A. Provide Horizontal Split Case pumps, single stage, double suction type, with pump characteristics which provide rising heads to shut off.
- B. Refer to pump schedules for pump flows, heads, motor speed, enclosure, efficiency and power requirements.
- C. Pumps shall be Horizontal Split Case type, each with flexible type coupling and OSHA guard and mounted, with motor, on a fabricated steel baseplate.
- D. Pump Casing – Cast iron, axially split, with 15° angle tilted parting to allow for lower NPSH requirements and to minimize pump dimensions. Suction and discharge connections, located in the lower casing, shall be flanged and of sizes indicated in the schedule and shall be drilled and tapped for gauge connections. Suction and discharge connections shall be on the same elevation. The top of the casing and the rotating assembly shall be removable without disturbing the piping connections.
- E. Wearing Rings – The pump casing shall be fitted with replaceable bronze wearing rings.
- F. Impeller – Bronze, double suction, fully enclosed type. Dynamically balanced.
- G. Shaft – Carbon steel, designed for minimum deflection and vibration.
- H. Shaft Sleeves – Shall be stainless steel and form components of the cartridge mechanical seals.



- I. Mechanical Seals – Each seal chamber shall be fitted with a cartridge type mechanical seal. The seal component shall be of stainless steel construction with carbon vs ceramic faces and EPDM secondary seal. The mechanical seal, shaft sleeve and seal plate shall be easily removable as a single component. Provide seal plates with factory installed flush lines.
- J. Bearings – Supply dust tight deep groove ball bearings. With permanently sealed grease type lubrication.
- K. Bearings shall be mounted in cartridge type housings that are replaceable without opening the pump casing.
- L. Bearings shall be removable by simply rotating the removal nut behind the bearing. No special tools or pullers are to be necessary.
- M. Motor kW ratings shown on the schedule are minimum acceptable and have been sized for continuous operation without exceeding full load nameplate rating over the entire pump curve, exclusive of motor service factor.
- N. Pumps shall be hydrostatically tested to 150% of the maximum pump working pressure.
- O. The pump and motor shall be mounted and aligned at the pump manufacturer's factory on a common baseplate. Final alignment shall be made, on site, after the pump is installed and brought to operating temperature.
- P. If supplied, the drip pan tapped connection shall be piped to the nearest drain.
- Q. Supply in each flush line to the cartridge mechanical seal a 50-micron cartridge filter and sight flow indicator, to suit the working pressure encountered.
- R. Filters shall be changed, by the installing contractor, after system flushing and on a regular basis until turned over to the Commissioner.
- S. Supply in each flush line to the cartridge mechanical seal a cyclone type separator, with sight flow indicator.

## 2.6 DUPLEX CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Shipco
  - 2. Bell & Gossett; Div. of ITT Industries.
  - 3. PACO Pumps.
  - 4. Taco, Inc.
  - 5. Weinman; Div. of Crane Pumps & Systems.
  - 6. Federal
  - 7. Or Approved Equal.
- B. Description: Complete Unit with corrosion-resistant pump, Cast-Iron Receiver with cover, and automatic controls. Pumps shall be as made by manufacturer noted on drawings or approved.



- C. Pumps shall be of the centrifugal, close-coupled type, with enclosed bronze impeller and stainless steel shaft. The pump shall be so constructed that access may be had to impeller and other interior parts without breaking pipe connections. The motor shall be ball bearing type, designed for continuous operation, rate for electrical characteristics noted elsewhere. Operation of motor shall be controlled by automatic float-operated switch.
- D. Mechanical alternator shall be provided with the duplex unit. It shall provide simultaneous operation of both pumps when peak flow of condensate occurs. It shall also provide alternate operation of pumps or operation of one pump when the other is inoperative. A manual lock-out shall be provided to permit maintenance on one pump with the other in operation.
- E. Unit shall be furnished with wiring suitable for dual electrical feed.
- F. This trade shall connect the overflow to the nearest floor drain and shall connect a vent pipe terminating in a gooseneck near the ceiling. No vent shall be less than 1" regardless of unit size.

## 2.7 PUMP SUCTION DIFFUSER/STRAINER

- A. Unit shall consist of cast iron angle type body with easily removable end cap, pressure gauge tapping, stainless steel straightening vanes, stainless steel diffuser-strainer-orifice cylinder with free area equal to five times cross-sectional area of actual pump suction connection, removable permanent magnet located with the flow stream and adjustable foot to carry weight of suction pipe.
- B. Design working pressure shall be as required to match specified pump working pressure. Inlet shall be full line size as shown on the drawings. Outlet shall be same size as actual pump suction connection. Maximum pressure drop shall not exceed 7 feet water pressure drop.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.



3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete".

### 3.4 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written installation and alignment instructions.
- B. Refer to Section: 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components" for additional installation requirements.
- C. Install pumps with access for periodic service including removal of motors, impellers, couplings, and accessories.
- D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- E. Install continuous-thread hanger rods with vibration isolators of sufficient size to support pump weight. Vibration isolation devices are specified under another section of this work. Fabricate brackets or supports as required. Hanger and support materials are specified under another section of this work.
- F. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and vibration isolators of sufficient size to support pump weight. Vibration isolation devices are specified under another section of this work. Hanger and support materials are specified under another section of this work.
- G. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
  2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
- H. Bedplate (Motor Drive): Cast iron, channel steel or structural steel with drip collection chamber and tapped drain connections and a large opening for grouting. Jig drilled and tapped for pumps and NEMA frame motors. On close-coupled pumps, motor assembled as integral part of the complete unit; no bedplate required. Pumps and/or pumps sets shall be leveled with tapered steel wedges to allow a minimum of 3/4 inch pump base and inertia base or concrete pad.
- I. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

### 3.5 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.



- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by one of two methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation" or HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill base plate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### 3.6 CONNECTIONS

- A. Piping installation requirements are specified in other Sections of this work. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check valve and throttling valve on discharge side of pumps.
- F. Triple-Duty valves are not permitted.
- G. Connect pump suction diffuser strainer and shutoff valve on suction side of pumps.
- H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- I. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- J. Install check valve and gate or ball valve on each condensate pump unit discharge.
- K. Install electrical connections for power, controls, and devices.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 6. Start motor.





7. Open discharge valve slowly.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct City of New York's service operators to adjust, operate, and maintain hydronic pumps. Refer to DDC General Conditions for instruction requirements.

**END OF SECTION 23 21 23**



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**SECTION 23 25 00****HVAC WATER TREATMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".

**1.2 SUMMARY**

- A. This Section includes the following HVAC water-treatment systems:
  - 1. Chemical treatment for Closed Loop Heat Transfer Systems
  - 2. Chemical treatment for Open Loop Heat Transfer Systems Bypass chemical-feed equipment and controls.
  - 3. Biocide chemical-feed equipment and controls.
  - 4. Chemical treatment test equipment.
  - 5. HVAC water-treatment chemicals.
  - 6. Makeup water softeners.
  - 7. Water filtration units for HVAC makeup water.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the



LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 DEFINITIONS**

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- C. RO: Reverse osmosis.
- D. TDS: Total dissolved solids.
- E. UV: Ultraviolet.

**1.6 PERFORMANCE REQUIREMENTS**

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of New York Department of Buildings.
- C. Closed hydronic systems, including hot-water heating and chilled water shall have the following water qualities:
  - 1. pH: Maintain a value within 9.0 to 10.5.
  - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
  - 3. Boron: Maintain a value within 100 to 200 ppm.
  - 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
  - 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
  - 6. TDS: Maintain a maximum value of 10 ppm.
  - 7. Ammonia: Maintain a maximum value of 20 ppm.
  - 8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
  - 9. Microbiological Limits:
    - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
    - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
    - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
    - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
- D. Steam Boiler and Steam Condensate:
  - 1. Steam Condensate:
    - a. pH: Maintain a value within 7.8 to 8.4.



- b. Total Alkalinity: Maintain a value within 5 to 50 ppm.
      - c. Chemical Oxygen Demand: Maintain a maximum value of 15 ppm.
      - d. Soluble Copper: Maintain a maximum value of 0.20 ppm.
      - e. TDS: Maintain a maximum value of 10 ppm.
      - f. Ammonia: Maintain a maximum value of 20 ppm.
      - g. Total Hardness: Maintain a maximum value of 2 ppm.
    2. Steam boiler operating at 15 psig and less shall have the following water qualities:
      - a. "OH" Alkalinity: Maintain a value within 200 to 400 ppm.
      - b. TDS: Maintain a value within 600 to 3000 ppm.
    3. Steam boiler operating at more than 15 psig shall have the following water qualities:
      - a. "OH" Alkalinity: 200 to 400 ppm.
      - b. TDS: Maintain a value within 600 to 1200 ppm to maximum 30 times RO water TDS.
  - E. Open hydronic systems, including condenser water, shall have the following water qualities:
    1. pH: Maintain a value within 8.0 to 9.1.
    2. "P" Alkalinity: Maintain a maximum value of 100 ppm.
    3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
    4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
    5. TDS: Maintain a maximum value of 10 ppm.
    6. Ammonia: Maintain a maximum value of 20 ppm.
    7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm
    8. Microbiological Limits:
      - a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
      - b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
      - c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
      - d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
      - e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
    9. Polymer Testable: Maintain a minimum value within 10 to 40.
  - F. Passivation for Galvanized Steel: For the first 60 days of operation.
    1. pH: Maintain a value within 7 to 8.
    2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
    3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.
- 1.7 SUBMITTAL PROCEDURES
- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."
- 1.8 SUBMITTALS
- A. Manufacturer's Literature and Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
    1. Cleaning Compounds and recommended procedures for their use
    2. Chemical treatment for Closed systems, including installation and operating instructions
    3. Chemical Treatment for open loop systems, including installation and operating



- instructions
  - 4. Bypass feeders.
  - 5. Water meters.
  - 6. Inhibitor injection timers.
  - 7. pH controllers.
  - 8. TDS controllers.
  - 9. Biocide feeder timers.
  - 10. Chemical solution tanks.
  - 11. Injection pumps.
  - 12. Chemical test equipment.
  - 13. Chemical material safety data sheets.
  - 14. Water softeners.
  - 15. Multimedia filters.
  - 16. Self-cleaning strainers.
  - 17. Bag- or cartridge-type filters.
  - 18. Centrifugal separators.
- B. Shop Drawings: Pretreatment and chemical, and ozone-generator biocide and UV-irradiation biocide treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
- 1. Wiring Diagrams: Power and control wiring.
- C. Field quality-control test reports.
- D. Manufacturer Seismic Qualification Certification: Submit certification that the water treatment equipment and components will withstand seismic forces as defined in section 230548 of this work. Include the following:
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Operation and Maintenance Data: For sensors, injection pumps, equipment and controllers to include in emergency, operation, and maintenance manuals.
- F. Other Informational Submittals:
- 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
  - 2. Water Analysis: Illustrate water quality available at Project site.
  - 3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces and confirm this observation in a letter to Commissioner.

## 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
- B. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section and having at minimum of 5 years' experience with similar projects.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York City Department of Buildings, and marked for intended use.

## PART 2 - PRODUCTS

### 2.1 HVAC WATER TREATMENT – GENERAL

- A. Provide, for the full construction period as well as for 1 additional year starting from the date, complete water treatment equipment, associated piping, chemicals and service for systems as specified and/or shown on the drawings. Equipment, chemicals and service shall be provided by the independent water treatment company. That company shall supervise the installation of the chemical feed equipment, chemical cleaning of the systems and testing. Provide all necessary wiring to an adequate source of electric power, and all required interwiring.
- B. Obtain and become familiar with all necessary building technical plant and operating information. Appointments must be made with facility management and engineering personnel for this purpose.
- C. Daily records of all water treatment activities shall be maintained by the water treatment company and made available to the building operators of The City of New York. These records shall consist of all communications and test records from the water treatment company, all chemical additions, all fill and drain cycles, cleanings, additions to the piping system and any other pertinent data, starting at the first filling of the system.
- D. The water treatment company shall include with service all required chemicals for testing, initial cleaning, startup treatments, test equipment and all chemicals required for the two-year period during which service is rendered.
- E. All service visits shall be confirmed in writing to the Commissioner.
- F. The water treatment company selected shall be responsible for insuring that all pipe systems and equipment for which they are responsible remain clean and free from all corrosion during all testing or filling and draining operations.
- G. Under no circumstances shall raw, untreated water be introduced into these pipes and equipment or be allowed to remain in place anytime during construction. All hydronic testing shall only be with treated water at all times.
- H. Upon completion of all building construction operations associated with the piping system in question, the system shall be cleaned by the water treatment company using appropriate chemicals which are nonaggressive to the materials in that pipe system, but which will clean surface rust, oil, grease and silt from the steel piping and other contaminants associated with the piping fabrication process.
- I. Cooling systems shall be cleaned with an alkaline phosphate and/or detergent solution.
- J. Chemicals for initial treatment of the water must be on-hand before cleaning is started, so that



these chemicals can be added to the initial water fill after cleaning is complete. Under no circumstances shall the cleaned system be filled with untreated water or allowed to stand empty between cleaning and initial fill.

- K. The start-up chemical treatment program shall be, at a minimum, 3-4 times the dosage of the maintenance chemical treatment program.
- L. The cleaning operation shall be completed when agreed upon representative pipe lengths which have been in place during the entire building process have been satisfactorily cleaned as established by all interested parties.
- M. At no time shall the Contractor add water to a system without that water containing a corrosion inhibiting treatment chemical. The addition of minimal amounts of untreated water to an already treated system is allowed.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. GE Betz
  - 2. Aqua-Chem, Inc.; Cleaver-Brooks Div.
  - 3. ONDEO Nalco Company.
  - 4. U.S. Water
  - 5. Clarity Water Technologies
  - 6. Or approved equal.

## 2.3 MICROBIOLOGICAL CONTROL

- A. The Supplier must provide a specific microbiological control program. Both oxidizing and non-oxidizing biocides are acceptable, along with biodispersants and other control measures. The program must list specific biocides with application dosages and frequency, and must include all of the information specified herein. Acquired immunity to one biocide must be considered.

## 2.4 CHEMICAL PROGRAMS

- A. All chemicals provided for use in the open condenser water and all closed water systems, and for testing purposes, must meet EPA and OSHA requirements as well as 2014 New York City Construction Codes. In addition, all chemicals must meet the following criteria:
- B. Toxicity
  - 1. Chemicals must be non-toxic to personnel and safe to handle when usual precautions are observed.
- C. Disposal and Cleanup
  - 1. At use concentrations in the systems, all chemicals must be acceptable in the building's sewer system. The supplier must provide clear directions for cleanup of accidental chemicals spills, including necessary safety precautions, and must ensure that sufficient supplies and equipment required for cleanup of chemical spills are on hand for emergency use.
- D. Furnish chemicals recommended by water treatment system company for treating water to meet specified water quality. Provide only chemicals that are compatible with piping materials, seals



and all accessories.

## 2.5 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and 3/4" bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 5 gal.
  2. Minimum Working Pressure: 125 psig.

## 2.6 AUTOMATIC CHEMICAL-FEED EQUIPMENT

- A. Water Meter:
1. AWWA C701, turbine-type, totalization meter.
  2. Body: Bronze.
  3. Minimum Working-Pressure Rating: 150 psig.
  4. Maximum Pressure Loss at Design Flow: 3 psig.
  5. Registration: Gallons.
  6. End Connections: Flanged.
  7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow. Control: Low-voltage signal capable of transmitting 1000 feet.
- B. Inhibitor Injection Timers:
1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at the BMS.
  2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
  3. Test switch.
  4. Hand-off-auto switch for chemical pump.
  5. Illuminated legend to indicate feed when pump is activated.
  6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
  7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.
- C. pH Controller:
1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at the BMS.
  2. Digital display and touch pad for input.
  3. Sensor probe adaptable to sample stream manifold.
  4. High, low, and normal pH indication.
  5. High or low pH alarm light, trip points field adjustable; with silence switch.
  6. Hand-off-auto switch for acid pump.
  7. Internal adjustable hysteresis or deadband.
- D. TDS Controller:



1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at the BMS.
  2. Digital display and touch pad for input.
  3. Sensor probe adaptable to sample stream manifold.
  4. High, low, and normal conductance indication.
  5. High or low conductance alarm light, trip points field adjustable; with silence switch.
  6. Hand-off-auto switch for solenoid bleed-off valve.
  7. Bleed-off valve activated indication.
  8. Internal adjustable hysteresis or deadband.
  9. Bleed Valves:
    - a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.
    - b. Steam Boilers: Motorized ball valve, steel body, and TFE seats and seals.
- E. Biocide Feeder Timer:
1. Microprocessor-based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at the BMS.
  2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
  3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
  4. Solid-state alternator to enable use of two different formulations.
  5. 24-hour display of time of day.
  6. 14-day display of day of week.
  7. Battery backup so clock is not disturbed by power outages.
  8. Hand-off-auto switches for biocide pumps.
  9. Biocide A and Biocide B pump running indication.
- F. Chemical Solution Tanks:
1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
  2. Molded cover with recess for mounting pump.
  3. Capacity: 50 gal.
- G. Chemical Solution Injection Pumps:
1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
  2. Adjustable flow rate.
  3. Metal and thermoplastic construction.
  4. Built-in relief valve.
  5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Requirements for HVAC Equipment."
- H. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.
- I. Injection Assembly:
1. Quill: Minimum ½" with insertion length sufficient to discharge into at least 25 percent of



- pipe diameter.
- 2. Ball Valve: Two-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.
- 3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
- 4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

## 2.7 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.
- B. Sample Cooler:
  - 1. Tube: Sample.
    - a. Size: 1/4" tubing.
    - b. Material: ASTM A 666, Type 316 stainless steel.
    - c. Pressure Rating: Minimum 2000 psig.
    - d. Temperature Rating: Minimum 850 deg F.
  - 2. Shell: Cooling water.
    - a. Material: ASTM A 666, Type 304 stainless steel.
    - b. Pressure Rating: Minimum 250 psig.
    - c. Temperature Rating: Minimum 450 deg F.
  - 3. Capacities and Characteristics:
    - a. Tube: Sample.
      - 1) Flow Rate: 0.25 gpm.
      - 2) Entering Temperature: 400 deg F.
      - 3) Leaving Temperature: 88 deg F.
      - 4) Pressure Loss: 6.5 psig.
    - b. Shell: Cooling water.
      - 1) Flow Rate: 3 gpm.
      - 2) Entering Temperature: 70 deg F.
      - 3) Pressure Loss: 1.0 psig.
- C. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
  - 1. Three (3) station racks for closed-loop systems.
  - 2. Five (5) station rack for open systems.

## 2.8 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.



B. Water Softener Chemicals:

1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb. of salt.
2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.3 INSTALLATION

- B. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- C. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Refer to Section 23 05 48 "Vibration Isolation, Seismic, Flood And Wind Load Restraints For HVAC Components" for seismic restraints.
- D. Install water testing equipment on wall near water chemical application equipment.
- E. Install interconnecting control wiring for chemical treatment controls and sensors.
- F. Mount sensors and injectors in piping circuits.
- G. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water, and equipped with the following:
1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
  2. Install water meter in makeup water supply.
  3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
  4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
  5. Install a swing check on inlet after the isolation valve.
  6. As manufactured by Neptune or approved equal.
- H. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:
1. Install makeup water softener.
  2. Install water meter in makeup water supply.
  3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.



- a. Pumps shall operate for timed interval when contacts close at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.
- 4. Install test equipment and furnish test-kit to Commissioner.
- 5. Install TDS controller with sensor and bleed valves.
  - a. Bleed valves shall cycle to maintain maximum TDS concentration.
- 6. Install inhibitor injection timer with injection pumps and solution tanks.
  - a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into main steam supply header.
- I. Install automatic chemical-feed equipment for condenser water and include the following:
  - 1. Install makeup water softener.
  - 2. Install water meter in makeup water supply.
  - 3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
    - a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.
  - 4. Install test equipment and provide test-kit to Commissioner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
  - 5. Install TDS controller with sensor and bleed valves.
    - a. Bleed valves shall cycle to maintain maximum TDS concentration.
  - 6. Install pH sensor and controller with injection pumps and solution tanks.
    - a. Injector pumps shall operate to maintain required pH.
  - 7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.
    - a. Injection pumps shall operate to feed biocide on an alternating basis.

### 3.3 WATER SOFTENER INSTALLATION

- A. Install water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure. Refer to Division 23 Section 23 05 48 "Vibration Isolation, Seismic, Flood And Wind Load Restraints For HVAC Components" for seismic restraints.
- C. Install brine lines and fittings furnished by equipment manufacturer but not factory installed.
- D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

- E. Install water-testing sets on wall adjacent to water softeners.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified.
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified.
- E. Backflow preventers are required in makeup water connections to potable-water systems, as specified.
- F. Confirm applicable electrical requirements as specified.
- G. Ground equipment according to requirements.
- H. Connect wiring according to requirements.

### 3.5 FIELD QUALITY CONTROL.

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
  - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
  - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and



prepare test report advising the Commissioner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at four week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

- E. At four week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising The Commissioner of changes necessary to adhere to Part 1 "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
  - 1. Silica: ASTM D 859.
  - 2. Steam System: ASTM D 1066.
  - 3. Acidity and Alkalinity: ASTM D 1067.
  - 4. Iron: ASTM D 1068.
  - 5. Water Hardness: ASTM D 1126.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct The City of New York's service operators to adjust, operate, and service HVAC water-treatment systems and equipment. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 25 00**



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**SECTION 23 25 10****HVAC WATER FILTRATION SYSTEM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work"
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".
- F. Section 23 25 00 "HVAC Water treatment".
- G. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes providing a complete high-efficiency water filtration system for the HVAC water systems.
- B. Filter shall be designed to provide 0.5-micron filtration.
- C. The system shall include, but not be limited to the following: filter, filter media, filtration tank(s), circulation pump(s), backwash tank(s), interconnecting piping, controls and all other appurtenances required for a complete and fully operational system.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the



Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements

#### 1.5 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote control, signaling power-limited circuits.
- C. RO: Reverse osmosis.
- D. TDS: Total dissolved solids.
- E. UV: Ultraviolet.

#### 1.6 PERFORMANCE REQUIREMENTS

- A. Water Filtration for HVAC water systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Provide a High Efficiency Sand Filtration System rated for 0.5-micron particle removal for the condenser water system.
- C. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of New York Department of Buildings.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
  - 1. Multimedia filters.
  - 2. Self-cleaning strainers.
  - 3. Bag- or cartridge-type filters.
  - 4. Centrifugal separators.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections,



details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.
  - C. Field quality-control test reports.
  - D. Manufacturer Seismic Qualification Certification: Submit certification that water filtration units and components will withstand seismic forces defined in Division 23 Section "Vibration Isolation, Seismic and Wind Load Restraints for HVAC Components." Include the following:
    1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
    2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - E. Operation and Maintenance Data: For sensors, injection pumps, water filtration units and controllers to include in emergency, operation, and maintenance manuals.
- 1.9 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements."
  - B. Source Limitations: Obtain water filtration equipment through one source from a single manufacturer.
  - C. Manufacturer's Certification: Certify filtration system performance.
  - D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- 1.10 MAINTENANCE SERVICE
- A. Scope of Maintenance Service: Provide service program to maintain water conditions required above to provide 0.5-micron filtration by utilizing ultrafine sand with an effective size of not more than 0.16 millimeters.
  - B. Services shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
    1. Startup assistance for Contractor to flush the systems, clean filters and tanks.
    2. Customer report charts and log sheets.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS



- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AmeriWater Corp.
2. Diamond Water Systems
3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
4. GE Betz.
5. ONDEO Nalco Company.
6. Or approved equal.

## 2.2 CONDENSER WATER FILTRATION

- A. Description: Factory-fabricated and tested, high efficiency Sand Filtration System rated for 0.5-micron particle removal for the condenser water system. The system shall include filter tank, backwash tank, media, strainer, circulating pump, piping, and controls for removing particles from condenser water.
- B. Filter shall be designed to provide 0.5-micron filtration by utilizing ultrafine sand with an effective size of not more than 0.16 millimeter.
- C. Filter shall operate continuously to remove suspended particles from the tower water until either a pressure drop across filter bed of 18 PSI is reached or 24 hours has elapsed. At either point filter shall automatically backwash for 5 minutes on each vessel sequentially. After backwash cycle, filter shall automatically return to filtration mode.
- D. Filter shall be capable of field adjustment to utilize either City water or condenser water as the backwash source.
- E. Filter shall be comprised of #304L Stainless Steel vessels (filter tank(s) and backwash storage tank(s)) with Type L copper manifold and cast iron circulating backwash booster pump.
- F. A separate backwash collection tank shall be provided (sized by manufacturer) to maintain a low flow (limited flow) of the backwash water to the drain.
- G. Filter and Backwash Tanks: Corrosion resistant with distribution system and media.
1. Tanks shall be #304L Stainless Steel rated for 125 PSIG operating pressure.
  2. Fabricate and label steel filter tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  3. Pipe Connections
    - a. 2" and Smaller: Threaded according to ASME B1.20.1.
    - b. 2-1/2" and Larger: Steel, Class 150 flanges according to ASME B16.5.
- H. The filter shall be mounted on a Stainless Steel skid. The backwash storage tank shall be sized to limit the drainage flow.
1. Fabricate and label steel filter tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
  2. Fabricate supports and base and attachment to tank with reinforcement strong enough to resist filter movement during a seismic event when filter base is anchored to building structure.
- I. Components:



1. Natural quartz media shall meet AWWA B-100, ANSI, and NSF-61 standards for consistently uniform and chemically inert filter media. Crushed or ground media is not acceptable.
  2. Valves shall be JC two-piece 125 psig bronze ball type with multi-piece packing set, blowout proof stem design, adjustable packing gland, stainless ball and stem, RPTFE seat. Valves shall be actuated with individual 24V electric motors on each valve.
  3. Filter shall be equipped with two pressure gauges. The gauges shall be anti-flutter and shall have a stainless steel casing, with brass internals. The minimum face size shall be no less than 2-1/2". One gauge marked (IN) shall be connected to the filter pump discharge and the second gauge marked (OUT) shall be connected to the outlet side of the filter.
  4. Top inlet distributor shall be 304 stainless steel. Under drain shall be 316 stainless steel wedgewire screen pipe.
  5. Backwash flow control shall be rated for full backwash flow from 25 PSIG to 120 PSIG.
  6. Safety Valves: Automatic and manual pressure relief.
    - a. Steel Tank Pipe Connections 2-1/2" and Larger: Steel, Class 150 flanges according to ASME B16.5.
    - b. Motorized Valves: Flanged, ductile-iron butterfly type with EPDM valve seat and stem seal; with ASTM B 148 aluminum bronze disc.
    - c. Strainer: Basket type mounted on pump suction.
    - d. Piping: ASTM A 53/A 53M, Type S, F, or E; Grade B, Schedule 40 black steel, with flanged joints and malleable, steel welding fittings.
    - e. Piping: ASTM B 88, Type L copper water tube, copper-alloy solder-joint fittings, and brazed, flanged, or grooved joints.
    - f. Safety Valves: Automatic pressure relief.
- J. Support:
1. The filter and tanks shall be mounted on stainless steel skid.
  2. Fabricate supports and base and attachment to tank with reinforcement strong enough to resist filter movement during a seismic event when filter base is anchored to building structure.
- K. Circulating Pump: Overhung impeller, close coupled, single stage, end suction, centrifugal. Comply with UL 778 and with HI 1.1-1.2 and HI 1.3.
1. Casing: Radially split, cast iron.
  2. Pressure Rating: 150 psig minimum.
  3. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
  4. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
  5. Seal: Mechanical.
  6. Pump motor to be TEFC with a service factor of not less than 1.15. Motor to be supported on the pump bearing frame. General requirements for motors are specified under another section of this work.
- L. Filter pump shall be cast iron, close coupled with mechanical seal.
- M. Piping: ASTM B 88, Type L copper water tube, copper-alloy solder-joint fittings, and brazed or flanged joints.
- N. Provide a NEMA 4X (corrosion resistant) control panel containing the filter controls, a service disconnect switch with thermal overload and short circuit protection, a motor contactor, a fused



step-down transformer, access door with door interlock, controller to be connected to BMS, Backwash lockout switch and automatic controls for backwash holding tanks.

1. Control Panel shall also contain the following:
  - a. Allen Bradley 1200 Series PLC
  - b. An Allen Bradley motor starter and service disconnect.
  - c. A step-down transformer to convert 3 phase power to 115 VAC to operate control components and convert 115 VAC to 24V for valve actuation.
  - d. A pressure differential switch factory set to initiate backwash at 18 PSI differential across the filter bed.
  - e. A manual backwash switch, of a momentary contact design, mounted on the outside of the control panel door.
  - f. A backwash indicating light, pump status light and pump on/off switch mounted on the outside of the control panel door.
  - g. A non-resettable backwash counter mounted on the outside of the control panel door to indicate the number of times the filter has backwashed.
  - h. PLC shall be programmed to control valve actuation, duration of the backwash cycle, and pump on/off. Backwash shall be initiated by the 24-hour timer, pressure differential switch, or manual backwash button. An internal delay of no less than 15 seconds shall be built into the program timer to avoid false backwashing.
  - i. PLC shall also include a set of dry contacts that can be connected to the BMS to monitor backwash frequency.
  - j. A 24-hour timer to force backwash once per day.
  - k. A pressure differential switch which is factory set to initiate backwash at 18 psi differential across the filter bed.
  - l. A manual override switch, of a momentary contact design, mounted on the control box door.
  - m. A program timer shall be designed to control the duration of the backwash cycle. It shall be engaged by either the 24-hour timer, pressure differential switch, or the manual override button. This program timer shall control a valve sequence multiport valve. An internal delay of no less than 90 seconds shall be built into the program timer to avoid false backwashing.
  - n. A valve sequence multiport valve which shall operate filter's diaphragm actuated valves. It shall be equipped with a position indicator and two control switches. One switch shall be used electrically to override the multiport valve, in the event that it is not in sequence with the program timer, and will automatically reset the multiport valve to filtration position.
  - o. A backwash indicating light mounted on the outside of the panel door.
  - p. A non-resettable backwash counter mounted on the outside of the panel door to indicate the number of times the filter has backwashed.
  - q. A motor starter and disconnect.
  - r. A step down transformer to convert 3 phase power to 115 volts AC to operate control components.
  - s. Dry Contacts outputs to BMS for the following:
    - 1) System Backwash running/frequency
    - 2) Common alarm
    - 3) High level holding tank alarm
2. The filter shall be provided with factory-installed, Schedule 40 steel interconnecting piping with inlet, clean water return and waste water outlet connections, as well as city water connection.



- O. Filter system shall be rated for 75 PSIG inlet pressure to filter pump.
- P. System shall be factory assembled and tested for rated pressure and control functions.

## 2.3 SOURCE QUALITY CONTROL

- A. Description: Factory-fabricated and -tested, simplex, sand-filter system of filter tank, media, strainer, circulating pump, piping, and controls for removing sediment particles from water.
- B. Filter Tank: Corrosion resistant with distribution system and media.
- C. Construction:
  - 1. Fabricate and label steel filter tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
  - 2. Fabricate supports and base and attachment to tank with reinforcement strong enough to resist filter movement during a seismic event when filter base is anchored to building structure.
- D. Strainer: Basket type.
- E. Safety Valves: Automatic and manual pressure relief.
- F. Motor: General requirements for motors are specified under another section of this work.
- G. Support: Skid mounting.
- H. Hydrostatically test before shipment to minimum of one and one-half times pressure rating.
- I. Filtration system shall be guaranteed to perform the capacities as specified herein. Manufacturer shall submit a written guarantee, certifying the performance of the filter in the location and shown on the drawings. Such guarantee shall be furnished with first shop drawings submitted.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine proposed route of moving filtration system into place and verify that it is free of interferences.
- B. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of filters.
- C. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- D. Examine walls and floors for suitable conditions where filters will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.



- F. Examine elements and surfaces to support equipment.
- G. Verify piping and wiring roughing-in locations.
- H. Verify suitability of branch-circuit wiring.

### 3.3 INSTALLATION

- A. Install filtration system according to manufacturer's written instructions.
- B. Install equipment on concrete bases level and plumb, and fasten to supporting structure with vibration isolators and seismic restraints.
- C. Place vessels as shown in installation drawing and level. Use manifold as guide for spacing.
- D. Install upper and lower manifolds as per manufacturer's instructions.
- E. Install piping between manifold and pumps.
- F. Anchor control panel to floor or wall mount.
- G. Connect control tubing to valves and manifold according to manufacturer's instructions.
- H. Connect electrical power to pumps, control panel and control to pumps according to local electrical codes and wiring diagram supplied by manufacturer.
- I. Install media according to manufacturer's instructions.
- J. Maintain recommended clearances for service and maintenance.
- K. Install filters and their support structures to withstand the effects of seismic events according to New York Department of Buildings.
- L. Electrical Wiring: Install electrical devices furnished by manufacturer that are not factory mounted.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements
- B. Install piping valves, etc., adjacent to filtration system to allow service.
- C. Connect system to water piping.
- D. Install piping for fresh water
- E. Connect overflow and tank drain and bleed lines to sanitary sewage system.
- F. Domestic Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to filtration system with backflow preventer, shutoff valve, strainer and union or flange at each connection.





- G. Condenser-Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to supply and return water piping with shutoff valve, strainer, and union or flange on supply connection and shutoff valve and union or flange to return connection.
- H. Electrical: Comply with applicable requirements in Division 26 Sections.
  - 1. Ground equipment.
  - 2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.5 CONDENSER WATER FILTER PIPING REQUIREMENTS

- A. Filter unit piping shall include two 3-way diverting valves to accomplish normal filter mode and backwash mode. Valves shall be bronze ball valve with actuator. Actuators shall be controlled by the differential pressure switch located in the control panel. Coordinate requirements with filter manufacturer.
- B. Connect a feed water line from the system sump or piping to the inlet connection. If the inlet connection is located above the operating water level of the system sump, install a foot/check valve to prevent loss of suction on the pump.
- C. Connect the return line from the outlet connection to the system sump or piping.
- D. A service valve should be installed on the inlet, outlet, and backwash water line to allow servicing of the filter. If municipal water is used for backwash, a backflow preventer (see details) is required in the line on all units (to conform to local codes).
- E. Connect the backwash waste line to the storage tank to collect the waste water.
- F. All interconnecting piping, fittings, valves, or other accessories connected to the filter system must be independently supported to eliminate stress on piping.
- G. Coordinate municipal water requirements with Contractor's plumbing trade.
- H. Provide heat tracing (with insulation) for the pre-strainer tank, filter tank, pump, piping valves, pressure switch tubing, and all other components subject to freezing.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

### 3.7 STARTUP AND TESTING

- A. Startup by factory-authorized agent shall be provided.
- B. Submit cooling water particle analysis reports showing frequency and volume of particles within the following micron size ranges: 0.5 to 1, 1 to 5, 5 to 10, 10 to 15, 15 to 20, and 20 and larger at time of startup.
- C. Submit cooling water particle analysis reports showing frequency and volume of particles within the following micron size ranges: 0.5 to 1, 1 to 5, 5 to 10, 10 to 15, 15 to 20, and 20 and larger



30 days after startup.

- D. Submit report analyzing results confirming that system meets performance specifications.

### 3.8 ADJUSTING

- A. Set and balance condenser-water flow to filtration unit.

### 3.9 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

### 3.10 COMMISSIONING

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
  - 1. Clean entire unit and washbasins.
  - 2. Ensure accessories are properly installed.
  - 3. Check makeup backwash water controls.
  - 4. Check clearances for servicing.
  - 5. Check for vibration isolation and structural support.
- B. Start cooling-tower and condenser-water pumps. Follow manufacturer's written starting procedures.
  - 1. Check operation of filtration backwash line, and controlling devices.
  - 2. Check operation of basin immersion heater and control thermostat.
- C. Ensure system chemical treatment is working, and measure chemical treatment levels. Check operation of tower basin automatic blow-down, and controlling device.

### 3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative (for a minimum of 1-8 hour day) to instruct the City of New York's facility operators.
- B. Instruction the City of New York's facility operators on procedures and schedules for starting up and shutting down, troubleshooting, and servicing cooling towers.
- C. Review data in maintenance manuals. Refer to the DDC General Conditions.
- D. Review data in maintenance manuals. Refer to the DDC General Conditions.
- E. Schedule training with The Commissioner, with at least seven days' advance notice.

### 3.12 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.
- B. Submit cooling water particle analysis reports showing count and volume of particles within the following micron size ranges: 0.5 to 1, 1 to 2, 2 to 5, 5 to 10, 10 to 20, and 20 and larger at time



of start-up.

- C. Submit cooling water particle analysis reports showing count and volume of particles within the following micron size ranges: 0.5 to 1, 1 to 2, 2 to 5, 5 to 10, 10 to 20, and 20 and larger 30 days after start-up.
- D. Submit report analyzing above results confirming that filtration system meets performance specifications as described herein.

### 3.13 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Refer to Section "Vibration Isolation, Seismic, Flood And Wind Load Restraints For HVAC Components" for seismic restraints.
- C. Install water-testing equipment on wall near water chemical application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.

### 3.14 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between HVAC equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified under another section of this work.
- D. Install shutoff valves on HVAC equipment inlet and outlet. Metal general-duty valves are specified under another section of this work."
- E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.
- F. Connect system to CW piping.
- G. Install piping for fresh water
- H. Connect overflow and tank drain and bleed lines to sanitary sewage system.
- I. Domestic Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to filtration system with backflow preventer, shutoff valve, strainer and union or flange at each connection.
- J. Condenser-Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to supply and return condenser water piping with shutoff valve, strainer, and union or flange on supply connection to the CW and shutoff valve and union or flange to return



connection to CW.

### 3.15 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
  - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
  - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
  - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
  - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
  - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. At eight-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising The City of New York of changes necessary to adhere to Part 1 "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
  - 1. Silica: ASTM D 859.
  - 2. Steam System: ASTM D 1066.
  - 3. Acidity and Alkalinity: ASTM D 1067.
  - 4. Iron: ASTM D 1068.
  - 5. Water Hardness: ASTM D 1126.



**3.16 DEMONSTRATION**

- A. Engage a factory-authorized service representative to instruct The City of New York's service operators to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to the DDC General Conditions for instruction requirements.
- B. Instruction: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

**END OF SECTION 23 25 10**



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**SECTION 23 31 13****METAL DUCTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 08 00 "Commissioning of HVAC".

**1.2 SUMMARY**

- A. This section includes all the rectangular, round and flat-oval metal ducts and plenums for the complete heating, ventilating and air conditioning systems in all pressure classes. In addition, this section includes the following:
  - 1. Sheet Metal
  - 2. Flexible Air Duct
  - 3. Fume Extractor Arms (Snorkels)
  - 4. Stainless Steel Sheet Metal for Fume Hood Exhaust Systems
  - 5. Air Casings and Plenums
  - 6. Air Casings and Plenums (Acoustical Type).
  - 7. Dampers for Balancing
  - 8. Access Doors in Sheet Metal Work.
  - 9. Inspection Portholes
  - 10. Flexible Connections
  - 11. Sheet Metal Materials
  - 12. Turning Vanes
  - 13. Sealants and Gaskets
  - 14. Hangers and Supports
  - 15. Seismic-Restraint Devices.
  - 16. Refer to other Division 23 00 00 sections for air distribution devices and accessories required in conjunction with this work.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:



1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- D. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- E. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 REFERENCE STANDARDS

- A. SMACNA
- B. ASHRAE
- C. NFPA
- D. ASTM
- E. International Mechanical Code
- F. ACGIH - American Conference of Industrial Hygienists

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Qualify welding processes and welding operators in accordance with AWS.D1.1 "Structural Welding Code - Steel" for hangers and supports and SWS.D9.1 "Sheet Metal Welding Code."
- C. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- D. NFPA Compliance: Comply with the following NFPA Standards:
  1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
  2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.
- E. SMACNA - HVAC Duct Construction Standards, Latest Edition.



- F. SMACNA – HVAC Air Duct Leakage Test Manual.
- G. At the discretion of the Commissioner, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.8 SUBMITTALS

- A. Submit product data under provisions of Section 01 30 00.
- B. Include product description, list of materials for each service, and locations.
- C. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
  - 1. Sealing Materials.
  - 2. Fire-Stopping Materials.
  - 3. Dampers, turning vanes, access doors, plenums, flexible connectors, etc.
- D. Ductwork Shop Standards, including but not limited to, materials, duct gauges, fittings, joint and seam construction and sealing, reinforcement details and spacing., materials, fabrication, assembly, and spacing of hangers and supports.
- E. Fabrication, assembly, and installation, including plans, elevations, sections, components, take-offs and attachments to other work.
- F. Duct layout for all areas of work, indicating pressure classifications and sizes in plan view.
- G. For exhaust duct systems, indicate the classification of the materials handled as defined in this Section.
- H. Shop drawings from duct fabrication shop, drawn to scale not smaller than 3/8 inch equals 1 foot, detailing:
  - 1. Factory- and shop-fabricated ducts and fittings.
  - 2. Fittings.
  - 3. Reinforcing details and spacing.
  - 4. Seam and joint construction details.
  - 5. Penetrations through fire-rated and other partitions.
  - 6. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 7. Elevation of top and bottoms of ducts.
  - 8. Dimensions of main duct runs from building grid lines.
  - 9. Fittings.
  - 10. Reinforcement and spacing.
  - 11. Seam and joint construction.
  - 12. Penetrations through fire-rated and other partitions.
  - 13. Equipment installation based on equipment being used on Project.
  - 14. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 15. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.



- a. AC unit, equipment, terminal unit, coil installations.
    - b. Hangers and supports, including methods for building attachment, seismic restraint, vibration isolation, and duct attachment.
  - I. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders qualifications test records complying with requirements specified in "Quality Assurance" above.
  - J. Service data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 23 Section "Common Requirements for HVAC Work" and the DDC General Conditions.
  - K. Submit all fan room sheet metal ductwork shop drawings to the AC unit manufacturer prior to submission to Commissioner for review. AC unit manufacturer shall approve the air performance and acoustical performance of the AC units in the location and with the ductwork configuration and construction as shown on the shop drawings. AC unit manufacturer shall indicate approval directly on the ductwork shop drawing.
  - L. Welding certificates.
  - M. Field quality-control reports
  - N. Engineering services Submittal:
    - 1. Engineering Services Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer licensed in the State of New York responsible for their preparation for selecting hangers and supports and seismic restraints.
- 1.9 COORDINATION DRAWINGS:
- A. Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved. Refer to Section, General Requirements for HVAC Work for additional requirements.
    - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
    - 2. Suspended ceiling components.
    - 3. Structural members to which duct will be attached.
    - 4. Size and location of initial access modules for acoustical tile.
    - 5. Penetrations of smoke barriers and fire-rated construction.
    - 6. Items penetrating finished ceiling including the following:
      - a. Lighting fixtures.
      - b. Air outlets and inlets.
      - c. Sprinklers.
      - d. Access panels.
      - e. Perimeter moldings.
- 1.10 DEFINITIONS
- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply.



1. Seams: A seam is defined as jointing of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
2. Joints: Joints include girth joints, branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections, louver and air terminal connection to ducts; access door and access panel frames and jambs; duct, plenum and casing abutments to building structures.

#### 1.11 SYSTEM PERFORMANCE REQUIREMENTS

- A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA Duct Manuals where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that specified herein.
- B. All ductwork shown on the Drawings, specified or required for the heating, ventilating and air conditioning systems shall be constructed and erected in a first class workmanlike manner. The work shall be guaranteed against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by the Commissioner.
- C. Except for special ducts specified elsewhere herein, all sheet metal used on the project shall be constructed from prime galvanized steel sheets and/or coils up to 60" in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be stenciled throughout on ten foot (10') centers with manufacturer's name and must be visible after duct is installed. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."
- D. Provide a duct system with minimum resistance to airflow. Take-offs shall be throated and transitions made as gradual as possible. 'Bullhead' or sharp take-offs are not acceptable. Branch take-offs shall be 45 deg entry type. Straight tap or butt flanged connections are not acceptable. Clinch lock connections are preferred.
- E. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout of configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposal layout will provide the original design results without increasing the system total pressure.
- F. Structural Performance: Duct hangers and supports, wind and seismic restraints shall withstand the effects of gravity, wind and seismic loads and stresses within limits and under conditions described in section 230548 of this work.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

#### 1.12 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Welding Qualifications: Qualify procedures according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.



2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- E. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems,"
- F. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.
- G. SMACNA – HVAC Duct Construction Standards, Latest Edition.
- H. SMACNA – "Guidelines for Welding Sheet Metal."
- I. The contractor must comply with the specification in its entirety.
- J. At the discretion of the Commissioner, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance. If on inspections, changes have been made without prior approval, the contractor will make the applicable changes to comply with this specification, at the contractor's expense.
- K. Duct sealants, liners, insulation, etc. shall have a UL label and shall have a Flame Spread rating not over 25 and a Smoke Developed rating no higher than 50, when in the final dry state.

#### 1.13 SEISMIC DESIGN

- A. This project is located within a seismic zone requiring special provisions for the support and restraint of equipment, components and piping.
- B. See Sections 23 05 00 "Common Requirements for HVAC Work" and 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components" for additional requirements.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Duct dimensions indicated on drawings are clear, inside dimensions. The sheet metal dimensions shall be increased to accommodate internal liner where liner is required.
- B. Drawings are diagrammatic and indicate the arrangement of the principal apparatus, ductwork and piping and shall be followed as closely as possible. All offsets, rises, drops, fittings and accessories are not indicated on drawings, but shall be provided as required to install system. Carefully investigate structure, finish conditions, and the work of other sections affecting sheet metal work, including work associated with testing, adjusting and balancing, in order to arrange all items accordingly. Provide best possible arrangement so as to provide maximum headroom and maintenance clearances.

- C. In addition to sheet metal ductwork specified herein, furnish and install, or install as furnished by section 233113, accessories and devices including, but not limited to, air distribution devices, smoke detectors, plenums, canopy hoods, and blank-off panels at unused louver areas.
- D. Furnish and install intake and exhaust plenums attached to louvers.
- E. Except as noted, all reinforcement shall be external.

## 2.2 DUCTWORK FABRICATION REQUIREMENTS

- A. All Ductwork construction shall comply with both the “SMACNA HVAC Duct Construction Standards” and “SMACNA HVAC Air Duct Leakage Test Manual”, latest editions.
- B. Joints and Seams: Select joint and seam types and fabricate according to SMACNA's “HVAC Duct Construction Standards - Metal and Flexible” and SMACNA HVAC Air Duct Leakage Test Manual”, latest editions for static-pressure class, applicable sealing requirements, materials involved, reinforcement, duct-support intervals, etc.
- C. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's “HVAC Duct Construction Standards - Metal and Flexible,” Chapter 2, “Fittings and Other Construction,” for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's “HVAC Duct Construction Standards - Metal and Flexible.”
- D. Duct systems other than fume hood exhaust, lab exhaust, and high humidity exhaust shall be galvanized steel
- E. The specifications refer to SMACNA standards, which shall be considered minimal. Use the standards of 2014 New York City Building Code if and where they are more stringent.

Duct System	SMACNA Table No.	SMACNA Pressure Classification	SMACNA Seal Classification
All supply ducts on systems with VAV/CV terminal boxes from fan discharge to terminal box.	2-6	+4” wg	A
All supply ducts downstream of VAV/CV terminal boxes to diffusers.	2-4	+3” wg	B
All supply ducts downstream of Fan Coil Unit to diffusers	2-3	+2” wg	C
All return ducts and general exhaust ducts (toilets, MER Ventilation, non-lab exhaust, etc.)	2-4	-3” wg	B
All generator room exhaust. All fume hood, laboratory and other special exhausts	2-6	-4” wg	A

## 2.3 STAINLESS STEEL SHEET METAL FOR FUME HOOD EXHAUST DUCTWORK



- A. All fume hood exhaust ductwork including fan inlet and discharge; shall be constructed of Type 316 stainless steel, U.S. Standard Gage in accordance with SMACNA HVAC Duct Construction Standards, second edition, 1995 for 4" W.G. (Table 1-8), except that 20 gage will be the minimum acceptable gage.
- B. Welded flange connections shall be provided at all joints.
- C. All longitudinal seams and transverse joint shall be continuously welded.
- D. Where bracing is required by SMACNA, angles are to be located 4" to 6" away from joint and secured to ductwork by tack welding.
- E. All fume hood exhaust ductwork located inside building, shall be supported by 1" wide x 1/8" stainless steel bands clamped to ducts and securely attached to concrete floor construction with concrete inserts. Spacing of horizontal duct hangers shall not exceed 8'-0" on center.
- F. Fume exhaust ductwork located exposed to weather shall be supported with stainless steel angles attached to building roof slab. Spacing of duct supports shall not exceed 8'-0" on center. Provide pitch pockets (copper for all angles attached to roof).
- G. Fume exhaust risers passing thru floor construction shall be provided with stainless steel, 10 gage, floor sleeves. Floor sleeves shall be carefully located in concrete floor construction by this Trade and shall extend a minimum of 4" above finished floor. Space between sleeve and outside wall or duct shall be caulked with an acid resistant flexible caulking material to make a watertight joint.
- H. Vertical fume hood risers passing thru floors shall be supported at each level with a split band clamp installed at the ceiling on each floor. In addition, the fume hood riser shall be fitted with an intermediate stainless steel band type wall brace.
- I. All flexible connections at fume hood exhaust fans shall be heavy gage glass fabric coated with Teflon fluorocarbon resin (airtight, watertight and flame resistant) attached with stainless steel clamping bands.
- J. All volume dampers and fire dampers in fume hood exhaust system ductwork shall be of stainless steel construction.
- K. This trade shall make the final connection to the hoods.

## 2.4 SPECIAL DUCTWORK CONSTRUCTION

- A. Ductwork required to be removable shall be companion flanged SMACNA Type T-22.
- B. Ductwork serving areas of high humidity shall be constructed of aluminum, with gauges in accordance with SMACNA standards, as referenced herein. Minimum gauge shall be 20 gauge. Ductwork shall be continuously welded and watertight. Pitch duct to low point drains. Pipe drains (1" copper drain line with dielectric fitting) to floor drains or other open drains.
  - 1. Areas Include, but are not limited to:
    - a. Exhaust ductwork exposed on roof.
    - b. Exhaust from sterilizers

- C. Ductwork exposed to weather: After exposed ductwork and joints are sealed and tested, as specified, apply over and around the same areas of possible leakage (joints), an approved sealer system. Refer to Section INSULATION for additional requirements for outdoor ductwork.
- D. Exhaust Stacks on Top of Exhaust Fan:
  - 1. Construct stacks from same material as exhaust duct.
  - 2. Stacks shall be self-supporting and constructed for wind velocities up to 125 MPH from all directions.
  - 3. Fabricate stackhead as indicated on ACGIH Fig. 8-6 for vertical discharge stack. Refer to drawings for additional details.

## 2.5 DAMPERS FOR BALANCING

- A. General Volume Damper Requirements:
  - 1. Provide factory fabricated manual volume dampers in all supply, return and exhaust branch ducts for properly regulating and balancing airflow to all terminal outlets, whether indicated on drawings or not. Dampers shall be constructed per SMACNA Latest Edition, with locking quadrant and 8" maximum blade width.
  - 2. Volume dampers are specified under section 23 33 10 "Dampers."
  - 3. When installing dampers in ducts to be insulated provide raised bracket for damper quadrant with height equal to insulation thickness such that the adjustment of the damper handle will not disturb the insulation.
  - 4. Locate damper as far as possible from air outlet to avoid noise transmission.
  - 5. For inaccessible ceilings, as well as for specialty areas such as lobbies, etc., furnish remote damper actuator operable through face of nearest diffuser. Damper controller and cable shall be concealed above the ceiling. Similar to Bowden remote cable control system with Young regulator damper controllers or approved equal. Balancing dampers shall include all necessary hardware to ensure compatibility with remote cable control system
  - 6. Coordinate with for easy access to damper.
  - 7. Dampers in stainless steel ductwork shall be of stainless steel construction.

## 2.6 ACCESS DOORS IN SHEET METAL WORK

- A. Provide suitable access doors and frames to permit inspections, operation and maintenance of all valves, all coils including reheat coils, controls, fire dampers, air monitors where applicable, automatic or motorized dampers, filters, bearings, traps or other apparatus concealed behind the sheet metal work. All such doors shall be of double construction of not less than No. 20-gauge sheet metal and shall have sponge rubber gaskets around their entire perimeter. Doors in insulated ducts or insulated casings shall have rigid fiberglass insulation between the metal panels.
- B. All access doors in sheet metal ducts shall be hung on heavy flat hinges and shall be secured in the closed position by means of cast zinc clinching type latches. Where space conditions preclude hinges, use four heavy window type latches. Doors into ducts shall in general not be smaller than 18" x 18" except for access door to fire dampers which will depend on size of fire damper. Submit samples for approval.
- C. In no case shall access to any items of equipment requiring inspections, adjustment, or servicing require the removal of nuts, bolts, screws, wing nuts, wedges, or any other screwed or loose device.



- D. Each sheet metal chamber shall have access doors for access to all parts of the system. Doors shall be fitted with cast zinc door latches, two per door. Latches shall be operable from both sides of casing. Hinges shall be extra heavy, zinc plated hinges, minimum of two per door. The doors shall be felted or provided with rubber gaskets so as to make them airtight. The doors shall be made with inner and outer shells 2 inches apart so that they may be properly insulated and properly operated. Doors shall be a minimum size of 20" x 48".
- E. See Section 08 31 13 "Access Doors and Frames" for access door requirements.

## 2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M, A924.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 316L cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B.
- E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.8 INSPECTION PORTHOLES

- A. Provide viewing portholes at both sides of fan sections and return air mixing plenums at air handling units 10,000 CFM or larger (package or built-up) to allow for inspection of fan belts, inlet vanes, damper actuators, etc.
- B. Portholes shall be 16" dia. or 12" x 8" made of 1/4" thick acrylic reinforced with flanges in both sides.

## 2.9 FLEXIBLE CONNECTIONS

- A. Where indicated, provide connections made with flexible material so as to prohibit the transfer of vibration from fans to ductwork connecting thereto, without air leakage. The material between the clamps shall have sufficient slack so as to prevent tearing due to fan movement.





- B. The flexible connections shall be a minimum of 12" long. Material shall be mechanically locked to the outside helix. Use of adhesives to lock fabric in place is not acceptable. The helix is constructed of a corrosive resistant galvanized steel, formed and mechanically locked to the ducts fabric on the outside to prevent tearing.
- C. Flexible fabric ductwork shall be rated at 6" positive pressure and at 4" negative pressure.
- D. Flexible metal duct shall be listed UL Class 1.
- E. Flexible connections shall be fabricated from approved flame proofed fabric conforming to NFPA 90A. Asbestos cloth is not permitted.
- F. Indoor installations shall be Neoprene or vinyl coated fabrics.
- G. Outdoor installations shall use Hypalon coated fabric.
- H. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster, Type 8.
  - 2. Kinetics
  - 3. Durodyne
  - 4. Or approved equal.

#### 2.10 FLEXIBLE AIR DUCTS

- A. Flexible air ducts shall be all metal construction consisting of a core of stranded triple lock metal flexible ducting for strength and air tightness. The ducting shall have applied at the factory a UL listed glass or mineral wool insulating blanket, sheathed in a UL approved seamless exterior vapor barrier jacket. Flexible air ducts shall be semi-rigid construction capable of being easily hand pre-formed into required elbows or offsets to suit job conditions without subsequent sagging or droop. Duct connections to equipment outlet collars shall be made in accordance with the duct manufacturer's recommendations.
- B. The joint shall consist of a triple lock that is mechanically performed without the use of adhesives to make a durable, airtight seam. A double lock is not acceptable.
- C. Length of flexible duct shall be as shown on the drawings, but shall not exceed length dictated by 2014 New York City Construction Codes.
- D. Bends shall be made with not less than 1 duct diameter centerline radius. Ducts should extend a few inches beyond the end of a sheet metal connection before bending. Ducts shall not be compressed.
- E. The complete assembly shall have been tested by UL and given the listing ULK 181 Class I Duct Material and shall also comply with NFPA 90A & 90B.
- F. Flexible duct shall be Flexmaster Triple Lock Type V, as manufactured by Flexmaster USA Corporation or approved equal.

#### 2.11 AIR INTAKES AND DISCHARGES

- A. Air intake and discharge louvers and screens in the façade of the building shall be furnished and installed under Louver, Screens specification section.



## 2.12 BLANK-OFF PANELS FOR UNUSED LOUVER AREAS

- A. Provide a minimum 20-gauge sheet metal blank-off panels for unused louver areas that are not enjoined or connected to an active plenum.
- B. Exterior/visible face of blank-off panel shall be cleaned and painted flat black, prior to installation.
- C. Provide safing consisting of 2" rigid insulation on an aluminum panel for all unused portions of the louver.
- D. Louver areas on mechanical drawings may be indicated in free area. Contractor to review architectural drawings and fixed louver and glazed aluminum curtain wall shop drawings, as applicable, to determine actual louver areas.

## 2.13 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. METALAIRE, Inc.
  - 4. SEMCO Incorporated
  - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
  - 6. Or approved equal
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall for ducts up to 32 inches wide and double wall for larger dimensions.

## 2.14 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Sealant: Modified styrene acrylic.



3. Water resistant.
4. Mold and mildew resistant.
5. Service: Indoor and outdoor.
6. Service Temperature: Minus 40 to plus 200 deg F.
7. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch w.g, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S
3. Grade: NS
4. Class: 25
5. Use: O
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch w.g and shall be rated for 10-inch w.g static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.15 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electro galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct Hangers Minimum Size," and "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. All ductwork indicated on drawings is schematic. Therefore, changes in duct size and/or location shall be made where necessary to conform to space conditions, at no additional expense to The City of New York.
- C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- D. Provide necessary offsets, transitions and streamliners to avoid interference with the building construction, piping, or equipment. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- E. Provide fittings, branches, inlets and outlets in such a manner that air turbulence is reduced to a minimum.
- F. Provide a duct system with minimum resistance to airflow. Take-offs shall be throated and transitions made as gradual as possible. 'Bullhead' or sharp take-offs are not acceptable. Branch take-offs shall be 45 deg entry type. Straight tap or butt flanged connections are not acceptable. Clinch lock connections are preferred.
- G. Provide straight runs of ductwork at equipment, fans, coils, terminal boxes and humidifiers per manufacturer's recommendations.
- H. Tees and laterals at 90 deg or round ducts shall be 45 deg lateral or 90 deg tee with oval to round tap. 90 deg tee fitting or 90 deg tap is not acceptable. Conical tees are acceptable.



- I. Provide flexible connector where ductwork connects to fans, air handling units and other rotating equipment and where indicated on drawings.
- J. Furnish and install manual dampers, fire dampers, registers, grilles, register boxes, access doors, sound traps, etc., as described elsewhere in the specifications and as required for a complete system, ready for operation.
- K. Where fire and smoke dampers, automatic dampers or combination fire/smoke dampers are shown on drawings or are required, their selection shall be made so that the dampers of all ratings and types shall be of the nominal 100% face area type, with blade package and frame components out of the airstream. These dampers shall include the required oversize enclosures that shall be sealed by the damper manufacturer for the appropriate duct pressure class into which they are installed. Such dampers shall have appropriate rectangular, flat oval or round duct collars to facilitate connection of mating ductwork. The Contractor shall be responsible for any additional sealing of duct collars and connections required to maintain the duct seal class requirements, but shall not jeopardize the UL breakaway connection.
- L. All dampers are to be selected and installed with duct transitions so that the damper clear open area (including frames, stops, etc.), equals to or exceeds the connecting duct (inlet and outlet) clear open area (duct clear inside dimensions). Provide the required duct transitions.
- M. Install ducts with fewest possible joints.
- N. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- O. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- P. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- Q. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- R. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures as well as avoid any NEC required working and service space.
- S. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- T. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- U. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines." Ductwork shall not be left exposed for more than 8 hours at a time.
- V. Ductwork connected to intake or discharge louvers shall be galvanized steel, painted for the first 10 feet with bitumastic, pitched to a low point, and provided with a 1-1/2" copper drain piped by this trade to a building drain.



- W. Provide companion flange joints, fabricated in the contractor's shop, similar to SMACNA Type T-24a, T-25a or T-25b (Table 2-32, SMACNA, "HVAC DUCT CONSTRUCTION STANDARDS"). Joints shall be consistent with ductwork pressure class. PVC clips are not permitted (use metal) and all corners shall be bolted (boltless connectors are not permitted).
- X. For fire damper (or fire/smoke damper) use UL approved, flanged breakaway bolted connections, assembled in the contractor's shop.
- Y. Use gasketed type joint when dissimilar metals are joined.
- Z. All ductwork unless otherwise noted shall be hung with 1 in. x 1/8 in. galvanized iron bands. Ductwork with cross sectional area under 4 square feet shall be hung on 8'-0 in. centers. For ducts with a cross-sectional area of more than 4 sq. ft. but not over 10 sq. ft. hangers shall be no more than 6 feet apart, and for ducts with a cross sectional area of more than 10 sq. ft. hangers shall be no more than 4 ft. apart. All hangers shall be bent (2" minimum) under the bottom as well as the sides and secured with sheet metal screws.
- AA. Where ducts are stacked they shall be independently supported as above or shall be supported on minimum 1 1/4" x 1 1/4" x 1/8" angle cradle hung by either 1 1/4" x 1 1/4" x 1/8" angles or 3/8" diameter threaded rod.
- BB. All ductwork shall be substantially built with approved joints and seams smooth on the inside and a neat finish on the outside. Duct joints as near air tight as possible, with laps made in the direction of air flow and no flanges projecting into the air stream. Ducts shall be adequately braced to prevent vibration. All angles shall be galvanized or shop painted with two coats or rust resistant paint.
- CC. Changes in shape and dimension shall conform to the following:
  - 1. Increase and reduce duct sizes gradually. Limit transition angle (for each side) to the following:
    - a. For increases in cross-sectional area, the shape of the transformation shall not exceed 1" in 7".
    - b. For reductions in area the slope may be 1" in 4" but 1" in 7" is preferred.
- DD. Changes in direction shall conform to the following:
  - 1. Unvaned elbow with throat radius not less than 1/2 the width of the duct.
  - 2. Provide square elbows in rectangular ducts where radius elbows will not fit or where specifically noted on drawings. Square elbows with single thickness duct turns shall be as per SMACNA with 3-1/4" spacing, and are acceptable in ducts with not more than 2200 FPM air velocity. For higher velocities, use sweep type vanes.

### 3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified herein according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Sealant: Water based elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) specifically for sealing ductwork. Use products as recommended by manufacturer for low, medium or high pressure systems.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Aeroseal
  - 2. Hardcast
  - 3. United McGill
  - 4. Ductmate
  - 5. Or approved equal
- D. Provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable.
- E. Tape: Use only tape specifically designated by the sealant manufacturer. SMACNA recommends that foil tape not be used and that pressure sensitive tape not be used on bare metal surface or on dry sealant.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Provide fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2,
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet (5 m).

- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by 2014 NYCBC. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.
- B. Refer to Section: "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components" for additional requirements.
- C. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install cable restraints on ducts that are suspended with vibration isolators.
- F. Install seismic-restraint devices using methods approved by an agency acceptable to New York Department of Buildings.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

### 3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with these specifications.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.8 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

### 3.10 LEAKAGE, TESTING, AIR DISTRIBUTION SYSTEMS

- A. Each air distribution system shall be tested for leakage before insulation is applied.
- B. Testing will be done under another section of this work. Refer to section 23 05 93 "TESTING, ADJUSTING AND BALANCING" for additional requirements.
- C. This contractor is responsible to provide all necessary labor to assist in the testing as well as make all provisions for the installation and removal of testing equipment, probes, sensors, etc.





- D. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- E. Give (7) seven days' advance notice for testing.

### 3.11 START UP

- A. Air Balance: Comply with requirements in Section 230593 "TESTING, ADJUSTING, AND BALANCING FOR HVAC."

### 3.12 DUCT SCHEDULE

- A. A perforated inner metal liner consisting of 22 ga. galv. Steel with 3/32" dia. Holes on 3/16" or 1/4" centers or the equivalent aluminum shall be installed in every one of the following conditions. (Fastening for metal liners shall only be by welded stud. Where duct cross section exceeds 48" the top section shall be fastened with twice the amount of clips).

- 1. Where shown on drawings.
- 2. Where called for elsewhere in these documents.
- 3. Where the duct can be walked on, metal liners shall be used on bottom portions.
- 4. Where the velocity in the duct exceeds 3500 FPM.

- B. Double-Wall Duct Interstitial Insulation:

- 1. Supply Air Ducts: 1-1/2 inches (38 mm).
- 2. Return Air Ducts: 1 inch (25 mm).
- 3. Exhaust Air Ducts: 1 inch (25 mm).

- C. Elbow Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.



**END OF SECTION 23 31 13**



## **SECTION 23 31 20**

### **FIRE-RESISTIVE DUCT-PIPE INSULATION AND ENCLOSURE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 07 00 "HVAC Insulation".
- F. Section 23 11 13 "Facility Fuel Oil Piping".
- G. Section 23 31 13 "Metal Ducts".
- H. This section is a part of each Division 23 00 00 section.

##### **1.2 SUMMARY**

- A. Supply all labor, material, methods and equipment to provide, where shown on the Drawings, 1 and/or 2-hour fire rated duct or pipe wrap insulation or enclosures for piping, ventilation, exhaust or kitchen exhaust grease ducts and for zero-inch clearance to combustible materials.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with

the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 REFERENCES

- A. Test standards and reports for evaluating and rating performance of fire resistive and zero-inch clearance duct wrap systems.
- B. Underwriters Laboratories Inc., (UL):
  - 1. UL 723, surface burning characteristics per ASTM E 84:
  - 2. UL 1978, First Edition of the Standard for Grease Ducts.
  - 3. UL 263, Full Scale External (Engulfment) Fire Test.
- C. ISO 6944-1985, 'Fire Resistive Tests - Ventilation Ducts'.
- D. ASTM:
  - 1. ASTM E 2336, 'Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems'.
  - 2. ASTM E 84, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.
  - 3. ASTM C 1338, 'Fungi Resistance of Insulation Materials and Facings Standard'.
  - 4. ASTM E119 (UL 263) Standard Method of Fire Tests of Building Construction and Materials; 2-hour Wall Panel Test, and 2-hour External Total Engulfment Test.
  - 5. ASTM E814 (UL 1479) Standard Method of Fire Test of Through-Penetration Fire Stops; 2-hour Firestop Test.
  - 6. ASTM E1529 (UL 1709): Determining Effects of Large Hydrocarbon Pool Fires on Structural Members.
  - 7. ASTM E 1725 (UL 1724) Fire Tests of Fire-Resistive Barrier Systems.
    - a. C518-91, Aging Test.
- E. BOCA Evaluation Services, Inc.
- F. NFPA 96, 1994 Edition, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- G. California State Fire Marshall.
- H. US Department of Transportation (DOT)
- I. New York City Department of Buildings

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".



- B. Applicator: Manufacturer trained, specializing in fire resistive ductwork enclosure application with seven years minimum experience.

**1.7 SYSTEM PERFORMANCE REQUIREMENTS**

- A. A lightweight, high-temperature, fiber blanket thermal insulation encapsulated in a fiberglass-reinforced aluminized polyester foil.
- B. Duct wrap density shall be nominal 6 pcf and have a nominal 1-1/2" thickness. The fiber blanket shall have a continuous use limit of 1000°C (1832°F).
- C. The blanket thermal resistance (R-value) at ambient temperature shall be a minimum of 6.3 °F-ft<sup>2</sup>-hr/BTU.
- D. The bare blanket and the foil encapsulated blanket insulation shall have composite (insulation, foil encapsulation, facing, and adhesive used to adhere the facing to the blanket) fire and smoke hazard Index as tested by procedure ASTM E.84, NFPA 255 or UL 723 of:

Flame Spread	0
Smoke Developed	0

- E. The wrap shall provide a 2-hour fire resistive rated enclosure system, shaft enclosures, when used with a listed or approved through-penetration protection system.
- F. Two-hour rated fire resistive enclosure assembly, ASTM E119: Large Scale Wall Test and Total Engulfment Test.
- G. Non-Combustibility, ASTM E136
- H. Class 1 interior finish materials, ASTM E84.
- I. Zero-inch clearance to combustibles, maximum allowable surface temperature on unexposed side, UL 1978.
- J. Listing Agency: Provide products that are listed by the following:
1. Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory" category HNLJ, HNMF or XHEZ as appropriate.
  2. Intertek Testing Services (ITS) (formerly Omega Point Laboratories (OPL)), in "Intertek Directory of Listed Products."
  3. International Code Council, Evaluation Services (ICC-ES). See report ESR-1255.
  4. Furnish products identical to those tested for classification by listing agency.
- K. Mark product packing with classification marking of listing agency.
- L. Fire-resistant Enclosure Listings – Provide the below listings or a similar approved listing with identical rating and similar material construction:
1. Chemical Fume Duct:
    - a. Intertek 3MU/FRD 120-10, 3MU/FRD 120-11
  2. Ventilation Duct:



- a. Intertek 3MU/DI 60-01, 3MU/DI 120-01
- b. UL: HNLJ.V-27

- M. Fire Rating (Ventilation Air Duct): All duct wraps must be One (1) hour rated, but in no case less than the rating of any time-rated assemblies which are penetrated.
- N. Fire Rating (Ventilation Air Duct): All duct wraps must be Two (2) hour rated, but in no case less than the rating of any time-rated assemblies which are penetrated.
- O. Fire Rating (Grease Duct): All duct wraps must be compliant to all five (5) sections of ASTM E 2336. All duct wraps must be a minimum one (1) hour rated, but in no case less than the rating of any time-rated assemblies which are penetrated.
- P. Fire Rating (Plenum Rated): All plenum wraps must be compliant to NFPA 262 (electrical cables) and/or UL 1887 (non-metallic pipe).

#### 1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.9 SUBMITTALS

- A. Submit test reports substantiating performance requirements and Code compliance.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original sealed containers or unopened packages, and clearly labeled with manufacturer's name, product identification, and lot numbers.
- B. Store materials out of weather and in an enclosed shelter fully protected from physical damage.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M
  - 2. Premier Refractories International
  - 3. Hilti
  - 4. Or approved equal

#### 2.2 FIRE BARRIER DUCT WRAP INSULATION - GENERAL

- A. A lightweight, high-temperature, fiber blanket thermal insulation encapsulated in a fiberglass-reinforced aluminized polyester foil.
- B. Duct wrap density shall be nominal 6 pcf and have a nominal 1-1/2" thickness. The fiber blanket shall have a continuous use limit of 1000°C (1832°F).
- C. The blanket thermal resistance (R-value) at ambient temperature shall be a minimum of 6.3 °F-ft<sup>2</sup>-hr/BTU.
- D. Smoke developed Index and Flame Spread Index of the bare blanket and of the foil



encapsulated blanket shall be 0/0. The foil encapsulation shall be bonded to the core blanket material.

- E. Duct wrap system shall provide zero-inch clearance to combustible construction.
- F. The bare blanket and the foil encapsulated blanket insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard Index as tested by procedure ASTM E.84, NFPA 255 or UL 723 of:

Flame Spread	0
Smoke Developed	0

- G. The duct wrap shall provide zero clearance to combustible construction throughout the entire enclosure system.
- H. The duct wrap shall be certified according to ASTM E2336 (Grease Duct Test Standard) in two-layer system and ISO 6944 (Air Duct Test Standard) in single layer system.
- I. The product shall be listed with both UL and Intertek (OPL) for 2 hour rated application.

## 2.3 FIRE RATED DUCT ACCESS DOORS

- A. Provide fire rated duct access doors meeting the rating required for the adjacent construction as indicated on the drawings and as specified herein as well as other sections of this work, as well as per 2014 New York City Construction Codes.
- B. The doors and accessories shall be UL 1978 listed for grease leakage and Intertek/OPL listed when combined with the submitted Duct Wrap.
- C. Doors shall meet the requirements of NFPA 96.
- D. See Section 08 31 13 "Access Doors and Frames".

## 2.4 FIRESTOPPING:

- A. As part of this work, for penetrations through fire rated walls, ceilings or floors, furnish and install a complete, UL and Intertek approved firestop system sole sourced from a single approved manufacturer, as listed above.
- B. Firestop Listings:
  - 1. The following is only a partial list of ASTM E 814 tested through-penetration designs. Consult with the manufacturer for more information.
    - a. UL: W-L-7180, W-J-7104, C-AJ-7096, F-C-7054.
  - 2. Intertek (formerly Omega Point Laboratories): Note: Intertek Design Listings for fire-resistant enclosures contain the information about firestopping the ducts where they penetrate a fire rated assembly; they are stand-alone listings which do not require an additional firestop listing.
  - 3. Firestopping Exposed to View: Provide products with flame spread index of less than 25 and smoke developed index of less than 450, when tested in accordance with ASTM E 84.
  - 4. Materials: Use only products specifically listed for use in listed systems.



5. Compatibility: Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this project, based on testing and field performance demonstrated by manufacturer.
  - C. Firestopping material must be asbestos-free and capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM and UL standards cited in this section.
  - D. Firestopping materials must meet and be acceptable for use by all building codes and NFPA codes cited in this section.
    1. Materials must be suitable for the firestopping of penetrations made by steel or duct wrap
    2. Through-penetration firestop materials:
      - a. Packing materials: Pieces of 4 pcf mineral wool.
      - b. Sealants: 1000 NS non-slump silicone sealant, 1003 SL self-leveling silicone sealant, 2000+ premium non-slump silicone sealant, or CP 25WB+ premium intumescent latex caulk, as stated in firestop Design Listing.
  - E. The firestopping shall be installed under the direction and supervision of the Fire Duct Wrap manufacturer.
  - F. Products shall conform to the appropriate system design Listings for the intended application:
  - G. The contractor shall be Manufacturer instructed, specializing in fire duct wrap insulation and firestopping applications.
  - H. Refer to Section – FIRESTOPPING for additional details
- 2.5 FIRE BARRIER DUCT WRAP INSULATION (TYPE D-7)
- A. Fire resistive duct wrap must be approved for use in NYC.
  - B. Duct wrap density shall be a nominal 6 pcf and have a nominal 1-1/2" thickness. The fiber blanket shall have a continuous use limit of 1832 F. The single layer R-value at 77 F temperatures shall be a minimum of 6.3.
  - C. Duct wrap shall provide zero clearance to combustible construction throughout the entire enclosure system.
  - D. Products to conform to the following system design Listings for the intended application, or equivalent designs offering an identical UL rating with similar construction:
    1. Ventilation Air Ducts: UL Design No. V-27 or Intertek Design No. 3MU/FRD-120-15.
    2. Kitchen Exhaust Grease Ducts: Intertek Design Listing No's. GD 531 F, GD 547 F, GD 556 F or GD 557 F.
    3. Firestop Listings: UL Design Nos. W-L-7180, W-J-7104, C-AJ-7096 or Intertek Design No's. FS 557 W – FS 563 W, FS 565 W – FS 574 F, FS 576 F, FS 578 F, FS 579 W.
  - E. 3M Fire Barrier Duct Wrap 615 (Basis-of-Design), or equivalent product from an approved manufacturer listed above:
    1. Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate





- (CMS) woven wool blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 1.5 inches.
2. The Smoke Developed Index and Flame Spread Index (ASTM E 84) of the bare blanket and of the foil-encapsulated blanket shall be 0/0. The foil encapsulation shall be bonded to the core blanket material.
  3. The duct wrap shall provide zero clearance to combustible construction throughout the entire enclosure system.
  4. The duct wrap shall be certified according to ASTM E2336 (Grease Duct Test Standard) in two-layer system and ISO 6944 (Air Duct Test Standard) in single layer system.
  5. Fire Resistance Rating (ASTM E119, ASTM E814): 2 hour
  6. ISO 6944-1985 – Fire Resistance test.
- F. 3M Fire Barrier Duct Wrap 615+(Plus) (Basis-of-Design), or equivalent product from an approved manufacturer listed above:
1. High temperature, lightweight, non-asbestos, bio-soluble, fiber blanket thermal insulation encapsulated in a fiberglass – reinforced aluminized polyester foil.
- G. 3M Fire Barrier Plenum Wrap 5A+ (Basis-of-Design), or equivalent product from an approved manufacturer listed above:
1. High-Temperature, Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 0.5 inches for protection of items within a plenum area.
  2. Color: White blanket, aluminum foil encapsulated.
  3. Weight: 0.25 psf.
  4. Density: 6 pcf nominal.
  5. Thermal Conductivity (k-value) at 500 Degrees F (ASTM C411, ASTM C518): 0.48 Btu/(ft<sup>2</sup> × h × F)
  6. Service range up to 2000°F.
  7. Plenum Rating (electrical cables): Product complies with NFPA 262 (UL 910).
  8. Plenum Rating (non-metallic pipe): Product complies with UL 1887.
  9. Non-combustible per ASTM E 136
- H. 3M Fire Barrier Duct Wrap 20A (Basis-of-Design), or equivalent product from an approved manufacturer listed above:
1. Non-asbestos, biosoluble, patented inorganic fire resistant blanket encapsulated with a scrim-reinforced foil, blanket thickness of 2.0 inches for kitchen exhaust grease duct applications.
- I. The products shall be listed with both UL and Intertek (OPL) for 2 hour rated application.
- J. Products shall conform to the appropriate system design listings for the intended application:
- K. The contractor shall be Manufacturer instructed, specializing in fire duct wrap insulation and firestopping applications.
- L. Ventilation Duct Applications:
1. Ventilation Ducts:
    - a. 3M Fire Barrier Duct Wrap 615+ + (Basis-of-Design), or equivalent product from an approved manufacturer listed above:



- 1) For Ventilation Duct enclosures, provide a minimum of 1 layers of wrap with 3" perimeter and 3" longitudinal overlaps.
  2. Fire Resistance Rating (ASTM E119, ASTM E814): 2 hour
  3. Provide a minimum of 2 layers of wrap with 3" perimeter and 3" longitudinal overlaps.
  4. Two-layer grease duct application – meets the criteria of ASTM E 2336 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- M. 3M Fire Barrier Duct Wrap 20A + (Basis-of-Design), or equivalent product from an approved manufacturer listed above:
1. Non-asbestos, biosoluble, patented inorganic fire resistant blanket encapsulated with a scrim-reinforced foil, blanket thickness of 2.0 inches for kitchen exhaust grease duct applications.
  2. Materials: Fire resistive duct wrap insulation; 1.5" or 2" thick, fully encapsulated with a scrim-reinforced foil, marked with Manufacturer's logo and UL and Intertek markings.
  3. Tapes: High performance filament tape, Aluminum foil tape (for sealing cut blanket edges and seams).
  4. Banding material: Stainless steel banding:
  5. Insulation pins and clips: Copper-coated steel pins (10 ga), 1.5" diameter or square galvanized steel speed clips.
  6. Through-penetration firestop materials:
    - a. Packing materials: 4 pcf mineral wool.
    - b. Sealants: 1000 NS non-slump silicone sealant, 1003 SL self-leveling silicone sealant, 2000+ premium non-slump silicone sealant, or CP 25WB+ premium intumescent latex caulk, as stated in firestop Design Listing.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Remove dirt and dust, and clean surfaces of openings and items penetrating rated floors and rated walls.

### 3.3 INSTALLATION

- A. Install Duct Enclosure system in accordance with manufacturer's instructions and referenced standards.
- B. Install Duct Enclosure in direct contact with the duct it encloses. Protect every portion of duct including access doors with no less than 2 layers for 2-hour air duct enclosures. Overlap both perimeter and longitudinal joints minimum of 3" per layer of material. Filament tape is used as temporary hold on both layers until banding hardware is in place. Band exterior layer spaced minimum of 10.5" on center. For duct widths greater than 24", weld insulation pins to bottom, sides and vertical duct runs. Impale Duct Wrap over pins and secure with stainless steel speed clips until banding is applied.
- C. In transition areas (at bends and elbows) and at access door openings, provide additional pins



to assure integrity of the fire barrier. Perimeter of access door openings shall be sealed with approved, non-slump grade sealant.

- D. Protect floor and wall penetrations with an approved through-penetrations firestopping system having an hourly rating not less than that of assembly penetrated and installed in accordance with manufacturer's instructions.

#### 3.4 REPAIR PROCEDURE

- A. Repair damaged Duct Enclosure in accordance with manufacturer's instructions.
- B. Completely remove damaged section. Apply a new section of same direction. Place and fit ensuring same overlap that existed previously. Place banding around new material and tension to sufficiently hold in place.
- C. If damage has penetrated to interior layer, the affected sections of duct be stripped and reinstalled as specified in installation.

#### 3.5 INSPECTION

- A. Manufacturer's representative shall visit the site to verify that installation conform to manufacturer's requirements.

**END OF SECTION 23 31 20**



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**SECTION 23 33 10****DAMPERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".

**1.2 SUMMARY**

- A. This Section Includes:
  - 1. Damper junction box and wiring
  - 2. Dampers – Trade responsibilities
  - 3. Backdraft and pressure relief dampers.
  - 4. Dampers for balancing
  - 5. Dampers for Fire Protection
  - 6. Fire dampers
  - 7. Smoke dampers
  - 8. Combination fire and smoke dampers
  - 9. Smoke/Isolation dampers
  - 10. Positive Seal (Bubble-tight) Dampers
  - 11. Remote damper operators

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per subcontractor) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 REFERENCE STANDARDS

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. AMCA 511 - Certified Ratings Program for Air Control Devices.
- C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems
- E. NFPA 92A - Smoke-Control Systems.
- F. NFPA 101 – Life Safety Code.
- G. UL 555 - Standard for Safety; Fire Dampers.
- H. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.
- I. SMACNA – HVAC Duct Construction Standards, Latest Edition.
- J. BSA - Department of Buildings, Board of Standards and Appeals.
- K. MEA –Department of Buildings, Material and Acceptance Division.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 SUBMITTALS

- A. General:
  1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Dampers:
      - 1) Verify Conformance to NFPA, UL, BSA, MEA and 2014 NYCBC.
      - 2) Indicate materials, construction, and dimensions.
      - 3) Include damper pressure drop data for all damper sizes in accordance with AMCA 500-D test figure 5.3 (Ducted Inlet, Ducted Outlet).



- 4) Indicate damper leakage meets AMCA Class 1A in accordance with AMCA 500-D.
  - 5) Indicate damper is licensed to bear the AMCA Certified Ratings Seal for Air Performance and Air Leakage.
  - 6) Include a copy of the Installation Instructions.
- b. Special fittings.
  - c. Manual volume damper installations.
  - d. Control damper installations.
  - e. Fire-damper, smoke-damper, combination fire/smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
  - f. Duct security bars.
  - g. Wiring Diagrams: For power, signal, and control wiring.
2. Clearly indicate location, size and rating of all dampers on the shop drawings and shall provide access doors in the ducts at each damper of sufficient size (min. 14" x 14") and type to permit inspection and replacement of linkage or actuator. Provide itemized list (indicating size, location and type) of all fire, smoke and combination fire/smoke dampers for inspection and for posting in Engineers office. Coordinate all locations of duct access doors.
3. Provide installation detail showing the damper mountings as well as duct transitions, if required, to maintain the 100% damper free area in the ductwork.
4. Include damper manufacturer's installation instructions. These instructions shall describe the applicable requirements for damper sleeve thickness, retaining angles, sealing, duct to sleeve connections, preparation of wall, floor or ceiling openings, and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL 555, UL 555S and UL 555C qualification process. Detail any propose deviations. Any deviations must be approved by the Commissioner.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with AMCA 500-D testing for damper pressure drop rating.
- D. Dampers shall be licensed to bear the AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to Air Performance and Air Leakage.

## 1.9 DEFINITIONS

- A. Sealing Requirements Definition: For the purposes of duct systems sealing requirements specified in this section, the following definitions apply:
  1. Seams: A seam is defined as jointing

## PART 2 - PRODUCTS

### 2.1 GENERAL



- A. Furnish and install all electric operated dampers as well as all fire dampers for fire protection, manual dampers for balancing and/or shut-off as well as dampers which are specified as part of factory built air handling units or terminal units.
- B. Actuators for all fire and/or smoke rated dampers shall be factory installed by the damper manufacturer, as per their UL listing. The actuators shall be mounted outside of the airstream.
- C. Furnish the damper actuators for all non-rated dampers. The actuators shall be shipped to the factory and installed by the damper manufacturer. The actuators shall be mounted outside of the airstream.
- D. All dampers installed in air handling units or exposed to ambient conditions shall be constructed of aluminum with stainless steel linkages, fittings, etc.
- E. The mechanical contractor shall install all dampers.
- F. All dampers are to be selected and installed so that the frames, stops, etc. are located outside of the airstream so as to provide a nominal 100% free area damper.
- G. Dampers shall be installed per the condition of their UL listing and the manufacturer's installation instructions. The maximum single damper assembly whether single or multi-section shall not exceed the limit as certified by UL. Where multiple assemblies are required, provide UL approved mullions.
- H. Provide wiring as follows:
  - 1. Line and low voltage wiring for all motor operated fire and/or smoke rated dampers.
  - 2. Line and low voltage wiring for all motor operated control dampers
  - 3. Wiring from the damper actuator and any associated end switches and sensors to a junction box that is wall mounted alongside the damper.
  - 4. Between the central control system BMS and the junction box for all dampers monitored and/or controlled by the BMS.
  - 5. Between the junction box for all dampers and their associated thermostats, pressure switches, etc.
- I. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See section below for more installation details.)
- J. Dampers incorporating multiple sections shall be designed in such a way that the actuators are easily accessible. Under no circumstances shall it be necessary to remove damper sections or structural or other fixtures to facilitate removal of damper motors. Provide access doors wherever necessary to meet this requirement.
- K. Multi-blade type, with parallel blades for two-position, throttling and modulating service shall be provided. Damper blades or frames shall not distort or rack under operation.
- L. For inaccessible ceilings, as well as for special areas such as lobbies, etc., furnish remote damper actuator operable through face of nearest diffuser. Damper controller and cable shall be concealed above the ceiling. Similar to Bowden remote cable control system with Young regulator damper controllers. Balancing dampers shall include all necessary hardware to ensure compatibility with remote cable control system

## 2.2 DAMPER JUNCTION BOX AND WIRING





- A. Provide junction box(es) for each motorized damper.
- B. Provide the necessary relays, interconnect wiring and other components to meet the requirements detailed below. The junction box(es) relays, etc. shall be housed in wall-mounted enclosures, which meet the specifications detailed for local starter enclosures.
- C. The junction boxes shall be wired such that the Building Management System (BMS) can undertake the following control and monitoring functions:
  - 1. Open Control - A pair of terminals shall be wired such that when a controls (BMS) relay closes a contact pair across these terminals the damper is driven open. If the damper is two position with an actuator which drives closed and springs open on loss of power then these terminals shall not be used. This signal from the BMS shall be overridden by a close signal from the Fire Alarm System (FAS). Where dampers are interlocked to motors then the wiring shall be to these terminals.
  - 2. Close Control - A pair of terminals shall be wired such that when a controls (BMS) relay closes a contact pair across these terminals the damper is driven closed. If the damper is two positions with an actuator which drives open and springs closed on loss of power then these terminals shall not be used. This signal from the BMS shall be overridden by an open signal from the FAS.
  - 3. Motor Interlock - A pair of terminals shall be wired to an end switch on the actuator such that the contacts between the terminals shall be closed when the damper is fully open and open when the damper is not fully open. This pair of terminals shall be used for interlocking a damper with a motor such that the motor will not be able to start if the damper is not fully open.
  - 4. Damper Status: A pair of terminals shall be wired to an end switch on the damper such that the contacts between the terminals shall be closed when the damper is fully open and open when the damper is not fully open. This pair of terminals shall be used for open/closed status monitoring at the BMS.
- D. Smoke Evacuation Dampers
  - 1. For each damper which is to be monitored and/or controlled by the Fire Alarm System (FAS), the damper actuator, heat sensor and end switches shall each be wired by the mechanical trade to a junction box mounted adjacent to the damper so that the FAS can undertake the following control and monitoring functions:
    - a. FAS "Open/Close" Control - The damper will be driven open in response to closure of an FAS relay contact and will spring closed in response to opening of this relay contact.
    - b. FAS "Override Open" Control (Smoke Evacuation Dampers Only) - The damper will be re-opened, subsequent to a heat sensor initiated closure, in response to closure of a second FAS relay contact (or reclosure of the first contact for single sensor dampers).
    - c. FAS "Open/Closed" Status Monitoring Control (Smoke Evacuation Dampers Only) - End Switch closures will cause activation of FAS "opened" and "closed" relays in response to operation of end switches at both ends of travel.
    - d. FAS "Override of BMS" Control - For each damper requiring both FAS and BMS control, mount an interface relay within 30 circuiting feet of the junction box, so wired as to permit FAS override of the BMS control.
- E. The controls contractor's damper manufacturer shall provide all necessary wiring diagrams to the FAS contractors.



- F. Dampers furnished by the mechanical trade shall have similar junction boxes to which the controls contractor shall wire where necessary.
- G. Comply with code requirements. Segregate high and low voltage wiring & circuits and segregate the FAS and controls BMS terminals.

## 2.3 DAMPERS – TRADE RESPONSIBILITIES

- A. The following summarizes the trade responsibilities with respect to automatic dampers:
  - 1. Non-Fire or non-Smoke Rated Dampers
    - a. Furnish Damper - HVAC
    - b. Install damper – HVAC
    - c. Furnish Actuator – BMS
    - d. Install Actuator – HVAC
    - e. Provide junction box complete with all relays, wiring, etc. – BMS
    - f. Provide wiring between actuator, end switches, sensors, and junction box – BMS
    - g. Provide wiring from BMS to damper junction box - BMS
    - h. Provide wiring from FAS to damper junction box - N/A
    - i. Furnish 120V main power to elect. Actuators – BMS
    - j. Provide wiring from damper junction box to junction box for interlocked motors, etc. – BMS
    - k. Provide wiring from damper junction box directly to thermostats, etc. – BMS
  - 2. Fire and/or Smoke Rated Dampers not controlled by Fire Alarm system (FAS)
    - a. Furnish Damper - HVAC
    - b. Install damper – HVAC
    - c. Furnish Actuator – HVAC
    - d. Install Actuator – HVAC
    - e. Furnish and install junction box complete with all relays, wiring, etc. – HVAC
    - f. Provide wiring between actuator, end switches, heat sensors, and junction box – HVAC
    - g. Provide wiring from Central Control System (BMS) to damper junction box – BMS
    - h. Provide wiring from FAS to damper junction box – N/A
    - i. Furnish 120V main power to elect. Actuators – BMS
    - j. Provide wiring from damper junction box strip to junction boxes for interlocked motors, etc. – BMS
    - k. Provide wiring from damper junction box directly to thermostats, etc.- BMS
  - 3. Fire or Smoke Rated Dampers controlled by Fire Alarm system (FAS).
    - a. Furnish Damper - HVAC
    - b. Install damper – HVAC
    - c. Furnish Actuator – HVAC
    - d. Install Actuator – HVAC
    - e. Furnish and install junction box complete with all relays, wiring, etc. – HVAC
    - f. Provide wiring between actuator, end switches, heat sensors, and junction box – HVAC
    - g. Provide wiring from Central Control System (BMS) to damper junction box - BMS
    - h. Provide wiring from FAS to damper junction box – Electrical (FAS)
    - i. Furnish 120V main power to elect. Actuators – Electrical
    - j. Provide wiring from damper junction box to junction boxes for interlocked motors, etc. – BMS



k. Provide wiring from damper junction box directly to thermostats, etc. – BMS

4. Emergency Generator Intake Dampers - HVAC

- B. Controls contractor shall have overall responsibility for the complete coordination of the work and the operation of the damper/actuator installation.
- C. In mechanical or electrical rooms 120V power circuits will be provided from an emergency distribution board. These circuits will be terminated in a junction box located in each associated mechanical room and shall be used by the controls contractor to supply local control panels and critical equipment.
- D. These circuits will also be used by the electrical trade to supply dampers, etc., requiring control by the Fire Alarm System. Final connection from the junction boxes to the actuators, end switches and sensors shall be by the mechanical trade.
- E. For dampers not requiring control by the fire alarm system and for other non-critical equipment, obtain power from either the emergency circuits as detailed above or from the motor starter junction box. All wiring shall be by the controls contractor.

2.4 DAMPER END SWITCH

- A. All fire/smoke and smoke rated dampers shall be provided with two (2) factory installed end switches.
- B. All automatic control dampers shall be provided with one (1) factory installed end switches.
- C. Damper end switches shall be devices that directly detect the desired position of the damper blades. The switch shall not be a component of the actuator nor shall it be mounted on the damper shaft.
- D. The damper end switches shall be wired by the BMS contractor to enable the BMS to exercise, monitor and log the status (open/closed) of each damper. The BMS shall be able to open and close the individual dampers for verification and maintenance programs. This BMS wiring and monitoring is independent of the fire alarm system.
- E. The end switch shall be as manufactured by Square D, Allen Bradley, Cutler hammer, or approved equal.

2.5 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ruskin Company
  - 2. Imperial
  - 3. Pottorff; a division of PCI Industries, Inc.
  - 4. Or approved equal
- B. Description: Gravity balanced.
  - 1. Maximum Air Velocity: 5000 fpm.
  - 2. Maximum Pressure drop: 0.05" w.g.
  - 3. Maximum System Pressure: 10-inch w.g.
  - 4. Maximum Leakage: 2cfm/sf @ 1" sp.



5. Frame: Minimum of 3 inches wide with a maximum of 1/8-inch-thick extruded aluminum, with welded corners and mounting flange.
6. Blades: Single piece, maximum width of 6 inches, counter-balanced, 0.050-inch- thick aluminum sheet with sealed edges, blade ends shall overlap for maximum closure.
7. Blade Seals: Neoprene and mechanically attached to blade edge.
8. Bearings: Stainless steel
9. Linkages: Stainless steel.
10. Blade Axles:
  - a. Material: Stainless Steel.
  - b. Diameter: 0.20 inch.
11. Mounting shall be suitable for the required orientation.
12. Fittings: Stainless steel
13. Accessories:
  - a. Mounting holes.
  - b. Adjustment device to permit setting for varying differential static pressure.
  - c. Counterweights and spring-assist kits for vertical airflow installations.
  - d. Electric actuators.
  - e. Chain pulls.
  - f. Screen Mounting: Front mounted in sleeve.
  - g. Sleeve Thickness: 20-gage minimum.
  - h. Sleeve Length: 6 inches minimum.
  - i. Screen Mounting: Rear mounted.
  - j. Screen Material: Aluminum
  - k. Screen Type: Insect
  - l. 90-degree stops.

## 2.6 DAMPERS FOR BALANCING

### A. Low-Leakage, Steel, Manual Volume Damper

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ruskin Company
  - b. Imperial.
  - c. Pottorff; a division of PCI Industries, Inc.
  - d. Or approved equal
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.

### B. General Volume Damper Requirements:

1. Provide factory fabricated manual volume dampers in all supply, return and exhaust branch ducts for properly regulating and balancing airflow to all terminal outlets, whether indicated on drawings or not. Dampers shall be constructed per SMACNA, latest edition, figures 2-12 and 2-13 with locking quadrant and 8" maximum blade width.
2. Volume dampers shall be controlled by an approved galvanized locking quadrant indicating the damper position.



3. When installing dampers in ducts to be insulated provide raised bracket for damper quadrant with height equal to insulation thickness such that the adjustment of the damper handle will not disturb the insulation.
4. Locate damper as far as possible from air outlet to avoid noise transmission.
5. Coordinate with G.C. for easy access to damper.
6. Dampers in stainless steel ductwork shall be of stainless steel construction.
7. Frames:
  - a. Galvanized-steel channels, 0.064 inch thick.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
8. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized, roll-formed steel, 0.064 inch thick.
  - e. Maximum 6-inch width.
9. Blade Axles: Aluminum.
10. Bearings:
  - a. Stainless-steel sleeve.
  - b. Dampers in ducts with pressure classes of 3-inch w.g or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
11. Blade Seals: Neoprene.
12. Jamb Seals: Cambered aluminum.
13. Tie Bars and Brackets: Galvanized steel.
14. Accessories:
  - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

## 2.7 AUTOMATIC CONTROL DAMPERS

- A. Automatic control damper actuators are specified under section 23 09 00 - HVAC Instrumentation and Controls.
- B. Dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
- C. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
- D. All dampers installed in air handling units or exposed to ambient conditions shall be constructed of aluminum with stainless steel linkages, fittings, etc.
- E. For dampers not located in air handling units or are not exposed to ambient conditions shall be constructed of aluminum with aluminum or corrosion resistant zinc & nickel-plated steel linkages, fittings, etc.



- F. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
- G. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For Single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
- H. Damper manufacturer shall supply alignment plates for all multi-section dampers.

## 2.8 DAMPERS FOR FIRE PROTECTION - GENERAL

- A. Dampers and fire doors for fire protection shall be installed where shown on the drawings and where required by code and shall be of the folding blade type.
- B. Dampers shall bear the UL label and shall be provided with factory installed UL rated full sleeves. Comply with UL recommendations for break-away connections at maximum distance of 6" from wall and all other UL recommendations and code requirements. Retaining angles must be wide enough to have sufficient bearing on wall (minimum surface contact) of 1".
- C. Type: Static and dynamic rated and labeled according to UL 555 by an NRTL.
- D. For installation in 1-1/2 Hr. or 2 Hr. fire separations of fire divisions provide 1-1/2 hour fusible link fire dampers U.L. labeled for use in Class B openings. For installation in 3 or 4 hour fire separations or fire divisions provide two fire dampers in series U.L. labeled for use in Class A openings, or other U.L. classified damper rated for 3 hrs.
- E. Damper blades and frame shall be out of airstream, to provide nominal 100% free area dampers and to minimize pressure drops.
- F. Dampers shall be approved by the New York Department of Buildings. NYC codes shall take precedence where they supersede NFPA. However, the notify the Engineer in writing citing such differences by reference to such codes should the contract documents not reflect these differences.
- G. Provide duct access doors at each damper of sufficient size and type to permit inspection and replacement of linkage. It shall be the contractor's responsibility to coordinate all locations for duct access doors.
- H. Access doors shall be cam latched with vinyl gasket to provide tightest possible seal between the duct and frame. Doors shall be self-tightening and gasketed with hand operated cam locks and will be fully insulated. Access doors shall be Air Balance Inc. Fire/Seal or approved equal.
- I. Units shall be MEA and Board of Standards and Appeals for use in New York City.

## 2.9 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ruskin Company
  - 2. Imperial
  - 3. Pottorff; a division of PCI Industries, Inc.
  - 4. Or approved equal



- B. Type: Static and dynamic rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch w.g. static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- installed, galvanized sheet steel, UL approved.
- G. Minimum Thickness: 0.138 inch thick, and of length to suit application.
- H. Mounting Orientation: Vertical or horizontal as indicated.
- I. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- J. Horizontal Dampers: Include blade lock and stainless steel closure spring with locking devices to insure closure.
- K. Heat-Responsive Device: Fusible link, factory installed, 212 deg F rated.

#### 2.10 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ruskin Company
  - 2. Imperial
  - 3. Potoroff. Pottorff; a division of PCI Industries, Inc.
  - 4. Greenheck Fan Corporation
  - 5. Nailor Industries Inc.
  - 6. Or approved equal
- B. Similar to Ruskin SD 60.
- C. Dampers shall meet the requirements of NFPA90A, 92A and 92B and shall be classified as Smoke Dampers in accordance with the latest version of UL555S.
- D. General Requirements: Label according to UL 555S by an NRTL.
- E. Damper length shall not exceed UL approved damper size. Provide intermediate supports and bearings for damper blades, as required.
- F. All dampers shall be provided with two (2) factory installed position indicator end switches to enable remote status of open or closed positions by the BMS. Those dampers designated in the documents as being controlled by the central fire alarm (FAS) system (or central fire command station) will be wired for both remote status (BMS) and remote open/closed operation (FAS).
- G. The damper manufacturer shall provide the damper actuators.
- H. Dampers shall have UL label and be provided with factory installed UL-rated sleeves.
- I. Type: Static and dynamic rated and labeled according to UL 555 and UL 555S.



- J. Closing rating in ducts up to 4-inch w.g static pressure class and minimum 4000-fpm velocity.
- K. Smoke Detector: Integral, factory mounted and wired for single-point connection, located within airstream.
- L. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- M. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- N. Leakage: Class I in accordance with UL 555S.
- O. Rated pressure and velocity to exceed design airflow conditions.
- P. Temperature rating: 350 deg F.
- Q. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- R. Damper Motors: Modulating action.
  - 1. Motor Sizes: Sized so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  - 3. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
- S. Accessories:
  - 1. Auxiliary switches for signaling or position indication.
  - 2. Test and reset switches, remote mounted

## 2.11 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ruskin Company
  - 2. Inperial
  - 3. Pottorff; a division of PCI Industries, Inc.
  - 4. Or approved equal
- B. Similar to Ruskin FSD60 or approved equal.
- C. All dampers shall be provided with two (2) factory installed position indicator end switches to enable remote status of open or closed positions by the BMS. Those dampers designated in the documents as being controlled by the central fire alarm (FAS) system (or central fire command station) will be wired for both remote status (BMS) and remote open/closed operation (FAS).
- D. Damper length shall not exceed UL approved damper size. Provide intermediate supports and bearings for damper blades, as required.





- E. Dampers that are controlled from a central fire command station shall be provided with the following:
  - 1. A 212 deg F heat sensor with normally closed contacts (manual reset) to close and lock damper, if open.
  - 2. Dampers shall be factory equipped with a second normally close heat sensor correlating to the operator/actuator degradation temperature classification (250 deg F to 350 deg F depending on actuator used). The second sensor is wired through a manual override switch on the central fire command station.
- F. The damper manufacturer shall provide the damper actuators.
- G. Dampers shall have UL label and be provided with factory installed UL-rated sleeves.
- H. Type: Static and dynamic rated and labeled according to UL 555 and UL 555S.
- I. Closing rating in ducts up to 4-inch w.g. static pressure class and minimum 4000-fpm velocity.
- J. Fire Rating: 1-1/2 hours in accordance with UL555.
- K. Temperature rating: 350 deg F
- L. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- M. Heat-Responsive Device: See above.
- N. Smoke Detector: Integral, factory wired for single-point connection.
- O. Blades: Roll-formed, opposed, horizontal, interlocking, minimum 14 gauge thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- P. Bearings: Self-Lubricating, stainless steel sleeve.
- Q. Leakage: Class I in accordance with UL555S.
- R. Rated pressure and velocity to exceed design airflow conditions.
- S. Mounting Sleeve: Factory-installed, UL rated, stainless sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- T. Damper Motors: Modulating action.
  - 1. Motor Sizes: Sized so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  - 3. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
- V. Accessories:
  - 1. Auxiliary switches for signaling or position indication.



2. Test and reset switches, remote mounted

#### 2.12 SMOKE/ISOLATION DAMPERS

- A. Smoke/isolation dampers, shall be provided at air handling units in discharge and return ductwork, shall comply with NFPA 90A and the above requirements for smoke dampers, except that dampers shall have UL rated electronic actuators, with a minimum of one actuator for each sixteen square feet of damper area.

#### 2.13 POSITIVE SEAL (BUBBLE-TIGHT) DAMPERS

- A. Provide positive seal dampers at the inlet of each Mixed-Flow Induced Dilution Fans to allow for fan removal or for maintenance.
- B. Dampers shall have zero leakage rating at 10" WG differential pressure as per ANSI/ASME N510/ Furnish dampers with two flanges for connection to flanges in the ductwork. Provide duct transitions in connecting ductwork as required to accommodate dampers.
- C. Materials of construction:
  1. Casing: 304 Stainless Steel
  2. Dish: 304 Stainless Steel
  3. Shaft: 304 Stainless Steel
  4. Linkages: 304 Stainless Steel
  5. Gasket: Silicone
  6. Bearings: Nylon
  7. Tandem Seal Casing: 304 Stainless Steel
  8. Tandem Seals: Nitroxile
- D. Provide industrial grade manual operated actuators which shall be factory mounted, Actuator assemblies shall be installed outside airstream, linked to damper by jackshaft penetrating through tandem seals for airtight seal. Actuator shall be capable of closing damper at pressures encountered in system.
- E. Size positive seal dampers as close as possible to duct size, but in no case is damper size to be less than duct size.

#### 2.14 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Bowden
  2. Pottorff; a division of PCI Industries, Inc.
  3. Young Regulator Company.
  4. Or approved equal
- B. For inaccessible ceilings, as well as for specialty areas such as lobbies, etc., furnish remote damper actuator operable through face of nearest diffuser. Damper controller and cable shall be concealed above the ceiling. Similar to Bowden remote cable control system with Young regulator damper controllers or approved equal. Balancing dampers shall include all necessary hardware to ensure compatibility with remote cable control system



- C. Description: Cable system designed for remote manual damper adjustment.
  - 1. Tubing: Brass.
  - 2. Cable: Stainless steel.
  - 3. Wall-Box Mounting: Recessed, 2 inches deep, coordinate with Commissioner.
  - 4. Wall-Box Cover-Plate Material: Stainless steel, coordinate with Commissioner.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. All dampers are to be selected and installed with duct transitions so that the damper clear open area (including frames, stops, etc.) equals to or exceeds the connecting duct (inlet and outlet) clear free area (duct inside clear dimensions). The mechanical contractor shall furnish and install all required duct transition segments.
- C. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and stainless steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- F. Install steel volume dampers in steel ducts.
- G. Install aluminum volume dampers in aluminum ducts.
- H. Install aluminum dampers with stainless steel linkages in ductwork exposed to ambient air.
- I. Set dampers to fully open position before testing, adjusting, and balancing.
- J. Install test holes at fan inlets and outlets and elsewhere as indicated.
- K. Install fire, smoke and combination fire/smoke dampers according to UL listing.
- L. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 2. Adjacent to and close enough to fire, smoke and combination fire/smoke dampers, to reset or reinstall fusible links or service dampers.



3. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation.

M. Install access doors with swing against duct static pressure.

N. Access Door Sizes: minimum 14" x 14".

O. Label access doors according to indicate the purpose of access door.

### 3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 23 33 10**

**SECTION 23 33 11****HVAC SOUND ATTENUATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. SECTION INCLUDES:

1. Reactive sound attenuator devices for air ducts. May be referred to as silencers or sound traps.
2. Factory built packless (no media) sound attenuators & Duct Silencers

- B. Furnish and install reactive air duct sound attenuators with no fiber media of the type (encapsulated or exposed) and sizes shown on the plans and/or listed in the schedule and in accordance with the requirements of the contract documents.

- C. All systems, equipment and materials shall be approved for use in the State of New York.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

## 1.5 DEFINITIONS

- A. Decibel (dB): A standard unit of measure for sound pressure level or level difference. The sound pressure level in decibels (dB) is  $dB = 20 \log_{10} (P/P_0)$  where P is the instantaneous sound pressure and  $P_0$  is a reference sound pressure of  $20 \times 10^{-6}$  Pascals.

## 1.6 REFERENCE STANDARDS

- A. Each duct silencer and all components shall be designed, manufactured, and tested in accordance with the following standards:
1. ADC
  2. AMCA
  3. ASHRAE
  4. ASTM A 90 / A 90M-01
  5. ASTM A 568 / A 568M
  6. ASTM Procedure C-423-66
  7. ASTM Procedure E90-70
  8. ASTM E477-06a
  9. NFPA
  10. SMACNA
  11. UL

## 1.7 PERFORMANCE REQUIREMENTS

- A. All sound attenuators and assemblies shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
- B. Prefabricated sound attenuators shall be constructed of all incombustible materials and shall be the standard product of an approved manufacturer. The shell of the attenuator shall be at least 22-gauge galvanized steel sheet and shall be leak proof when subjected to a differential pressure of 6 inches w.g.
- C. Pressure drop shall be not greater than 0.34" w.c. Total system pressure before and after the sound attenuator shall be measured after the traps are installed. Should the pressure drop be greater than specified or scheduled, replace the attenuator and/or modify the entrance or discharge aerodynamic flow to achieve the specified results. Make all corrective measures at no additional expense to the City of New York.
- D. There shall be no acoustic fill within sound attenuator or within the air stream. No sound absorptive material of any kind is to be used in the attenuator. The sound attenuator shall attenuate air/gas transmitted noise solely by virtue of controlled impedance membranes and broadly tuned resonators
- E. All terminal units serving spaces designed for NC-35 or lower shall include a sound trap on the discharge.
- F. All main air handling units shall include sound attenuators on the main inlet and return or fresh air paths.
- G. The sound attenuators shall provide the following net insertion ratings under design airflow velocities as scheduled on the drawings. The ratings shall be determined by the duct to reverberant room test method.



- H. The maximum self-generated noise by the above sound trap types shall not exceed the following sound power levels at face velocities of 1,500 fpm.

Sound Attenuator Dynamic Insertion Loss (dB)				
		Unit Type		
Band #	Band Center Frequency (Hertz, cps)	A	B	C
1	63	8	8	11
2	125	7	11	15
3	250	15	19	22
4	500	17	23	27
5	1000	11	16	20
6	2000	11	14	18
7	4000	9	13	16
8	8000	8	11	15

Sound Power Level (dB re: 10 <sup>-12</sup> Watts)			
		Unit Type	
Band #	Band Center Frequency (Hertz, cps)	A	B, C & D
1	63	54	66
2	125	54	67
3	250	57	65
4	500	54	61
5	1000	54	58
6	2000	62	63
7	4000	65	69
8	8000	59	67

## 1.8 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.9 SUBMITTALS

- A. Sound attenuator manufacturer to provide submittal drawings detailing all duct attenuator data specified in the mechanical drawing schedule. Duct silencers for all equipment are included under this Section. Shop drawings shall state the sound attenuator manufacturer, tag number, cfm, static pressure loss, sound reduction in all eight (8) octave bands, model number, dimensions, weight and hanging point loads. In addition, any special tools, materials or details shall be listed on these drawings.
- B. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477-06a and so certified when submitted for approval. The laboratory must be currently NVLAP



accredited for the ASTM E477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop drawings submitted without proper certifications will be rejected.

1. Submitted sound attenuator pressure drops shall not exceed those listed in the silencer schedule. Sound attenuator pressure drop measurements shall be made in accordance with the ASTM E-477-06a test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.
2. The manufacturer shall supply certified dynamic insertion loss and self-noise power level data for each scheduled silencer. The data shall match the project's air distribution system requirement for forward or reverse flow, and total system airflow. All ASTM E-477-06a tests to obtain this data shall be conducted in the same facility and shall utilize the same silencer.
  - a. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule.
  - b. Silencer generated noise shall not be greater than that listed in the silencer schedule
3. The silencer manufacturer shall test the silencer(s) as indicated in the silencer schedule. The Commissioner shall be notified of the test date at least two weeks in advance and the test may be witnessed by the Commissioner. Test shall show compliance with the project criteria and is subject to Commissioner approval. Test facilities and test reports shall be open to inspection upon request from the Commissioner.
4. For specific silencers indicated on the silencer schedule, the silencer manufacturer shall provide Computational Fluid Dynamics (CFD) aerodynamic analysis. The analysis shall include the attached ductwork, a minimum of 5 equivalent duct diameters up and downstream of the silencer, as shown on the drawings, to determine silencer pressure drop, including system effects, at design airflow. The manufacturer must report and validate a converged solution domain of the CFD analysis to show the solution is independent of mesh refinement such that two models of different mesh refinement levels produce equivalent results, each with a maximum residual tolerance of 0.001. The minimum cell count shall be 200,000 and the validation model shall have a cell count at least 50% higher. The manufacturer must report the selection of CFD parameters, including mesh type, mesh size, boundary conditions, convergence criteria, and turbulence model. Each CFD analysis shall also include additional post-processed information including number of iterations, convergence status, and resulting y+ values.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Comply with NYS/IBC Section 717, "Installation of Air Conditioning and Ventilating Systems," and with NYS/IBC Section 717, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Silencer performance must have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477-06a. The test facility must provide for airflow in both directions through the test silencer. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption. The aero-acoustic laboratory must be currently NVLAP accredited for the ASTM E477-06a test standard.



- D. Provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to the compliance with the requirements, provide reactive sound attenuators from one of the following:
1. Vibro-Acoustics Corporation
  2. Industrial Acoustics Company
  3. Kinetics Noise Control
  4. Or approved equal.

### 2.2 FACTORY BUILT PACKLESS (NO MEDIA) SOUND ATTENUATORS & DUCT SILENCERS

- A. Silencers shall be of the reactive (no media) type with size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
- B. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
- C. Outer casings of reactive (no media) rectangular straight and elbow silencers shall be made of solid, lockformer quality 304 stainless steel in the following gauges and shall be leak proof when subjected to a differential pressure of 8 inches w.g.
1. OUTSIDE DIA. METAL GAUGE- (0-10"wg+)
    - a. 12-26 inches: 20 ga.
    - b. 27-60 inches: 18 ga.
    - c. 61-84 inches: 16 ga
- D. Internal casings shall be made of lockformer quality, 304 stainless steel.
- E. Sound attenuating units shall be leak proof and shall not fail structurally when subjected to a differential air pressure of 8" W.G. from inside to outside the casing.
- F. No sound absorptive material of any kind is to be used in the silencers. The silencers shall attenuate transmitted air noise solely by virtue of controlled impedance membranes and broadly tuned resonators.
- G. Units shall be constructed in accordance with the ASHRAE Guide recommendations for high-pressure ductwork. Seams shall be lockformed and mastic filled. Rectangular casing seams shall be in the corners of the silencer shell to provide maximum unit strength and rigidity. Interior partitions shall be fabricated from single piece sheets and shall have die-formed entrance and exit shapes so as to provide the maximum aerodynamic efficiency and minimum self-noise characteristics in the sound attenuator. Blunt noses or squared off partitions will not be accepted.
- H. The interior partitions shall be attached to the casing by means of an interlocking track assembly or spot welded to the outer silencer casing. Tracks shall be solid stainless steel and



shall be welded to the outer casing. Attachment of the interior partitions to the tracks shall be such that a minimum of 4 thicknesses of metal exists at this location.

- I. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the silencer for consistent aerodynamic and acoustic performance.
- J. Sound attenuating units shall be leak proof and shall not fail structurally when subjected to a differential air pressure of 8" W.G. from inside to outside the casing.
- K. Acoustic Performance
  - 1. Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E-477. The test facility shall be NVLAP accredited for the ASTM E477 test standard. Data from a non-accredited laboratory will not be acceptable. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated.
  - 2. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with airflow of at least 1000 fpm entering face velocity. Data for rectangular silencers shall be presented for tests conducted using silencers no smaller than the following cross-sections:
    - a. Rectangular, in. - 24x24, 24x30, or 24x36
- L. Aerodynamic Performance -
  - 1. Airflow measurements shall be made in accordance with ASTM specification E 477 and applicable portions of ASME, AMCA, and ADC airflow test codes.
  - 2. Airflow data shall be reported on the identical units for which acoustic data is presented.
  - 3. Airtight construction where required shall be provided by use of a duct sealing compound on the job site, material and labor furnished by the contractor.
- M. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- N. Accessories:
  - 1. Access Doors: Where indicated on the silencer schedule, silencers shall be supplied with an access door(s) to permit fire damper service. The silencer manufacturer shall supply access doors as an integral part of the silencer.
  - 2. Shipping Protection: Silencers shall be shipped with factory-installed end caps to prevent contamination during shipping.
  - 3. Airflow Measuring Devices: Where indicated on the silencer schedule, silencers shall have airflow measuring devices factory installed as part of the silencer assembly.

## 2.3 SOURCE QUALITY CONTROL:

- 1. Test the silencer(s) according to ASTM E 477-06a. The Commissioner shall be notified of the test date at least two weeks in advance and the test may be witnessed by the Commissioner. Test shall show compliance with the project criteria and is subject to Commissioner approval.
- 2. Test facilities and test reports shall be open to inspection upon request from the Commissioner. Silencer performance must have been substantiated by laboratory testing



according to ASTM E-477-06a and so certified when submitted for approval. The aero-acoustic laboratory must be NVLAP accredited for the ASTM E-477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.

### **PART 3 - EXECUTION**

#### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

#### **3.2 INSTALLATION**

- A. Install silencer according to manufacturer's written installation instructions.

#### **3.3 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Ensure duct silencers are installed with airflow arrows in direction of airflow.

**END OF SECTION 23 33 11**



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**SECTION 23 33 13****ACOUSTICAL DUCT LINING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Ductwork acoustical lining.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 REFERENCES**

- A. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.



- B. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- C. ASTM C 1071 – Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
- D. NFPA 90A
- E. NFPA 90B
- F. NAIMA AH 124
- G. ASTM E84 - Surface Burning Characteristics of Building Materials.
- H. NFPA 255 - Surface Burning Characteristics of Building Materials.
- I. UL 723 - Surface Burning Characteristics of Building Materials.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Submit product data under provisions of the DDC General Conditions.
- B. Include product description, list of materials and thickness for each service, and locations.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Applicator: Company specializing in ductwork acoustic lining application with three years minimum experience.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Acoustical Duct Lining Materials manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Owens Corning Aeroflex
  - 2. Manville Linacoustic
  - 3. CertainTeed Ultralite 150
  - 4. Substitutions are not acceptable.
  - 5. Or approved equal.

#### 2.2 MATERIALS

- A. Acoustical Duct Lining density shall be 1-1/2 lb. per cubic foot, minimum thickness of 1", unless specified greater.
- B. Lining shall have a composite fire and smoke hazard rating (UL 723) not exceeding:



Flame Spread: 25  
Smoke Developed: 50

- C. Asbestos shall not be used in the manufacture of lining products.
- D. Polymer film lining shall be pre-formed polyvinyl fluoride film, 1.5 mil thick.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PREPARATION

- A. Clean surfaces before applying adhesives.

#### 3.3 INSTALLATION

- A. This contractor shall make all necessary repairs to the lining where improperly applied, or damaged.
- B. Duct sizes shown on drawings shall be considered as clear inside dimensions.
- C. A perforated inner metal liner consisting aluminum (0.03 in thick) with 3/32" dia. holes on 3/16" or 1/4" centers or the equivalent aluminum shall be installed as specified herein. (Fastening for metal liners shall only be by welded stud. Where duct cross section exceeds 48" the top section shall be fastened with twice the amount of clips.)
- D. Refer to Details for additional requirements.
- E. The leading edge of acoustical duct liner (facing into the air flow) of each non-abutting section such as the first section facing into the fan, or the first section after a sound trap, or ducts having a velocity in excess of 3,500 FPM shall have a metal nosing.
- F. All portions of duct designated to receive acoustical duct liner shall be completely covered with acoustical duct liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. The black coated surface of the acoustical duct liner shall face the air stream. The acoustical duct liner shall be adhered to the sheet metal with 100% coverage of adhesive and all exposed leading edges and all transverse joints coated with adhesive. Adhesive shall conform to Adhesive and Sealant Council Standards for Adhesives for duct liner; ASC-C-7001C-1972. The acoustical duct liner shall be additionally secured with mechanical fasteners (Mechanical fasteners shall conform to Mechanical Fastener Standard MF-1-1971, available from Sheet Metal and Air Conditioning Contractors National Association), except that gripnails or the equivalent shall not be allowed. Acoustical duct liner shall be cut to assure overlapped and compressed longitudinal corner joints. Fasteners shall start within 3" of the upstream transverse edges of the liner and 3" from the longitudinal joints and shall be spaced as recommended by SMACNA.
- G. The film lining shall be placed on the airstream face of the acoustical duct lining material.
- H. Provide a perforated metal inner duct liner (as specified herein) for full extent of acoustical lining with polymer film.



- I. Duct liner shall not be installed within 15 downstream of humidifiers.
- J. Acoustical duct liner shall be installed per manufacturers' recommendation.

### 3.4 SCHEDULE

- A. The following items shall be acoustically lined. Where distances of lining are indicated, the intent is that all ductwork in any direction be acoustically lined.
  - 1. Ductwork downstream of fan coil units and terminal units a minimum distance of 10 feet.
  - 2. Upstream of return fans and exhaust fans, a minimum distance of 15 feet.
  - 3. Upstream of outside air supply fans, a minimum of 15 feet.
  - 4. Downstream from exhaust fans a minimum of 10 feet if the discharge of the exhaust fan runs through occupied spaces.
  - 5. Where shown on drawings.
- B. The following items shall, in addition to being acoustically lined (as specified above), shall also be provided with a Polymer film inner lining and perforated metal inner liner. For distances of lining, see above.
  - 1. All supply air ductwork located downstream of air handling Equipment (i.e. fan coil units, etc.).
  - 2. Where shown on the drawings.
  - 3. Where called for elsewhere in these documents.
  - 4. Where the duct can be walked on, metal liners shall be used on bottom portions.
  - 5. Where the velocity in the duct exceeds 3500 FPM.

**END OF SECTION 23 33 13**



**SECTION 23 34 16****HVAC FANS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".
- F. Section 23 34 17 "Vane Axial Fans".
- G. Section 23 34 18 "Mixed Flow Induced Dilution Fan".
- H. Section 23 34 19 "Plenum Fans".
- I. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section includes the following:
  - 1. Airfoil centrifugal fans.
  - 2. Backward-inclined centrifugal fans.
  - 3. Forward-curved centrifugal fans.
  - 4. Tubeaxial fans.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 PERFORMANCE REQUIREMENTS**

- A. Project Altitude: Base fan performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99
- C. AMCA Compliance:
  1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
  2. Operating Limits: Classify according to AMCA 99.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**1.6 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

**1.7 SUBMITTALS**

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
  1. Certified AMCA fan performance curves with system operating conditions indicated.
  2. Fan RPM shall be selected 10% above specified fan operating point.
  3. Certified AMCA fan sound-power ratings for the eight octave bands, decibels, and sones.
  4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  5. Material thickness and finishes, including color charts.
  6. Dampers, including housings, linkages, and operators.
  7. Provide dimensional drawings and product data on each fan.
  8. Provide manufacturer's certification that exhaust fans are licensed to bear Air Movement and Control Association (AMCA), Certified Rating Seal for sound and air performance
- B. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
  2. Duct installation in congested spaces, indicating coordination with general construction,



building components, and other building services. Indicate proposed changes to duct layout.

- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
  - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
  - 4. Conditions for Review
    - a. Submission for review must show air flow, static pressure, brake horsepower, KW input sound power ratings and full load efficiency complying with motor efficiency as specified under another section of this work.
    - b. Fans to be selected at or near efficiency peak (submit fan curves).
- D. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.8 REFERENCE STANDARDS;

- A. AMCA 99, "Standards Handbook"
- B. ANSI/AMCA Standard 204-96, "Balance Quality and Vibration Levels for Fans"
- C. ANSI/AMCA Standard 210-99, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating"
- D. AMCA Publication 211-05, "Certified Ratings Program – Product Rating Manual for Fan Air Performance"
- E. AMCA Standard 300-96, "Reverberant Room Method for Sound Testing of Fans"
- F. AMCA Publication 311-05, "Certified Ratings Program – Product Rating Manual for Fan Sound Performance"
- G. AMBA - Method of Evaluating Load Ratings of Bearings ANSI-11 (r1999).
- H. OSHA guideline 1910.212 – General requirements for Machine Guarding. ([www.osha.gov](http://www.osha.gov))
- I. OSHA guideline 1926.300 – General requirements for safe operation and maintenance of hand and power tools. ([www.osha.gov](http://www.osha.gov))



- J. OSHA guideline 1910.219 – General requirements for guarding safe use of mechanical power transmission apparatus. ([www.osha.gov](http://www.osha.gov))
- K. AMCA 260 – Certified Testing for Laboratory Dilution Fans.
- L. NFPA 96 - Commercial Cooking Operations

1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Fan shall be listed by Underwriters Laboratories (UL 705) for US.
- C. For smoke control applications, fan shall be listed by Underwriters Laboratories (Power Ventilator for Smoke Control Systems) for US.
- D. Classification for spark resistant fan construction shall conform to AMCA 99.
- E. For restaurant applications, fans shall be listed by Underwriters Laboratories (UL 762) for USA. Fans shall conform to NFPA 96.
- F. Centrifugal fans to be non over-loading having a sharply rising pressure characteristic which will extend throughout the operating range and continue to rise well beyond the efficiency peak to insure quiet, stable operation under all conditions.
- G. Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA seal for air performance and sound.
- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- I. Each fan shall be given an electronic vibration analysis in accordance with ANSI/AMCA Standard 204-96, while operating at the specified fan RPM. The vibration signatures shall be taken on each bearing in the horizontal, vertical and axial direction. The maximum allowable fan vibration shall be 0.15 in/sec peak velocity, filter-in as measured at the fan RPM. Report shall be provided at no charge to the customer upon request.
- J. ARI Compliance: Test and rate air devices in accordance with ARI Standards.
- K. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- L. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
- M. ADC Seal: Provide devices bearing ADC Certified Rating Seal.
- N. UL Compliance: The complete device must be labeled and listed by UL and must be installed to meet their requirements.
- O. All devices must be tested and approved for safety in accordance with the latest N.E.C.



- P. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance grade of G6.3).
- Q. Wheels shall be statically and dynamically balanced in accordance with AMCA Standard 204-96 "Balance Quality and Vibration Levels for Fans."
- R. High pressure air handling units shall only be furnished with Class III air foil fan wheels.
- S. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1 and NEMA 4 if exposed to the elements.
- T. NFPA Compliance: Comply with the following NFPA Standards:
  - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
  - 2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

#### 1.10 SEISMIC DESIGN

- A. This project is located within a seismic zone requiring special provisions for the support and restraint of equipment, components and piping.
- B. Refer to section 23 05 48 "Vibration Isolation, Seismic and Wind Restraints for HVAC Components".

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering with labels clearly indicating manufacturer, material, products included, and location of installation.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.
- E. Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual.

#### 1.12 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items



are specified in Division 7 Section "Roof Accessories."

**1.13 WARRANTY**

- A. Manufacturer's Warranty: Submit, for Commissioner's acceptance, manufacturer's standard warranty document executed by authorized company official.
  - 1. The warranty of this equipment is to be free from defects in material and workmanship for a period of five (5) years from date of Substantial Completion. Any units or parts which prove defective during the warranty period will be replaced at no expense to the City of New York.
  - 2. Motor Warranty is warranted by the motor manufacturer for a period of ten (10) years from Substantial Completion. Should motors furnished by us prove defective during this period, it will be replaced at no expense to the City of New York.

**PRODUCTS**

**1.14 MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Twin City
  - 2. Greenheck
  - 3. Bayley Fans, a division of Lau Industries, Inc.
  - 4. New York Blower Company
  - 5. Chicago Blower
  - 6. Howden Fan Co.
  - 7. Or approved equal

**1.15 FANS GENERAL:**

- A. It shall be understood that the requirements of this section are complementary to requirements delineated under other sections of this work.
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.
  - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  - 2. Spun inlet cone with flange.
  - 3. Minimum 1" discharge flange.
  - 4. The entire fan housing shall have continuously welded seams for leak proof operation.
  - 5. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. Braced to prevent vibration or pulsation.
  - 6. Inlet to be fully streamlined.
- D. Fans shall be statically and dynamically balanced at the factory prior to shipment. Wheels shall be statically and dynamically balanced in accordance with AMCA Standard 204-96 "Balance Quality and Vibration Levels for Fans."

- E. Fans shall be balanced for inverter duty operation (Variable Frequency Drives). The fan will be balanced over the entire range of fan operation (30% to 100% of RPM). Filter-in measurements shall not exceed 5 mils in the horizontal and vertical planes. Filter-out measurements shall not exceed 7.5 mils in the horizontal, vertical and axial planes.
- F. Fans to be non-overloading having a sharply rising pressure characteristic which will extend throughout the operating range and continue to rise well beyond the efficiency peak to insure quiet, stable operation under all conditions. The horsepower characteristic shall be truly self-limiting and shall reach a peak in the normal selection area.
- G. Spark-Resistant Construction: AMCA 99.
- H. Inlet Screens: Required for all fans, constructed for easy removal, of heavy wire mesh.
- I. Drain Connections: Provide 1" drain connection at bottom of fan.
- J. Access Doors: Are required in all fan scrolls of the quick opening type, secured to the frame by hand grip bolts and provided with lift handles. Raised type access doors shall be provided on all insulated fans (inner surface to be flush with the scroll).
- K. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
- L. Companion Flanges: Rolled flanges for duct connections of same material as housing.
- M. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
- N. Fans shall be provided with mechanical brake, coordinate with BMS.
- O. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
- P. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
- Q. Finish: Interior and exterior of fan to be factory coated
- R. Standard finish shall be a baked industrial grade finish conforming to the following ASTM Standards. Final coating thickness is 1.5 - 2.5 mils.

Property	Test Method	Value
Salt Spray	ASTM B117	1000+ hours
Humidity Resistance	ASTM D2247	1000+ hours
Impact Resistance	ASTM D2794	100 in. lbs.
Pencil Hardness	ASTM D3363	2H
Crosshatch Adhesion	ASTM D3359-B	100%
Max Service Temperature		230 deg F

- S. Vibration Isolation: Vibration isolators shall be provided as specified under another section of this work.
- T. In cases of fans where more than one speed is specified isolators shall be selected for the lowest speed.



- U. Motors: Motors shall meet or exceed the requirements specified herein and as specified in Section 23 05 13 "Motors for HVAC Equipment."
- V. The motor and fan base shall be welded or bolted to form a common base to prevent any uncommon physical motion of the fan and motor
- W. All fans that are field assembled, or are 75 HP or over, shall require the services of a factory engineer to balance and check bearings, pulleys, belts, etc. A report shall be filed attesting to the readiness of the fan to run and that the bearings are properly lubricated. He shall sign the lubrication tag which shall be turned over to the building maintenance personnel.
- X. Bearings: Heavy duties, self-aligning pillow block, grease lubricated, anti-friction ball or roller type bearings. Provide extended fittings to be mounted externally. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.
  - 1. Ball-Bearing Rating Life: ABMA 9, LI0 at 120,000 hours at maximum operating speed.
  - 2. Roller-Bearing Rating Life: ABMA 11, LI0 at 120,000 hours at maximum operating speed.
  - 3. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life and improve serviceability. Bearings that use set screws shall not be allowed.
  - 4. Extend lubrication lines to outside of casing and terminate with grease fittings.
- Y. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
  - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
  - 3. Fan shaft shall be ground and polished solid steel. (AISI 1018 steel through 2-inch diameter and AISI 1045 steel for greater than 2-inch diameter) with an anti-corrosive coating.
  - 4. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.

#### 1.16 AIRFOIL CENTRIFUGAL FANS

- A. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- B. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate; hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws and special coating.
- C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
  - 1. Service Factor Based on Fan Motor Size: 1.5
  - 2. For motors 3 HP and larger, there shall be at least two (2) belts; and drive capable of carrying the entire load with an additional 50% safety factor





3. Sheaves shall be adjustable ratio type; they shall be sized to give the required fan speed with motor sheave at about the middle of its range of adjustment.
  4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  5. Motor Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  6. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
  7. Belt Guards: Fabricate of steel to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
  8. Motor Mount: Adjustable for belt tensioning.
- D. Replacement of Sheaves: Provide additional adjustable or fixed sheaves at no extra expense, if required for balancing
- E. Characteristics:
1. Housing Material: Reinforced steel
  2. Special Housing Coating: Epoxy.
  3. Wheel Material: Steel.
  4. Special Wheel Coating: Epoxy

#### 1.17 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- B. Backward-Inclined Wheels:
1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blade welded to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
  2. Statically and dynamically balanced in accordance to AMCA Standard 204-05
  3. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
  4. Constructed of aluminum
- C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5
  2. For motors 3 HP and larger, there shall be at least two (2) belts; and drive capable of carrying the entire load with an additional 50% safety factor
  3. Sheaves shall be adjustable ratio type; they shall be sized to give the required fan speed with motor sheave at about the middle of its range of adjustment.
  4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  5. Motor Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  6. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
  7. Belt Guards: Fabricate of steel to comply with OSHA and SMACNA requirements of



diamond-mesh wire screen welded to steel angle frame, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

8. Motor Mount: Adjustable for belt tensioning.

D. Characteristics;

1. Housing Material: reinforced Steel
2. Special Housing Coating: Epoxy
3. Special wheel Coating: Epoxy
4. Vibration isolators: Restricted spring isolators having a static deflection of 1 inch

1.18 FORWARD-CURVED CENTRIFUGAL FANS

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

- B. Forward-Curved Wheels: Black-enameled or galvanized steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

- C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5
2. For motors 3 HP and larger, there shall be at least two (2) belts; and drive capable of carrying the entire load with an additional 50% safety factor
3. Sheaves shall be adjustable ratio type; they shall be sized to give the required fan speed with motor sheave at about the middle of its range of adjustment.
4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
5. Motor Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
6. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
7. Belt Guards: Fabricate of steel to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
8. Motor Mount: Adjustable for belt tensioning.

D. Characteristics:

1. Housing Material: Reinforced steel
2. Special Housing Coating: Epoxy
3. Special Wheel Coating: Epoxy
4. Vibration Isolators: Restrained spring isolators having a static deflection of 1 inch

1.19 TUBEAXIAL FANS

- A. Description: Fan wheel and housing, factory-mounted motor with direct drive, an inlet cone



section, and accessories.

- B. Housings: Galvanized steel with flanged inlet and outlet connections.
- C. Wheel Assemblies: Cast or extruded aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.
- D. Wheel Assemblies: Fiberglass-reinforced plastic cured under pressure with airfoil-shaped blades keyed to stainless-steel shaft.
- E. Wheel Assemblies: Cast aluminum, machined and fitted to shaft.
- F. Belt Drives:
  - 1. Factory mounted, with adjustable alignment and belt tensioning.
  - 2. Service Factor Based on Fan Motor Size: 1.5.
  - 3. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
  - 4. Fan Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
  - 5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  - 7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
  - 8. Motor Mount: Adjustable base.
  - 9. Shaft Bearings: Radial, self-aligning bearings.
    - a. Ball-Bearing Rating Life: ABMA 9, L10 of 120,000 hours.
    - b. Roller-Bearing Rating Life: ABMA 11, L10 of 120,000 hours.
    - c. Extend lubrication lines to outside of casing and terminate with grease fittings.
- G. Accessories:
  - 1. Companion Flanges: Rolled flanges of same material as housing.
  - 2. Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.
  - 3. Propeller Access Section Door: Short duct section bolted to fan inlet and outlet allowing access to internal parts of fan for inspection and cleaning, of same material as housing.
  - 4. Swingout Construction: Assembly allowing entire fan section to swing out from duct for cleaning and servicing, of same material as housing.
  - 5. Mounting Clips: Clips welded to fan housing, of same material as housing.
  - 6. Horizontal Support: Pair of supports bolted to fan housing, of same material as housing.
  - 7. Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.
  - 8. Inlet Screen: Wire-mesh screen on fans not connected to ductwork, of same material as housing.
  - 9. Outlet Screen: Wire-mesh screen on fans not connected to ductwork, of same material as housing.
  - 10. Backdraft Dampers: Butterfly style, for bolting to the discharge of fan or outlet cone, of same material as housing.
  - 11. Shaft Seal: Elastomeric seal and Teflon wear plate, suitable for up to 300 deg F.
  - 12. Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.
  - 13. Inlet Vanes: Adjustable; with peripheral control linkage operated from outside of



airstream, bronze sleeve bearings on each end of vane support, and provision for manual or automatic operation of same material as housing.

14. Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.
15. Inlet Cone: Round-to-round transition of same material as housing.
16. Outlet Cone: Round-to-round transition, of same material as housing.
17. Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.
18. Direct-Driven Units: Encase motor in housing outside of airstream factory wired to disconnect switch located on outside of fan housing. Extend lubrication lines to outside of casing and terminate with grease fittings.

H. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.
3. Coatings: Epoxy.
  - a. Apply to finished housings.
  - b. Apply to fan wheels.

1.20 PLENUM FAN

- A. Plenum fans are specified under another section of this work.

1.21 LOW VIBRATION VANEAXIAL FANS

- A. Vane Axial fans are specified under another section of this work.

1.22 MIXED-FLOW FANS

- A. Mixed flow fans are specified under another section of this work.

1.23 FAN OUTLET BACKDRAFT DAMPERS

- A. Each individual supply, return and exhaust fan in the air-handling units' fan arrays shall be provided with an integral back flow prevention device (damper) that prohibits recirculation of air in the event a fan or multiple fans become disabled or is not operating.
- B. All fans shall be provided with a back flow prevention means that produces near zero static pressure drop and/or system effect when that fan is enabled.
- C. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals.
- D. Damper performance data that is per AMCA ducted inlet and discharge arrangements will not be accepted. Damper data must be for the specific purpose of preventing back flow in any disabled fan and that is close coupled to the entering face of the inlet of each fan.
- E. AHU Manufacturers that do not manufacture the fans being submitted must provide tested and certified performance data for fans as installed in the AHU unit including the backflow prevention damper system effects introduced by close coupled back flow prevention dampers at the fan inlet.



- F. Backdraft dampers are specified under another section of this work.
- G. Dampers shall be factory installed in the air-handling units.
- H. All dampers installed in air handling units or exposed to ambient conditions shall be constructed of aluminum with stainless steel linkages, fittings, etc.

**1.24 FAN MOTORS AND DRIVE.**

- A. Motors shall meet or exceed the requirements specified herein and as specified in Section 23 05 13 MOTORS FOR HVAC EQUIPMENT
- B. Motors shall meet or exceed EPACT (NEMA 1240 standards) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.
- C. Each fan shall be provided with a premium efficiency electrical motor and motor controller as specified elsewhere. Coordinate motor and motor control requirements with fan manufacturer.
- D. To minimize obstruction to air flow and to allow motors to be replaced without realignment, all motors are to be "C" Face, flange mounted type with the flange recessed into a machined motor support plate.
- E. Motor frame sizes shall be selected to deliver nominal horsepower at a maximum air-over velocity of 500 FPM.
- F. For VFD applications, motors shall be designed and labeled for use with VFDs and suitable for use throughout speed range without overheating and shall be approved by VFD controller manufacturer.
- G. Motor shall be mounted on vibration isolators, out of the airstream.
- H. For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants.
- I. Fan motors shall be accessible for maintenance
- J. Shaft length shall allow wheel adjustment for wall thickness up to 4 inches.
- K. Bearings shall have zerk fittings to allow for lubrication.
- L. Motors:
  - 1. The motor and fan base shall be welded or bolted to form a common base to prevent any uncommon physical motion of the fan and motor
  - 2. Motor shall be foot-mounted, totally enclosed fan cooled (TEFC), continuous duty, ball bearing type.
  - 3. Efficiency: Premium efficient motors, as defined in NEMA MG 1, and with applicable EPACT efficiency standards.
  - 4. Service Factor: 1.15.
  - 5. Insulation Type: Class F
  - 6. Cast Iron Construction
  - 7. Wiring connections shall be extended to an exterior conduit box located on the exterior of the fan housing.



8. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
9. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

**M. Variable Frequency Drives (VFD):**

1. The variable frequency drives shall control the fan motors.
2. The VFD shall be as specified under another section of this work.
3. There shall be a separate VFD drive system for each fan motor. Controlling multiple motors by one drive system will not be allowed.
4. The VFD shall be furnished and installed at the air handling unit factory by the AHU manufacturer. The variable speed controller shall be mounted in a NEMA 4 enclosure with all power and control wiring between the VFD and fan factory installed. Electrical lugs for incoming power wiring shall be provided.
5. The VFD shall be compatible with a BACnet BMS system.
6. The fan manufacturer shall supply a start-up engineer to identify and lock out critical speeds, and to verify correct operation.
7. Designed with critical vibration frequencies outside operating range of controller output.

**1.25 VIBRATION ISOLATION:**

- A. Double studded or pedestal mount true isolators
- B. No metal to metal contact
- C. Sized to match the weight of each fan
- D. Comply with requirements in section 23 05 48 "Vibration, Isolation, Seismic and Wind Restraints for HVAC Components".

**1.26 DISCONNECT SWITCHES:**

- A. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1 and NEMA 4 if exposed to the elements.
- B. Positive electrical shut-off
- C. Wired from fan motor to junction box installed within motor compartment.

**1.27 SOURCE QUALITY CONTROL**

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

**PART 2 - EXECUTION**

**2.1 EXECUTION REQUIREMENTS**



- A. Refer to DDC General Conditions for execution requirements.

## 2.2 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using restrained spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified under another section of this work.
  - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified under another section.
- D. Fan mounting on concrete bases shall be designed to withstand, without damage to equipment, the seismic force required by New York Department of Buildings. Concrete, reinforcement, and formwork requirements are specified under another section.
- E. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control devices are specified in another section of this work.
- F. Install units with clearances for service and maintenance.

## 2.3 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified under another section of this work
- B. Duct installation and connection requirements are specified in another section of this work.
- C. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- D. Install ducts adjacent to fans to allow service and maintenance.
- E. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- F. Ground equipment according to Division 26 Section "Grounding and Bonding."
- G. Connect wiring according to Division 26 Section "Conductors and Cables."

## 2.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.



3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

## 2.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain centrifugal fans. Refer to the DDC General Conditions for instruction requirements.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

**END OF SECTION 23 34 16**



**SECTION 23 34 33****AIR CURTAINS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 23 "Valves for HVAC"
- D. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- E. Section 23 05 93 "Testing, Adjusting and Balancing".
- F. Section 23 09 00 "HVAC Instrumentation and Controls".
- G. Section 23 21 13 "HVAC Piping".

**1.2 SUMMARY**

- A. This Section includes air doors/curtains with hot-water heat.
- B. Air curtain shall be completely factory assembled. The unit shall consist of stainless steel casing, centrifugal fan, raised stainless steel inlet screen and grille, discharge nozzle and grille, motor filter and heating element.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED



Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

**1.6 SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer licensed in the State of New York.
  - 1. Engineering Calculations: Calculate requirements for selecting vibration isolators and seismic restraints.
  - 2. Include plans, elevations, sections, details, and attachments to other work.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Plans and details drawn to scale and coordinating penetrations of exterior walls.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Operation and Maintenance Data: For air curtains to include in maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air curtains and are based on the specific product indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- D. Comply with AMCA 220, "Test Methods for Air Curtain Units," for airflow, outlet velocity, and power consumption.
- E. Comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils," for components, construction, and rating.
  - 1. Certify coils according to ARI 410.

- F. Comply with NSF 37, "Air Curtains for Entranceways in Food and Food Service Establishments."

## 1.8 COORDINATION

- A. Coordinate layout and installation of air curtains and suspension system components with other construction, including light fixtures, fire-suppression-system components, and partition assemblies.
- B. Coordinate installation of wall penetrations and louvers. These items are specified in Section 08 91 19 Section "Fixed Louvers".

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period (Water Heating Units): Five years from Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Powered Aire, Inc.
  - 2. Berner International Corp.
  - 3. Loren Cook Company.
  - 4. Marley Engineered Products.
  - 5. Mars Air Products; Dynaforce Division.
  - 6. Mars Air Products; Mars Air Door Division.
  - 7. Miniveil Air Systems.
  - 8. TMI Inc.
  - 9. Or approved equal

### 2.2 AIR DOORS/CURTAINS

- A. Housing Materials: Heavy-gage, aluminum construction.
  - 1. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
  - 2. Mounting Brackets: Steel.
- B. Intake Louvers: Integral part of the housing, mechanically field adjustable and capable of reducing air-outlet velocity by 60 percent with louver in totally closed position.
- C. Discharge Nozzle: Integral part of the housing, containing adjustable air-directional vanes with 40 -degree sweep front to back.

2.3 FANS

- A. Fans: Galvanized steel, Centrifugal, statically and dynamically balanced.
- B. Wheels and Housings: Dynamically balanced curved double inlet double width galvanized blower wheels with brazed hubs and matched blower housings.
- C. Drives: Direct Drive. Belt Drive Not Acceptable

2.4 MOTORS

- A. Motor Type: Multispeed, resiliently mounted, continuous duty, totally enclosed, air over, with integral thermal-overload protection.
- B. Bearings: Permanently sealed, lifetime, pre-lubricated, ball bearings.
- C. Disconnect: Internal power cord with plug and receptacle.
- D. Bearings: Heavy duty type, shielded ball bearings of equal size

2.5 WATER COILS

- A. Description: Continuous-circuit coil.
- B. Piping Connections: Threaded on same end.
- C. Tubes: Copper, complying with ASTM B 75 (ASTM B 75M).
  - 1. Tube Diameter: 0.625 inch.
- D. Fins: Copper with fin spacing 0.067 inch.
- E. Fin and Tube Joint: Mechanical bond.
- F. Headers: Seamless copper tube with brazed joints, prime coated
- G. Frames: Galvanized-steel channel frame, 0.0625 inch.
- H. Ratings: According to ASHRAE 33.
  - 1. Working-Pressure Ratings: 200 psig, 325 deg F.
- I. Source Quality Control: Test to 300 psig and to 200 psig underwater.

2.6 FILTERS

- A. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with glass-fiber media sprayed with nonflammable adhesive in galvanized-steel frame.
- B. Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

## 2.7 ACCESSORIES

- A. Field-Installed Thermostat: Line voltage, factory installed and wired to the junction box on air curtain.
- B. Automatic Door Switch: Plunger type installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.
- C. Start-Stop, Push-Button Override Switch: Manually activates and deactivates air curtain.
- D. Motor-Control Panel: Complete with motor starter, 115-V ac transformer with primary and secondary fuses, terminal strip, and NEMA 250, Type 12 enclosure.
- E. Mounting Brackets: Adjustable mounting brackets for drum-type roll-up doors.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and conditions where air curtains will be installed for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for hot-water piping systems to verify actual locations of piping connections before air-curtain installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install air curtains with clearance for equipment service and maintenance.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air curtain to allow service and maintenance.
- C. Ground equipment according to Section "Grounding and Bonding."
- D. Connect wiring according to Section "Conductors and Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing air curtains completely, perform visual and mechanical check of individual components.
  - 2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.



3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Repair or replace malfunctioning units and retest as specified above.

### 3.6 ADJUSTING

- A. Adjust belt tension.
- B. Adjust motor and fan speed to achieve specified airflow.
- C. Adjust discharge louver and dampers to regulate airflow.
- D. Adjust air-directional vanes.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and service air curtains.

**END OF SECTION 23 34 33**

**SECTION 23 36 00****AIR TERMINAL UNITS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 09 00 "HVAC Instrumentation and Controls".

**1.2 SUMMARY**

- A. This section includes the air terminal units.
  - 1. Single duct variable air volume units.
  - 2. Or approved equal

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 REFERENCE STANDARDS**

- A. All air distribution equipment shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
  - 1. SMACNA
  - 2. ASHRAE - Test and rate air devices in accordance with ASHRAE Standards.
  - 3. ARI – Test and rate air devices in accordance with ARI Standards.
  - 4. ADC Seal – Provide devices bearing ADC Certified Rating Seal.
  - 5. AMCA Compliance: Test and rate air devices in accordance with AMCA Standards and shall bear AMCA Certified Seal.
  - 6. NFPA Compliance: Install air devices in accordance with NFPA90A “Standard for the Installation of Air Conditioning and Ventilating Systems.”
- B. All equipment and material to be furnished and installed as part of this work shall be UL or ETL listed, in accordance with the requirements of the New York Department of Buildings and suitable for its intended use.

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.
- B. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of air distribution devices, air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
- C. Codes and Standards:
  - 1. ARI Compliance: Test and rate air devices in accordance with ARI Standards.
  - 2. ASHRAE Compliance: Test and rate air devices in accordance with ASHRAE Standards.
  - 3. ADC Seal: Provide devices bearing ADC Certified Rating Seal.
  - 4. AMCA Compliance: Test and rate air devices in accordance with AMCA Standards and shall bear AMCA Certified Rating Seal.
  - 5. NFPA Compliance: Install air devices in accordance with NFPA90A “Standard for the Installation of Air Conditioning and Ventilating Systems.”
  - 6. UL Compliance: The complete device must be labeled and listed by UL and must be installed to meet their requirements.
  - 7. All devices must be tested and approved for safety in accordance with the latest N.E.C.

**1.7 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described under section 230548 of this work.





- B. Refer to Section 23 33 11 – “HVAC Sound Attenuation” for additional casing lining and duct acoustical lining requirements.

#### 1.08 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.9 SUBMITTALS

- A. For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
  - 1. Air terminal units.
- B. For each type of terminal unit, submit manufacturer’s technical product data including, but not limited to the following:
  - 1. Manufacturer’s technical product data, including performance data for each size and type of air distribution device furnished; schedule showing drawing designation, room location, number furnished, model number, size and accessories furnished and installation and start-up instructions.
  - 2. Data sheet for each type of air outlet and inlet, and accessory furnished, indicating construction, finish and mounting details.
  - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- C. Shop Drawings: For air terminal units, include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.
  - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- D. Engineering Services Submittal:
  - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
  - 2. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York responsible for their preparation for selecting hangers and supports and seismic restraints, to be submitted to Commissioner for review and approval.
- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Size and location of initial access modules for acoustic tile.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.



- F. Field quality-control reports.

#### 1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air distribution devices wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of device and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors, when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

### PART 2 - PRODUCTS

#### 2.1 SINGLE DUCT VARIABLE AIR VOLUME UNITS (ELECTRONIC ACTUATOR)

##### A. MANUFACTURERS:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Titus
  - b. Siemens ZCU
  - c. Nailor
  - d. HVAC Manufacturing
  - e. Anemostat
  - f. Or approved equal
- B. Provide single duct variable volume terminal units in locations shown on the plans. Capacities and performance shall be as indicated on the schedule and are based upon Nailor Industries type 3000 or equal as approved. All units shall be capable of shutoff features without additional control components or piping.
- C. Sizes, capacities, and performance are based upon units as manufactured by Nailor Industries. Units as manufactured by other manufacturers shall be considered as equal, if they meet performance specifications. Any substituted product shall, in all aspects, conform to the engineered sound and pressure drops specified.
- D. The units shall be pressure independent and shall reset CFM air volume within +/- 5% of required air flow, as determined by the space thermostat, regardless of changes in system air pressure. Devices utilizing CFM limiters will not be acceptable. The terminal air valve shall normally open on loss of electrical power. The minimum setting shall be 20% of peak flow.
- E. The internal resistance of the terminal shall not exceed 0.4 inch w.g. for all sizes when handling maximum air volume shown on schedules.
- F. A Diamond-Flow (basis of design) sensor or approved equal shall be incorporated within the terminal. Differential pressure taps (separate from the control pressure taps) shall be provided for air flow measurement with a 0-1 inch gauge. Each terminal shall have a flow chart attached.
- G. The units shall be designed, installed and field adjusted, if necessary, to maintain controlled pressure independent air flow.



- H. Features to accommodate field calibration and readjustment of air volume settings shall include gauge taps for balancing with a standard pressure gauge and adjustable flow settings at the controller.
- I. Unit casing shall be 22 ga. Galvanized steel with round or flat oval inlets meeting SMACNA or ASHRAE standards. Outlets shall be rectangular with slip and drive connections. Valve assemblies of 16 ga. Steel are to have opposed blade dampers to reduce air turbulence and fitted with special seals for tight closure and minimized sound generation. In the fully closed position, air leakage past the closed damper shall not exceed 3% of the nominal catalog rating at 3" inlet static pressure, as rated by the Air Diffusion Council test procedure.
- J. All units are lined with 3/4", 1-1/2 lb. density fiberglass insulation. Edges are sealed against air flow erosion. Materials are to be in accordance with NFPA - 90A and 90B and UL 181 standards. All insulation/sound absorbing material shall be fully covered by a protective polymer film (3 mil) to prevent any contact between the airstream and the insulation and be protected by means of 24 gauge galvanized perforated steel panels to retain the insulation.
- K. The acoustical performance of the variable volume unit shall be tested in accordance with ADC Test Code 1062R4 standards, in an ADC, or independent approved laboratory. The manufacturer shall submit guaranteed sound power levels by octave bands. The sound power level shall be based on 10-13 watts. The octave band analysis shall be shown for .75", 1-1/2" and 3" S.P. differential across the terminal unit. Neither the manufacturer nor the specific unit selection will be approved until such ratings have been submitted.
- L. The sound power level data submitted shall substantiate that the equipment types and sizes operating, as in an installed condition per plans and specifications, shall conform with data scheduled.
- M. Prior to the approval of variable air volume boxes, the manufacturer shall demonstrate to the Commissioner, the operation of a typical unit. This demonstration shall be conducted over the full operational range. If the unit so demonstrated is acceptable, the manufacturer shall make and submit an octave band analysis of this unit over the full operational range in an acoustical laboratory reverberant chamber. All similar production units shall have acoustical characteristics within plus or minus 2 db of the unit demonstrated, when operated under the same design conditions in the same test facility.
- N. The manufacturer shall submit the following information determined in a reverberant chamber subsequent to the demonstration of the unit in the typical space for both discharge and radiated sound:
  - 1. Sound power data by octave bands.
  - 2. A description of the technique and apparatus used to determine sound power.
  - 3. The test chamber room constants by octave bands.
  - 4. The technique and apparatus used to determine the room constant.
  - 5. Complete operating conditions at the time of testing, including room temperature, air temperature, static pressures, etc.
- O. Furnish and ship the DDC controller and actuator to the VAV terminal unit manufacturer for installation at the factory. The Contractor shall supply written instructions and drawings containing sufficient information to enable the VAV unit manufacturer to undertake the installation satisfactorily.
- P. Furnish and ship all electronic room type thermostat (one stat per VAV terminal box) with locked cover.



- Q. Terminal box manufacturer shall provide for each unit proportional control electric actuator and electronic room type thermostat (one stat per VAV terminal) with locked cover. Actuators shall be factory mounted and linked. The controls shall have capability of field adjustment of maximum and minimum cfm quantities. There shall be separate adjustments for maximum and minimum cfm. Each unit shall include a warm-up sensor factory set at 75°F (adjustable setting from 70°F to 85°F) to provide morning warm-up features. Include the expense of mounting thermostats and wiring between terminals and thermostats.
- R. The electronic room thermostat and actuator (one (1) each per box) shall control the VAV as follows:
- S. Room thermostat on a call for less cooling shall modulate the air flow from 100% cfm to 25% cfm. On a call for cooling, reverse sequence shall occur.
- T. The VAV terminal box manufacturer shall provide a 24 VAC transformer, flow sensor, electric heat SCR controller, and controls enclosure. The VAV box manufacturer shall install and connect all controls in the factory.
- U. Box manufacturer shall provide field calibration and check-out of all control components and shall furnish wiring diagrams and provide one years free service on the box and control components.
- V. Where indicated provide hot water reheat coils of capacities on the terminal unit schedule. Heating coils shall be furnished as part of the terminal unit.
- W. Box manufacturer shall provide access door upstream of reheat coil for ease of cleaning.
- X. Terminal Unit Hot Water Heating Coils:
1. Hot water heater coils shall be integral to the unit, not an add on.
  2. The heating coils shall be constructed and installed in accordance with the requirements of the New York City Department of Buildings and shall be ETL listed as component of Box
  3. The heating coils shall be fabricated from round seamless copper tubes rolled into headers to form a permanent pressure tight joint. Coils are to be self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Coil Finned tube shall be fabricated to permit expansion without transmitting stresses to casing. Provide even distribution of water to each tube.
  4. Headers: constructed of close-grained gray cast iron, heavy wall copper, having pipe threads for supply and return connections.
  5. Tubes: seamless deoxidized copper, 5/8" O.D. and 0.020" minimum wall thickness.
  6. Fittings: return bends and expansion bends to be fabricated from 5/8" O.D. or 1" O.D. seamless deoxidized copper tubing. Wall thickness, after forming, must be equal to or greater than the tube wall thickness.
  7. Fins: aluminum or copper plate type or helically wound on the tubes. The plate type fins shall be continuous across entire coil width. Provide efficient bond between fin and tube, making each fin perform as an integral part of the tube.
  8. The coils are to be designed, tested and guaranteed for operation with steam or water pressure and temperature as per system pressures for valves and fittings.
  9. Coil Performance: all data pertaining to coil performance are shown on drawings. Pipe all coils counterflow. All water coils to have not more than 6 feet/second water velocity and not more than 10 fins per inch.
- Y. Heating coils shall be provided with automatic control valves and shall be designed for operation with the DDC controller and control system as specified in the BMS section.



- Z. Shop Drawings shall be submitted for review as specified. These Shop Drawings shall indicate specifically the exact construction, materials, etc., of the heating coils to be furnished under these Specifications.

### **PART 3 - EXECUTION**

#### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

#### **3.2 PREPARATION**

- A. Clean sheet metal.

#### **3.3 INSPECTION**

- A. Examine areas and conditions under which air distribution devices are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

#### **3.4 INSTALLATION**

- A. See Specification section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Restraints for HVAC Components"
- B. General: Install air devices in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
- C. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air devices.

**END OF SECTION 23 36 00**



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## **SECTION 23 37 13**

### **DIFFUSERS, REGISTERS AND GRILLES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 "Common Requirements for HVAC Work".
- C. Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- D. Section 23 05 93 "Testing, Adjusting and Balancing".
- E. Section 23 31 13 "Metal Ducts".
- F. This section is a part of each Division 23 00 00 section.

##### **1.2 SUMMARY**

- A. This section includes the following:
  - 1. Square panel diffusers.
  - 2. Linear slot diffusers
  - 3. Radial Air Pattern Diffuser
  - 4. Panel face diffuser
  - 5. Grilles and Registers

##### **1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.3 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.4 REFERENCE STANDARDS

- A. All air distribution equipment shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
  - 1. SMACNA
  - 2. ASHRAE - Test and rate air devices in accordance with ASHRAE Standard 70-2006.
  - 3. ARI – Test and rate air devices in accordance with ARI Standards.
  - 4. ADC Seal – Provide devices bearing ADC Certified Rating Seal.
  - 5. AMCA Compliance: Test and rate air devices in accordance with AMCA Standards and shall bear AMCA Certified Seal.
  - 6. NFPA Compliance: Install air devices in accordance with NFPA90A "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. All equipment and material to be furnished and installed as part of this work shall be UL or ETL listed, in accordance with the requirements of the New York Department of Buildings and suitable or its intended use.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Manufacturer shall submit engineering data in a manner to facilitate convenient review of the following factors:
  - 1. Throw, terminal velocity, noise criteria (NC), sound power, static pressure and total pressure of each type and size of air outlet.
  - 2. Supply air units shall distribute the specified quantity of air evenly throughout the occupied zone uniformly, draftlessly and noiselessly. Sound levels shall not exceed ratings as required in the "Acoustical Treatment" section of these specifications.
- C. The manufacturer shall provide published performance data for the diffusers, registers and grilles. They shall be tested in accordance with ANSI/ASHRAE Standard 70-2006.
- D. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- E. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.





- F. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- G. Source quality-control reports.

#### 1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air distribution devices wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of device and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors, when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

### PART 2 - PRODUCTS

#### 2.1 DIFFUSERS, REGISTERS AND GRILLES - GENERAL

- A. Contractor shall furnish and install where shown on the drawings all air devices, diffusers, grilles and registers of the sizes, types and capacities indicated and as required for proper distribution of conditioned air within the conditioned spaces and for return of conditioned air from the conditioned spaces to the various air conditioning systems. Exhaust grilles and registers shall also be provided where indicated on the drawings and as required for the proper flow of exhaust air.
- B. Devices shall be aluminum or steel, as specified by the Commissioner and shall be factory finished with baked enamel finish or extruded aluminum finish of color selected by Commissioner.
- C. Air inlets and outlets shall be tested in accordance with ASHRAE 70.
- D. Throw, horizontal distance from the diffuser to the point where the theoretical centerline velocity is 50 feet per minute, shall not exceed the horizontal distance between the diffuser and the nearest wall, or half the horizontal distance between ceiling diffusers.
- E. Equipment manufacturer shall submit engineering data in a manner to facilitate convenient review of the following factors:
- F. Supply air units shall distribute the specified quantity of air evenly throughout the occupied zone uniformly, draftlessly and noiselessly. Sound levels shall not exceed ratings as required in the "Acoustical Treatment" section of these specifications.
- G. For devices installed in plaster construction, supply plaster frames as required for setting. All design and margin construction shall be coordinated with architectural requirements. Plaster frames where required shall be constructed of same material and finish as air terminal.



- H. The air outlet manufacturer shall review architectural plans and shall be responsible for furnishing all air outlets with mounting frames and margins that are fully compatible with ceiling construction.
- I. All ceiling diffusers shall be furnished and installed with an equalizing deflector and volume damper. If diffuser is to be used for return air, omit equalizing deflector. Supply diffusers shall be designed to protect ceilings from streaking and smudging. Blank-off or sectorizing baffles shall be furnished as indicated.
- J. For VAV systems, devices shall be specifically designed for variable-air-volume flows.
- K. Coordinate duct connections with coordination drawings.

## 2.2 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Titus
  - 2. Anemostat
  - 3. Price
  - 4. Or approved equal

## 2.3 DIFFUSERS - GENERAL

- A. Diffusers shall be constructed with quick positioning pattern control permitting 180-degree air pattern adjustment.
- B. Diffusers shall have dampers which operate separate from pattern control. Inner pattern control and brackets shall be black coated.
- C. Slot opening shall be as shown on plans.
- D. Throw terminal velocity, noise criteria (NC), sound power, static pressure and total pressure of each type and size of air outlet.

## 2.4 SQUARE PANEL DIFFUSER

- A. Architectural square panel ceiling diffusers shall be provided either as steel or aluminum diffusers of the same design, of the sizes and mounting types shown on the plans and outlet schedule. The steel diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The aluminum diffuser shall have a heavy gauge aluminum face panel that captures a secondary heavy gauge aluminum panel.
- B. The face panel is removable by means of four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners.
- C. The airflow discharge pattern shall be field adjustable from horizontal to vertical by repositioning the plaque assembly using the adjustment screws. The plaque assembly shall be constructed as a single inner assembly and must be easily removable using a spring lock mechanism.
- D. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern.
- E. A single metal thickness on the edges of the face panel will not be accepted. Ceiling diffusers



with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel size. Ceiling diffusers with a 12 x 12-inch full face shall have no less than a 9 x 9-inch face panel size.

- F. The back pan shall be one-piece precision die-stamped and shall include an integrally drawn inlet (welded-in inlets and corner joints are not acceptable). The diffuser back pan shall be constructed of 22-gauge steel (OMNI) or aluminum (OMNI-AA). The diffuser neck shall have a minimum of 1<sup>0</sup>-inch depth available for duct connection.
- G. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H.
- H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- I. Damper shall be constructed of heavy gauge steel and shall have radially opposed blades. Damper must be operable from the face of the diffuser. Directional Blow clips shall be available to restrict the discharge air in certain directions.
- J. Molded insulation blanket shall be provided for each supply diffuser to prevent condensation. The insulation will be R-6, foil-backed with vapor barrier and provide an additional 1-inch gap around the neck to install insulated duct.
- K. Accessories:
  - 1. Equalizing grid.
  - 2. Safety chain.
  - 3. Sectorizing baffles.
- L. The manufacturer shall provide published performance data for the square panel diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

## 2.5 RECTANGULAR AND SQUARE CEILING

- A. Furnish and install Adjustable Stamped Architectural Square or rectangular ceiling diffusers. The diffuser shall be manufactured from corrosion resistant steel and incorporate four die-formed concentric cones. Diffuser shall have an adjustable sliding type inner cone assembly that is securely retained by a spring-loaded friction arrangement. The inner core assembly is to be removable using a spring clip arrangement. The diffuser shall have a removable plug for screwdriver adjustment of damper without removing the core.
  - 1. Face Size: Refer to drawings.
  - 2. Mounting: Refer to drawings.
  - 3. Pattern: Adjustable.
  - 4. Dampers: Radial opposed blade.
  - 5. Accessories:
  - 6. Equalizing grid.
  - 7. Safety chain.
  - 8. Sectorizing baffles.
  - 9. Operating rod extension.
  - 10. External Foil Back Insulation
- B. Subject to compliance with requirements, product shall be equivalent to:



1. Titus OMNI (Basis-of-Design)
2. Price (Equivalent product)
3. Anemostat (Equivalent product)

## 2.6 LINEAR SLOT DIFFUSER

- A. Furnish and install Linear Slot Diffusers of the sizes and capacities as indicated in the contract documents. The slot diffusers shall be TITUS Model ML (supply) (Basis-of-Design), or an equivalent product by an approved equal manufacturer listed above. with slot spaces of the sizes shown on the plans and schedules.
- B. The maximum length of a single section shall be 72" long. All sizes longer than 72" will be provided in continuous multiple sections. Alignment strips are to be provided for joining continuous diffuser sections.
- C. The manufacturer shall provide all alignment components. The return models shall be constructed the same as the supply diffusers without the pattern controllers.
- D. The linear shall be supplied in 1 – 8 slots wide as specified. Pattern control deflectors shall have an aerodynamic "ice tong" shape that can be adjusted to regulate the volume and direction of the airflow from the face of the diffuser. Deflector shall be capable of 180 ° pattern adjustment. The maximum length of the deflectors shall be 24". Longer sizes shall be provided in multiple sections. The pattern deflector finish shall be black.
- E. Optional diffuser curving to a 6-foot minimum radius with fixed deflection shall be available as required.
- F. The frame and support bars shall be constructed of heavy gauge extruded aluminum.
- G. Heavy gauge extruded aluminum end borders; end caps and mitered corners shall be available to close off the ends of the diffusers.
- H. Provide factory fabricated and installed plenums for all linear slot diffusers. Plenums shall be manufactured by the same manufacturer of the linear slot diffusers. The plenums shall include side inlet for connection to duct. The width shall fit the linear slot diffuser as specified and the length shall be in standard nominal lengths. When continuous sections are required, end caps shall be folded up to provide uninterrupted airflow.
- I. Plenums shall have internal insulation with polymer film and perforated panels. Insulation shall be as specified under another section of this work.
  1. Material - Shell: insulated. Insulation shall be as specified under another section of this work
  2. Material - Pattern Controller and Tees: Aluminum.
  3. Finish - Face and Shell: Baked enamel, color selected by Commissioner.
  4. Finish - Pattern Controller: Baked enamel, black.
  5. Finish - Tees: Baked enamel, color selected by Commissioner.
  6. Slot Width: Refer to Drawings
  7. Number of Slots: Refer to Drawings.
  8. Length Refer to Drawings.
  9. Accessories: Refer to architectural ceiling plans.

## 2.7 RADIAL AIR PATTERN DIFFUSER



- A. Low velocity hemispherical 2-way pattern.
- B. Diffusers shall be constructed using a maximum 6 inches tall backpan designed for optimum performance with the diffuser. The backpan shall be divided into two chambers: upper and lower. The backpan shall have integral hanger tabs for securing the unit to the overhead structure.
- C. The upper velocity dampening chamber shall be separated from the lower air dampening chamber by a pressure induction plate. All pattern controllers shall be internal to the unit and shall be located in the lower air dampening chamber.
- D. The face of the diffuser shall be 51 percent free area perforated steel with 3/16-inch diameter holes on 1/4-inch staggered centers, and shall match the appearance of industry standard perforated diffusers. The face shall not hang below the ceiling more than 5/8 inches and shall have 6 clips securing it in place.
- E. The diffuser face shall have factory attached retainer cables. The cables shall have removable clips to allow field cleaning of all diffuser components.
- F. Quarter-turn fasteners on the face are not acceptable.
- G. The face, lower air chamber, directional blades, and the pressure induction plate shall be one assembly that can be removed from the face of the unit for sanitizing in an autoclave. The face shall be provided with two retainer cables.
- H. The backpan shall be manufactured of 22-gauge steel. The diffuser must be available for full radial air diffusion (two-way) and/or 1/2 radial air diffusion (one-way).
- I. NC values shall be published. Throw for terminal velocities of 100, 75 and 50 fpm shall be published along with corresponding pressure drop.
- J. Performance tests shall have been conducted per ASHRAE Standards 70-2006 and 113.

## 2.8 GRILLES AND REGISTERS

### A. Return Air Grilles

- 1. Return air grilles shall be TITUS Model 350 F (3/4" spacing) or 355F (1/2" spacing).
- 2. The fixed deflection blades shall be parallel to the long or short dimension of the grille.
- 3. Construction material: Extruded aluminum with 1-1/4" wide border on all sides.
- 4. Corners shall be welded with full penetration resistance welds.
- 5. Deflection blades shall be contoured to a specifically designed and tested cross section to meet test performance data.
- 6. Opposed blade damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from face of the grille.

### B. Supply Air Grilles

- 1. Supply air grilles shall be single deflection type with one set of fully adjustable airfoil shaped deflection blades spaced 3/4in. on center. The blades shall run parallel to the (long/short) dimension of the grille.
- 2. Both blades and border shall be of heavy extruded aluminum construction.
- 3. The grille shall be finished in (B12 White Powder Coat / B15 Aluminum Powder Coat). Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in



accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610.

C. Supply Air Registers

1. Registers shall be double deflection type with two sets of fully adjustable airfoil shaped deflection blades spaced  $\frac{3}{4}$ " on center.
2. The front set of blades shall run parallel to the (long / short) dimension of the register.
3. Both blades and border shall be of heavy extruded aluminum construction.
4. The integral volume control damper shall be of the opposed blade type and shall be constructed of aluminum construction 22DAL). The damper shall be operable from the register face. The damper shall be coated steel (mill finish aluminum 22DAL). The grille shall be finished in (B12 White Powder Coat / B15 Aluminum Powder Coat). Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 an

D. Transfer Grilles:

1. Shall match return grilles in appearance.

2.9 PERIMETER DIFFUSERS

- A. Perimeter diffusers shall be of two (2) slot combination heating-cooling type suitable for overhead heating without exceeding stratification factor of 4.0 when handling CFM ranges shown on the drawings at a maximum discharge temperature of 90°F. Cooling air shall be at 18%dt and comfort conditions of velocity and room stratification factor shall be maintained below 3.0.
- B. Diffuser face shall consist of one adjustable volume control and one adjustable direction vertical pattern factory set for proper angle but with adjustable locking device to facilitate field adjustment. Unit shall be of extruded aluminum construction throughout. Diffusers shall be of lengths indicated on drawings and complete with sheet metal plenum, having a maximum height of 7".
- C. Diffusers shall be painted in flat black with center septum in off-white for installation on exposed ceiling T-Bars.
- D. The diffuser manufacturer shall demonstrate (by laboratory mock-up) to the Commissioner complete diffuser performance of discharge angle, volume control, pressure drop and sound level.

2.10 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.



- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. The air outlet manufacturer shall review architectural plans and shall be responsible for furnishing all air outlets with mounting frames and margins that are fully compatible with ceiling construction.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Commissioner for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 37 13**



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**SECTION 23 41 00****AIR FILTERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- E. Section 23 08 00 – COMMISSIONING OF HVAC WORK.
- F. Section 23 73 15 – FACTORY FABRICATED CUSTOM AIR HANDLING UNITS.
- G. Section 23 73 16 – FACTORY FABRICATED SEMI-CUSTOM MODULAR AIR HANDLING UNITS.
- H. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Disposable Pleated Panel Filters – medium efficiency – MERV 8.
  - 2. Disposable Pleated Panel Filters – medium efficiency – MERV 9.
  - 3. Disposable Pleated Panel Filters – medium efficiency – MERV 11.
  - 4. Rigid synthetic offset rigid, extended surface, V filter – MERV 15.
  - 5. Front- and rear-access filter frames.
  - 6. Side-service housings.
  - 7. Filter gages.
  - 8. Low-leak filter bank isolation dampers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS



- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (Voc) Limits for Adhesives, Sealants, Paints And Coatings for Leed Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- C. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
  1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
  2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
  3. Wiring Diagrams: For power, signal, and control wiring.
- D. Manufacturer shall issue a standard certificate of compliance certifying that the filter meets the materials, components, performance and construction characteristics as indicated in the contract documents.
- E. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

#### 1.6 REFERENCE STANDARDS

- A. All filters, media, frames and ancillary equipment shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
  1. ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
  2. ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
  3. NFPA 90A and NFPA 90B.
  4. Underwriters Laboratories: UL 900, UL 586
  5. National Air Filtration Association (NAFA)

- B. All equipment and material furnished and installed on this project shall be UL or ETL listed, in accordance with the requirements of the New York Department of Buildings and suitable for its intended use on this project.

#### 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fire Performance Characteristics: Provide filters identical with those tested for the fire performance characteristics specified.
- D. Comply with provisions of ARI Standard 850 pertaining to testing and performance of air filter units.
- E. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B pertaining to installing air filters.
- F. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
- G. UL Rating: Air filters shall have either a Class 1 or Class 2 rating in accordance with UL 900, standard for test performance of air filter units.
- H. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
- I. All products shall be National Air Filtration Association (NAFA) certified for performance. Filter style code and MERV rating shall be stamped on each filter cell.

#### 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

#### 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Provide one complete set of filters for each filter bank. If system includes pre-filters, provide for all filters.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by one of the following:
- B. Air Filters and Filter Holding Frames:
  - 1. Viledon.
  - 2. American Air Filter

3. Cambridge Filter Corp.
4. Camfil Farr
5. Flanders-Precisionaire.
6. Or approved equal.

C. Filter Gages:

1. Cambridge Filter Corp.
2. Dwyer Instruments, Inc.

**2.2 DISPOSABLE PLEATED PANEL FILTERS – MEDIUM EFFICIENCY - MERV 8**

- A. Description: Factory-fabricated, dry, self-supported, pleated, panel-type, disposable air filters with holding frames. Thickness shall be as scheduled.

1. High capacity.
2. Disposable Filters,
3. Permanent washable types will not be acceptable.
4. Filter Unit Class: UL 900, Class 1.

- B. Media: 100% non-woven synthetic fibers coated with nonflammable adhesive.

1. Pleat Design: V-Pleat
2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Media shall be coated with an antimicrobial agent.
4. Metal Retainer: Upstream side and downstream side.

- C. Mounting Frames: Material shall match air handling interior casing, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

- D. Capacities and Characteristics:

1. Maximum or Rated Face Velocity: 500 FPM.
2. Maximum Initial Pressure drop: 0.23" wg
3. MERV Rating: 8 when tested according to ASHRAE 52.2 - 2007.
4. Average efficiency of 30 % – 35% based on ASHRAE Test Standard 52.1.

**2.3 DISPOSABLE PLEATED PANEL FILTERS – MEDIUM EFFICIENCY - MERV 9**

- A. Description: Factory-fabricated, dry, self-supported, pleated, panel-type, disposable air filters with holding frames. Thickness shall be as scheduled.

1. High capacity.
2. Disposable Filters,
3. Permanent washable types will not be acceptable.
4. Filter Unit Class: UL 900, Class 1.

- B. Media: 100% non-woven synthetic fibers coated with nonflammable adhesive.

1. Pleat Design: V-Pleat
2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Media shall be coated with an antimicrobial agent.

4. Metal Retainer: Upstream side and downstream side.
- C. Mounting Frames: Material shall match air handling interior casing, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- D. Capacities and Characteristics:
1. Maximum or Rated Face Velocity: 500 FPM.
  2. Maximum Initial Pressure drop: 0.28" wg
  3. MERV Rating: 9 when tested according to ASHRAE 52.2 - 2007.
  4. Average efficiency of 40 % – 45% based on ASHRAE Test Standard 52.1.

#### 2.4 DISPOSABLE PLEATED PANEL FILTERS – MEDIUM EFFICIENCY - MERV 11

- A. Description: Factory-fabricated, dry, self-supported, pleated, panel-type, disposable air filters with holding frames. Thickness shall be as scheduled.
1. High capacity.
  2. Disposable Filters,
  3. Permanent washable types will not be acceptable.
  4. Filter Unit Class: UL 900, Class 1.
- B. Media: 100% non-woven synthetic fibers coated with nonflammable adhesive.
1. Pleat Design: V-Pleat
  2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Media shall be coated with an antimicrobial agent.
  4. Metal Retainer: Upstream side and downstream side.
- C. Mounting Frames: Material shall match air handling interior casing, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- D. Capacities and Characteristics:
1. Maximum or Rated Face Velocity: 500 FPM.
  2. MERV Rating: 11 when tested according to ASHRAE 52.2 - 2007.
  3. Average efficiency of 60 % – 65% based on ASHRAE Test Standard 52.1.

#### 2.5 RIGID SYNTHETIC OFFSET RIGID, EXTENDED SURFACE, V FILTER – MERV 15

- A. The filter media shall be 100% synthetic and manufactured from two distinct layers of polyester and polypropylene microfibers. The pre-filter layer shall be a spunbond polyester while the microfiber layer shall be constructed from electrostatically enhanced microfiber.
- B. The filter media shall be resistant to mechanical damage caused by handling.
- C. The filter media packs shall be potted within the top and bottom horizontal end caps, while the media packs shall be sealed to nonwoven vertical support stabilizers with hot melt glue that creates a molecular bond to the nonwoven vertical supports, eliminating any possibility of air filter bypass.
- D. The filter shall not contain metal parts to ensure 100% incinerability.

- E. The nominal size shall be 24 x 24 x 12.5 (594x594x317.5mm) and the filter shall contain no less than 8 media panels.
- F. The filter media shall be non-hydroscopic and the filter shall operate unaffected at relative humidity up to 100%.
- G. The filter shall be UL 900 classified as to flammability, Class 1. Filter shall meet NYC Material Acceptance Code Certification, MEA-438-00-M, Vol 11, Pursuant to Administrative Code Section 27-131.
- H. Performance
  - 1. The filter shall have a documented maximum initial pressure drop of 0.31 inches WC when tested at 492 FPM.
  - 2. The filter shall be tested to ASHRAE test standard 52.-2 and conducted by an independent lab, and have a MERV 15 Efficiency when tested at 1968 CFM.
  - 3. The filter shall have a documented burst strength of no less than > 12" w.g.
  - 4. The filter shall have a microbial resistance "Level 4" certification in accordance to ASTM Standard D632G.
  - 5. The filter shall be certified by Greenguard Environmental Institute Certification No: ACIAF97011-1- low-emitting materials and products. Provide a Certificate of Certification
- I. The filter shall be a Viledon MVFR 95 1" offset or approved equal.

## 2.6 FRONT AND REAR ACCESS FILTER FRAMES

- A. Framing System: Aluminum framing members having minimum thickness of 0.09 inch (2.3 mm), designed for either upstream (front) or downstream (rear) filter servicing. Cut to size and pre-punch members for assembly into modules of size and capacity as indicated. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation. Provide hardware necessary for field assembly.
- B. Pre-filters: Incorporate a separate track, removable from front or removable from back, after removing after filters.
- C. Sealing: Permanently gasket framing members to prevent bypass of unfiltered air. Provide factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements.

## 2.7 SIDE-SERVICE HOUSINGS

- A. Description: Factory-assembled, side-service housings with flanges to connect to duct system as indicated. Construct of 16-gage (1.6mm) galvanized steel.
- B. Pre-filters: Integral tracks to accommodate 2-inch (50mm) throw-away or cleanable filters.
- C. Access Doors: Continuous gaskets on perimeter and positive locking devices. Arrange so filter cartridges can be loaded from either access door.
  - 1. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent air bypass.

## 2.8 FILTER GAGES



- A. Provide Differential pressure sensor across each fan bank. In addition to having a visual gage and pointer the differential pressure sensor for air filter applications shall provide a current or voltage signal (4-20 Ma, 0-10 VDC, or 0-5 VDC) with an accuracy of +/- 1% fs (including non-linearity, hysteresis, and non-repeatability). Accuracy for pressure sensors used in flow measurement applications shall be +/- 0.5%. Operating temperature range and compensated temperature range shall be as appropriate for the temperature extremes of the environment where it is used and the application it is intended for.
- B. The gauge shall be in a metal case, have vent valves, with black figures on white background, and front recalibration adjustment.
  - 1. Diameter: 4-1/2 inches (115 mm).
  - 2. Scale Range for Filter Media Having a Recommended Final Resistance of 0- to 2.0-inch wg (0 to 500 Pa).
- C. Manometer-Type Filter Gage: Molded plastic, with epoxy-coated aluminum scale and logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg and accurate within 3 percent of the full scale range.
- D. Static pressure taps shall be located in the airstream as recommended by the manufacturer and connected to gauges located on air handling unit casings, or on walls for in-duct HEPA filter locations, as directed, with 1/4" O.D. aluminum tubing.
- E. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

## 2.9 LOW-LEAK FILTER BANK ISOLATION DAMPERS

- A. The dampers shall be Flanders Model CV-D as manufactured by Flanders Filters, Inc. of Washington, NC.
- B. The dampers shall be fabricated of unpainted 14-gauge type 316L stainless steel with a 2-B mil finish and shall be designated to mount to Flanders containment housings. All seams and joints shall be free of burrs and sharp edges. The dampers shall have type 316L stainless steel convex damper width 1/2" thick silicone gasket seals. Each blade shall be independently operated by a drive mechanism. The torque required to operate the damper shall be approximately 20 foot-pounds. Operating position shall be shown on the frame adjacent to the drive mechanism. The maximum permissible leak rate shall be no greater than 0.2% of the internal volume of the damper assembly per hour at 10" w.g. when tested per the pressure decay method described in ANSI N510-1980.
  - 1. Pneumatic actuators shall be provided for remote damper operation.
  - 2. Damper end switches to be supplied as part of bag filter damper assembly.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Charcoal Service Corp.,
  - 2. Flander,
  - 3. American Air Filter
  - 4. Barnebey Cheney.
  - 5. Or approved equal.

## PART 3 - EXECUTION

3.1 Refer to DDC General Conditions for execution requirements.

3.2 INSTALLATION

- A. Filters, filter frames, filter housings, and filter gauges shall be installed in accordance with manufacturer recommendations and approved submittals.
- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Install filter gage for each filter bank.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- F. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- G. Coordinate filter installations with duct and air-handling-unit installations.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Operate automatic roll filters to demonstrate compliance with requirements.
  - 2. Filters: Leak-test housing by pressurizing to a minimum 3 inches w.g. (750 Pa) or to designed operating pressure. Soap-bubble test housing joints, door seals, and filter sealing edges.
  - 3. Test for leakage of unfiltered air while system is operating.
- D. Air filter will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 CLEANING

- A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

**END OF SECTION 23 41 00**



**SECTION 23 51 00****BREECHINGS, CHIMNEYS, AND STACKS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC AND WIND RESTRAINTS FOR HVAC COMPONENTS
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING
- E. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS
- F. Section 23 31 20 – FIRE RESISTIVE DUCT/PIPE INSULATION AND ENCLOSURES
- G. Section 23 52 16 – CONDENSING BOILERS
- H. Section 23 52 39 – CLEAN STEAM GAS FIRED BOILER
- I. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Prefabricated Boiler Stack and Breeching
  - 2. Prefabricated Double Wall Generator Exhaust Pipe and Vents
  - 3. Listed double-wall vents & chimneys.
  - 4. Listed, refractory-lined breechings and stacks.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"



- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

1.5 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.
- B. Product Data: For the following:
  1. Prefabricated Boiler Stack and Breeching
  2. Prefabricated Double Wall Generator Exhaust Pipe and Vents
  3. Type B and BW vents.
  4. Type L vents.
  5. Special gas vents.
  6. Guy wires and connectors.
- C. The shop drawings shall be prepared and approved by a registered structural engineer licensed in the State of New York designated by the manufacturer. Drawings shall be prepared showing all features of the work including thickness of steel shell and refractory, overall height and diameter, and the design of the anchor system (including seismic) and foundation. The stack shall be through roof, which includes a drain. Detailed design calculations for tension, compression, cantilever, vibration ovaling, dynamic stability and seismic forces shall be furnished (signed and sealed) by the registered structural engineer. Wind forces are to be calculated in accordance with the requirements of ANSI-A58.1-1972. Deflection shall in no case exceed a ratio of 1 to 200 in reference to stack height.
- D. Engineering report certifying that stacks meet the design wind and seismic loads.
- E. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
  1. Drawings showing the actual layout and drawn to scale.
  2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
  3. Submit for review for installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer licensed in the State of New York responsible for their preparation.



4. Design, materials, weights, construction, pressure and temperature limitations of breeching and stack systems, flue gas recirculation system. Seismic design data.
  5. Drawings showing all components, system arrangement and dimensions.
  6. Design, construction, allowable movements, movement forces, pressure and temperature limitations of expansion joints.
  7. Damper design, construction, pressure and temperature limitations, pressure loss at design flow, and leakage of closed damper.
  8. Support designs, locations and loads for entire assembly.
  9. Written statement from boiler/burner manufacturer that the design of the system is satisfactory to achieve the required boiler/burner performance.
- F. Shop drawings detailing fabrication and installation of breechings and stacks, including plans, elevations, sections, details of components, and attachments to other construction elements. Detail connections to equipment.
- G. The chimney manufacturer shall certify that the shop drawings' proposed exhaust system complies with the appliance manufacturers' written requirements and that the installation will safely exhaust the connected equipment. For listed Category I equipment, listed equipment equipped with a draft hood or equipment listed for use with Type B gas vent, the draft calculation shall be based upon the requirements set forth in the latest edition of NFPA 54 including NFPA 54's 'Sizing of Category I Venting Systems' and NFPA 54's Vent Tables. For all other Categories and appliance types, draft calculations shall be based upon the appliance manufacturers' written requirements. The draft calculation shall be based upon ASHRAE's Chimney Design Equation and submitted with the appliance manufacturers' requirements for review and approval by the Commissioner. Draft calculations indicating non-compliance with NFPA 54 or insufficient draft shall have a termination-mounted mechanical draft system installed.
- H. Welding certificates.
- I. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic and wind forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic or wind forces specified and the unit will be fully operational after the seismic event."
  3. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
  4. Detailed description of anchorage devices on which the certification is based and their installation requirements.
- 1.6 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Source Limitations: Obtain listed system components through one source from a single manufacturer.

- C. Welding: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.
- D. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.
- E. Welder Qualifications: Certified according to AWS D9.1.
- F. Manufacturer Qualifications: Firm experienced in manufacturing breechings, chimneys, and stacks similar to those indicated for this Project and that have a record of successful in-service performance.
- G. Provide scale drawings showing nominal dimensions and weight of the systems.
- H. Boiler and burner manufacturer shall review complete system from boiler flue gas outlet to stack outlet to atmosphere and advise the Commissioner of any changes required to meet boiler and burner performance requirements. Note the altitude of plant site.
- I. Flue gas recirculation ductwork shall be designed and provided by the burner manufacturer.
- J. Conform to NFPA 54 and NFPA 31 for installation of fuel burning equipment and appliances.
- K. Comply with NFPA 211 for components and installation.
- L. Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabricated breechings.
- M. Comply with SMACNA "Guide for Steel Stack Design and Construction."
- N. Comply with AWS D1.1 for welder qualifications, welding details, and workmanship standards.
- O. Comply with ASHRAE "Systems and Equipment Handbook", Chapter 31 for "Chimney, Gas Vent, and Fireplace Systems," for material requirements and design criteria.
- P. UL Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.
- Q. Structural Steel - ASTM - A36 (36,000 PSI Min.) American Institute of Steel Construction.
- R. Light Gauge Sheet - ASTM A570-30 (30,000 PSI Min.)
- S. Concrete - 3000 PSI (Min.) American Concrete Institute Specifications.
- T. Anchor Bolts - ASTM A-307 (Min.)
- U. Refractory – UL 959
- V. Single-Source Responsibility: Obtain all system components from 1 source and by a single manufacturer.

#### 1.7 COORDINATION

- A. Bases: Concrete, reinforcement, and formwork requirements are specified with concrete under another section..



- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

- 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PREFABRICATED BOILER STACK & BREECHINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Selkirk Metalbestos
  - 2. Van-Packer
  - 3. Metal-fab
  - 4. Ampco,
  - 5. Schebler
  - 6. Or approved equal.
- B. Boiler stack & breechings shall be completely factory fabricated of the sectional type listed by Underwriters Laboratories, Inc.
- C. The manufacturer shall furnish all items which form a part of the assembly, including cleanout section, tee section, straight sections, elbows, expansion joints, boiler adapter kits, guybands, flashing, counter flashing, and insulated thimble where required. Each section shall bear the factory applied Underwriters Laboratories label.
- D. In addition, manufacturer shall furnish all items which form a part of the breeching assembly, including sections with cleanout and access doors, tee sections, straight sections, expansion joints, increasers, elbows, hanger bands, end caps and sample ports.
- E. Each stack section shall be up to 4 ft. in length with an insulating refractory wall encased in an 11 gage galvanized steel jacket with welded seams. Insulating refractory shall be flush and square with ends of jacket to insure 100% bearing surface between sections after erection. Insulating refractory shall be suitable for high incinerator exit temperatures and shall be centrifugally spun into the metal jacket. Slumped or poured mix is not acceptable.
- F. All portions of the chimney system shall be supplied, including appliance adapters straight lengths, adjustable lengths, elbows, drain sections, reducers, lateral tees, tees, tee caps, barometric dampers, support plates, storm collar, flashing and chimney top.
- G. Chimney shall have a 304 stainless steel inner wall, an aluminized steel outer jacket, and 2" of fiber insulation between the walls. Outdoor portions of the chimney shall have a 304 stainless steel outer jacket.
- H. The chimney system shall be installed per the chimney manufacturer's recommendations and in conformance with the manufacturer's warranty.



- I. System configuration must confirm to the equipment manufacturer's venting recommendations, pertinent local codes and the most recent edition of NFPA 31 or NFPA 54 and NFPA 211.
- J. Provide removable insulated flue connection to each boiler to facilitate access to the boiler for removal, inspection and cleaning.
- K. Stack sections shall be circular with diameter as shown on drawing.
- L. Assembly shall be made by joining stack sections with high temperature joint cement and covering joint with aluminized steel joint bands by stack manufacturer. Total height shall be as shown on drawings, with lateral and/or vertical bracing and support as recommended by the stack manufacturer.
- M. A Barometric Damper shall be installed as required by the stack manufacturer.
- N. An insulated thimble supplied by the stack manufacturer shall be installed wherever the stack passes through roof of combustible material with flashing and counter flashing as required.
- O. A rain cap shall be provided at top of stack.
- P. Tee sections shall be required height and shall have a 6" refractory projection for the breeching condition.
- Q. Cleanout door sections shall be provided at the heel of the stack and at 15' maximum intervals in horizontal breeching.
- R. Installation shall be made in accordance with the Manufacturer's recommendation and in compliance with the Underwriters Laboratories, Inc. listing.

## 2.2 DOUBLE WALL GENERATOR EXHAUST PIPE AND VENTS.

- A. Factory fabricated, all steel, positive pressure, double wall metal, diesel generator exhaust system.
- B. Manufacturers: subject to compliance with requirements, provide products by one of the following:
  - 1. Chiminee Lining.E Inc, model IPPL2F
  - 2. Selkirk Metalbestos
  - 3. Van-Packer
  - 4. Metal-fab
  - 5. Or approved equal.
- C. The manufacturer shall furnish all items which form a part of the assembly, including cleanout section, tee section, straight sections, elbows, expansion joints, boiler adapter kits, guybands, flashing, counter flashing, and insulated thimble where required. Each section shall bear the factory applied Underwriters Laboratories label.
- D. The factory built exhaust system shall be fabricated in accordance with NFPA 211. The system shall be designed and installed to be gas tight. It shall be UL Listed to withstand up to 60" w.c. positive pressure. Exhaust system shall be designed to compensate for all flue gas induced thermal expansions.



- E. Insulation shall be Ceramic Fibre between inner and outer pipe and shall be 2 inches thick. Clearances to combustible materials shall be per installation instructions and shall have been determined for a continuous operation at temperatures up to 1400 F. Mineral wool insulation will not be acceptable.
- F. The UL listed insulated exhaust system shall have skin temperatures that have been obtained by UL test procedures. The published surface temperatures shall be the result of the UL 103 chimney test.
- G. Each system component shall include a factory installed alignment sleeve at each connection flange. Sleeve to be laser welded 360 degrees to components inner pipe wall and shall extent a minimum 2.5 inches in length beyond the mounting flange. Sleeve to provide long term protection to each joint seal from condensate, water and exhaust gas temperature. Sleeve to provide for added ease of installation. Include flange to flange termination with V-band assembly. Pipe that does not include the factory installed alignment sleeve are not acceptable.
- H. The double wall exhaust pipe has an inner gas carrying pipe of 20-gauge type 304 stainless steel. The outer jacket shall be 24 gauge 304 stainless steel. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL Listing.
- I. The entire generator exhaust system shall be designed, fabricated and installed to include all components connecting from generator muffler outlet to the atmospheric termination point. Included accessories for pressure relief, expansion, v bands with hardware, sealant, guiding and support connections, shall be from one manufacturer.
- J. This exhaust system shall be designed and installed to be gas tight and thus prevent leakage of combustion products into a building.
- K. The exhaust system shall be designed to compensate for all flue gas induced thermal expansion.
- L. Manufacturer shall provide certified design drawings and calculations for the entire generator exhaust system. Drawings and calculations shall be signed and sealed by the manufacturers licensed professional engineer licensed in the State of New York. and submitted as part of the shop drawing submission.
- M. Provide sufficient types, quantities and locations of expansion joints to completely absorb all thermal expansion of the system without imposing excessive loads on equipment or building structure. Use bellows-type joints engineered by designer of the generator exhaust system. Provide bellows joints between all rigid support locations.
- N. Provide threaded pipe drain section at the base of the generator exhaust to allow drainage.
- O. Provide rainshield at the top of the chimney designed to exclude all rainfall penetration into the exhaust system.
- P. The generator exhaust system shall be warranted against functional and structural failure for a period of 10 years from the date of completed installation.
- Q. The manufacturer shall provide drawings showing the actual layout and drawn to scale shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and certified by their licensed professional engineer licensed in the State of New York.



- R. The inner diameter for the generator exhaust shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow ASHRAE calculation methods and incorporate the specific flow characteristics of the inner pipe. Computations shall be certified by the manufacturer's professional engineer licensed in the State of New York. Certification shall be included as part of the shop drawing submittal.
- S. The factory fabricated modular system shall be furnished by a vendor and representative organization which guarantees design, installation and service coordination and provides in-warranty and post warranty unified responsibility.

## 2.3 LISTED SPECIAL GAS VENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Heat-Fab, Inc.
  - 2. Metal-Fab, Inc.
  - 3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
  - 4. Or approved equal.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/2- 1 inch airspace.
- D. Vent shall be factory-built special gas type, double wall, engineered and designed for use on Category I, II, III, and IV appliances, or as specified by the equipment manufacturer.
- E. Maximum continuous flue gas temperature not to exceed 550°F for gas burning appliances. Maximum temperature for appliances approved to vent with Type L-Vent (gas or oil) is 570°F.
- F. Vent shall be constructed with an inner conduit constructed of AL29-4C or 29-4 (S44735) superferritic stainless steel with a minimum thickness of .015" for diameters 3"-8", .020" for diameters 10"-16", .025" for diameters 18"-24", and .035" for 26" and greater.
- G. Vent shall be listed for an internal static pressure of 15" w.g. and tested to 37" w.g.
- H. All inner wall conduit components shall be manufactured for AL29-4C or 29-4 (S44735). The joint closure system shall be an Inner Wall Mechanical Locking Strap design. Joints shall not use screws or fasteners that penetrate the inner conduit.
- I. Vent shall be constructed with a factory installed gasket used to seal the joint for diameters 4"-16". Use of gasket lube, available from the factory, should be used for maximizing gasket life and ease of installation. For diameters 18'-32", joints shall be sealed with factory supplied RTV sealant.
- J. Inner wall joints shall be designed with a male and female overlapping metal-metal connection to maintain condensate on the AL29-4C stainless steel. Proper 1/4" per foot pitch must be maintained at all times and condensate should flow back toward the appliance to the required number of drains.
- K. The outer wall casing shall be constructed of 430 stainless that shall not require additional surface preparation, such as painting, in order to withstand the outdoors or high humidity environments.



- L. Inner conduit and outer wall casing shall be constructed with a one-inch air space between them and in such a fashion that prevents cross-alloy contamination. Optional 1" fiber insulation is available to maintain higher flue temperatures, but does not reduce clearances beyond the standard clearances tested for 1" airspace model CI Plus.
- M. Tees and elbows shall provide a pressure drop less than 15 feet equivalent horizontal vent.
- N. Fittings that increase or decrease vent diameter shall be asymmetric in construction with a flat wall that maintains a straight line with adjoining parts in order to facilitate the unobstructed flow of all condensate.
- O. All parts shall be compatible with other single wall and double wall products of the same manufacturer.
- P. System is to be sized in accordance with the appliance manufacturer's specifications, NFPA 54-national Fuel gas code (ANSI Z223.1), and ASHRAE recommendations.
- Q. Vent shall be warranted by the manufacturer against defects for a period of (15) fifteen years from date of substantial completion.
- R. SEALANT
  - 1. General Electric RTV106 (aka Mumentive) or Dow Corning 736 High Temperature Sealant shall be used to seal all joints on systems where the maximum flue gas temperature will not exceed 550°F.

## 2.4 BOILER OUTLET DAMPERS AND ACCESSORIES

- A. Type: Multi-blade, opposed horizontal blades, automatically controlled. Modulating operation for draft control. Locate at the outlets of the boilers and economizers.
- B. Boiler outlet draft control is specified under another section of this work.
- C. Service: Design for 1000 °F, 5 inches W.C. positive and negative pressure. Maximum leakage, when closed, shall be ten percent of maximum required flow. Maximum pressure loss at maximum boiler output, 0.05 inches WC.
- D. Construction:
  - 1. Blades: ASTM A242 carbon steel, air foil, dowelled to shafts.
  - 2. Shafts: Stainless steel. Provide seals at casing penetrations.
  - 3. Bearings: External to flow stream, carbon, self-contained, bushing, packing-gland assemblies, self-lubricating.
  - 4. Linkages: Control arms dowelled to shafts. All control arms linked to drive motor. External to flow stream. All steel construction.
- E. Accessories:
  - 1. Interlock Switch Mounting: Rigid mounting located to allow switch to sense damper linkage position. Switch is connected to burner control system.
  - 2. Damper Drive Unit: Electric type that shall operate damper without overload. Provide 100 percent duty cycle maintenance-free motors that never overheat or burnout under stalled conditions. Constant speed coordinated with the controlled process so that performance parameters remain within requirements. For systems without draft control, the drive unit

shall automatically open damper 90 degrees on boiler purge and firing cycle; close damper on boiler shut down. For systems with draft control, the drive unit shall automatically open damper 90 degrees on boiler purge cycle, position damper as required for proper burner ignition, modulate damper during boiler firing to maintain constant outlet draft, close damper on boiler shut down.

## 2.5 DRAFT CONTROL

- A. The Draft Control System (MODS) is specified under another section of this work.

## 2.6 EXPANSION JOINTS

- A. Provide sufficient types, quantities, and locations of expansion joints to completely absorb all thermal expansion of the system without imposing excessive loads on equipment or building structure. Fabric joints shall be used on single-wall stack and breeching system. On factory-fabricated double wall stack or breeching system, use slip-type, bellows-type, or fabric expansion joints engineered by manufacturer of the stack and breeching system.
- B. Service: Design for 575 °F, 20 inches WC positive and negative internal pressure, continuous duty.
- C. Construction, Fabric Joints:
  - 1. Fabric: High strength, designed for dewpoint service.
  - 2. Internal Baffles: Carbon steel with stiffeners. Designed to protect interior surfaces of fabric from wiping action of the flue gases.
  - 3. Welded frame, 1/4-inch-thick ASTM A568 steel with 4-inch minimum flange height, flat-belt design, fabricated by expansion joint manufacturer. Fabric element bolting, 3/8-inch diameter, 6 inch maximum centers.
- D. Construction, Factory-Fabricated Double-Wall System Joints:
  - 1. Materials: Same as factory-fabricated breeching system.
  - 2. Packing Gland: High temperature rating. Provide seal between sliding and fixed portions of joint.

## 2.7 ACCESSORIES

- A. Provide all necessary Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as straight sections; all listed for same assembly.
- B. Drains:
  - 1. Provide threaded pipe drain section at the base of the chimney and generator exhaust to allow stack drainage.
  - 2. Provide drains at all low points and drain connections in stack and breeching systems.
  - 3. Slope piping system to the drain.
  - 4. Pipe size shall be 1 inch minimum.
- C. Rain Cap/Rainshield:
  - 1. Provide rainshield at the top of each chimney to prevent any rain penetration into the stack.

2. Raincap shall be made from .025" thick type 304 stainless steel.
  3. Provide wind and rain shield to prevent wind driven rain from entering the chimney.
- D. Instrument Ports: Locate on individual stack or breeching serving each boiler. Locate in non-turbulent zone within 12 feet of boiler room floor between boiler and economizer (when economizer is provided) or locate accessible from platform. Provide separate ports for the following:
1. Flue gas oxygen analyzer: Coordinate with analyzer furnished.
  2. Opacity monitor: Coordinate with sensor furnished. Locate downstream from oxygen analyzer.
  3. Stack temperature sensor: Coordinate with sensor furnished.
  4. Draft gauge: 1-inch diameter coupling, plugged.
  5. Test instruments: 1-inch diameter coupling, plugged.
- E. Access Doors: Bolted, gasketed, insulated, with handles. Minimum opening 16 inches x 16 inches.

## 2.8 GUYING AND BRACING MATERIALS

- A. Cable: Four galvanized, stranded wires of the following thickness:
  1. Minimum Size: 1/4-inch diameter.
  2. For ID Sizes 4 to 15 Inches: 5/16 inch
- B. Pipe: Three galvanized steel, 1-1/4".
- C. Angle Iron: Three galvanized steel, 2 by 2 by 0.25 inch.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 APPLICATION

- A. Listed Chimney Liners: High-efficiency boiler or furnace vents in masonry chimney, dishwasher exhaust, or Type II commercial kitchen hood.
- B. Listed Type B and BW Vents: Vents for certified gas appliances.
- C. Listed Type L Vent: Vents for low-heat appliances.
- D. Listed Special Gas Vent: Condensing gas appliances.

- E. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.
- F. Listed Grease Ducts: Type I commercial kitchen grease duct.
- G. Listed, Refractory-Lined Metal Breechings and Chimneys: Freestanding dual-fuel boiler vents, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.
- H. Field-Fabricated Metal Breechings and Chimneys: Dual-fuel boilers, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.
- I. Field-Fabricated Metal Breechings and Chimneys: Steel pipe for use with engine exhaust.

### 3.4 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. The exhaust systems shall be installed according to the manufacturer's installation instructions. The joining of pipe sections must be made using the assembly band, the finishing band and the appropriate sealing material. Roof penetrations shall be suitable for a combustible roof and shall be according to the manufacturer's detail drawings and installation instructions.
- B. Provide all modular straight sections, fittings, supports, guides, expansion joints, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars and stack cap terminations as required to provide a complete system per the manufacturer's installation instructions.
- C. When installed according to the manufacturer's installation instructions the generator exhaust pipe and its supporting system shall resist side loads at least 1.5 times the weight per foot of piping for both horizontal and vertical portions of the system.
- D. The entire flue system from the appliance outlet to the termination point, including all accessories shall be from one manufacturer.
- E. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- F. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- G. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- H. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- I. Lap joints in direction of flow.
- J. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.
- K. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.
- L. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.



3.5 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

**END OF SECTION 23 51 00**



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**SECTION 23 52 16****CONDENSING BOILERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 13 - MOTORS FOR HVAC EQUIPMENT.
- D. Section 23 05 15 – VARIABLE FREQUENCY MOTOR DRIVES.
- E. Section 23 05 23 – VALVES FOR HVAC.
- F. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- G. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- H. Section 23 07 00 – HVAC INSULATION.
- I. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- J. Section 23 21 13 – HVAC PIPING.
- K. Section 23 21 23 – HVAC PUMPS.
- L. Section 23 25 00 – HVAC WATER TREATMENT.
- M. Section 23 50 00 – FACTORY ASSEMBLED, SKID MOUNTED, PACKAGED BOILER PLANTS.
- N. Section 23 51 00 – BREECHINGS, CHIMNEYS AND STACKS.
- O. This Section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section includes packaged, factory-fabricated and -assembled, gas-fired, condensing boilers, trim, and accessories for generating hot water.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.



B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

1.5 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- C. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
  1. Design calculations and vibration isolation base details signed and sealed by a qualified professional engineer.
    - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
    - b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.
  2. Include diagrams for power, signal, and control wiring.
- D. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints For HVAC Components." Include the following:
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."





- b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Warranty: Special warranty specified in this Section.
- H. Other Informational Submittals:
- 1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by New York Department of Buildings, and document hydrostatic testing of piping external to boiler.
- F. Engineering Services Submittal:
- 1. Engineering calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
  - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.
  - 5. All Engineering Services shall be performed by Contractor's professional engineer licensed in the State of New York, and submitted to Commissioner for review and acceptance.
- G. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- 1. Suspended ceiling components.
  - 2. Other building services.
  - 3. Structural members.
- H. Qualification Data: For Installer.
- I. Welding certificates.
- J. Field quality-control reports.
- I. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

- B. Manufacturer's Qualifications: Firms engaged in the manufacturing of steel, steam boilers, of types and sizes required. Manufacturer must be in the business of manufacturing heat transfer equipment for no less than sixty years.
- C. The boiler package shall be certified to UL 795.
- D. The Steam boiler maximum working pressure shall be 15 psig.
- E. The Tribute Boiler Flame Safeguard Control will be of an accepted quality manufacturer bearing UL Certification.
- F. The entire boiler system and its installation shall conform to the manufacturer's instructions, applicable local, state and federal codes and associated National Board requirements.
- G. The equipment shall, as a minimum, be in strict compliance with the requirements of this specification and shall be the manufacturer's standard commercial product unless specified otherwise. Additional features, details, accessories, etc. which are not specifically identified but which are a part of the manufacturer's standard commercial product, shall be included in the equipment being furnished.
- H. The equipment shall be of the type, design, and size that the manufacturer currently offers for sale and appears in the manufacturer's current catalog.
- I. The equipment shall fit within the framework of the skid. The skid shall fit within the allocated space, leaving ample allowance for clearances, maintenance and inspection.
- J. The equipment shall be new and fabricated from new materials. The equipment shall be free from defects in materials and workmanship.
- K. Boilers must be fully factory test fired prior to shipment. Manufacturer shall supply copies of the Test Fire Report, including fuel/air settings and combustion test results.
- L. All units of the same classification shall be identical to the extent necessary to ensure interchangeability of parts, assemblies, accessories, and space parts wherever possible.
- M. In order to provide unit responsibility for the specified capacities, efficiencies, and performance, the boiler manufacturer shall certify in writing that the equipment being submitted shall perform as specified.
- N. Installer Qualifications:
  - 1. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- K. Pipe Welding: Qualify procedures and operators according to the following:
  - 1. ASME Compliance: Comply with ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. ANSI/ASME SEC 9 – Welding and Brazing Qualifications
  - 3. ANSI/AWS D10.12 – Guide for Welding Mild Steel Pipe
  - 4. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
  - 5. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

6. ASTM B36.1 – Standardization of dimensions of welded and seamless wrought steel pipe for high or low temperatures and pressures.
  7. Welding Materials and Procedures: Conform to Chapter V, ANSI/ASME SEC B31.9 and applicable local regulations.
- N. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- A. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- B. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- C. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- D. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to New York Department of Buildings.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- F. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- G. "ASHRAE/IESNA 90.1 Compliance" Paragraph may be required to comply with Project requirements or New York Department of Buildings. Also, LEED Prerequisite EA 2 requires compliance with ASHRAE/IESNA 90.1.
- H. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- I. Delete first paragraph below if boiler rating exceeds 300,000 Btu/h (87.9 kW).
- J. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- K. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to New York Department of Buildings.
- 1.7 COORDINATION
- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Pulse-Combustion Boilers:
    - a. Heat Exchanger Damaged by Thermal Shock: 15 years from date of Substantial Completion.
    - b. Heat-Exchanger Corrosion: 15 years from date of Substantial Completion.
  - 2. Warranty Period for Fire-Tube Condensing Boilers:
    - a. Leakage and Materials: 10 years from date of Substantial Completion.
    - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: 15 years from date of Substantial Completion.
  - 3. Warranty Period for Water-Tube Condensing Boilers: 20 years from date of Substantial Completion.
  - 4. Warranty Period for Water-Jacketed Condensing Boilers:
    - a. Leakage and Materials: 15 years from date of Substantial Completion.
    - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Lochinvar Corporation; (Basis-of Design),
  - 2. AERCO International,
  - 3. Patterson Kelly,
  - 4. Or approved equal.

### 2.2 MANUFACTURED UNITS

- A. Description: Factory fabricated and assembled.
  - 1. The Condensing boiler shall be provided with a fully modulating burner. The 316L stainless steel combustion chamber shall be designed to drain condensate to the bottom of the heat exchanger assembly. A built in trap shall allow condensate to drain from the heat exchanger assembly.
- B. Heat Exchanger Section Design:
  - 1. Configuration: Fire tube design; 316L stainless steel fire-tube heat exchanger
  - 2. Number of Passes: Single pass; condensate shall flow through and drain to the bottom of the vessel.
  - 3. Fully welded tube/header assembly. There shall be no banding material, bolts, gaskets or "O" rings in the header construction.
  - 4. Tubes shall be precision welded into the top and bottom tube sheets. Tube sheet weld area shall not have overlapping tube weld deposits to help prevent cracking and breaking of welds.



5. ASME "H" stamp for 160-psi working pressure

C. Combustion Chamber:

1. Equipped with insulation and flame observation port
2. Sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal.
3. Fuel supply: Natural gas or Liquid Propane where noted on the schedule.

D. Casing:

1. Jacket: Heavy gauge primed and pre-painted sheet metal, with snap-in or interlocking closures and baked-enamel protective finish.
2. Insulation: Minimum 2-inch- (50-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
3. Combustion Chamber Access: Back, removable panel access
4. Sealed combustion for direct venting of the combustion and flue vent. Stainless Steel, category VI vent.
5. Boiler based designed to permit boiler to be installed on combustible floor.
6. Mounting Frame: Steel rails to mount assembled boiler package on concrete base.
  - a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler, accessories, and components with reinforcement strong enough to withstand seismic forces. Seismic restraints by others.
7. Control Cabinet: Sheet metal casing shall cover all controls, gas train, and burner.

## 2.3 BURNER

- A. Burner: Shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. Boiler shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. Manufacturers unable to provide stable operation at 4-inches water column shall provide a gas booster at the expense of the contractor.
- B. Blower: Forward-curved centrifugal fan integral, directly driven by motor; fully modulating
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- C. Gas Train: Control devices and modulating control sequence shall comply with requirements in IRI and UL. The gas valve shall be designed with negative pressure regulation and be equipped with a variable speed blower system to precisely control the fuel/air mixture to provide modulating boiler firing from 100% to 5.5% of full load capacity.
- D. Pilot: Intermittent-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.

## 2.4 TRIM

- A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."
- B. Boiler shall be equipped with: a temperature/pressure gauge, high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, return

water temperature sensor, a UL353 certified flue temperature sensor, outdoor air sensor, low water flow protection, and built-in adjustable freeze protection.

- C. Safety Relief Valve: ASME rated set for 50-psi as standard with an optional range up to 160-psi; see drawings for safety relief valve rating.
- D. Multiple boilers shall be able to utilize a common venting system. For common vented systems, manufacture shall provide vent dampers to positively seal against backflow of exhaust gases into the non-operating boiler(s). Boiler control shall verify proper position of dampers and static air pressure prior to boiler operation. Dampers shall be pre-tested by manufacture for proper operation prior to shipment.

## 2.5 EMISSIONS

- A. The low emissions burner shall be design certified to SCAQMD Rule 1146.2.
- B. The low emissions burner shall be capable of operating at less than 20 ppm NOx, 50 ppm CO, corrected to 3% O2 throughout the range of operation.

## 2.6 CHIMNEY AND BREECHING

- A. Breechings, Chimneys and stacks are specified under another section of this work.

## 2.7 CONTROLS

- A. Refer to Section 23 09 00 - HVAC Instrumentation and Controls.
- B. Boiler operating controls shall include the following devices and features:
  - 1. The Boiler shall utilize a 24 VAC control circuit and components. The control system shall have an 8" multi-color liquid crystal touch screen display for boiler set-up, status, and diagnostics. All components shall be easily accessed and serviceable from the front of the boiler jacket.
  - 2. The boiler shall feature the "Smart System" control with password security, outdoor air reset, pump delay with freeze protection, pump exercise, domestic hot water prioritization, night set-back, service reminder, time clock, data logging of run hours and space heating. A USB PC port connection provided standard for direct PC connection
  - 3. The Boiler shall have the capability to accept a 0-10 VDC input connection from a BMS control of modulation or set-point, enable/disable of the boiler.
  - 4. The boiler shall have a built-in Cascade with sequencing options for "efficiency optimized" modulation logic; capable of rotation while maintaining modulation of up to eight boilers without utilization of an external controller. Supply voltage shall be 120volt/60hz/1-ph.
  - 5. Built-in controls for each boiler shall incorporate Open Protocol Communications. Controls shall interface with the BMS system as outlined in section 23 09 00 HVAC INSTRUMENTATION AND CONTROLS. Communications shall be achieved by means of a job specific, boiler manufactures supplied and pre-programmed gateway device.
- C. Interface to Boiler Control Panel: BMS shall hard wire can hardware to boiler control panel to monitor, control, and display boiler status and alarms. Microprocessor interface noted in item B.5 above.
  - 1. Hardwired Points:
    - a. Monitoring: On/off status, common trouble alarm



- b. Control: On/off operation, hot water supply temperature set-point adjustment.

## 2.8 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.
- B. The BOILER shall be equipped with two terminal strips for electrical connection.
  - 1. The low voltage connection board provided with 30 data points for safety and operating controls including: Alarm contacts, runtime contacts, louver proving switch, 2 flow switches, DHW tank thermostat, remote enable/disable (wall thermostat/zone control), system supply sensor, outdoor sensor, tank sensor, Modbus BMS signal and cascade control circuit.
  - 2. The high voltage terminal strip shall be provided for supply voltage. Supply voltage shall be 120v/1ph/60hz. The boiler may be factory trimmed for optional supply voltages of 208/3/60, 480/3/60, and 240/1/50.
  - 3. The high voltage terminal strip plus integral relays are provided for independent pump control of up to (3) pumps: 1) System pump, 2) Boiler pump, 3) Domestic Hot Water pump.
  - 4. The System pump and Boiler pump dry contacts shall be sized for up to 1.5-hp @ 120/1/60 or 3-hp @ 240/1/50, or 30 amps.

## 2.9 CAPACITIES AND CHARACTERISTICS:

- A. Refer to plan schedules for additional information.
  - 1. Heating Medium: Hot water.
  - 2. Design Water Pressure Rating: 160 psi
  - 3. Safety Relief Valve Setting: 50 psig standard. Optional range up to 160 psig
  - 4. Design Pressure Drop: 5 psig
  - 5. Minimum Efficiency: 92% AFUE
  - 6. Number of Passes: Single
  - 7. Blower: Variable Speed
  - 8. Electrical Characteristics: refer to plan schedules.

## 2.10 SOURCE QUALITY CONTROL

- A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
- B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test. The boilers shall have an independent laboratory rating for Oxides of Nitrogen (NOx) to meet the requirements of South Coast Air Quality Management District in Southern California and the requirements of Texas Commission on Environmental Quality. The manufacture shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
  - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 SKID MOUNTING**

- A. Refer to Section 23 50 00 Factory Assembled, Skid Mounted, Packaged Boiler Plant for additional details.
- B. All the components in this specification, unless otherwise specified, shall be mounted on steel skid(s) with the appropriate number of lifting fork holes to insure ease of movement and installation of system. The steel skid shall be constructed of ¼ inch thick steel decking material welded to 4-inch structural steel channel primed and painted. All components shall be welded or bolted to the deck of the skid. Boiler feedwater piping shall include a check valve, globe valve, and discharge pressure gauge, in order to properly facilitate throttling of the pump discharge, to position the pumps operating characteristics at the correct point on its corresponding pump curve. All cold water piping will be sweated/threaded copper. All blow-down piping and fittings are to be forged steel. All interconnecting steel piping shall be SA 53 F schedule 80. All piping shall be factory supported, unless otherwise clearly defined on the factory submittal drawings. All specified components are to be completely factory piped to allow for single point field connections for cold water make-up, drain, steam supply, condensate return, and fuel. Connections for air/steam/fuel venting, as well as safety relief valve outlets, shall not be manifolded together, and must be accomplished per 2014 New York City Construction Codes. All specified components shall be completely factory wired to allow for a single point field power, fused disconnect connection. Multiple skid assemblies may also require some field re-assembly and wire pulling of loosely shipped, factory supplied components and wire. This re-assembly of loosely shipped components shall be provided by others, during the installation process.

**3.4 BOILER INSTALLATION**

- A. Equipment Mounting: Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified under another section.
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct bases to withstand, without damage to equipment, seismic force required by code.





3. Construct concrete bases 4 inches high and extend base not less than 6 inches in all directions beyond the maximum dimensions of boiler unless otherwise indicated or unless required for seismic anchor support.
  4. Minimum Compressive Strength: 5000 psi at 28 days.
  5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
  7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  8. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.

### 3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified under another section of this work.
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- G. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tapplings with shutoff valve and union or flange at each connection.
- H. Install piping from safety relief valves to nearest floor drain.
- I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.
- J. Boiler Venting:
1. Install flue venting kit and combustion-air intake.
  2. Connect full size to boiler connections.
  3. Comply with requirements in Section 23 51 00 "Breechings, Chimneys, and Stacks."

- K. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform special inspections only. The Contractor shall be responsible for conducting and coordinating all required progress inspections and their associated expenses, and submitting testing and inspection data to the Commissioner.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature steam pressure.
    - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.
- F. Occupancy Adjustments: When requested within 24 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to five visits to Project during other than normal occupancy hours for this purpose.
- G. Performance Tests:
  - 1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
  - 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
  - 3. Perform field performance tests to determine capacity and efficiency of boilers.
    - a. Test for full capacity.
    - b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.
  - 4. Repeat tests until results comply with requirements indicated.
  - 5. Provide analysis equipment required to determine performance.
  - 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.



7. Notify Commissioner in advance of test dates.
8. Document test results in a report and submit to Commissioner.

**3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain draft control devices. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 52 16**



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**SECTION 23 55 33****GAS-FIRED UNIT HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract.

**1.2 SUMMARY**

- A. Section includes gas-fired unit heaters.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. **Product Data:** For each type of gas-fired unit heater.



1. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: For gas-fired unit heaters. Include plans, elevations, sections, and attachment details.
  1. Prepare by or under the supervision of a qualified professional engineer detailing fabrication and assembly of gas-fired unit heaters, as well as procedures and diagrams.
  2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  4. Include diagrams for power, signal, and control wiring.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Structural members to which equipment will be attached.
  2. Items penetrating roof and the following:
    - a. Vent and gas piping rough-ins and connections.
- B. Seismic Qualification Certificates: For gas-fired unit heaters, accessories, and components, from manufacturer.
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gas-fired unit heaters to include in emergency, operation, and maintenance manuals.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.10 MANUFACTURER'S WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Reznor  
B. Indecco  
C. Vulcan  
D. Or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Gas-fired unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
1. Seismic Fabrication Requirements: Fabricate and reinforce suspension attachments of gas-fired unit heaters, accessories mountings, and components with reinforcement strong enough to withstand seismic forces defined in Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components" when gas-fired unit heater is anchored to building structure.
2. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Capacities and Characteristics: See schedules on M-600.

2.3 MANUFACTURED UNITS

- A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- C. Type of Venting: Gravity vented.
- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
2. Discharge Louvers: Independently adjustable, horizontal blades.
3. Discharge Nozzle: Discharge at 25 to 65 degrees (0.44 to 1.13 radians)] from horizontal.
- E. Accessories:



1. Four-point suspension kit.
  2. Power Venter: Centrifugal aluminized-steel fan, with stainless-steel shaft; 120-V ac motor.
  3. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Propeller Unit Fan:
1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
  2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
- I. Centrifugal Unit Fan:
1. Steel, centrifugal fan dynamically balanced and resiliently mounted.
  2. Belt-Driven Drive Assembly:
    - a. Resiliently mounted to housing, with the following features:
      - 1) Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
      - 2) Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
      - 3) Pulleys: Cast-iron, adjustable-pitch motor pulley.
- J. Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  2. Enclosure Materials: Rolled steel.
  3. Motor Bearings: as required
  4. Unusual Service Conditions:
    - a. Ambient Temperature: 15 deg F.
  5. Efficiency: Premium efficient.
- K. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
1. Gas Control Valve: Two stage
  2. Ignition: Electronically controlled electric spark with flame sensor.
  3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  4. Vent Flow Verification: Flame rollout switch
  5. Control transformer.
  6. High Limit: Thermal switch or fuse to stop burner.
  7. Thermostat: Devices and wiring are specified in Section 230923.27 "Temperature Instruments."
  8. Wall]-Mounted Thermostat:



- a. Two stage.
- b. Fan on-off-automatic switch.
- c. 24-V ac.
- d. 50 to 90 deg F (10 to 32 deg C) operating range.

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54 NYC DOB and FDNY regulation, and manufacturer's written instructions.

### 3.2 EQUIPMENT MOUNTING

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- B. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.
  - 1. Spring hangers and seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - 2. Threaded Rods, Spring Hangers, and Building Attachments: Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" and Section 230548 "Vibration and Seismic Controls for HVAC."
  - 3. Threaded Rods, Spring Hangers, Building Attachments, and Seismic Restraints: Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." and Section 230548 "Vibration and Seismic Controls for HVAC."
  - 4. Anchor the unit to resist code-required horizontal acceleration.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.
- C. Gas Piping: Comply with the Plumbing section on Natural gas piping. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- D. Vent Connections: Comply with Section 23 51 23 "Gas Vents."
- E. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."



#### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a service representative that is properly trained by the manufacturer to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Verify bearing lubrication.
  - 3. Verify proper motor rotation.
  - 4. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

#### 3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

#### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and service gas-fired unit heaters.

**END OF SECTION 23 55 33**

**SECTION 23 57 00****HEAT EXCHANGERS FOR HVAC****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- E. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- F. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Furnish and install on suitable pipe frame on structural steel supports, converters and exchangers of size and capacity as scheduled on the drawings. Manufacturer shall be as noted on drawings or approved equal.
- B. This Section includes:
  - 1. Shell-and-tube Heat Exchangers
  - 2. Flat plate heat exchangers.
  - 3. Automatic Backflushing System

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile



Organic Compound (Voc) Limits for Adhesives, Sealants, Paints And Coatings for Leed Buildings” where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements

**1.5 SUBMITTALS**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- C. Shop Drawings: Signed and sealed by a qualified professional engineer licensed in the State of New York. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Design Calculations: Calculate requirements for selecting seismic restraints and for designing bases.
  - 2. Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
- D. Coordination Drawings: Equipment room, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Tube-removal space.
  - 2. Structural members to which heat exchangers will be attached.
- E. Manufacturer Seismic Qualification Certification: Submit certification that heat exchanger, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration Isolation, Seismic, Flood and Wind Load Restraints For HVAC Components." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Product Options: Drawings indicate size, profiles, performance, and dimensional requirements of heat exchangers and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
- C. ASME Compliance: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- D. Registration: Fabricate and label shell-and-tube heat exchangers to comply with the Tubular Exchanger Manufacturers Association's standards.

**PART 2 - PRODUCTS****2.1 HEAT EXCHANGERS – GENERAL**

- A. Furnish and install on suitable pipe frame on structural steel supports exchangers of size and capacity as scheduled on the drawings.
- B. The contractor shall furnish and install all auxiliary steel required to support and restrain all converters and exchangers.
- C. All heat exchangers shall be selected for a .0005 fouling factor.
- D. Convertors and exchangers shall be ASME constructed and furnished with insurance certificates.
- E. Provide automatic backflush valve for free cooling heat exchangers on open side.

**2.2 SHELL-AND-TUBE HEAT EXCHANGERS**

- A. Manufacturers:
  - 1. Subject to compliance with requirements, provide products by one of the following manufacturers:
    - a. API Heat Transfer Inc.
    - b. Armstrong Pumps, Inc.
    - c. ITT Industries; Bell & Gossett.
    - d. Taco, Inc.
    - e. Or approved equal.
- B. General:
  - 1. Water to water exchangers shall conform to the following:
    - a. Primary water through tubes, secondary water in baffled shell. Channel type construction with removable cover plate for inspection of tubes with breaking pipe connections. Straight tube connections with fixed tube sheet at each end of the shell. Removable return head at far end. Shell and channel shall be fabricated steel ASTM-A-285 Gr. C Tubes shall be seamless copper ¾" OD x 18 ga. Shell flanges and cover plate shall be steel ASTM – A 201 Gr. B Baffles to be steel.



Provide relief valve or valves on secondary waterside between exchanger and shut off valves set at 15 psi above the normal working water pressures at the exchanger. Relief valves shall be furnished by the exchanger manufacturer in conformance with 2014 New York City Construction Codes.

- C. Configuration: Straight tube with removable bundle.
- D. Shell Materials: ASTM A-285 Gr. C Steel. Shell flanges and cover plate shall be steel ASTM A-201 Gr.B.
- E. Head:
  - 1. Materials: Fabricated stainless steel with removable cover.
  - 2. Flanged and bolted to shell.
- F. Tube:
  - 1. Seamless copper tubes.
  - 2. Tube diameter is determined by manufacturer based on service.
- G. Tubesheet Materials: Steel tubesheets.
- H. Baffles: Steel.
- I. Piping Connections:
  - 1. Shell: Flanged inlet and outlet fluid connections, threaded drain, and vent connections.
  - 2. Head: Flanged inlet and outlet fluid connections.
  - 3. Provide relief valve or valves on secondary water side between exchanger and shut-off valves set 15 p.s.i. above the normal working water pressures at the exchanger. Relief valves shall be furnished by exchanger manufacturer in conformance with 2014 New York City Construction Codes.
- J. Support Saddles:
  - 1. Fabricated of material similar to shell.
  - 2. Foot mount with provision for anchoring to support.
  - 3. Fabricate attachment of saddle supports to pressure vessel with reinforcement strong enough to resist heat-exchanger movement during a seismic event when heat-exchanger saddles are anchored to building structure.
- K. Testing and Certification:
  - 1. Heat exchangers are to be hydrostatically tested at the factory.
  - 2. All factory hydrostatic testing of the heat exchangers is to be scheduled in conjunction with the Commissioner.
  - 3. The heat exchanger manufacturer is required to make factory representation available should field thermal and/or pressure testing be required.

## 2.3 FLAT PLATE HEAT EXCHANGERS

- A. Manufacturers:



1. Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Alfa Laval Thermal, Inc.
  - b. API Heat Transfer Inc.
  - c. Armstrong Pumps, Inc.
  - d. ITT Industries; Bell & Gossett.
  - e. Mueller, Paul Company.
  - f. Or approved equal.
- B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.
- C. The plate heat exchangers shall be shipped to the site as completely assembled units. The exchangers shall be pressure tested and flushed clean at the factory prior to shipment. All nozzle connections shall be factory sealed prior to shipment to prevent the entrance of foreign matter into the heat exchangers during shipment, storage and installation.
- D. Codes and Standards:
  1. The plate heat exchangers shall be factory tested in accordance with the requirements of Section VIII, Div. I of the ASME Code.
  2. Flanged nozzle connections shall conform to ANSI B16.5 standards, and shall be of the pressure rating design as indicated on the schedule or as specified under another section of this work.
  3. Pressure ratings assume full pressure on one side and zero pressure on the other side. Studded port construction is not acceptable.
- E. Design Requirements:
  1. Heat exchanger performance and design shall be in accordance with the schedule. Surface area shown per plate heat exchanger is the minimum acceptable. All performance calculations must include a minimum of ten percent (10%) additional surface for fouling. Calculated heat transfer surface area, with and without the additional fouling surface, must be indicated on the manufacturer's submitted performance calculation data sheets. Heat transfer rates fouled in excess of 750 BTU/HR/FT<sup>2</sup>/Deg. F are not acceptable.
  2. Pressure drops in pounds per square inch across each circuit of the plate heat exchanger indicated on the schedules are the maximum allowed.
  3. Heat exchanger design is to be of diagonal flow to optimize fluid flow distribution across the plate surfaces.2.3
- F. Frame:
  1. Frame shall be constructed of carbon steel in sufficient thickness and strength to operate within the designated design and test pressures. Design strength calculations are to be submitted at the Commissioner's request.
  2. Frame tightening bolts shall receive a rust-protective coating of molybdenum grease and shall also be covered with plastic sleeves.
  3. All exposed frame parts shall be surface prepared to an SSP-6 finish, receive two prime coats of a glycerophthalic zinc chromate primer and two finish coats of an epoxy enamel to a minimum dry film thickness of 3mm.
  4. Capacity to accommodate 25 percent additional plates.



5. Painted carbon steel with provisions for anchoring to support.
  - G. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.
    1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during a seismic event when heat-exchanger carrying and guide bars are anchored to building structure.
  - H. End-Plate Material: Painted carbon steel.
  - I. Tie Rods and Nuts: Steel or stainless steel.
  - J. Plate Material:
    1. Plates shall be fabricated from SA312-304 stainless steel having a 2B finish. Pattern shall be Chevron and shall be of a minimum thickness as indicated for the following Design/Test Pressure requirements:
      - a. 150 psi design/225 psi test - .024-inches minimum plate thickness before stamping
      - b. 300 psi design/450 psi test - .032-inches minimum plate thickness before stamping
  - K. Gasket Material: One piece molded design formulated of Nitrile rubber. Inactive port gasket areas shall be vented to the exterior in such a manner that no mixing can occur between fluid circuits.
  - L. Nozzles shall be flanged and shall comply with the requirements of ANSI B 16.5 for a 300 pound - 150-pound rating, as applicable.
  - M. Heat exchanger frames shall have a minimum of two external lifting lugs per frame.
  - N. Piping Connections:
    1. End plate with welded carbon-steel nozzles. Threaded pipe connection for 2" and smaller; carbon-steel flanged pipe connection for larger sizes.
  - O. Enclose plates in a solid stainless-steel removable shroud.
  - P. Testing and Certification:
    1. Plate heat exchangers are to be hydrostatically tested at the factory.
    2. All factory hydrostatic testing of the plate heat exchangers is to be scheduled in conjunction with the Commissioner.
    3. The plate heat exchanger manufacturer is required to make factory representation available should field thermal and/or pressure testing be required.
- 2.04 AUTOMATIC BACKFLUSHING SYSTEM
- A. General:
    1. An Automatic Backflushing System (ABS) shall be supplied as an integral part of each plate and frame heat exchanger to maintain optimum heat transfer surface cleanliness.
  - B. Manufacturers:





1. Subject to compliance with requirements, provide products by the following:

- a. Water Technology of Pensacola, Inc.
- b. Hydac
- c. WSA Engineered Systems
- d. Or approved equal.

C. Product Description:

1. The ABS automatically maintains clean heat transfer surfaces without interrupting normal equipment operation.
2. The ABS System consists of an integrally mounted 4-way reversing valve that permits the reversing of the direction of water flow in the heat exchanger. This flow reversal has been found to significantly reduce fouling in the plate and frame heat exchanger. The flow reversal is controlled by a control panel mounted to the plate and frame heat exchanger or at a separate location as desired. The frequency of flow reversal is set up to match job conditions. Normally, flow reversal would occur once every six to eight hours.

D. Equipment Specification:

1. Four-Way Valve: Valve shall be per Water Technology's standard HX or CX configuration and shall be of steel construction (A36 or better), positive sealing type with all internal sealing parts of hard rubber and 304 stainless steel. It shall be manufactured in accordance with ASME Unfired Pressure Vessel Code Specification per Section VIII for operation at a minimum system working pressure of 125 PSIG with a maximum system differential of 35 PSIG. The valve will be mounted as an integral part of the plate and frame heat exchanger. It shall be hydro-statically tested to 1.5 times designed working pressure. Valve shall allow for manual fail-safe turning, and have a mechanical position indicator.
2. Electronic Actuator: To be pre-mounted on the valve. Double actuating cylinder to assure trouble-free operation.
3. Position Control Switches: Micro-switch to be supplied for valve to indicate complete turn of valve in normal and reverse flow.
4. Control Panel: The on-load control shall have the following features:
  - a. Nema 4x enclosure with mounting bracket.
  - b. Cycle counter.
  - c. 24-hour timer to automatically initiate the on-load cleaning cycle.
  - d. Manual Override of pre-set cleaning cycle.
  - e. Power On light
  - f. Diverter Position Indicator Lights:
    - 1) Normal Flow
    - 2) Reverse Flow
    - 3) Malfunction Light: To indicate slow turning or incomplete valve turning.
    - 4) 4-way solenoid valve for actuator operation to be mounted at control panel or actuator.
    - 5) Electric Unloading Feature
    - 6) Flow Switch Bypass
  - g. Operation and Installation Manual: Two (2) copies to be provided.
  - h. Shop Testing: In addition to tests specified for the valve, Manufacturer will functionally test the entire system prior to shipment including valve, actuator and control panel.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 HEAT-EXCHANGER INSTALLATION**

- A. Install shell-and-tube heat exchangers on saddle supports.
- B. Install shell-and-tube heat exchangers on concrete base.
- C. Provide automatic backflush valve for free cooling heat exchangers on open side.
- D. Concrete Bases: Anchor heat exchanger to concrete base.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Cast-in-place concrete materials and placement requirements are specified in Division 03.

**3.4 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Maintain manufacturer's recommended clearances for service and maintenance. Install piping connections to allow service and maintenance of heat exchangers.
- C. Install shutoff valves at heat-exchanger inlet and outlet connections.
- D. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.
- E. Install vacuum breaker at heat-exchanger steam inlet connection.
- F. Install hose end valve to drain shell.

**3.5 FIELD QUALITY CONTROL**

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.



3.6 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain heat exchangers. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 57 00**



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**SECTION 23 64 18****HEAT RECOVERY CHILLER HEATER PACKAGED MODULAR WATER CHILLER****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 13 – MOTORS FOR HVAC EQUIPMENT.
- D. Section 23 05 14 – VARIABLE FREQUENCY MOTOR DRIVES.
- E. Section 23 05 19 – METERS AND GAUGES FOR HVAC PIPING.
- F. Section 23 05 23 - VALVES FOR HVAC PIPING.
- G. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- H. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- I. Section 23 08 00 – COMMISSIONING OF HVAC.
- J. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS
- K. Section 23 09 05 - SEQUENCES OF OPERATION FOR HVAC CONTROLS.
- L. Section 23 25 00 – HVAC WATER TREATMENT.
- M. Section 23 25 10 – HVAC WATER FILTRATION SYSTEM.
- N. Section 23 82 50 – MISCELLANEOUS MECHANICAL SYSTEMS.
- O. This section is a part of each Division 23 00 00 section.

**1.02 SUMMARY**

- A. Provide factory fabricated and factory run tested, outdoor, packaged, modular, air-cooled centrifugal chillers with integral free cooling complete with base and frame with the capacities as scheduled on the Documents.
- B. Each chiller shall consist of hermetic scroll compressors, brazed plate evaporator, brazed plate water-cooled condensers, control system and all components necessary for proper unit operation.
- C. Refrigerant shall be R-410A.

- D. Compressor motors must not exceed 15 Horsepower
- E. Provide all related appurtenances to allow for a complete, fully operational system that will supply chilled water for HVAC use, whether indicated herein or which may be reasonably implied as essential, irrespective of it being mentioned in the Drawings and Specifications or not.
- F. System Description: Chiller shall incorporate Scroll type compressors and can consist of multiple modules. Each refrigerant circuit shall consist of an individual compressor set, common dual circuit evaporator, dual circuited condenser, electronic expansion valves, liquid line solenoid valves, filter driers, fin and tube condenser, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical stand-point. The multi-circuit chiller must be able to produce chilled water even in the event of a failure of one or more refrigerant circuits.
- G. Chiller Modules shall be ETL listed in accordance with UL Standard 1995, CSA certified per Standard C22.2#236. Chiller modules shall be AHRI certified.
- H. The manufacturer shall, prior to submitting bid, examine the complete set of the Contract Documents in order to verify that the chillers will perform under installed conditions.
- I. Manufacturer shall certify that the performance of the chillers will meet the requirements as indicated on the schedules, including, but not limited to the entering air-dry bulb temperatures, entering and leaving chilled water temperatures, entering and leaving condenser water temperatures, water flow rates, compressor motor horsepowers, pressure drops, etc.
- J. The manufacturer shall also certify that the space requirements and location for the chillers as indicated on the contract requirements are sufficient for a complete, safe, fully operational, maintainable and satisfactory installation.
- K. All equipment and material to be furnished and installed on this project shall be UL or ETL listed, in conformity with the requirements of all New York Department of Buildings and suitable for its intended use on this project.
- L. Grooved piping or connections shall not be unacceptable.

#### 1.03 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile



Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.04 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.05 REFERENCED STANDARDS**

- A. All factory fabricated chillers and accessories shall be designed, manufactured and tested in accordance with the latest applicable industry standards including, but not limited to the following:
  - 1. ANSI/ASHRAE Standard 15
  - 2. ASHRAE 147
  - 3. ANSI B31.5 Refrigeration Piping Code.
  - 4. ARI 550/590
  - 5. ANSI/UL 465
  - 6. ANSI/ASME SEC 8
  - 7. ANSI/ASHRAE 90.1
  - 8. ANSI/ ASME SEC 8
  - 9. ANSI/ UL 465
  - 10. ANSI/UL-1995
  - 11. ASME Section VIII Unified Pressure Vessel Code.
  - 12. UL Standard.
  - 13. OSHA – Occupational Safety and Health Act.
  - 14. ISO – International Organization for Standardization

**1.06 DEFINITIONS**

- A. Chiller or chillers: Fully assembled refrigeration machine(s) consisting of multiple modules.
- B. Refrigeration machine: Chiller or chillers, fully assembled, consisting of multiple modules.
- C. BMS: Building management system.
- D. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- E. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- F. GFI: Ground fault interrupt
- G. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- H. kW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.



- I. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

#### 1.07 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Centrifugal chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. Performance Tolerance: Comply with the following in lieu of ARI 550/590:
  - 1. Allowable Capacity Tolerance: Two (2) percent.
  - 2. Allowable IPLV/NPLV Performance Tolerance: Two (2) percent.
  - 3. Allowable Capacity Tolerance: Zero percent.
  - 4. Allowable Full-Load Energy Efficiency Tolerance: Zero percent.
  - 5. Allowable Part-Load Energy Efficiency Tolerance: Zero percent.
- C. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.
- D. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- G. Comply with NFPA 70.
- H. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.
- I. Operation Following Loss of Normal Power:
  - 1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
  - 2. See drawings for equipment served by backup power systems.
  - 3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

#### 1.08 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Submit shop drawings and product data in accordance with contract specifications.
- C. Submittals shall include the following:





1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections.
  2. Summary of all auxiliary utility requirements such as: electricity, water, etc. Summary shall indicate quality and quantity of each required utility.
  3. Single-line schematic drawing of the power field hookup requirements, indicating all items that are furnished.
  4. Chiller Controls:
    - a. Schematic diagram of control system indicating points for field connection. Diagram shall fully delineate field and factory wiring.
    - b. Chiller control hardware layout, wiring diagrams depicting factory installed wiring, field installed wiring with points of connection, and points of connection for BMS control/interface points.
    - c. Sequence of operation depicting overview of control logic used.
  5. Installation and Operating Manuals.
  6. Manufacturer certified performance data at full load in addition to either IPLV or NPLV.
  7. Installation manual.
- D. Product Data: For each type of product.
1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
  2. Performance at AHRI standard conditions and at conditions indicated.
  3. Performance at AHRI standard unloading conditions.
  4. Minimum evaporator flow rate.
  5. Refrigerant capacity of water chiller.
  6. Oil capacity of water chiller.
  7. Fluid capacity of evaporator.
  8. Characteristics of safety relief valves.
  9. Force and moment capacity of each piping connection.
  10. Minimum entering air.
  11. Performance at varying capacities with constant design condenser-fluid temperature. Repeat performance at varying capacities for different condenser-fluid temperatures from design to minimum in 5 deg F increments.
- E. Sustainable Design Submittals
1. Product Data: For refrigerants.
  2. Product Data: For energy performance.
- F. LEED Submittal:
1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
- G. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
1. Assembled unit dimensions.
  2. Weight and load distribution.
  3. Required clearances for maintenance and operation.
  4. Size and location of piping and wiring connections.
  5. Diagrams for power, signal, and control wiring.

**1.09 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings:
  - 1. Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    - a. Structural supports.
    - b. Piping roughing-in requirements.
    - c. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
    - d. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
  - 2. Coordination drawings showing plan, section and elevation views.
  - 3. Each view to show screened background with the following:
    - a. Column grids, beams, columns, and concrete housekeeping pads.
    - b. Layout with walls, floors, and roofs, including each room name and number.
    - c. Equipment and products of other trades that are located in vicinity of chillers and part of final installation, such as plumbing systems.
- B. Certificates: For certification required in "Quality Assurance" Article.
- C. Seismic Qualification Data: Certificates, for water chillers, accessories, and components, from manufacturers.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Installation instructions.
- E. Source quality-control reports.
- F. Startup service reports.
- G. Warranty: For special warranty.

**1.10 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
- B. Spare Parts List: Recommended spare parts list with quantity for each.
- C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
- D. Instructional Videos: Including those that are prerecorded and those that are recorded during instruction.

**1.11 SERVICE MATERIAL SUBMITTALS**

- A. Tool kit to include the following:
  - 1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
  - 2. Special tools required to service chiller components not readily available to service personnel in performing routine service.
  - 3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit.
  - 4. A list of each tool furnished. Permanently attach the list to underside of case cover.
- B. Touchup Paint: 32 oz. container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

**1.12 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Company specializing in manufacture of refrigeration machines with ten years minimum experience.
- C. Chiller shall be manufactured in a facility, which has been registered by Underwriters' Laboratories, Inc. (UL) to the International Organization for Standardization ISO Series Standards for quality.
- D. ARI Certification: Certify chiller according to ARI 550/590 certification program. Chillers must be certified as shipped and not altered in any way that would affect AHRI certification.
- E. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.
- F. ASHRAE Compliance:
  - 1. ASHRAE 15 for safety code for mechanical refrigeration.
  - 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013.
- H. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design.
- I. Compressor impellers shall be dynamically balanced and over-speed tested by the manufacturer at a minimum of 120% design operating speed. Each compressor assembly shall undergo a mechanical run-in test to verify vibration levels and oil pressures and temperatures are within acceptable limits.
- J. Entire chiller assembly shall be proof tested at 232 psig and leak tested at 355 psig with a tracer gas mixture on the refrigerant side. The leak test shall not allow any leaks greater than 0.5 oz/year of refrigerant. The waterside of each heat exchanger shall be hydrostatically tested at 1.5 times rated working pressure.
- K. Chiller and VFD shall be factory wired and tested together to verify proper starter operation prior to shipment.



- L. All motors controlled by VFD shall be compatible for inverter duty (VFD) operation and fully tested at the factory
- M. Comply with NFPA 70.
- N. Comply with requirements of UL and include label by a qualified testing agency showing compliance.
- O. Green Seal Compliance: Signed by Green Seal certifying compliance with GS-31.
- P. All electrical fitting connections shall be watertight.

#### 1.13 VERIFICATION OF CAPACITY AND EFFICIENCY FACTORY RUN-IN TEST

- A. The completed chiller (each unit) shall be factory performance tested, before shipment, according to ARI 550/590 procedures and tolerances, under full and partial load conditions in an ARI certified test facility. The manufacturer shall supply a certified test report to confirm performance as specified. Proper ARI certification documents for the test loop shall be made available for inspection.
- B. Tonnage shall be measured on the water side of the evaporator.
- C. Each chiller shall undergo a series of factory performance tests to ensure that the completed unit is leak tight, that all electrical components operate as intended, and that every aspect of unit fabrication meets stringent quality standards in accordance with good practice and the manufacturer's quality assurance requirements. Chiller shall be fully assembled in factory and tested in the factory.
- D. Factory test and inspect evaporator, condenser, and heat-reclaim condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Pressure test fluid side of chiller modules to 1.5 times the rated pressure. Pressure proof test refrigerant side to a minimum of 45 psig. Vacuum and pressure test for leaks.
- F. Factory testing using components (such as vessels) other than the actual components to be installed in the field, or field run-testing in lieu of factory run-testing, shall not be acceptable.
- G. Test at the following conditions:
  - 1. Design conditions indicated.
  - 2. Reduction in capacity from design to minimum load in steps of 20% or 5 points selected by the Commissioner.
  - 3. The performance test shall be run in accordance with ARI 550/590 to include the following:
    - a. A downward temperature adjustment to the design leaving evaporator water temperature to adjust from the design fouling to the clean tube condition.
    - b. An upward temperature adjustment to the design entering condenser water temperature to adjust from the design fouling to the clean tube condition.
    - c. There shall be no exceptions to conducting the performance test with clean tubes and with temperature adjustments above. The manufacturer shall clean tubes, if necessary, prior to test to obtain a test fouling factor of .00025 hr. sq. ft. F/BTU for condenser and 0.0001 hr sq. ft. F/BTU for evaporator.



4. The performance test shall also include sound tests, according to ARI 575.
  5. Compressor assembly shall be tested. Vibrations shall not exceed 0.14 (inch per second) at the compressor housing
- H. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
- I. The factory test instrumentation shall be per latest edition ARI Standard 550/590 and the calibration of all instrumentation shall be traceable to the National Institute of Standards Technology (formerly NBS).
- J. A certified test report of all data shall be submitted to the Commissioner prior to shipping. The factory certified test report shall be signed by an officer of the company from the manufacturer. Preprinted certification will not be acceptable; certification shall be in the original.
- K. The chiller automated controls test shall be executed to check for proper wiring and ensure correct controls operation. Provide demonstration of BACnet interface of all chiller data.
- L. For Performance Test Tolerances, see the requirements specified herein.
- M. Factory performance tests shall be witnessed by Commissioner. All expenses associated with the attendance Commissioner shall be borne by the Contractor.
- N. Notify Commissioner 14 days in advance of testing.
- O. The equipment will be accepted if the test procedures and results are in conformance with ARI Standard 550/590. If the equipment fails to perform within allowable tolerances, the manufacturer will be allowed to make necessary revisions to his equipment and retest as required.

#### 1.14 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled in accordance with manufacturer's instructions.
- B. Unit shall be shipped with all refrigerant piping and control-wiring factory installed.
- C. Unit shall be shipped charged with a nitrogen holding charge. The initial charge of refrigerant and oil will be supplied, shipped in containers and cylinders for field installation. Refrigerant shall be stored by the manufacturer, until requested for delivery by Contractor. Unit shall be field charged with refrigerant by the manufacturer.
- D. Unit shall be shrink wrapped at the factory prior to shipment with the lugs lifting expose. Unit shall be provided with waterproof protection for outdoor storage.
- E. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, chiller model number, chiller serial number, and refrigerant used.
- F. Rigging: Refrigeration machine shall be fully assembled. Units field charged shall be pressure tested at the factory and charged, at the site, by the manufacturer. Machines requiring disassembly for rigging shall be factory assembled and pressure tested. Disassembly, reassembly in the field with new gaskets, pressure testing shall be by this Contractor and supervised by the manufacturer's representative and charging with refrigerant shall be by the manufacturer.



- G. Manufacturer's representative and this Contractor shall be at the storage site when each unit is delivered to verify that delivered unit set and means of storage meets manufacturer's requirements and shall indicate such approval in writing. Manufacturer's representative along with this contractor shall visit storage site monthly to verify same, and issue report to Commissioner after each visit.
- H. Manufacturer's representative shall be on site for delivery of each unit, unit set, and float units to verify that such operations meets manufacturer's requirements and shall indicate such approval in writing.
- I. Manufacturer shall visit site monthly after delivery to site to review condition, progress, address questions and check and log the holding charges or holding vacuums. They shall document each unit in writing.

#### 1.15 STORAGE AND HANDLING (BY INSTALLING CONTRACTOR)

- A. Store equipment in dry location. Protect from damage. Retain all protective covers.
- B. Provide shipping from riggers yard for all equipment and materials required for delivery and installation at site.

#### 1.16 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.
- C. Modules shall require clearance on only two sides in order to perform all service functions.

#### 1.17 WARRANTY

- A. Special Warranty: Manufacturer shall provide full parts and labor warranty coverage for entire chiller for a period of two years.
- B. Manufacturer shall provide full parts-only extended warranty coverage for entire chiller for an additional period of three years.
- C. Manufacturer shall provide full parts and labor warranty for the chillers' compressors for a period of five years.
- D. Warranty Period: Shall commence from date of Substantial Completion.

#### 1.18 START-UP SERVICE

- A. Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. After start-up a Manufacturer's Representative shall provide a minimum of 12-hours of operator instruction to the City of New York's service operators.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Multi-Stack
2. Aermec
3. Climacool
4. Or approved equal.

## 2.02 HEAT RECOVERY CHILLER/HEATER MODULAR, WATER-COOLED CHILLER

- A. Description: Chiller/Heater shall be a heat recovery Chiller/Heater. Chiller/Heater shall be equipped with integral valves that allows the assembly to serve the following functions:
  1. Simultaneous Heating and Cooling Mode – Chiller/Heater assembly must be capable of varying the flow rate on the evaporator and condenser sides of the modules to maintain heating and cooling water set points simultaneously. Simultaneous loads must be satisfied with a single compression cycle and cannot use the source/sink solution as the means of energy transfer. Systems that require double compression to satisfy simultaneous loads are not acceptable.
  2. Cooling Dominant Mode – Chiller/Heater must be able to reject cooling dominant load to the source/sink. Cooling dominant modules must be capable of running at a lower head pressure than simultaneous modules to minimize power consumption.
  3. Heating Dominant Mode – Chiller/Heater must be able to satisfy heating dominant load by extracting heat from the source/sink. Heating dominant modules must be capable of running at optimal suction pressure to minimize power consumption.
  4. Packaged System Shall Be Reversing Valve Free Design – Chiller/Heater must be reversing valve free and optimize heat transfer in all control modes.
  5. Source/Sink Water Connections – Chiller/Heater must allow geothermal loop water to enter both the evaporator and condenser side of the machine.
- B. System shall be configured to allow modules to run in simultaneous Heat/ Cool mode, dominant cooling mode, and dominant heating mode. The Chiller/Heater must be capable of allowing modules to run in multiple modes at the same time to optimize efficiency..
- C. Chiller/Heater shall be designed to operate using R-410a Refrigerant.
- D. The liquid to be heated and cooled will be water containing corrosion inhibitors or other Multistack approved heat transfer fluid.
- E. System Description: Chiller/Heater shall incorporate Scroll-type compressors and consist of multiple refrigerant circuits. Each refrigerant circuit shall consist of an individual compressor (two compressors per circuit on Quad Scroll modules), condenser, evaporator circuit, electronic expansion valve (thermal expansion valve not acceptable), and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical standpoint. The multi-circuit Chiller/Heater must be able to produce chilled or heated water even in the event of a failure of one or more refrigerant circuits.
  1. Each circuit shall not contain more than 10 lb. of R-410a refrigerant.

## 2.03 Chiller/Heater

- A. The Chiller/Heater shall be designed for simultaneous variable heating and cooling capacity. VME II valve module shall contain fast-acting motorized butterfly valves that open/close on a command from the central control system. The motorized actuators shall be modulating NEMA 4X rated with easily visible position indicators and internal thermal motor overload protection.



Valves shall be fast acting type with a maximum stroke time (full closed to full open) of 30 seconds. Valve modules shall be built into pre-engineered headers and powered by the Chiller/Heaters buss bar. VME II valves shall be grooved connection type.

- B. Heat Exchanger Variable Flow Valves: Condenser and Evaporator heat exchangers shall be equipped with motorized modulating butterfly type valves driven independently by signals from the module controller and powered from the main power feed. The motorized actuators shall be modulating NEMA 2, IP-54 with a stroke time of no more than 35 seconds.

1. Optional: NEMA 4X rated valves with easily visible position indicators and internal thermal motor overload protection. Valves shall be fast acting type with a maximum stroke time (full closed to full open) of 15 seconds. NEMA 4X are standard on Quad Scroll Modules

Load side valves shall modulate to maintain modular leaving load temperatures. When heat exchangers are using sink/source due to unequal heating/cooling duty, master controller shall modulate valve to provide minimum required head pressure control in order to maximize efficiency of those Chiller/Heater modules and to provide equipment protection. All valves must be installed such that proper piping practices are observed, including proper distances before and after elbows.

C. General

1. All Modules shall be ETL listed in accordance with UL Standard 1995, CSA certified per Standard C22.2#236
2. All modules shall be AHRI certified according to the AHRI 550 certification program
3. Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment on an AHRI certified test stand.
4. Compressors, heat exchangers, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module.

- D. Water Mains: Each module shall include supply and return mains for both load and source-sink water. Cut grooved end connections are provided for interconnection with grooved type couplings. Water Mains shall be installed such that they are beneath any power or control wiring so as to insure for safe operation in the event of condensation or minor piping leaks.

- E. Heat Exchangers: Each load and source-sink heat exchanger shall be brazed plate heat exchangers constructed of 316 stainless steel; designed, tested, and stamped in accordance with UL 1995 code for 650 psig refrigerant side working pressure and 360 psig water side working pressure. Both the load side and source-sink side heat exchangers shall be mounted below the compressor, to eliminate the effect of migration of refrigerant to the cold heat exchanger with consequent liquid slugging on start-up.

F. Total Access Design

1. Isolation valves shall be installed between the heat exchangers and water supply mains for heat exchanger isolation and removal without the requirement to remove a module or shut down the entire chiller allowing for total access to all serviceable components.

G. Sound Reduction Panel Package

1. Each module shall be supplied with a light weight aluminum frame with sound reduction panels. Panels are powder coated 20 gauge steel with 1" of fiberglass insulation to





reduce sound levels. Optional sound package will reduce sound pressure levels measured at 1 meter at a minimum of 12 dBA

- H. Compressor: Each module shall contain two hermetic scroll compressors independently circuited and mounted to the module with rubber-in-shear isolators. Each system also includes high discharge pressure and low suction pressure manual reset safety cut-outs.
- I. Master Controller
  - 1. Sequencing and operation of the of the various compressors, VME Isolating Valves, and Heat Exchanger Variable Flow Valves shall be performed and coordinated by a microprocessor based controller to maximize efficiency and minimize system energy usage.
  - 2. The Master Controller shall monitor and report the following on each refrigeration system:
    - a. Discharge Pressure Fault
    - b. Suction Pressure Fault
    - c. Suction Temperature
    - d. Load Leaving Water Temperature
    - e. Source-Sink Leaving Water Temperature
  - 3. The Master Controller shall be powered by the chillers single point power connection and shall monitor and report the following system parameters:
    - a. Cooling Load Water Entering and Leaving Temperature
    - b. Heating Load Water Entering and Leaving Temperature
    - c. Source-Sink Water Entering and Leaving Temperature
    - d. Load Water (both heating and cooling) and Source Sink Water Flow
  - 4. An out of tolerance indication from these controls or sensors shall cause a "fault" indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire Chiller/Heater will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall. This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller's 2 line by 40 character back-lit LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).
  - 5. Individual monitoring of leaving water temperatures from each refrigeration system shall be programmed to protect against heat exchanger freeze-up.
  - 6. The control system shall evaluate the water temperatures of the heating and cooling systems to assess the required capacity of each and cycle compressors of the Chiller/Heater Modules, open/close VME Isolation Valves, and modulate Heat Exchanger Variable Flow Valves to meet load requirements, optimize efficiency, minimize system energy usage and equalize compressor run times.  
Chiller/Heater shall have a single point power connection and external inputs and outputs to be compatible with the building management system. Hardwire Inputs/Outputs include:
    - a. Remote Start/Stop
    - b. General Alarm
    - c. Cooling Load Limit
    - d. Heating Load Limit
    - e. Cooling Load Reset
    - f. Heating Load Reset



7. The Chiller/Heater shall be capable of communicating the above points with the Building Automation System via an Interoperability Web Portal. BACnet, available. Additional points shall include:
  - a. Chiller/Heater leaving chilled water temperature
  - b. Chiller/Heater leaving hot water temperature
  - c. Chiller/Heater percent cooling capacity
  - d. Chiller/Heater percent heating capacity
  - e. Module level leaving condenser temperature
  - f. Module level leaving evaporator temperature
  - g. Individual Compressor Status On/Off
  - h. Condenser VME valves Open/Close status
  - i. Evaporator VME valve Open/Close status

J. Single Point Power

1. Chiller shall be equipped with a pre-engineered genuine buss bar electrical system for single point power at a 5,000 amp SCCR. Where the equipment size exceeds the amp rating of the buss bar, multiple power connections may be applied. Pre-engineered system shall also incorporate individual module isolation circuit breakers for full redundancy and ability of a module to be taken off-line for repair while the rest of the modules continue to operate. Individual power feeds to each module shall be unacceptable.

- K. IFM flow switch per module. Integral to each module and powered by the module for individual module proof of flow and flow safety. Modules without independent IFM switches per module are not acceptable alternates.

L. Interoperability Web Portal

1. The Chiller shall be capable of interfacing to a building automation system. Interface shall be accomplished using an Interoperability Web Portal and shall be capable of communication over BACnet.

## 2.4 SAFETIES, CONTROLS AND OPERATION

- A. Chiller/Heater safety controls system shall be provided with the unit (minimum) as follows:

1. Low refrigerant pressure
2. Loss of flow through the source/sink heat exchanger
3. Loss of flow through the load (cooling and/or heating) heat exchanger
4. High refrigerant pressure
5. High compressor motor temperature
6. Low suction gas temperature
7. Low leaving water temperature

- B. Failure of Chiller/Heater/Heater to start or Chiller/Heater shutdown due to any of the above safety cutouts shall be enunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English. Alphanumeric codes shall be unacceptable.

- C. The Chiller/Heater/Heater shall be furnished with a Master Controller as an integral portion of the Chiller/Heater control circuitry to provide the following functions:



1. Provide automatic Chiller/Heater shutdown during periods when the load level decreases below the normal operating requirements of the Chiller/Heater. Upon an increase in load, the Chiller/Heater shall automatically restart.
2. Provisions for connection to automatically enable the Chiller/Heater from a remote energy management system.
3. The control panel shall provide alphanumeric display showing all system parameters in plain English language with numeric data in English units.

**D. Normal Chiller/Heater Operation.**

1. When Chiller/Heater/Heater is enabled, the factory supplied Master Controller modulates the Chiller/Heater heating and cooling capacity from minimum to maximum as required by building load
2. The Chiller/Heater/Heater control system shall respond to Entering Water Temperature and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions

**E. Power Phase Monitor**

1. Provide a Power Phase Monitor on the incoming power supply to the Chiller/Heater. This device shall prevent the Chiller/Heater from operating during periods when the incoming power is unsuitable for proper operation
2. The Power Phase Monitor shall provide protection against the following conditions:
  - a. Low Voltage (Brown-Out)
  - b. Phase Rotation
  - c. Loss of Phase
  - d. Phase Imbalance

**2.05 SOURCE QUALITY CONTROL**

- A. Perform functional test of water chillers before shipping.
- B. Factory performance test water chillers, before shipping, according to AHRI 550/590.
  1. Test the following conditions:
    - a. Design conditions indicated.
    - b. AHRI 550/590 part-load points.
  2. Allow Commissioner access to place where water chillers are being tested. Notify Commissioner 30 days in advance of testing.
- C. Factory test and inspect evaporator and water-cooled condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- D. For water chillers located outdoors, rate sound power level according to AHRI 370 procedure.

**2.06 SERVICE:**

- A. Units shall be Easily accessible for inspection and service.
- B. Compressor's internal components shall be accessible without having to remove compressor-drive assembly from chiller.

- C. Provide lifting lugs or eyebolts attached to casing.

### PART 3 - EXECUTION

#### 3.01 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.02 EXAMINATION

- A. Examine chillers before installation. Reject chillers that are damaged.
- B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.
  - 1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.03 PIPING SYSTEM FLUSHING PROCEDURE

- A. Prior to connecting the chiller to the building chilled water loop, the piping shall be flushed with a detergent and hot water (110-130° F) mixture to remove previously accumulated dirt and other organic residue. In old piping systems with heavy encrustation of inorganic materials consult a water treatment specialist for proper passivation and/or removal of these contaminants.
- B. During the flushing a 30 mesh (max.) Y-strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The use of on board chiller strainers shall not be acceptable. The flushing process shall take no less than 6 hours or until the strainers, when examined after each flushing, are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with the detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.
- C. Prior to supplying water to the chiller, the Water Treatment Specification shall be consulted for requirements regarding the water quality during chiller operation. The appropriate chiller manufacturer's service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

#### 3.04 WATER TREATMENT REQUIREMENTS

- A. Supply water for the chilled water circuit shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the chiller's heat exchangers, headers and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:
  - 1. pH Greater than 7 and less than 9

2.	Total Dissolved Solids (TDS)	Less than 1000 ppm
3.	Hardness as CaCO <sub>3</sub>	30 to 500 ppm
4.	Alkalinity as Ca CO <sub>3</sub>	30 to 500 ppm
5.	Chlorides	Less than 200 ppm
6.	Sulfates	Less than 200 ppm

### 3.05 CHILLER INSTALLATION

- A. Install chillers on concrete pad as indicated.
- B. Equipment Mounting: Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Isolation, Seismic and Wind Restraints for HVAC Components."
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge chiller with refrigerant and fill with oil if not factory installed.
- E. Install separate devices furnished by manufacturer and not factory installed.

### 3.06 FIELD INSTALLED ACCESSORIES

- A. Mounting Package:
  - 1. Unit manufacturer shall furnish a floor plate package consisting of floor plates, jacking screws, leveling pads, and neoprene pads.

### 3.07 CONNECTIONS

- A. Comply with requirements for piping specified in other sections of this work. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, flow meter, and drain connection with valve. Make connections to chiller with a flange.
- D. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to nearest floor or roof drain. Provide a shutoff valve at each connection.:
- E. Shall supply and install pressure gages in readily accessible locations in piping adjacent to the chiller such that they can be easily read from a standing position on the floor. Scale range shall be such that design values shall be indicated at approximately mid-scale. Gages shall be installed in the entering and leaving water lines of the evaporator.

### 3.08 START-UP

- A. Manufacturer shall provide the services of a Factory Authorized Service Engineer licensed in the State of New York to provide complete start-up supervision. Factory Authorized Service Engineer shall also be responsible for assembly of the chillers cabinetry package and electrical bus bar system. After start-up a Manufacturer's Representative shall provide a minimum of 8-hours of operator instruction to the City of New York's service operators.

- B. Factory-authorized service representative shall perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
  - 3. Verify that pumps are installed and functional.
  - 4. Verify that thermometers and gages are installed.
  - 5. Operate chiller for run-in period.
  - 6. Check bearing lubrication and oil levels.
  - 7. Verify that refrigerant pressure relief device is vented outside.
  - 8. Verify proper motor rotation.
  - 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
  - 10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator, condenser, and heat-reclaim condenser.
  - 11. Verify and record performance of chiller protection devices.
  - 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- C. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- D. Prepare test and inspection startup reports.

### 3.09 DEMONSTRATION

- A. Contractor's factory-authorized service representative shall instruct The City of New York's service operators to adjust, operate, and maintain chillers.

## PART 4 - EXECUTION

### 4.01 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
  - 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 4.02 WATER CHILLER INSTALLATION

- A. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.
- B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures with actual equipment provided.
- C. Install water chillers on support structure indicated.
- D. Equipment Mounting:



1. Install water chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Maintain clearances required by 2014 New York City Building Code.
- G. Chiller manufacturer's factory-trained service technicians shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- H. Install separate devices furnished by manufacturer and not factory installed.
1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-instructed service technicians.

#### 4.03 PIPING CONNECTIONS

- A. Comply with requirements in Section 23 21 13 "HVAC Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to chillers, allow space for service and maintenance.
- C. Evaporator Fluid Connections:
1. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage.
  2. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
  3. Make connections to water chiller with a union flange or mechanical coupling.
- D. Heat Recovery Condenser Fluid Connections:
1. Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage.
  2. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
  3. Make connections to water chiller with a union flange or mechanical coupling.
- E. Connect each drain connection with a drain valve, full size of drain connection. Connect drain pipe to drain valve with union and extend drain pipe to terminate over floor drain.
- F. Connect each chiller vent connection with an automatic or a manual vent, full size of vent connection.

**4.04 ELECTRICAL POWER CONNECTIONS**

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high. Locate nameplate where easily visible.

**4.05 CONTROLS CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.
- C. Connect control wiring between chiller control interface and DDC system for remote monitoring and control of chillers. Comply with requirements in Section 23 09 00 "HVAC Instrumentation and Controls".
- D. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high.

**4.06 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
  - 2. Verify that pumps are installed and functional.
  - 3. Verify that thermometers and gages are installed.
  - 4. Operate water chiller for run-in period.
  - 5. Check bearing lubrication and oil levels.
  - 6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
  - 7. Verify proper motor rotation.
  - 8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
  - 9. Verify and record performance of water flows and low-temperature interlocks.
  - 10. Verify and record performance of water chiller protection devices.
  - 11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.





- D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
- E. Prepare a written startup report that records results of tests and inspections.

#### 4.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain chiller. Refer to the DDC General Conditions for instruction requirements.
  - 1. Instructor shall be properly instructed by the factory.
  - 2. Provide not less than eight hours of instruction.
  - 3. Instruct the City of New York's staff in operation and service and to obtain maximum efficiency in plant operation.
  - 4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
  - 5. Obtain Commissioner sign-off that instruction is complete.
  - 6. Instruction shall be held at Project site.

**END OF SECTION 23 65 18**

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**SECTION 23 64 27****REFRIGERANT MONITORING AND ALARM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- E. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- F. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes refrigerant monitoring system, notification appliances, and SCBA. The refrigerant monitoring system shall employ photo-acoustic technology and shall be UL certified to accurately distinguish between different compounds.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 DEFINITIONS

- A. CPIR: Photoacoustic infrared.
- B. BMS: Building Management System

#### 1.6 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Product Data:
  - 1. For each type of refrigerant monitor, include refrigerant sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.
  - 2. For SCBA, include mounting details, service requirements, and compliance with authorized Federal agency.
- C. Shop Drawings:
  - 1. Air-Sampling Tubing: Size, routing, and termination including elevation above finished floor.
  - 2. Wiring Diagrams: Power, signal, and control wiring.
- D. Coordination Drawings: Include machinery-room layout showing location of monitoring devices and air-sampling tubing with filter/inlet locations in relation to refrigerant equipment.
- E. Product Certificates: For monitoring devices and SCBA, signed by product manufacturer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For refrigerant monitoring equipment and SCBA to include in emergency, operation, and maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

#### 1.8 COORDINATION

- A. Coordinate refrigerant detection and alarm system with refrigerant contained in refrigeration equipment for compatibility.

#### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. One calibration kit including clean air calibration gas bottle for zero calibration and



specific refrigerant calibration gas for span calibration, minimum 58-L capacity, pressure regulator, and tubing.

## PART 2 - PRODUCTS

### 2.1 PHOTOACOUSTIC INFRARED REFRIGERANT MONITOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Chillgard Refrigerant Monitors; MSA; Instrument Division.
  - 2. Haloguard Monitors; Thermal Gas Systems, Inc.
  - 3. Lumasense Technologies
  - 4. Or approved equal.
- B. Description: Sensor shall be factory tested, calibrated, and certified to continuously measure and display the specific gas concentration and shall be capable of indicating, alarming, shutting down fuel-fired equipment and automatically activating ventilation system.
- C. ASHRAE: Monitoring system shall comply with ASHRAE 147.
- D. Refrigerant monitoring system shall be manufactured and installed in compliance with ASHRAE Standard 15 equipment room guidelines.
- E. The accuracy of the refrigerant monitor shall be certified per UL 2075 and CSA 22.2.
- F. Performance:
  - 1. Refrigerant to Be Monitored: R-134a.
  - 2. Range: 0 to 1000 ppm.
  - 3. Sensitivity:
    - a. Minimum Detectability: 1 ppm.
    - b. Accuracy: 0 to 50 ppm; plus or minus 1 ppm. 51 to 1000 ppm; plus or minus 10 percent of reading.
    - c. Repeatability: Plus or minus 1 percent of full scale.
    - d. Response: Maximum 10 seconds per sample.
    - e. Detection Level Set Points:
      - 1) Detection Level 1: 1 ppm.
      - 2) Detection Level 2: 50 ppm.
      - 3) Detection Level 3: 250 ppm.
  - 4. Operating Temperature: 32 to 104 deg F (0 to 40 deg C).
  - 5. Relative Humidity: 20 to 95 percent, noncondensing over the operating temperature range. Compensate sensor for relative humidity.
  - 6. Site Elevation: Maximum 6560 feet (2000 m)
- G. Input/Output Features:
  - 1. Maximum Power Input: 120-V ac, 60 Hz, 75 W.
  - 2. Number of Air-Sampling Points: Four.
  - 3. Air-Sampling Point Inlet Filter: 0.10-micron filter element for each sampling point.
  - 4. Air-Sampling Point Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k



- ohms matched to sensor output.
5. Alarm Relays: Minimum 4 relays at a minimum of 5-A resistive load each.
  6. Alarm Set Points: Displayed and adjustable through keypad on front of meter.
  7. Alarm Silence Switch: Mount in the front panel of the monitor to stop audible and visual notification appliances, but alarm LED remains illuminated.
  8. Alarm Manual Reset: Momentary-contact push button in the front panel of the monitor stops audible and visual notification appliances, extinguishes alarm LED, and returns monitor to detection mode at current detection levels.
  9. Display: Alphanumeric LCD, LED indicating lights for each detection level; acknowledge switch and test switch mounted on front panel; alarm status LEDs and service fault/trouble LEDs.
  10. Audible Output: Minimum 75 dB at 10 feet (3 m).
  11. Visible Output: Strobe light.
  12. Sensor Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms.
  13. Serial Output: RS-232 or RS-485 - compatible with HVAC controls.
  14. Enclosure: NEMA 250, Type 1, with locking quarter-turn latch and key.

## 2.2 MONITOR ALARM SEQUENCE

- A. Detection Level 1: Notify HVAC control workstation of detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Start ventilation system at low speed to allow occupancy by maintenance technicians to identify leaks. Cycle blue strobe lights.
- B. Detection Level 2: Notify the HVAC control workstation of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Run ventilation system at high speed on a rise in concentration to this level, and change to low speed on a reduction in concentration below this level. Operate the ventilation system at high speed for a minimum of five minutes. Cycle amber strobe lights.
- C. Detection Level 3: Notify the HVAC control workstation of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Sound alarm horns and cycle red strobe lights inside and outside refrigeration equipment room. Terminate operation of any combustion-process equipment located in the refrigeration equipment room. Provide manual reset for this detection level.
- D. Sensor Fault/Trouble: Notify HVAC control workstation of fault/trouble detection in monitor.

## 2.3 NOTIFICATION APPLIANCES

- A. Horns: Comply with UL 464; electric-vibrating-polarized type, listed by a qualified testing agency with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn.
- B. Visible Alarm Devices: Comply with UL 1971; three color xenon strobe lights, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The words "REFRIGERANT DETECTION" printed in minimum 1/2-inch- (13-mm-) high letters on the lens. Rated light output is 75 candela.
- C. Provide both horn and visible alarm devices at each entrance to chiller plant.

## 2.4 AIR-SAMPLING TUBING

- A. Annealed-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

- B. Polyethylene Tubing: ASTM D 2737, flame-retardant, nonmetallic tubing rated for ambient temperature range of 10 to 150 deg F (minus 13 to plus 65 deg C).

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 INSTALLATION

- A. Comply with ASHRAE 15 and ASHRAE 147.
- B. Provide emergency power to system
- C. The refrigerant monitoring system shall include contacts to start the MER purge ventilation system, activate local and remote alarms and shutdown chillers in the alarm mode. Coordinate with chiller manufacturer.
- D. The refrigerant monitoring system shall integrate directly with the BMS system. Provide dry contacts for transmitting alarms to BMS.
- E. Refrigerant monitors shall be factory calibrated for the specific compound utilize
- F. Install air-sampling inlets, or diffusion type monitors in pits, tunnels, or trenches in machinery room that are accessible to personnel.
- G. Floor mount diffusion-type monitor, sensor/transmitters, or air-sampling inlets on slotted channel frame 12 to 18 inches (300 to 450 mm) above the floor in a location near the refrigerant source or between the refrigerant source and the ventilation duct inlet.
- H. Wall mount air-sampling multiple-point monitors with top of unit 60 inches above finished floor.
- I. Run air-sampling tubing from monitor to air-sampling point, in size as required by monitor manufacturer. Install tubing with maximum unsupported length of 36 inches, for tubing exposed to view. Terminate air-sampling tubing at sampling point with filter recommended by monitor manufacturer.
- J. Install air-sampling tubing with sufficient slack and flexible connections to allow for vibration of tubing and movement of equipment.
- K. Purge air-sampling tubing with dry, oil-free compressed air before connecting to monitor.
- L. Number-code or color-code air-sampling tubing for future identification and service of air-sampling multiple-point monitors.
- M. Extend air-sampling tubing from exhaust part of multiple-point monitors to outside.
- N. Extend air-sampling tubing from outdoors to outdoor inlet connection of NDIR monitors. Terminate air-sampling tubing at outdoor inlet location with filter recommended by monitor manufacturer.
- O. Install warning signs, labels, and nameplates to identify detection devices and SCBA according to Division 23 Section "Mechanical Identification."

- P. Place warning signs inside and outside each door to the refrigeration equipment room. Sample wording: "AUDIBLE AND VISUAL ALARM SOUNDING INDICATES REFRIGERANT DETECTION - ENTRY REQUIRES SCBA."
- Q. Audible Alarm-Indicating Devices: Install at each entry door to refrigeration equipment room, and position not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- R. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to refrigeration equipment room, and position at least 6 inches below the ceiling.
- S. Mount primary and secondary backup SCBA on wall outside each interior door to refrigeration equipment room.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Tests and Inspections:
  - 1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
  - 2. Test and adjust controls and safeties.
  - 3. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Restore or replace malfunctioning units and retest as specified above.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and service refrigerant monitoring and alarm devices. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 64 27**



**SECTION 23 65 00****COOLING TOWERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Furnish and install all factory fabricated cooling towers specified herein and as indicated on the contract documents.
- B. All systems, equipment and materials shall be approved for use in the City of New York.
- C. Cooling towers shall meet all the requirements, as specified herein, including, but not limited to:
  - 1. The towers shall be tested, rated, and certified in accordance with Cooling Technology Institute (CTI) Standard 201, and shall bear the CTI certification label.
  - 2. The cooling towers shall have the manufacturer's Seismic Qualifications Certification confirming that the cooling towers, accessories and components will withstand the seismic and wind forces as defined under another section of this work.
  - 3. The towers shall be tested both at the factory before shipping and at the site, once system is operational.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile

Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 SECTION INCLUDES

- A. Open-circuit, induced-draft, crossflow cooling towers.

#### 1.6 DEFINITIONS

- A. BMS: Building management system.
- B. FRP: Fiber-reinforced polyester.

#### 1.7 REFERENCE STANDARDS

- A. All factory assembled cooling towers shall be designed, manufactured, tested and certified in accordance with the latest applicable industry standards including the following:
  - 1. Cooling Tower Institute (CTI) – ATC Code 105, 128 and 201
  - 2. UL
  - 3. ASME PTC 23-03 – Performance Test Codes on Atmospheric Water Cooling Equipment
  - 4. NEC – National Electric Code
  - 5. NEMA Standard ICS – 2-1983 – Industrial Control Devices, Controllers and Assembly Standards.
  - 6. NEMA – ICS 3-303
  - 7. IEEE Standard 444 (ANSI C34.3)
  - 8. IEEE Standard 519-1992
  - 9. ASTM Standard E-64
  - 10. OSHA
  - 11. American Hot Dip Galvanizer Association Inc.
  - 12. SMACNA
  - 13. ASHRAE
  - 14. NFPA 214, Edition 2011
  - 15. ASTM E2058
  - 16. ISO 14000 Series
  - 17. NYC Mechanical Code
  - 18. NYC Energy Conservation Controls
  - 19. ACGIH - American Conference of Industrial Hygienists
  - 20. Factory Mutual
  - 21. American National Standard Institute (ANSI/ASSE)
  - 22. ASTM A10.18-2007 Safety Requirements for Temporary Floors, Holes, Wall Openings, Stairways and Other Unprotected Edges in Construction and Demolition Operation
  - 23. American Society of Mechanical Engineers (ASME):
  - 24. Performance Test Codes on Atmospheric Water Cooling Equipment
  - 25. American Society for Testing Materials (ASTM):
  - 26. ASTM A385-08 Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
  - 27. ASTM B117-07a Standard Practice for Operating Salt Spray (Fog) Apparatus



28. ASTM B209-07 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
29. ASTM E84-08a - Standard Test Method for Surface Burning Characteristics of Building Materials
30. Cooling Technology Institute (CTI):
31. ATC-105-00 Acceptance Test Code for Water-Cooling Towers (CTI Code Tower Standard Specifications)
32. ATC-105S-Rev. July 2004 Acceptance Test Code for Closed Circuit Cooling Towers (CTI Code Tower Standard Specifications)
33. CTI 201-02 (Rev. 04) Standard for Certification of Water Cooling Tower Thermal Performance (CTI Code Tower Standard Specifications)
34. ATC 128
35. National Electrical Manufacturers Association (NEMA):
36. MG 1-2006 Includes Motors and Generators (ANSI)
37. 250-03 Enclosures for Electrical Equipment (1000 Volts Maximum)

- B. All wiring, equipment and materials to be furnished and installed on the cooling towers shall be UL listed, in accordance with the requirements of the New York Department of Buildings and suitable for its intended use on this project.

#### 1.8 PERFORMANCE REQUIREMENTS

- A. The cooling tower manufacturer shall examine the contract documents prior to bid to verify that the towers will perform under installed conditions.
- B. Manufacturer shall certify that the performance of cooling towers will meet the contract requirements as indicated on the schedules, stating entering air wet bulb temperature, entering and leaving condenser water temperatures, water flow rates, fan motor kW (horsepower) and pump head at base of towers in the location and in the enclosure shown on the architectural and mechanical drawings. The possibility of recirculation shall be evaluated and considered by the manufacturer in the selection of the cooling tower to be furnished for this project.
- C. The towers shall be tested, rated, and certified in accordance with Cooling Technology Institute (CTI) Standard 201, and shall bear the CTI certification label, and shall be listed in the CTI directory of certified cooling towers.
- D. The alignment and balancing of the fans, motors and drive shaft as installed shall operate within the vibration tolerance specified in specification sections "Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components".
- E. Manufacturers' performance guarantees or performance bonds without CTI Certification or independent field thermal performance test shall not be accepted.
- F. The tower shall be capable of withstanding water having a pH of 6.5 to 8.0; a chloride content (NaCl) up to 750 ppm; a sulfate content (SO<sub>4</sub>) up to 1200 ppm; a sodium bicarbonate content (NaHCO<sub>3</sub>) up to 200 ppm; a calcium content (CaCO<sub>3</sub>) up to 800 ppm; silica (SiO<sub>2</sub>) up to 150 ppm; and design hot water temperatures up to 120°F.
- G. The cooling tower shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.
- H. The towers sound levels at 5 feet and 55 feet in any direction from the tower shall not exceed 73 dBA and 60 dBA, respectively and meet the sound power level (dB re: 10<sup>-12</sup> Watts).

#### 1.9 SEISMIC AND WIND LOAD DESIGN



- A. This project is located within a seismic and wind zone requiring special provisions for the support and restraint of equipment, components and piping in the event of earthquake or wind conditions.
- B. Design seismic restraints and wind restraints for the cooling tower, cooling tower support, mounting base, access platforms, structure, vibration isolators, pipe connections and connecting piping supports, including preparing comprehensive engineering analysis (signed and sealed) by a qualified professional engineer, commissioned by the tower manufacturer, using performance requirements and design criteria defined under another section of this work.
- C. Provide manufacturer's Seismic Qualifications Certification that the cooling towers, accessories and components will withstand the seismic and wind forces as defined under another section of this work. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. The term "withstand" means "the towers will remain in place without separation of any parts from the device when subjected to the seismic or wind forces specified and the towers will be fully operational after the seismic event."
  - 2. Dimensioned Outlined Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchoring provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event and when subject to wind forces, as described herein, when cooling tower is anchored to field support structure.
- E. It is the intent to keep all HVAC building system components in place during a seismic or wind event and operational after the seismic event.
- F. It shall be understood that the requirements for the seismic and wind restraints and vibration control as specified herein are complementary to requirements delineated elsewhere under other sections of this work for the support, fastening and isolating of equipment work. Nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this and other related sections.
- G. Deflection Limits:
  - 1. Design system to withstand design loads without deflections greater than the following:
    - a. 2.5"
- H. Wind Design Loading
  - 1. The cooling tower shall be designed and constructed so when erected it will withstand wind forces as defined under another section of this work.
  - 2. The cooling towers shall be thoroughly braced and tied together so that the structural parts; casing, basin and support beams, when anchored to a suitable base will withstand the overturning moments of the tower out of service and the basin is not filled with water.

#### 1.10 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".



- B. Product Data: Include rated capacities, flow rates, pressure drop, fan performance data, rating curves with selected points indicated, startup instructions, furnished specialties, and accessories.
- C. Cooling towers shall be guaranteed to perform the capacities as listed in the schedules.
- D. Manufacturer to submit a written guarantee certifying the performance of the cooling tower in the locations and within the enclosure as indicated on the contract documents.
- E. All certifications shall be made at the time of submittals and during project closeout.
- F. In addition, provide the following data:
  - 1. Maximum flow rate.
  - 2. Minimum flow rate.
  - 3. Drift loss as percent of design flow rate
  - 4. Sound power levels
    - a. Sound Power testing and data shall be in conformance with CTI ATC-128.
    - b. Sound testing to be conducted at the factory of the cooling tower manufacturer under controlled conditions. Submit data in all eight octave bands for operation on full speed with full water flow, with fans off at full water flow, fans at minimum with full water flow and design speed.
    - c. Measure sound power levels at all five sides of the cooling tower,
  - 5. Performance curves for the following:
    - a. Varying entering-water temperatures from design to minimum (summer and winter).
    - b. Varying ambient wet-bulb temperatures from design to minimum (summer and winter).
    - c. Varying water flow rates from design to minimum.
    - d. Varying fan operation (off, minimum, and design speed).
- G. Fan airflow, brake horsepower, and drive losses.
- H. Pump flow rate, head, brake horsepower, and efficiency.
- I. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
- J. Electrical power requirements for each cooling tower component-requiring power. Include electrical rating, detail wiring for power, signals and controls.
- K. Sound curves and sound characteristics information of sound required to meet the noise criteria listed herewith
- L. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:
  - 1. Detailed, dimensional, equipment loading drawings, which show the location of all anchor bolts and the size and location of load bearing areas with the loads imposed on them specifically showing dunnage steel requirements. The initial and operating weight of the assembled tower, as well as the weight of each major component, shall also be shown on Shop Drawings. In addition, the weight of component parts, which must be removed for maintenance and service operations, shall be indicated.



2. Materials
  3. Required clearances for maintenance and operation.
  4. Sizes and locations of piping and wiring connections.
  5. Wiring Diagrams: For power, signal, and control wiring.
  6. Submit five copies of performance curves, showing compliance with actual conditions specified, at least two weeks prior to the delivery of the equipment.
  7. At least two weeks prior to final inspection, submit five copies of the following:
    - a. Certification from the manufacturer that the cooling tower(s), accessories, and components are suitable for project seismic design category installations and that the unit will be fully operational after the seismic event at the project site.
    - b. Certification by the manufacturer that the cooling towers conform to the requirements of the drawings and specifications.
    - c. Certification by the Contractor that the cooling towers have been installed, adjusted, and tested in accordance with all standards and manufacturers procedures.
- M. Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of support structure.
  2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and wind restraints and for designing vibration isolation bases.
- N. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Structural supports.
  2. Piping roughing-in requirements.
  3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
  4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
- O. Certificates: For certification required in "Quality Assurance" Article.
- P. Source quality-control reports.
- Q. Field quality-control reports.
- R. Startup service reports.
- S. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.
- T. Warranty: Sample of special warranty.
- 1.11 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
  - B. Manufacturer's Certification: Certify cooling tower's thermal performance according to CTI 201.

- C. The cooling tower manufacturer shall guarantee that the tower supplied will meet the specified performance conditions when the tower is installed according to plans, in accordance with CTI
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- G. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."
- H. FMG approval and listing in the latest edition of FMG's "Approval Guide."
- I. Maximum drift loss from the tower not to exceed .05 of 1% of the water circulated.
- J. The cooling tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO 9001: 2000 to ensure consistent quality of products and services. Manufacturers that are not ISO 9001 Certified shall not be acceptable.

#### 1.12 SOURCE QUALITY CONTROL

- A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard

#### 1.13 COORDINATION

- A. Coordinate sizes, locations, and anchoring attachments for the cooling tower support.

#### 1.14 WARRANTY

- A. In addition to the standard one-year warranty against defects in materials and workmanship, the cooling tower manufacturer shall provide the following extended warranty:
  - 1. Cooling tower manufacturer shall warrant the entire cooling tower including, but not limited to each gearbox, coupling, fan and mechanical equipment support, motor, drive system, bearings, and structure, VFD and motor accessories - to be free from all defects in materials and workmanship, including leakage, for a period of ten (10) years from the date of substantial completion. The obligation under this warranty is to replace defective materials. This warranty shall be in addition to any other warranties set forth in the contract.

### PART 2 - PRODUCTS

#### 2.1 COOLING TOWERS - GENERAL

- A. Manufacturers:
  - 1. Subject to compliance with the requirements, provide cooling towers from one of the following:



- a. Marley Cooling Towers, Inc.
- b. Baltimore Aircoil Company
- c. Evapco Inc.
- d. Or approved equal.

**B. Construction:**

1. The tower casing, mechanical equipment support, panels, hot and cold-water basins, distribution covers, fan deck, fan cylinder and structural members and framework shall be constructed of heavy gauge (16-gauge minimum) stainless steel (Type 304, ASTM A666).
2. All hardware, including nuts, bolts, sheet metal washers shall be 304 stainless steel.
3. Hot decks to have vari-flow nozzle cups or similar.
4. Fill and eliminators shall be guaranteed against corrosion, rot, decay and biological attack for the life of the cooling tower.
5. The tower shall be non- combustible except for the fill and eliminators, which shall be fire-rated PVC.
6. PVC, where permitted, shall be self-extinguishing fire rated (per ASTM-568, UL94HB and UL94 V-0 Testing) polyvinyl chloride (PVC), with a flame-spread index of 5 per ASTM E 84 and shall be impervious to rot, decay, fungus and biological attack.
7. Fiberglass casing, polyurethane barriers and thermosetting hybrids and the components they are adhered to are not permitted.
8. The tower structure, anchorage and all its components shall be designed by licensed structural engineers licensed in the State of New York, employed by the tower manufacturer.

**C. Cooling Tower Fan Motors**

1. Comply with requirements as specified herein and in Section "Motors for HVAC Equipment".
2. The variable frequency controllers shall control fan motor.
3. Fan motors shall be as specified herein and under another section of this work.
4. Motors shall be rated for severe duty and designed specifically for cooling tower service.
5. Fan Motor(s) shall be Totally Enclosed, Fan Cooled (TEFC) designed specifically for cooling tower service. The motor(s) shall be furnished with special moisture protection on windings, shafts and bearings and labeled appropriately for cooling tower duty.
6. Energy Efficiency: Premium Efficiency, as defined in NEMA MG1 and with applicable EPACT efficiency standards.
7. Service Factor: 1.15.
8. Insulation: Class H F
9. Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
10. Motors shall be designed and labeled for use with VFDs and suitable for use throughout speed range without overheating.
11. Severe-duty rating with the following features:
  - a. Rotor and stator protected with corrosion inhibiting epoxy resin.
  - b. Double-shielded, vacuum-degassed bearings lubricated with premium, moisture-resistant grease suitable for temperatures between minus 20 and 300 deg F (minus 29 and 149 deg C).
  - c. Internal heater automatically energized when motor is de-energized.
  - d. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.





- D. The tower shall include all design and material modifications necessary to meet the requirements of Factory Mutual. The product proposed shall be listed in the FM Approval Guide, latest edition.
- E. An external oil level dipstick shall be located adjacent to the motor at the fan deck surface and shall be accessible from the platform.
- F. Provide low oil level cut out switch.
- G. A portable davit crane shall be mounted on the fan deck of each cooling tower cell and shall be capable of lifting, extending and lowering the heaviest mechanical component (minimum 1500 pounds) over the fan deck and down the air inlet face of the tower. The davit crane system shall include a winch, cable and load hook.
- H. Overall tower dimensions shall not exceed those indicated on the contract documents.

## 2.2 OPEN-CIRCUIT, INDUCED-DRAFT, CROSSFLOW COOLING TOWERS

- A. Furnish and install, as shown on the contract documents, factory assembled, induced draft, crossflow cooling towers with vertical air discharge conforming in all aspects to the specifications, schedules and as shown on the drawings.
- B. Similar to Marley NC Series 8401
- C. Fan:
  - 1. Fans shall comply with the requirements as specified herein and under another section of this work.
  - 2. Fans shall be the manufacturer's low noise design.
  - 3. Fans shall be adjustable –pitch propeller type.
  - 4. Balanced at the factory after assembly.
  - 5. Blade Material: Aluminum.
  - 6. Hub Material: Stainless steel
  - 7. Blade Pitch: Field adjustable.
  - 8. Housing: Hot dipped Galvanized.
  - 9. Protective Enclosure: Removable, heavy-duty galvanized-steel, wire-mesh screens complying with OSHA regulations.
  - 10. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 120,000 hours.
  - 11. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.
  - 12. Fan Guard: Removable fan discharge with a rigid framed screen guard, installed over the fan cylinder.
- D. Gear Drive: Right angle, reduced speed, and designed for cooling tower applications according to CTI STD 111. Motor and gear drive shall be aligned before shipment.
  - 1. Gear Drive and Coupling Service Factor: 2.0, based on motor nameplate horsepower.
  - 2. Housing: Cast iron, with epoxy or polyurethane finish, beveled high-strength steel gears continuously bathed in oil, and with lubrication to other internal parts at all operating speeds.
  - 3. Mounting: Directly mounted to fan hub and connected to motor so motor shaft is in horizontal position.
  - 4. Operation: Able to operate both forward and in reverse.



5. Drive-to-Motor Connection: Connected to motor located outside of cooling tower airstream by a full-floating drive shaft.
  6. Drive Shaft Material: Stainless steel and fitted with flexible couplings on both ends. Provide exposed shaft and couplings with guards according to OSHA regulations.
  7. Extend oil fill, drain, and vent to outside of cooling tower casing using galvanized-steel piping. Provide installation with oil-level sight glass.
  8. Gear units shall have an American Gear Manufacturers Association Class II 9 rating.
- E. Gear-Drive, Oil-Level Switch: Low-oil-level warning cutout switch for connection to a BMS.
1. Switch shall, on reaching a low-oil-level set point recommended by cooling tower manufacturer, signal an alarm through the BMS provide low level shutdown switch.
- F. Drift Eliminators:
1. Self-extinguishing (per ASTM-568, UL94HB and UL94 V-0 Testing) polyvinyl chloride (PVC), with a flame-spread index of 5 per ASTM E 84 and shall be impervious to rot, decay, fungus and biological attack.
  2. Eliminators shall effectively trap water droplets entrained in discharge air stream and limit drift loss to less than 0.005 percent of the total water circulated. Sections shall be assembled into easily removable racks of the same material as the casing.
  3. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
  4. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.
  5. Location: Separate and removable from fill.
  6. Minimum Thickness: 20 mils (minimum), to prevent sagging.
- G. Fill:
1. Materials: Self-extinguishing (per ASTM-568, UL94HB and UL94 V-0 Testing) polyvinyl chloride (PVC), with a flame-spread index of 5 per ASTM E 84 and shall be impervious to rot, decay, fungus and biological attack.
  2. Minimum Thickness: 20 mils (minimum), to prevent sagging.
  3. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer. Spacing between fill sheets shall be a minimum of 3/4 inches (19.1 mm) to reduce the tendency for fouling and ensure proper airflow for maximum cooling capacity.
  4. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 130 deg F (55 deg C).
  5. The fill shall be manufactured, tested and rated by the cooling tower manufacturer and shall be elevated above the cold water floor to facilitate cleaning.
- H. Each cell shall have the capability of independent operation
- I. Cold Water Basin:
1. Material: The cold-water basin shall be constructed of heavy-gauge type 304 stainless steel panels and structural members. All factory seams shall be welded to ensure watertight construction and welded seams shall be warranted against leaks for a period of ten (10) years from date of substantial completion. Stainless steel basins with bolted seams are not acceptable.
  2. All factory seams in the cold-water basin shall be welded to ensure watertight assembly and welded seams shall be warranted against leaks for ten (10) years. Stainless steel basins with bolted seams are not acceptable. FRP casing panels are not acceptable.

- J. Each cell shall have the capability of independent operation.
- K. Bottom Outlet
  - 1. Each cell basin shall be complete with a 304 stainless steel depressed side bottom outlet. Outlet shall be provided with flanged suction connection and flanged equalizer connection, a drain/clean-out connection, a suction screen and vortex baffling anti-cavitation device.
- L. Each basin shall include the following:
  - a. Removable, large area lift-out type 304 stainless-steel strainers with openings smaller than water distribution system nozzle orifices.
  - b. Overflow and drain connections.
    - 1) Makeup water connection.
    - 2) Outlet Connection: Suction - ASME B16.5, Class 150 flat face flange, beveled for welding.
    - 3) Outlet Connection: Equalizer - ASME B16.5, Class 150 flat face flange, beveled for welding
    - 4) Removable anti-vortex device (type 304 stainless steel) to prevent air entrainment.
    - 5) Removable equalization flume plate between adjacent cells of multiple-cell towers.
  - c. Equalizer connection for field installed equalizer piping
  - d. The strainer and vortex device shall be constructed of the same materials as the cold water basin to prevent dissimilar metal corrosion.
- M. Open Gravity Hot Water Distribution Basin:
  - 1. The covered hot water basin shall be equipped with a gravity type hot water distribution system.
  - 2. Non-pressurized, open gravity type design for easy cleaning with head of water level in basin adequate to overcome spray nozzle losses and designed to evenly distribute water over fill throughout the flow range indicated.
  - 3. The basins must be accessible from outside the unit and serviceable during tower operation.
  - 4. Material: Heavy gauge, type 304 Stainless steel.
  - 5. Removable or sliding basin covers shall be factory installed minimum 16-gauge stainless steel of lapped joint construction at seams and secured to the basin with stainless steel wing nuts and captive stainless steel bolts. Covers shall be designed and built to withstand 75 psf live load and 300 # concentrated load. Attach a warning label to top of cover to caution against using the cover as a walking surface or working platform.
  - 6. Basin weirs and PVC metering devices shall be provided to assure the even distribution of water over the fill.
  - 7. Gravity flow nozzles shall be snap-in type for easy removal.
  - 8. Vari-flow nozzle cups or similar.
  - 9. Each cooling tower distribution basin shall be furnished with two adjustable flow control valves with stainless steel stem and locking stop or bar. A single water inlet to the tower, which automatically balances water flow to the hot water distribution basins with factory installed internal non-corroding piping shall be valve to drain the water out of the riser piping upon shutdown of the cooling tower to prevent freezing.
  - 10. Field Pipe Connection: Galvanized-steel pipe arranged to provide balancing of flow within cooling tower cells without the need for additional balancing valves.



11. Pipe each cooling tower cell internally to a single, field connection suitable for mating to ASME B16.5, Class 150 flange.
12. Joints and Seams: Welded watertight.
13. Partitioning Dams: Same material as basin to distribute water over the fill to minimize icing while operating throughout the flow range indicated.
14. Removable Panels: Heavy gauge type 304 stainless steel, designed to withhold 75-psf live load and 300 lbs. constant load to completely cover top of basin. Secure panels to basin with removable stainless-steel hardware.

**N. Air-Intake Louvers:**

1. Air-Intake louvers shall be spaced to minimize air resistance and prevent splash out.
2. Air Inlet louvers shall be separate from the fill and removable to provide easy access for inspection of the air/water interface at the louver face. Louvers shall prevent water splashing out during fan cycling.
3. Material: Removable, corrosion resistant type 304 stainless steel (minimum 20 gauge).
4. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
5. Provide removable type 304 stainless steel mesh air intake screens.
6. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.
7. PVC louvers are not permitted.

**O. Provide Vibration Cutout Switch for each fan drive, as specified herein.**

**P. Controls:** In addition to the requirements specified herein, comply with requirements as specified under another section of this work.

**2.3 VARIABLE FREQUENCY DRIVE (VFD)**

- A. The VFD shall be as specified under another section of this work.
- B. There shall be a separate VFD drive system for each cooling tower fan motor. Controlling multiple motors by one drive system will not be allowed.
- C. The VFD shall be furnished and installed at the factory by the cooling tower manufacturer. The variable speed controller shall be mounted in a NEMA 4 enclosure with mechanical heating and cooling and with all power and control wiring between the VFD and cooling tower fan factory installed. Electrical lugs for incoming power wiring shall be provided.
- D. Provide rainshield cover.
- E. The VFD supplier shall warrant the VFD system to have sufficient capacity to operate successfully under all normal tower operating conditions, and its use shall in no way diminish the ten (10) year mechanical equipment warranty.
- F. The cooling tower manufacturer shall supply a start-up engineer to identify and lock out critical speeds, and to verify correct operation.

**2.4 STEEL SUPPORTS AND VIBRATION CONTROL**

- A. The Contractor shall provide steel dunnage as recommended by the cooling tower manufacturer.



- B. Contractor to provide spring vibration isolation between dunnage and building steel as specified herein and under another section of this work.
- C. Wind, Vibration and Seismic design requirements are specified herein and under other sections of the work.
- D. A steel grillage or other foundation suitable to support the tower and the provisions for attaching the tower thereto will be provided under another division of the work. Cooling tower design shall be based on using only two supporting steel members.

## 2.5 ACCESS DOORS

- A. Doors: Two (2) hinged access doors, large enough for personnel to access cooling tower internal components shall be provided at both endwalls of each cell (minimum 30" wide x 36" high). Doors shall be operable from both sides of the door.

2.6 See Section 08 31 13 "Access Doors and Frames" for requirements.

## 2.7 HANDRAILS, PLATFORMS AND LADDERS

### A. External Ladders with Safety Cages:

- 1. Provide an OSHA approved, heavy gauge galvanized steel fixed ladder with ladder extensions to access external platforms and top of cooling tower from roof level without the need for portable ladders (extension ladder shall be firmly attached to tower and anchored at base). Comply with 29 CFR 1910.27.
- 2. A heavy gauge, OSHA approved, safety cage, welded, shall surround the ladder, extending from a point 4'-0" above the foot of the ladder extending to the top of the guardrail.
- 3. A steel, self-closing gate shall be provided at the guardrail level of the ladder.
- 4. External Platforms with Handrails:
- 5. Provide a factory installed stainless steel grating platform walkway surrounding the top of each tower. The platform shall be OSHA compliant and shall be perforated to provide a non-slip surface for personnel safety. The platform shall be surrounded by an OSHA compliant guardrail system, including knee-rail and toeboard.
- 6. Provide an extension platform connecting the platforms at the top of each tower to provide continuous access from the top platform to all tower platforms. The platform shall be OSHA compliant and shall be perforated to provide a non-slip surface for personnel safety. The platform shall be surrounded by an OSHA compliant guardrail system, including knee-rail and toeboard.
- 7. All working surfaces shall be able to withstand 100 psf live load or 300 pound concentrated load.

### B. Handrail:

- 1. Aluminum or stainless steel complete with knee rail and toe board at all platforms and around top of cooling tower to insure the safety of the operation personnel. Provide safety cage. Comply with 29 CFR 1910.23.

### C. Internal Platforms (Plenum Walkway):

- 1. An internal platform/Plenum walkway (minimum 36" wide) with handrails shall be provided in the plenum section to provide for inspection and maintenance. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path



between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.

2. All working surfaces shall be able to withstand 100 psf live load or 300 pound concentrated load.
3. Platform shall be Aluminum or galvanized-steel bar grating.
4. The elevated internal platforms (with OSHA compliant guardrail system) shall be accessible from the fixed vertical ladders to access the fan drive assembly.

**D. Access Door Platform:**

1. Access to the hot water basins for inspection and maintenance of the basins, even during tower operation, shall be provided for each access door on all towers Access Door platforms.
2. Access platform shall be at the base of the tower extending from the vertical ladder to the endwall access doors. The platform shall be surrounded by an OSHA compliant guardrail system. The walking surface of the platform shall be perforated to provide a non-slip surface.
3. Fan deck ladders and handrails, which add to the overall height of the tower, are not acceptable.

**2.8 FAN GUARD**

- A. The fan openings shall be provided with a conical, non-sagging, removable fan guard fabricated of one-piece welded steel rod and wire guard, hot dipped galvanized after fabrication.

**2.9 BALANCING VALVES**

- A. Heavy-duty, high-performance, butterfly valves shall be provided at the hot water inlet connections and arranged to balance or shut off flow to each gravity distribution basin. These valves shall include cast iron bodies, elastomer seat and steel operating stems. There shall be a locking handle to maintain the valve setting in any position. Wafer type field supplied spool piece is required between the inlet connection and the valve.
- B. Valves shall be as specified under another section of this work.

**2.10 COLD WATER BASIN WATER LEVEL CONTROL**

- A. The cooling tower manufacturer shall provide an electric cold-water basin level control (EWLC) system for each cooling tower cell, which shall consist of water level sensing and control units.
- B. Each water level sensing and control unit shall consist of the following:
  1. NEMA 4 enclosure with gasketed access cover;
  2. Sensor: Solid-state controls with multiple stainless steel water level sensing electrode probes and relays factory wired to a terminal strip to control the water makeup valve, low- and high-level alarms, output for shutoff of pump on low level, heater safety cutoff and as required for achieving the specified sequence of operation;
  3. Water Stilling Chamber: Stainless steel.
  4. Electrode Probes: Stainless steel.
  5. Solenoid Valve: Slow closing with stainless-steel body, controlled and powered through level controller in response to water level set point.
  6. Schedule 40 PVC standpipe assembly with vent holes and all necessary stainless steel mounting hardware.



7. Provide PVC union directly below the control enclosure to facilitate the removal and access of electrodes and control enclosure.
8. Float switch shall be weather protected to -15 deg F.

- C. Electrical Connection Requirements: 120 V, single phase, 60 Hz.
- D. This contractor shall provide control wiring with power supply from the nearest BMS control panel.

## 2.11 BASIN HEATERS

- A. Each cell shall have an independent basin heater system in the cold-water basin to maintain 40° F water at -10° F and 25 mph wind velocity.
- B. Electric Basin Heater:
  1. Cooling tower shall be provided with electric immersion heaters with waterproof junction boxes factory mounted in the pan. The tower manufacturer shall include a control thermostat mounted on the tower and low water heater protection consisting of a relay and float less low water cut out.
    - a. Stainless-Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
    - b. Heater Control Panel: Mounted on the side of each cooling tower cell.
    - c. Enclosure: NEMA 250, Type 4X.
    - d. Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low-level set point.
    - e. Control-circuit transformer with primary and secondary side fuses.
    - f. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
    - g. Single-point, field-power connection to a fused disconnect switch and heater branch circuiting complying with NFPA 70.
    - h. Factory Wiring Method: Metal raceway for factory-installed wiring outside of enclosures, except make connections to each electric basin heater with liquid tight conduit.
    - i. Contractor shall provide the following:
      - 1) Master aquastat on leaving water to sequence fans (40° F to 95° F range (adj.))
      - 2) A remote reset with temperature readings both locally and at the BMS will permit the building operator to reset the leaving temperature.
      - 3) A low limit thermostat set at 40°F (adj.) to activate automatic cooling tower bypass valves.

## 2.12 VIBRATION CUTOFF SWITCH

1. A single pole double throw (SPDT) electronic remote vibration limit switch with manual-reset button enclosed in a NEMA 4 housing shall be furnished and installed on the fan/motor equipment support for each cell and wired into the buildings control system's (BMS) closest panel. It shall also be hardwired to fan motor electrical circuit
2. The purpose of this switch will be to interrupt power to the motor in the event of excessive vibration. It shall be adjustable for sensitivity and shall require manual reset.
3. The electronic vibration cutoff switch shall be set to trip at a point so as not to cause damage to the cooling tower. Enclosure: NEMA Type 4X



4. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
5. Switch shall, on sensing excessive vibration, signal an alarm through the BMS and shut down the fan.

#### 2.13 COOLING TOWER APPURTENANCES

- A. Provide the following with each cooling tower:
  1. Water basin covers
  2. Air Inlet Screens
  3. Galvanized gearbox
  4. Oil sight-glass
  5. External platform with handrails
  6. Internal platform with handrails
  7. Safety ladder with cage, guide/hand rails around the tower and platforms.

#### 2.14 DISCONNECT SWITCH

- A. A heavy-duty, fused safety disconnect switch shall be provided by the cooling tower manufacturer. Switch shall be single-throw, 3-pole design, rated up to 600 VAC. Switch shall have triple padlocking capability, a visible double break rotary blade mechanism, a clearly visible On/Off handle, an interlocking mechanism to prevent door opening with handle in On position, and a clear line shield.
- B. Safety switch shall be provided in a NEMA 4 enclosure.

#### 2.15 COOLING TOWER CONTROLS (coordinate with BMS)

- A. Contractor shall be responsible for full coordination of automation and shall provide wiring for final operation of cooling towers and equipment such as temperature sensors, interlocks with fan operation, pipe wells, etc.
- B. The system shall include a solid state, temperature controller to adjust frequency output of the drive in response to the tower cold-water temperature. The temperature of the cold water shall be displayed on the door of the control panel. It shall also include a complete magnetic bypass that isolates the VFD when in the bypass mode. Transfer to the bypass mode shall be automatic in the event of VFD failure. The bypass contactor shall be cycled on and off while operating in bypass to maintain the set-point temperature of the cold water.
- C. Operator controls shall be mounted on the front of the enclosure and shall consist of start and stop pushbuttons, bypass/VFDs selector switch, Auto//Manual selector switch, manual speed potentiometer, and the solid-state temperature controller.
- D. To prevent heating problems in the fan-cooled motor, the VFC system shall cycle the motor on/off when the minimum allowable motor speed is reached.
- E. Control Package: Factory installed and wired, and functionally tested at factory before shipment.
  1. NEMA 250, Type 4X enclosure with removable internally mount backplate.
  2. Control-circuit transformer with primary and secondary side fuses.
  3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.





4. Microprocessor-based controller for automatic control of fan based on cooling tower leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
5. Fan motor sequencer for multiple-cell and two-speed applications with automatic lead stage rotation.
6. Factory-installed and -wired, collection basin electric/electronic level controller.
7. Collection basin electric/electronic level controller, as specified herein.
8. Electric basin heaters with temperature control and low-water-level safety switch for each cell, complying with requirements as specified herein.
9. Vibration switch for each fan, as specified herein.
10. Single-point, field-power connection to a fused disconnect switch for each cooling tower cell.
  - a. Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch.
  - b. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
11. Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquid tight
12. Visual indication of status and alarm with momentary test push button for each motor.
13. Audible alarm and silence switch.
14. Visual indication of elapsed run time, graduated in hours for each motor.
15. Cooling tower shall have hardware to enable BMS to remotely monitor and display the following:
  - a. Operational status of each motor.
  - b. Position of dampers.
  - c. Cooling tower leaving-fluid temperature.
  - d. Fan vibration alarm.
  - e. Collection basin: high- and low water-level alarms.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements

#### 3.2 SOURCE QUALITY CONTROL

- A. Install cooling tower according to equipment manufacturer's written instructions.
- B. Install cooling towers plumb, level and anchored on structure provided. Coordinate steel structure with cooling tower mounting requirements. If installed on concrete base, refer to Division 03 of specification for concrete materials and installation requirements.
- C. Install vibration controls according to manufacturer's recommendations.
- D. Install anchor bolts to elevations required for proper attachment to supported equipment.
- E. Maintain manufacturer's recommended clearances for service and maintenance.

#### 3.3 EXAMINATION



- A. Examine proposed route of moving cooling towers into place and verify that it is free of interferences.
- B. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting tower performance, maintenance, and operation.
  - 1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections
  - 2. Examine elements and surfaces to support cooling tower.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.4 INSTALLATION

- A. Install cooling towers according to manufacturer's written instructions.
- B. Install cooling towers level and plumb, and fasten to supporting structure with vibration isolators and seismic restraints.
- C. Maintain recommended clearances for service and maintenance.
- D. Install cooling towers on support structure indicated.
- E. Install cooling towers and their support structures to withstand the effects of wind and seismic events, as specified in the contract documents and according to the New York Department of Buildings.
- F. Electrical Wiring: Install and provide wiring for electrical devices furnished by cooling tower manufacturer that are not factory mounted.

### 3.5 COOLING TOWER PIPING REQUIREMENTS

- A. Provide flanged connections for piping.
- B. Each return water connection to a cooling tower shall be separately valved (butterfly) for positive shut-off. A water flow control valve in the towers will not be permitted as a substitute.
- C. Each supply pipe from a cooling tower shall be separately valved (butterfly) for positive shut-off.
- D. Provide an equalizer line sized as per manufacturers recommendations and connected to each cell. Provide a positive shut-off valve (butterfly) in such equalizer to permit individual tower cleaning.
- E. Piping installation requirements are specified in another section of this work. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping adjacent to cooling towers to allow service and maintenance.
  - 2. Install flexible pipe connections for towers mounted on vibration isolators.
  - 3. Pitch piping down to drain into sump.
  - 4. Provide drain piping with valve at cooling tower drain connections and at low points in piping. Connect overflow drain and bleed lines to sanitary sewage system.



- F. Domestic Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to water-level control with backflow preventer, shutoff valve, water meter, strainer and flange at each connection.
- G. Supply and Return Piping: Comply with applicable requirements in Division 23 Sections. Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a flange
- H. Hot-Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to supply and return basin-heater tapplings with shutoff valve, strainer, control valve, and flange on supply connection and flange and balancing valve on return connection.
- I. Condenser-Water Piping: Comply with applicable requirements of Division 23 Sections. Connect to supply and return cooling-tower connections with shutoff valve, strainer, flow control valve, and flange on supply connection to the tower and shutoff valve and flange to return connection from the tower to the chiller.
- J. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.
- K. Condenser Water Filter Piping: Comply with applicable requirements of Division 23 sections.
- L. Electrical: Comply with applicable requirements in Division 26 Sections. Ground equipment.
- M. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.6 DIELECTRIC FITTINGS

- A. Provide dielectric fittings to isolate joined dissimilar materials to prevent galvanic action and stop corrosion. Fittings shall be of the non reducing type, which shall be suitable for the system fluid, pressure, and temperature and shall not restrict the flow.
- B. For factory fabricated equipment, manufacturer shall submit method of compliance or exceptions (if applicable) in writing as part of the shop drawings submission for review by Commissioner.
- C. It is the intent of this section that all system components (equipment connections, piping, etc.), whether they are field installed or factory fabricated, shall comply with these requirements.
- D. Insulating Material: Suitable for system fluid, pressure, and temperature, does not restrict flow.

### 3.7 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions

### 3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- B. Factory-authorized service representative shall perform start-up services.
- C. Engage a qualified independent Testing Agency to perform inspections for each tower, as specified.
- D. Tests and Inspections: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers".
- E. Cooling towers will be considered defective if they do not pass inspections.
- F. Prepare test and inspection reports

### 3.9 ON-SITE PERFORMANCE REQUIREMENTS

- A. Engage a qualified independent Testing Agency to supervise field performance testing.
- B. Tests: Comply with CTI ATC 105, "Acceptance Test Code for Water Cooling Towers".
- C. The Commissioner reserves the right to request, at his discretion and at no additional expense, anytime during the first 18 months of full operation, that an on-site thermal performance test be performed in accordance with CTI (Cooling Technology Institute) ATC-105 standards. The test shall be performed by the factory-authorized service representative and under the supervision of the Testing Agency.
- D. Irrespective of CTI standards, the limits of test tolerances for the cooling towers is 5%., under the project design conditions.
- E. Cooling towers will be considered defective if they do not pass tests.
- F. Failure to perform on site: Should tower fail to perform after installation according to the approved performance curves, the contractor shall perform, at no extra expense, a complete tower test on the site, in accordance with the ASME Power Test Code for atmospheric Water Cooling Equipment PTC-23-1958 or CTI Standard 201. If the tower fails to perform within those limits of test tolerance; then the cooling tower manufacturer shall make any and all alterations as necessary to overcome indicated deficiency.
- G. The cooling tower manufacturer shall certify that they will make whatever corrections, including new towers or additional cells, which are required to meet the performance guarantee, at no additional expense to the City of New York, regardless of the extent of the revisions required.
- H. A corporate officer of the manufacturer shall sign the certifications. Certification shall be made at the time of submittal.

### 3.10 START UP

- A. Provide the services of a factory-authorized and qualified representative to perform start up service.
- B. Inspect field-assembled components and equipment installation, including piping and electrical connections.

- C. Verify that accessories are properly installed.
- D. Obtain and review performance curves and tables.
- E. Perform startup checks, according to manufacturer's written instructions, and as noted below:
  - 1. Clean entire unit including basins.
  - 2. Verify that accessories are properly installed.
  - 3. Verify clearances for airflow and for cooling tower servicing.
  - 4. Check for vibration isolation and structural support.
  - 5. Lubricate rotating parts and bearings.
  - 6. Verify fan rotation for correct direction and for vibration or binding and correct problems.
  - 7. Adjust belts to proper alignment and tension.
  - 8. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
  - 9. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
  - 10. Check vibration switch setting. Verify operation.
  - 11. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
  - 12. Verify operation of basin heater and control.
  - 13. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
  - 14. Replace defective and malfunctioning units.
  - 15. Operate equipment controls and safeties.
  - 16. Verify that tower discharge does not recirculate into HVAC air intakes. Recommend corrective action.
- F. Adjust water level for operating level and balance condenser water flow to each tower inlet.
- G. Check water treatment water system, including blow down for proper operation of the tower. Check makeup water-level control and valve.
- H. Start cooling tower, including condenser water pumps and verify the tower operation.
- I. Prepare and submit a written report of startup and inspection service to the Commissioner.

### 3.11 INSTRUCTION:

- A. Furnish the services of a competent, factory-trained engineer licensed in the State of New York or technician for a 6-hour period for instructing personnel in operation and maintenance of the equipment, including review of the operation and maintenance manual, on a date requested by the Commissioner.

### 3.12 ADJUSTING

- A. Set and balance water flow to each tower inlet.
- B. Adjust water-level control for proper operating level.

### 3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and service devices. Refer to the DDC General Conditions for instruction requirements.



**END OF SECTION 23 65 00**

**SECTION 23 71 00****AIR COILS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- E. Section 23 07 00 – HVAC INSULATION
- F. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- G. Section 23 71 02 – WRAP AROUND HEAT PIPE SYSTEM
- H. Section 23 71 04 – UVC GERMICIDAL TREATMENT.
- I. Section 23 73 13 – FACTORY FABRICATED INDOOR AIR HANDLING UNITS.
- J. Section 23 73 15 – FACTORY FABRICATED CUSTOM AIR HANDLING UNITS.
- K. Section 23 82 10 – FAN COIL UNITS
- L. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes the following types of air coils:
  - 1. Hot Water Heating Coil
  - 2. Chilled Water Cooling Coil
  - 3. Glycol/Water Cooling/Heating Coils
  - 4. Heat Pipe Coils
  - 5. Primary and Intermediate Drain Pans
  - 6. Auxiliary Drain Pans

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:

1. Section 01 74 19 "Construction Waste Management and Disposal"
2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Submit each item in this section according to the Conditions of the Contract and Division 01 Specification Section.
- C. Coils shall meet or exceed the performance capacities set forth in the Schedules. Submit ARI certified coil performance ratings with system operating conditions indicated with shop drawing submittal. Include rated capacity and pressure drop for each air coil.
- D. A computer generated psychrometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted
- E. Shop drawings detailing fabrication and installation of air coils, including material descriptions, dimensions of individual components and profiles, finishes for each air coil. Detail connections to piping. Indicate dimensions, weight loading, weight distribution and clearances required
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of air coils with air handling unit manufacturers. Revise layout and elevations as required to suit field condition and as reviewed by the Commissioner.

#### 1.7 DI-ELECTRIC FITTINGS

- A. Provide dielectric fittings to isolate joined dissimilar materials to prevent galvanic action and stop corrosion. Fittings shall be of the non-reducing type, which shall be suitable for the system fluid, pressure and temperature and shall not restrict the flow. See Section "COMMON REQUIREMENTS FOR HVAC WORK" for additional requirements.



**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Single-Source Responsibility: Obtain air coil components from one source and by a single manufacturer.
- C. All coils shall be tested, rated and certified according to ARI 410 and ASHRAE 33.
- D. Water coils to have continuous water circuits f
- E. rom the inlet header to the outlet header. All joints in the water circuit are to be brazed.
- F. Coils are to be of the self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Each drain and vent outlet to be fitted with a hose-end valve, packless type, and a pipe cap. Each coil to bear the seal indicating manufacturer's compliance with ARI Standard 410.
- G. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- H. ASHRAE Compliance:
  - 1. Comply with ASHRAE 15 for refrigeration system safety.
  - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 3. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- I. Seismic fabrication Requirements
  - 1. Fabricate coil section, mounting frame and attachment to coils and other coil section components with reinforcement strong enough to withstand seismic forces defined under another section of this work.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products by one of the following for each product category:
  - 1. Cooling Coils (Chilled Water):
    - a. Aerofin
    - b. Heatcraft
    - c. Carrier Corporation.
    - d. Marlo
    - e. Dunham-Bush, Inc.
    - f. Or approved equal.
  - 2. Hot Water Heating Coils:



- a. Aerofin Corporation
- b. Marlo
- c. Heatcraft
- d. Carrier Corporation.
- e. Dunham-Bush, Inc.
- f. Or approved equal.

3. Glycol/Water Coils:

- a. Aerofin
- b. Heatcraft
- c. Carrier Corporation.
- d. Marlo
- e. Dunham-Bush, Inc.
- f. Or approved equal.

4. Heat Pipe Coils

- a. Heat Pipe Technology, Inc.
- b. Applied Air; Mestek Technology, Inc.
- c. Des Champs Technologies.
- d. Engineered Air.
- e. Gaylord Industries, Inc.
- f. Or approved equal.

2.2 COILS – GENERAL

- A. All coils shall meet or exceed all capacities specified on the schedules.
- B. Coil Pressure Ratings: As described in section 23 05 00 – “COMMON REQUIREMENTS FOR HVAC WORK,” but not less than 125 psig SWP at 200 deg F.
- C. All water coils shall have performance certified by the manufacturer to be in accordance with A.R.I. Standard 410. Each coil shall bear the seal indicating ARI 410 certification.
- D. Testing: before shipment, all coils to be subjected to a 350 psig air test under water or 1-½ times working pressure, whichever is greater. The factory pressure tests shall be continuously maintained for a minimum of two (2) hours.
- E. Integral face and bypass coils are not permissible.

2.3 COOLING COILS (CHILLED WATER)

- A. The maximum air velocity across any single point along the face of the coil shall not exceed 475 FPM.
- B. Coils to have continuous water circuits from the inlet header to the outlet header. All joints in the water circuit are to be brazed. Coils are to be of the self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Each drain and vent outlet to be fitted with a hose-end valve, packless type, and a pipe cap.
- C. Headers: constructed of a heavy wall copper.
- D. Tubes: seamless deoxidized copper, 5/8" O.D. minimum and .035" minimum wall thickness. With the specified circuiting, water velocity not to exceed 6 feet per second.



- E. Fittings: return bends to be fabricated from 5/8" O.D. seamless deoxidized copper tubing. Wall thickness, after forming, must be equal to .020" or greater.
- F. Joints: tube joint between fittings and tubes; and tubes and header to be brazed.
- G. Fins: Copper, plate type. Minimum thickness – 0.010". The plate type copper fins shall be continuous across the entire width and depth of the coil section and the tubes shall be mechanically expanded into the fins.
- H. Casing: Stainless Steel top and bottom casing. Flanges are to be formed into a box shape for strength and durability, with a flat surface for coil stacking. Tube support sheets and coil casings to be stainless steel.
- I. Operating Limits: coils to be designed, tested and guaranteed for operation with water pressure and temperature required by specific job application. Conform pressures designated for valves and fittings.
- J. Coils: installed in more than one section high to have intermediate pans. Each pan to be individually drained with piping to outlet pipe leading to floor drain.
- K. Insulation: shall be closed cell plastic, coated with an asphaltum binder cemented to inside surface with waterproof adhesive.
- L. Coating: Cathodic epoxy e-coat.
- M. Coil Performance: all data pertaining to coil performance are shown elsewhere. All coils shall be piped counterflow.

## 2.4 HOT WATER HEATING COILS

- A. General: round seamless copper tubes are to be rolled into headers to form a permanent pressure tight joint. Coils are to be self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Coil finned tube shall be fabricated to permit expansion without transmitting stresses to casing. Each coil to bear the seal indicating manufacturer's compliance with ARI Standard 410.
- B. Minimum Working-Pressure/Temperature Ratings: 250 psig, 325 deg F.
- C. Provide even distribution of water to each tube.
- D. Tubes (Hot Water Coil): ASTM B 743 seamless deoxidized copper, 5/8" OD minimum and 0.035-inch minimum wall thickness. Water velocity shall not exceed 6 feet per second.
- E. Fins: copper plate type, minimum 0.020 in. thick. The plate type fins shall be continuous across entire coil width. Provide efficient bond between fin and tube, making each fin perform as an integral part of the tube.
- F. Fittings: return bends and expansion bends to be fabricated from 1" O.D. seamless deoxidized copper tubing. Wall thickness, after forming, must be equal to or greater than the tube wall thickness.
- G. Frames: ASTM A 666, Type 316 stainless steel, minimum 0.0625-inch-thick for flanged mounting.

## 2.5 GLYCOL/WATER HEATING/COOLING COILS

- A. The maximum air velocity across any single point along the face of the coil shall not exceed 475 FPM.
- B. Glycol/water coils are to be provided and mounted as an integral part of the air handling units and heat recovery units and shall have the capacities as indicated on the plans and schedules.
- C. Coils are to have ARI Standard 410 certification and bear the ARI symbol.
- D. Coils to have continuous glycol/water circuits from the inlet header to the outlet header. All joints in the water circuit are to be brazed. Coils are to be of the self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Each drain and vent outlet to be fitted with a hose-end valve, packless type, and a pipe cap.
- E. Headers: constructed of a heavy wall copper.
- F. Tubes: seamless deoxidized copper, 5/8" O.D. minimum and .035" minimum wall thickness. With the specified circuiting, water velocity not to exceed 6 feet per second.
- G. Fittings: return bends to be fabricated from 5/8" O.D. seamless deoxidized copper tubing. Wall thickness, after forming, must be equal to .020" or greater.
- H. Joints: tube joint between fittings and tubes; and tubes and header to be brazed.
- I. Fins: Copper, plate type. Minimum thickness – 0.010". The plate type copper fins shall be continuous across the entire width and depth of the coil section and the tubes shall be mechanically expanded into the fins.
- J. Casing: Stainless Steel top and bottom casing flanges are to be formed into a box shape for strength and durability, with a flat surface for coil stacking. Tube support sheets and coil casings to be stainless steel.
- K. Operating Limits: coils to be designed, tested and guaranteed for operation with water pressure and temperature required by specific job application. Conform pressures designated for valves and fittings.
- L. Coils: installed in more than one section high to have intermediate pans. Each pan to be individually drained with piping to outlet pipe leading to floor drain.
- M. Insulation: shall be closed cell plastic, coated with an asphaltum binder cemented to inside surface with waterproof adhesive.
- N. Coating: Cathodic epoxy e-coat.
- O. Coil Performance: all data pertaining to coil performance are shown elsewhere. All coils shall be piped counterflow.

## 2.6 HEAT-PIPE COILS

- A. Casing: Stainless Steel flanged casing, with airtight partition between airstreams.
- B. Refrigerant: R 134A.
- C. Tubes: 5/8-inch- diameter, and .035" minimum wall thickness copper.
- D. Fins: Copper plate type. Minimum thickness 0.010".

- E. Fin Spacing: 10-1/2 fins per inch.
- F. Fin and Tube Joint: Mechanical bond.

## 2.7 COIL LIMITATIONS

- A. Cooling coils: not more than 10-1/2 fins per inch (14 fins per inch for 100% O.A. units)  
Not less than 8 rows.
- B. Hot Water Heating Coil Characteristics:
  - 1. Fin Spacing: Not more than 10-1/2 fins per inch.
  - 2. Rows: Not more than 2 rows.
- C. Reheat Coil Characteristics:
  - 1. Minimum Fin Spacing: Not more than 8 fins per inch.
  - 2. Rows: Not more than 2 rows.
- D. Coating: Cathodic epoxy e-coat.

## 2.8 PRIMARY AND INTERMEDIATE DRAIN PANS

- A. All Cooling Coils, Glycol/water coils, Moisture Eliminators and Humidifiers shall be provided with full-length drain pans.
- B. Provide IAQ style drain pan under the entire cooling coil section, which is in compliance with ASHRAE Standard 62.1- 2004.
- C. Drain pan shall extend a minimum 24 inches downstream of the cooling coil, Moisture Eliminators and Humidifier sections.
- D. The main drain pan and intermediate drain pans shall extend under each complete coil section, Moisture Eliminator and Humidifier section and shall be rigid and watertight with a 1-1/4" stainless steel pipe drain connection. The main drain pan and the intermediate drain pans are to be individually drained with piping outlet pipe leading to floor drain.
- E. Drain pans shall start 2" upstream of the coils and extend beyond the coil by a distance which is at least 1/3 the height of the coil (minimum 24" past coil). Total drain height shall be 6".
- F. Extend drain pans under coil headers and all exposed piping subject to sweating.
- G. The drain pans shall be minimum 12 gauge, 304 stainless steel double pan construction.
- H. Insulate the underside of the entire drain pan with two part sprayed on polyurethane closed cell foam with a minimum of R-14 insulation value. Insulation shall be water impervious rigid type, after curing, and shall occupy all voids and areas between drain pan and outer wall to prevent the occurrence of trapped water, condensation, and microbial growth. Install and seal insulation as is appropriate for the equipment construction.
- I. Drain pan triple sloped to the drain connection to prevent accumulation of standing water to meet the requirements of ASHRAE 62.
- J. Condensate from drain pans shall be piped as indicated on the Drawings. The pipe size shall be 1-1/2 inch minimum diameter, insulated as specified for chilled water piping. A trap as

required to prevent the escape or entry of air through the drain piping shall be provided as indicated on the Drawings.

- K. Provide an insulated intermediate drain pan for all coils more than one section high.
- L. Each pan to be individually drained with piping to outlet pipe leading to floor drain. Multiple coils in air handling equipment shall be provided with intermediate drain pans.
- M. Drain pans shall be triple sloped and constructed of 16 gage Type 304 stainless steel to match the main drain pan and shall be extended 6 inches from the coil face.
- N. Drain pans shall also be provided (non-condensing) for hot water and steam finned tube coils which are to be used for coil cleaning maintenance. Drain piping from the pans shall have NPT end caps that will only be removed on a temporary basis to drain water during coil cleaning or for in place coil tube repairs.
- O. Any condensation from the drain pan or drain connection shall be corrected by unit manufacturer to the satisfaction of the Commissioner, and at no expense to the City of New York.
- P. Drain pan shall comply with ASHRAE 62.1- 2004.
- Q. The drain pans shall be fabricated with two percent slope in at least two planes to collect condensate from coils, humidifiers, etc. (including coil piping connections, coil headers, and return bends) and to direct water toward drain connection to drain completely dry on unit shutdown.
- R. The drain pans shall be minimum 12 gauge, 304 stainless steel double pan construction. The drain pan shall be insulated with minimum 2" thick 3.0 lb. density fiberglass insulation. The insulation shall be covered on the exterior with 20-gauge stainless steel coversheet.
- S. Insulation shall be UL listed and shall be vapor sealed between the inner and outer pan.

## 2.9 AUXILIARY DRAIN PAN

- A. In addition to the primary/intermediate drain pan described above, provide an auxiliary drain pan shall be provided under the unit or coils in which condensation will occur. The pan shall have a minimum depth of 1.5 inches, shall not be less than 3 inches larger than the unit or the coil dimensions (in width and length).
- B. Construct the auxiliary drain pan of Type 304 stainless steel; minimum thickness of not less than 0.0276 inch.
- C. Insulate the underside of the entire drain pan with two part sprayed on polyurethane closed cell foam with a minimum of R-14 insulation value. Insulation shall be water impervious rigid type, after curing, and shall occupy all voids and areas between drain pan and outer wall to prevent the occurrence of trapped water, condensation, and microbial growth. Install and seal insulation as is appropriate for the equipment construction.
- D. Drain pan triple sloped to the drain connection to prevent accumulation of standing water to meet the requirements of ASHRAE 62.1 – 2004.
- E. Extend drain pans under coil headers and all exposed piping subject to sweating.
- F. Insulation shall be UL listed and shall be vapor sealed.

- G. Condensate Overflow Switch: A water level detection device conforming to UL 508 shall be provided that will send an alarm to the BMS and be capable of disabling all mechanical cooling in affected unit in the event that the condensate drain is blocked.
- H. The device shall typically be installed in the auxiliary drain pan, located at a point below the overflow rim of such pan.

## 2.10 UVC GERMICIDAL TREATMENT

- A. UVC Germicidal lights shall be factory installed, wired and mounted at the following locations:
  - 1. Downstream of all cooling and heat recovery coils.
  - 2. Above all condensate drain pans.
  - 3. Up-stream of final filtration sections.
- B. UVC Germicidal Treatment is specified under another section of this work.

## 2.11 MOISTURE ELIMINATORS

- A. No water carry-over from cooling coils into air stream accepted. Eliminators shall be provided where required by unit manufacturer. Pressure drop across eliminator shall be maximum 0.20" W.G. at 500 FPM, coil face velocity.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

## 3.2 EXAMINATION

- A. Examine air-handling unit casings, ducts and plenums to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.
- D. Straighten bent fins on air coils.
- E. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.
- F. Fully insulate coil end-caps for all duct mounted heating coils.

**3.4 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 00 00 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section "HVAC Instrumentation and Controls," and other piping specialties are specified in Section "HVAC Piping."
- D. Connect steam piping with gate valve and union and steam condensate piping with union, strainer, trap, and gate valve. Control valves are specified in Section "HVAC Instrumentation and Controls," and other piping specialties are specified in Division 23 Section "Steam and Condensate Piping."
- E. Ground equipment as specified under Division 26 – Electrical.
- F. Connect wiring as specified under Division 26 – Electrical.

**3.5 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
- B. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
- C. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**END OF SECTION 23 71 00**



**SECTION 23 71 03****UVC GERMICIDAL TREATMENT SYSTEM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- E. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- F. Section 23 71 00 – AIR COILS.
- G. Section 23 73 15 – FACTORY FABRICATED CUSTOM AIR HANDLING UNITS.
- H. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. This Section includes the following:
- B. Ultraviolet High-Output Lights in Air Handling Units.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 SUBMITTALS

- A. Shop drawings detailing fabrication and installation of UV Lights, including material descriptions, dimensions of individual components and profiles. Indicate dimensions, weight loading, weight distribution and clearances required
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: Include in operation and maintenance manuals.

1.7 COORDINATION

- A. Coordinate layout and installation of UV lights with air coils, drain pans and filter locations in the air handling unit. Revise layout and elevations as required to suit field condition and as reviewed by the Commissioner.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements
- B. Single-Source Responsibility: Obtain UV system components from one source and by a single manufacturer.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
- D. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- E. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- F. ASHRAE Compliance:
  - 1. Comply with ASHRAE 15 for refrigeration system safety.
  - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 3. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 – "Systems and Equipment" and Section 7 – "Construction and Startup".
- G. Seismic Fabrication Requirements:
  - 1. Fabricate mounting frames and attachments to coils, filters and other coil section components with reinforcement strong enough to withstand seismic forces defined under another section of this work.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products by one of the following
- B. UVC Utility Fixtures:
  - 1. American Ultraviolet
  - 2. York
  - 3. Klaran
  - 4. Or approved equal.

**2.2 GENERAL**

- A. Factory assembled, tested and installed utilizing moisture-proof construction, housing, power source, control panel, reflector, emitter sockets and emitter.
- B. Constructed to withstand HVAC environments.
- C. Lamps and housings shall be UL listed for application in air handling equipment.

**2.3 ULTRA VIOLET GERMICIDAL IRRADIATION SYSTEMS:**

- A. Provide factory installed Ultra Violet (UV) Germicidal Irradiation lamps. Lamps shall provide a minimum irradiance of 9 Watts per square foot at the cooling coil surface (at the coil leaving air temperature scheduled on the Drawings) as well as at the drain pans and filters.
- B. UV lamps shall be located:
  - 1. Downstream of cooling coils.
  - 2. Above condensate drain pans.
  - 3. Up-stream of final filtration sections.
- C. The UVC manufacturer in conjunction with the air handling unit manufacturer shall select and design the UVC device for full surface coverage and equal distribution of UVR energy and maximum effective control of microbial growth, surface bacteria, and mold on coils and condensate drain pans.
- D. Housing: Constructed of hospital grade stainless steel with electrical connection provisions on both ends. Mounting rails and hardware shall be stainless steel.
- E. Power:
  - 1. The air handling unit manufacturer shall factory pre-wire the UVC treatment system as required and provide code approved wiring termination enclosures to permit easy disassembly and field reassembly of the UVC system. Unit wiring shall terminal in a NEMA 3R enclosure terminal panel with a tagged terminal strips.
  - 2. Power Source: 120V, Class P2 rapid start type with power factor of 9.95 and power conversion of not less than seventy-five (75%) percent.
  - 3. Door safety switches will be provided on all doors in AH unit to de-energize the UV lights when an access door is opened. In addition, safety labels will be located on all doors that have a door safety switch. If the segment does not have a door, a label will be added to the segments panel.



4. To safely access the unit where UV lighting has been installed, use the UV Control Panel to turn off the UV lights.
- B. Reflector: Constructed of heavy gauge, specular finished stainless steel and designed to maximize reflectance and minimize corrosion
- C. All fixture components and fixture to fixture mechanical and electrical connections shall be UL approved.
- D. UV Lamps: T5 tube diameter lamps shall be constructed of hard glass quartz producing no ozone or secondary contamination. Lamps shall retain, at minimum, 80% of initial output after 18,000 hours of use. They are sealed for moisture protection with a water-tight connection.
- E. Provide UV filtering glass windows in access doors to block UV lighting, allowing the coil, drain pan and lights to be inspected while in use from outside the AHU.
- F. UVC fixtures shall have been tested and listed as UL under Category Code ABQK, UL standards 153, 1598, and 1995.
- G. UV CONTROL PANEL
  1. A control panel will be provided with every UV light. The control panel will be type NEMA 3R. The Control panel will be mounted in close proximity to the UV lamps.
  2. The purpose of the control panel is to provide a means of disconnecting the UV lighting circuit(s) before opening an access door. Should an access door be opened before disconnecting the UV circuit(s), the door safety switches will turn off the UV lights automatically. The control panel would then be used to reset the UV light circuit(s).

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine air-handling unit casings, cooling coils and drain pans to receive UVC Germicidal Treatment fixtures for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 INSTALLATION

- A. Install fixtures level and plumb.

#### 3.4 CONNECTIONS

- A. Connect wiring as specified under Division 26 – Electrical.

#### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
- B. Operational Test: After electrical circuitry has been energized, operate UVC fixtures to confirm proper unit operation.



- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**END OF SECTION 23 71 03**



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**SECTION 23 73 13****SEMI-CUSTOM AIR HANDLING UNITS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 13 – MOTORS FOR HVAC EQUIPMENT.
- D. Section 23 05 14 – VARIABLE FREQUENCY MOTOR DRIVES.
- E. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- F. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- G. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- H. SECTION 23 33 10 - DAMPERS
- I. Section 23 33 11 – HVAC SOUND ATTENUATION.
- J. Section 23 34 18 – FANS.
- K. Section 23 41 00 – AIR FILTERS.
- L. Section 23 71 00 – AIR COILS.
- M. Section 23 84 13 – HUMIDIFIERS.
- N. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Variable-air-volume, single-zone air-handling units (AHU - C-1, 1-1, 1-2, and 2-1)

**1.3 REFERENCES**

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AMCA 99 - Standards Handbook.
- C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
- F. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- G. ARI 430 - Central-Station Air-Handling Units.
- H. ARI 435 - Application of Central-Station Air-Handling Units.
- I. ASTM B117 - Standard Practice for Operating Salt Spray Apparatus.
- J. NEMA MG1 - Motors and Generators.
- K. NFPA 70 - National Electrical Code.
- L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- M. UL 723 - Test for Surface Burning Characteristics of Building Materials.
- N. UL 900 - Test Performance of Air Filter Units.
- O. UL 1995 - Standard for Heating and Cooling Equipment.
- P. UL 94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
- Q. IBC 2000, 2003 - International Building Code.
- R. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- S. NFPA 5000 - Building Construction and Safety Code.
- T. ASHRAE 90.1 Energy Code.
- U. ARI Standard 1060 - Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.
- V. GSA 2003 Facilities Standard - 5.9 HVAC Systems and Components.
- W. UL 873 - Actuators

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Engineering Services: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of New York, using performance requirements and design criteria indicated.
- B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of  $L/200$  where "L" is the unsupported span length within completed casings.
- C. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.





1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.
- D. The minimum external static pressure noted on the schedules is exclusive of all components furnished and/or factory installed by the unit manufacturer as part of the unit including, but not limited to, all coils, all filters (dirty), unit casing, discharge plenum, diffusion section, humidifier, sound attenuator, dampers (inlet and discharge), access platform, etc.

#### 1.5 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.6 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.8 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
  1. Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
  2. Assembly, unit dimensions and weight loading,
  3. Required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
  4. Cabinet material, metal thickness, finishes, insulation, and accessories.



5. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
  6. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
  7. Maintenance Data: Maintenance manuals specified in Division 1.
  8. Warranties: Special warranties specified in this Section
  9. Fans:
    - a. Certified, computer generated fan performance curves for each air handling unit shall be submitted with specific design operating point noted
    - b. Certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  10. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit.
  11. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted
  12. Certified coil-performance ratings with system operating conditions indicated.
  13. Calculations for required base rail heights to satisfy condensate trapping requirements of cooling coil shall be included.
  14. Dampers, including housings, linkages, and operators.
  15. Filters with performance characteristics.
- B. Engineering Services Submittal: For vibration isolation and seismic restraints indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of New York responsible for their preparation.
1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
- C. Coordination Drawings: Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.
- D. Seismic Qualification Certificates: For air-handling units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.



1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Air Handling units shall be ETL tested and listed in accordance with UL Standard 1995 and CAN/CSA Standard C22.2 No. 236
- D. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- E. ARI Certification: Air-handling units and their components shall be fabricated and factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- F. Air handling unit water heating & cooling coils shall be certified in accordance with the forced circulation air cooling and air heating coils certification program, which is based on ARI Standard 410.
- G. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- H. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- I. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- J. Energy Efficiency Ratio (EER) of package units shall be equal to or greater than prescribed by ASHRAE 90A "Energy Efficient Design of New Buildings."
- K. AC units and their components shall be factory tested according to the applicable portions of ARI and shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute (ARI).
- L. UL and NEMA Compliance: Provide motors required as part of AC units that are listed and labeled by UL and comply with applicable NEMA standards.
- M. Testing and rating of package units shall be in accordance with ARI 360, "Standard for Commercial and Industrial Air-Conditioning Equipment."
- N. Sound testing and rating of package units shall be in accordance with ARI 270, "Standard for Sound Rating of Outdoor Unitary Equipment."
- O. Fan Performance Ratings: Conform to AMCA 210.
- P. Sound Ratings: ARI 410.
- Q. Filter Media: ANSI/UL 900 listed, Class I or Class II, approved by New York City Department of Buildings

- R. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- S. Package Units shall be listed by UL or E.T.L. and have label as a unit.
- T. Units shall be accepted for use in New York City by the Department of Building, MEA 342-99-E.
- U. Units shall have MEA approval.

#### 1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

#### 1.11 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Air Handler products specified in this section must show a minimum five years documented experience and complete catalog data on total product.

#### 1.12 VERIFICATION OF FACTORY RUN-IN TEST

- A. Every unit shall be factory run-in tested
- B. Prior to the assembly of the unit, pressure test all coils (as specified under another section of this work).
- C. Unit Leakage:
  - 1. Unit manufacturer shall provide tests to verify CASING LEAKAGE. Casing leakage tests shall verify that unit casing leakage is less than 1% of design airflow at 1.33 times the design static pressure (minimum of 5"). Duct openings in positive pressure section shall be sealed. This section shall be connected to a fan developing 1.33 times design positive static pressure and CFM of this fan which shall be read using a calibrated orifice plate device. CFM shall be considered casing leakage. Duct openings in negative pressure section shall be sealed. This section shall be connected to a fan developing 1.33 times design negative static pressure and CFM of this fan which shall be read using a calibrated orifice plate device. CFM shall be considered casing leakage.
- D. Deflection:
  - 1. Unit casing deflection shall be limited to 1/200 of the span at 133 percent of the maximum fan static. Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/100 where "L" is the unsupported span length within completed casings.

#### 1.13 SAFETY AGENCY LISTED & CERTIFICATION

- A. Air handler furnished with double width, double inlet (DWDI) fans shall be certified in accordance with the central station air handling units certification program, which is based on ARI Standard 430.

**1.14 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site.
- B. Accept products on site on factory-furnished shipping skids. Inspect for damage.
- C. Store in clean dry place and protect from construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

**1.15 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set(s) for each air-handling unit.
  - 2. Fan Belts: One set(s) for each air-handling unit fan.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ventrol
  - 2. Temptrol
  - 3. Johnson Control
  - 4. Or approved equal.

**2.2 UNIT CASINGS**

- A. General Fabrication Requirements for Casings:
  - 1. Casing – Exterior and interior panels shall be constructed of G90 galvanized steel with welded framework construction. The frame shall be constructed to permit complete removal of the wall and roof panels without affecting the structural integrity of the unit. All panels are removable. The entire unit shall be provided with a full-length, continuous, base rail channel.
  - 2. All segments shall be double wall, formed and reinforced to provide a rigid assembly. The exterior casing shall be constructed of a minimum G90-u galvanized steel. The interior lining shall be a solid lining of a minimum of 18 gage galvanized steel.
  - 3. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
  - 4. Casing Joints: Sheet metal screws or pop rivets.
  - 5. Sealing: Seal all joints with water-resistant sealant.
  - 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
  - 7. All ferrous parts shall have a full 0.90 ounces per square foot of commercial grade galvanizing or have equivalent corrosion resistance when in an unpainted condition. Galvanizing shall be done before construction - all component parts of frame internal and external shall be galvanized.

**B. Casing Insulation and Adhesive:**

1. **Materials:** Moisture proof, fire resistant, two inch (2") thick 1-½ lb. density neoprene coated glass fiber blanket, cemented to internal surfaces, conforming with NFPA Standards for duct lining.
2. **Location and Application:** Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
  - a. **Liner Adhesive:** Comply with ASTM C 916, Type I.
  - b. **Mechanical Fasteners:** Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
  - c. **Liner materials** applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.
3. **Location and Application:** Encased between outside and inside casing for all walls, floors, roof, etc.

**C. Base Rail:**

1. A 6-inch formed 10 gauge G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping. The following calculation shall determine the required height of the baserail to allow for adequate drainage. Use the largest pressure to determine base rail height. Negative or Positive static pressure in (2) + 4" = required baserail height. Should the unit baserail not be factory supplied at this height, the contractor is required to supply a concrete housekeeping pad to make up the difference.

**D. Inspection and Access Panels and Access Doors:**

1. **Panel and Door Fabrication:** Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
2. **Inspection and Access Panels:**
  - a. **Fasteners:** Two or more camlock type for panel operation. Arrangement shall allow panels to be opened against air-pressure differential.
  - b. **Gasket:** Neoprene, applied around entire perimeters of panel frames.
  - c. **Size:** Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. **Access Doors:**
  - a. **Hinges:** A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
  - b. **Gasket:** Neoprene, applied around entire perimeters of panel frames.
  - c. **Fabricate windows** in each component section, motor section, filters section - doors of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.
  - d. **Size:** At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.



4. Locations and Applications:
  - a. Fan Section: Doors and inspection and access panels.
  - b. Access Section: Doors.
  - c. Coil Section: Doors.
  - d. Damper Section: Inspection and access panels.
  - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
  - f. Mixing Section: Doors.
  - g. Humidifier Section: Doors.
5. Service Light: A marine-type, 100-W vapor proof service light fixture with switched junction box shall be provided in each unit segment and located inside adjacent to door. Lights shall be factory wired to individual switches with a utility receptacle
  - a. Locations: Each section accessed with door or access panel.

**E. Condensate Drain Pans:**

1. All drain pans shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified herein and under another section of this work.
2. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
3. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

**2.3 FANS – GENERAL**

- A. The multiple fan array systems shall include multiple, direct drive, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified Class III as required. Class I and Class II fans are not acceptable.
- B. Fans shall be certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed.
- C. Fans shall be direct-drive Plenum Fans, designed for rugged industrial duty and suitable for continuous operation. Fans shall be furnished with an open-mesh protective enclosure screen completely enclosing all sides and the back of the fan wheel. The enclosure shall be removable to provide access to the motor, sheaves and fan wheel. A protective screen shall be mounted at the inlet cone of the fan to prevent foreign objects from entering.
- D. Fan shall be selected and supplied by air handling unit manufacturer with capacities as indicated on the schedule and fully compatible with specific air handling unit systems.
- E. Fans shall be as specified under another section of this work.
- F. All fans shall meet the air flow performance specified and shall not exceed the brake horsepower or sound power levels specified herein and on the HVAC equipment schedule.
- G. Fan capacity shall be AMCA standard 210-74 Rated.
- H. All fans shall include inlet screens.

## 2.4 FAN ARRAY CONSTRUCTION

- A. Fan and motor “cubes” or “cells”, shall be spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein.
- B. In order to assure uniform velocity profile in the AHU cross section, the fan cube dimensions must be variable, such that each fan rests in an identically sized cube or cell, and in a spacing that must be such that the submitted array dimensions fill a minimum of 90% of the cross sectional area of the AHU air way tunnel.
- C. Each fan/motor “cube” shall include an 11 gage; A60 galvanized steel motor support plate and structure. The fan air inlet cone and motor support structure shall be powdered coated for corrosion resistance. All motors are to be compatible for inverter duty, with sealed bearings and also include shaft grounding.
- D. The fan array shall produce a uniform airflow and velocity profile within the airway tunnel of the air handling unit not to exceed the specified cooling coil and filter bank face velocity when measured 12 inches from the intake side of the fan array intake plenum wall and at a distance of 48 inches from the discharge side of the fan array intake plenum wall.
- E. There shall be no blank off plates or “spacers” between adjacent fan columns or rows to position the fans across the air way tunnel.
- F. Each fan & motor assembly shall be removable through a 30” wide, free area, access door located on the discharge side of the fan wall array without removing the fan wheel from the motor.
- G. Each fan/motor cube shall be equipped with a metal grating fan outlet guard. The manufacturer of the array shall be responsible to determine if the addition of vibration isolators are required to meet the vibration requirements within this scope of work.
- H. Fans shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound.
- I. Fan motors shall be premium efficiency and compatible for inverter duty
- J. All motors with VFDs shall be compatible with the VFD and tested at the factory. Motors shall be capable of running continuously from 0 up to 120 Hz and deliver full rated horsepower at 60 Hz to 120 Hz operating frequencies
- K. All fan/motor access doors shall open against pressure.

## 2.5 FAN, DRIVE, AND MOTOR SECTION

- A. Fan and Drive Assemblies shall be furnished to meet the performance requirements set forth herein and in the schedules and as specified under another section of this work.
- B. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Enclosure Type: Totally enclosed, fan cooled.
  - 2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.





3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.
5. Mount unit-mounted disconnect switches on interior of unit.

## 2.6 VARIABLE FREQUENCY DRIVES (VFD):

- A. Variable Frequency Drives (VFD) shall be furnished and installed to meet the performance requirements set forth herein and in the schedules and as specified under another section of this work.

## 2.7 COIL SECTION

- A. General Requirements for Coil Section: See Section 23 71 00 "Air Coils".
  1. All coils shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified herein and under another section of this work.
  2. Coil section shall completely enclose all connections, coil headers and return bends. Furnish and install factory air seals reviewed by the Commissioner for the coil piping penetrations at the casing. Coil frames shall not be used as structural members of the coil section. The coil section shall be constructed in such a manner that the coils can be removed within the unit (coil pull space not required).
  3. All coils shall be factory installed on tracks for easy removal from the unit. Units that require disassembly of the unit for coil removal are not acceptable. Install coils such that headers and return bends are enclosed by unit casings.
  4. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
  5. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when coil-mounting frame and air-handling-unit mounting frame are anchored to building structure.

## 2.8 AIR FILTERS

- A. All filters shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified herein and under another section of this work.
- B. Provide filters and filter housing as an integral part of unit.
- C. There shall be a filter gauge for each filter bank – readable from the unit exterior.
- D. Provide a pressure differential sensor (with a contact for the BMS) for each filter bank.
- E. Provide filter holding frames with access doors on both sides of unit. All filters shall be installed on tracks for easy removal and installation from the unit.
- F. Filters shall be removable from either side of the unit or lifted out from access plenum.

## 2.9 DAMPERS

- A. All dampers shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified herein and under another section of this work.

- B. Dampers and damper actuators: Comply with requirements as specified in another section of this work.
- C. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
- D. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
- E. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
- F. Bearing support bracket and drive blade pin extension shall be provided for each damper section.
- G. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For Single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
- H. Damper manufacturer shall supply alignment plates for all multi-section dampers.
- I. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- J. Economizer Actuators shall utilize digital control 2-10 VDC, tied into the BMS. Floating control is not acceptable.
- K. Electric damper actuators shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
- L. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
- M. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section.
- N. Electronic Damper Actuators:
  - 1. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify Actuators.
  - 2. NEMA 2 rated actuator enclosures. Use additional weather shield to protect actuator when mounted outside
  - 3. 5-year Manufacturer's Warranty. Two-year unconditional + Three-year product defect from date of installation
  - 4. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15/23.
  - 5. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.



6. Mechanical spring-return mechanism shall be provided. Mechanical, with external, manual gear release on nonspring-return actuators. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
7. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator
8. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
9. A push button gearbox release shall be provided for all non-spring actuators.
10. Modulating actuators shall be 24Vac and consume 10VA power or less.
11. Conduit connectors are required when specified and when code requires it.
12. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
13. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal. Operator Motors:
14. Coupling: V-bolt and V-shaped, toothed cradle.
15. Power Requirements (Two-Position Spring Return): 24-V ac.
16. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
17. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
18. Temperature Rating: Minus 22 to plus 122 deg F.

## 2.10 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig (2070 kPa) according to ARI 410 and ASHRAE 33.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Equipment Mounting: Install air-handling units on concrete bases using restrained spring isolators. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 3. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
  - 1. Minimum Deflection: 2 inches (50 mm).
  - 2. Install galvanized-steel plate to equally distribute weight over elastomeric pad.
  - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Equipment Mounting: Install air-handling unit using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
  - 1. Minimum Deflection: 2 inches (50 mm).
  - 2. Install galvanized-steel plate to equally distribute weight over elastomeric pad.
- C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- F. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

### 3.4 CONNECTIONS

- A. requirements for piping specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using 1-1/4", ASTM B, Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.



- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 15/23.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  - 6. Verify that zone dampers fully open and close for each zone.
  - 7. Verify that face-and-bypass dampers provide full face flow.
  - 8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
  - 9. Comb coil fins for parallel orientation.
  - 10. Verify that proper thermal-overload protection is installed for electric coils.
  - 11. Install new, clean filters.



B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

### 3.7 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

### 3.8 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain devices. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 73 13**

**SECTION 23 73 15****FACTORY FABRICATED CUSTOM AIR HANDLING UNITS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 13 – MOTORS FOR HVAC EQUIPMENT.
- D. Section 23 05 14 – VARIABLE FREQUENCY MOTOR DRIVES.
- E. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- F. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- G. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- H. SECTION 23 33 10 - DAMPERS
- I. Section 23 33 11 – HVAC SOUND ATTENUATION.
- J. Section 23 34 18 – PLENUM FANS.
- K. Section 23 41 00 – AIR FILTERS.
- L. Section 23 71 00 – AIR COILS.
- M. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section includes work for the following air handling units, as indicated on Drawings:

- 1. AHU –C3-1&1A
- 2. AHU C3-2&2A

Provide complete and fully operational custom-built, factory fabricated, heavy-duty, hospital grade, indoor air-handling units to meet the performance requirements as shown on the equipment schedules, indicated on the drawings and specified herein. Air Handling units shall be complete (factory installed) with casings, frames, access doors, thermal breaks, fans, motors, variable frequency drives, plus accessories which include, but are not limited to, cooling coils, pre-heat coils, reheat coils (integral face and bypass coils are not acceptable), pre-filters, filters, after-filters, mixing section, dampers (fan outlet, isolation, etc.), access sections,

discharge section, diffuser section, humidifier, sound attenuators, controls, etc.

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

### 1.5 SUBMITTALS

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".
- B. Include in the submittal the following for each of the supplied components:
  - 1. Manufacturer's name and model number
  - 2. Drawings with complete dimensional data, weights,
  - 3. Materials for construction
  - 4. Certification, performance guarantee and warranty information.
- C. The thickness of the double wall construction shall be determined based on meeting and exceeding the thermal, structural, acoustical, etc. design criteria outlined herein. Manufacturer shall submit calculations, backup data and test results to substantiate selected wall thickness.
- D. **Product Data:** For each air-handling unit:
  - 1. Unit dimensions and weight.
  - 2. Capacities
  - 3. Pressure drops across each component in the unit.
  - 4. Required Clearances
  - 5. Cabinet material, gauges, metal thickness, finishes, insulation, and accessories.
  - 6. Fans:





- a. Certified fan-performance curves with system operating conditions indicated.
  - b. Certified fan-sound power ratings.
  - c. Fan construction and accessories.
  - d. Motor ratings, electrical characteristics, and motor accessories.
7. Coils:
  - a. Coil selection data sheets, clearly showing input data with proper consideration for altitude, air density.
  - b. Certified coil-performance ratings with system operating conditions indicated.
8. Dampers, including housings, linkages, and operators.
9. Filters with performance characteristics, product data of filter media, filter assembly and filter frames.
10. Details showing condensate drain connection height and required P-trap height.
11. Field connection details for ductwork, steam, water, power, etc.
12. Airflow measuring station details.
- E. Sound data - air handling unit inlet, discharge, and radiated sound power levels at nominal capacity.
- F. In addition, product data shall include accessories, sound data, motor electrical characteristics,
- G. Complete operations and maintenance manuals shall be provided. The manuals shall include a table of contents, specifications, drawings including exploded view of parts, and description of equipment, model number of each piece of equipment, installation instructions, operating instructions, maintenance instructions, parts list, test data, performance curves, and warranty. Include instructions for lubrication, filter replacement, motor and drive replacement and spare parts list.
- H. Contractor shall submit the complete, coordinated MER sheet metal and piping shop drawings to the air handling unit manufacturer prior to submission to the Commissioner. Based on the equipment location, including the ductwork, piping, etc. layout as indicated on the shop drawings, the AHU manufacturer shall review the air performance and acoustical performance of the AHUs and identify any issues that would adversely affect the air and/or acoustical performance or the maintenance of the AHU and then indicate all comments or approval directly on the shop drawing.
- I. Submit details of thermal performance of casing panels, including, but not limited to, thermal break construction details, and performance calculations.
- J. Dimensioned plan and elevation view drawings, including motor starter, VFD and control cabinets, required clearances, and location of all field connections.
- K. Wiring Diagrams: Detail wiring for power supply. Detail ladder-type wiring diagrams for interlock, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring.
- L. Start-up Reports: Indicate results of start-up and testing requirements. Submit copies of checklists.
- M. Operation and Maintenance Manuals: Complete operations and maintenance manuals shall be provided. The manuals shall include a table of contents, specifications, drawings including exploded view of parts, and description of equipment, model number of each piece of

equipment, installation instructions, operating instructions, maintenance instructions, parts list, test data, performance curves, and warranty. Include instructions for lubrication, filter replacement, motor and drive replacement and spare parts list.

#### 1.6 SEISMIC LOAD DESIGN

- A. This project is located within a seismic zone requiring special provisions for the support and restraint of equipment, components and piping.
- B. Fabricate unit sections, internal mounting frames and attachments and other section components with restraints to withstand seismic forces defined under another section of this work.
- C. Provide manufacturer's Seismic Qualifications Certification that the air handling units, accessories and components will withstand seismic forces as defined under another section of this work. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outlined Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchoring provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

#### 1.7 REFERENCED STANDARDS

- A. All factory fabricated air-handling units and accessories shall be designed, manufactured and tested in accordance with the latest applicable industry standards including, but not limited to the following:
  - 1. AMCA 99 - Standard Handbook.
  - 2. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
  - 3. AMCA 211 - Certified Ratings Program - Air Performance.
  - 4. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
  - 5. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
  - 6. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
  - 7. AMCA 611-95 - Methods of Testing Airflow Measurement Stations for Rating.
  - 8. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
  - 9. ANSI/UL 900 - Test Performance of Air Filter Units.
  - 10. ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment.
  - 11. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
  - 12. ARI 430 - Standard for Central-Station Air-Handling Units.
  - 13. ARI 435 - Standard for Application of Central-Station Air Handling Units.
  - 14. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
  - 15. SMACNA - HVAC Metal Duct Construction Standards.
  - 16. ANSI/ASHRAE 15.
  - 17. ASHRAE 52.11/52.2 - Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size
  - 18. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality
  - 19. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
  - 20. ASME Section VIII Unified Pressure Vessel Code.
  - 21. UL Standard.



22. ASTM A-653: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process.
23. OSHA – Occupational Safety and Health Act.
24. ISO – International Organization for Standardization
25. ARI 360 - Standard for Commercial and Industrial Air-Conditioning Equipment.
26. ANSI/UL 900
27. NFPA 70 - National Electric Code (conductors, equipment and raceways)
28. NFPA 90A - Installation of Air Conditioning and Ventilation Systems
29. UL-181 - Mold Growth and Humidity Test
30. UL-1995 - Standard for Safety for Heating and Cooling Equipment
31. ISO/PWD 13261-3 - Sound Power Rating of air-conditioning and air-source heat pump equipment: Part 3, Ducted Equipment.
32. ISO 9614 - Determination of sound power levels of noise sources using sound intensity: Part 1, Measurement at discrete points; Part 2, Measurement by scanning, and Part 3, Precision method for measurement by scanning.
33. ANSI/ASTM C533.
34. ANSI/ASTM C612.
35. ASTM E84.
36. NFPA 255.
37. UL 723.
38. ADC Standards.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. The air-handling units shall be UL or ETL listed as a complete unit and shall bear the UL or ETL label.
- C. Air handling units must comply with ASHRAE 90.1.
- D. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of custom, factory fabricated air handling units, of types (including screwless exterior panels) and capacities required, whose products have been in satisfactory use in similar service for not less than 10 years.
- E. Local service shall be available either directly from the factory or through the local certified factory representatives.
- F. Units shall be produced by a recognized manufacturer whose manufacturing process is certified by ISO (latest). Their quality control procedures must be thoroughly documented to ensure a consistently high quality product.
- G. The manufacturer shall certify that the equipment supplied by them meets or exceeds all specified capacities, airflow rates, heat transfer rates, filtration efficiencies, air mixing quality, etc. Any and all deviations must be fully disclosed as part of their bid proposal.
- H. Ratings and Certifications
  1. Air Handling Unit safety : ETL or UL 1995
  2. Air Handling Unit energy use: ASHRAE 90.1
  3. Fans: AMCA-210
  4. Air Coils: ARI 410
  5. Air Handling Unit certification program: ARI 430



6. Filter media: ANSI/UL 900 listed Class I or Class II
  7. Electrical Components: NFPA 70
  8. Control wiring: NEC codes & ETL requirements
  9. Motors: Federally mandated Energy Policy Act (EPACT).
  10. Airflow Monitoring Stations: AMCA 611-95
- I. The Commissioner shall maintain the right to tour the manufacturer's plant anytime during fabrication of the units specified herein. The vendor shall provide a fabrication schedule to the Commissioner informed of any changes in the schedule.
1. The vendor shall include the expenses for three (3) factory visits (4 people per visit) to view the fabrication process, in their bids. This is in addition to the witnessing of the performance tests.
- J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- K. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- L. ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- M. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- N. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- O. Comply with NFPA 70.

#### 1.9 COORDINATION

- A. It shall be the responsibility of this manufacturer and the contractor to confirm all dimensions and structural details based on the latest architectural and structural drawings relating to column, beam or wall locations or any other obstructions that must be accommodated as part of the equipment layout and support or to provide proper equipment clearances.
- B. This contractor shall fully coordinate any such changes or deviations from the drawings and specifications with the Commissioner. These changes and deviations may include but are not limited to, structural steel, weight, size, electrical, and controls. Any resulting expense due to deviation or substitutions from this specification or drawings shall be the sole responsibility of the manufacturer providing the equipment. These expenses shall include but not be limited to any additional engineering, architectural, mechanical or structural expenses.
- C. Any resulting expenses due to failure to coordinate or comply with the contract document requirements shall be the sole responsibility of this contractor.
- D. Provide a unit with a total footprint size (length and width) that will not exceed the one shown on the Drawings, including the height of individual unit components.

#### 1.10 UNIT PERFORMANCE REQUIREMENTS

- A. Casing leakage for the entire AH unit shall be less than 1% of design airflow at 1.5 times total design pressure of the unit (minimum shall be 10" wg static pressure).

- B. The minimum external static pressure noted on the schedules is exclusive of all factory installed components including, but not limited to, all coils, all filters (dirty), unit casing, discharge inlet/discharge plenums, inlet/outlet fan cones, outlet regain elbow attenuator, humidifier, sound attenuator, dampers (inlet and discharge), inlet & discharge duct connections, etc.
- C. Unit shall be constructed with all major components supported directly from an electrically welded, structural steel base with unit casing deflection limited to 1/200 of the span at the maximum fan static pressure (minimum static shall be 10").
- D. Stiffeners of angle steel shall be supplied as required to maintain casing design loading deflection criteria at 30#/sq. inch with a 6" negative and 6" positive static pressure without sagging, pulsating or oil canning. Each unit section shall be equipped with a minimum of four (4) non-removable structural angle-lifting lugs. The entire base shall be coated with corrosion resistant paint.
- E. The entire unit casing (walls, floors, roof, access doors, etc.) shall be heavy-duty, high-pressure, double wall construction with insulated panels, having complete thermal break and continuous vapor barrier construction, suitable for the scheduled duty requirements.
- F. The average thermal conductance of the unit casing shall not exceed 0.06 BTU/SQ.FT. /HR/°F.
- G. The thickness of the double wall construction shall be determined based on meeting the thermal, structural, acoustical, etc. design criteria outlined herein. Manufacturer shall submit calculations, backup data and test results to substantiate selected wall thickness.
- H. The entire housing (casing) of the units (including roof, floor, walls, etc.) shall be provided with a continuous thermal break.

#### 1.11 FACTORY PERFORMANCE TESTING

- A. Every unit when completed and all their components installed shall be factory run-in tested according to the applicable portions of ARI. The components shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute (ARI).
- B. The unit manufacturer shall either have testing facilities within their factory or shall utilize other testing facilities to run these tests. The testing facility shall conform to AMCA 210 airflow and AMCA 300 Sound Power Level standards to perform all the required testing specified herein.
- C. The unit testing shall be witnessed by a certified Engineer licensed in the State of New York with a copy of test reports submitted to the Commissioner for review and acceptance prior to shipping the units.
- D. The Commissioner shall be invited to witness the tests. All expenses associated with the attendance of the Commissioner shall be borne by this manufacturer.
- E. The manufacturer shall include the expenses for four (4) two (2) factory visits (4 people per visit) in their bids to witness the testing. All testing shall be scheduled so as to require no more than 4 visits to the lab.
- F. Prior to the assembly of the unit, pressure test all coils (as specified under another section of this work).
- G. Factory test shall include, but not limited to: dynamic trim balance of completed fan assembly; complete run check of all control and electrical components and safeties, including proper



control sequencing; leak check of completed water circuit, unit leakage test and sound performance testing.

- H. Every unit shall be dynamically balanced and tested at the factory at design RPM to less than 3 mils peak-to-peak. Provide full flow air testing at design CFM and static pressure. In addition, provide 50% flow test at 2/3 the design static pressure.
- I. Casing Leakage Testing:
  - 1. Unit manufacturer to test each completed (fully assembled) unit to verify casing leakage rates. Sections of the unit that will normally operate under positive pressure shall be tested under positive pressure. Sections of the air-handling unit that normally operate under negative pressure shall be tested under negative pressure.
  - 2. Casing leakage tests shall verify that casing leakage for the entire AH unit is less than 1% of design airflow at 1.5 times total design pressure of the unit (minimum shall be 10" wg static pressure).
  - 3. Determine leakage using the testing methods as described in SMACNA HVAC Air Duct Leakage Test Manual. Provide temporary sealing of openings as required for leakage testing.
- J. Deflection:
  - 1. Unit casing deflection shall be limited to 1/200 of the span at the maximum fan static pressure (minimum static shall be 10") to be measured at center of span.
- K. Sound Power Levels:
  - 1. Sound testing shall be conducted in the test lab. All test data shall be according to AMCA 300 and ANSI S12.31-1990 and S12.32-1990. Maximum sound power levels shall not exceed those listed on the equipment schedule and as delineated in specification Section 23 33 11 – HVAC Sound Attenuation.
  - 2. All OA, RA and SA openings shall be sound tested. Measurements shall be taken 5' from associated openings.
- L. Report:
  - 1. Adjust and report performance ratings for the proper altitude of operation.
  - 2. Report air-handling unit performance ratings in accordance with ARI-430 (static pressure, airflow, fan speed, and fan brake horsepower).
  - 3. Report static pressure profiles by component section.
  - 4. Report coil ratings in accordance with ARI -410 (capacities and pressure drops).
  - 5. Report and rate sound power levels in accordance with ARI-260 (ducted discharge, ducted inlet, free inlet sound).
  - 6. Airflow measuring device performance shall be certified and rated in accordance with AMCA-611. Report data in accordance with AMCA-611. Provide AMCA Certified Rating Seal for Airflow Measurement Performance.
  - 7. Report panel deflection at +/-10" w.g., stated in terms of 'L/X' where 'L' is the casing panel length and 'X' is a constant provided by the AHU manufacturer.
  - 8. Report casing leakage rate at +/-10" w.g., specified in terms of percentage of design airflow.
  - 9. Report weight loads and distributions by component section.
  - 10. Report product data for filter media, filter performance data, filter assembly, and filter frames.
  - 11. Report electrical requirements for power supply wiring including wiring diagrams for



- interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
12. Report motor electrical characteristics.
  13. As part of the factory test, all factory installed piping shall be hydrostatically or air pressure leak tested. The test pressure shall be as specified hereinafter.
  14. The factory hydrostatic or air pressure test shall be continuously maintained for a minimum of two (2) hours after which each piping joint, connection, etc., shall be examined to verify there is no evidence of weeping or leakage.
  15. The air handling unit manufacturer shall maintain a pressure test log listing the air handling unit tested, date of test, pressure at start of test, pressure at the end of the test, duration time for the test and the name of the test supervisor for each test. If liquid was used for the pressure testing, it shall be completely drained and blown out of all coils and the internal piping system prior to shipment. The factory test log shall be submitted as part of the certified test report.

#### 1.12 DI-ELECTRIC FITTINGS

- A. Provide dielectric fittings to isolate joined dissimilar materials to prevent galvanic action and stop corrosion. Fittings shall be of the non-reducing type, which shall be suitable for the system fluid, pressure and temperature and shall not restrict the flow.

#### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be completely cleaned and vacuumed. All pipe and duct openings shall be plugged or covered in such a manner to prevent entrance of foreign matter. Units shall be delivered with factory installed shipping skids or lifting lugs. Items/components that are shipped loose shall be packed in separate protective packages.
- B. Comply with ASHRAE 62, Section 5 (mold and corrosion resistant casings, filters upstream of wetted surfaces, and drain pan design).
- C. Comply with ASHRAE 62, Section 7 (practices to be followed during construction and startup). Protect equipment from moisture by appropriate in-transit and on-site procedures.
- D. The Air Handling Unit sections shall be shrink-wrapped prior to shipment using 10 mil. plastic sheet. Prior to the shipment from the factory, the manufacturer shall inspect the insides of each unit and clean inside surfaces that have visual appearance of oil, dirt, dust, rust, chips or grease.
- E. Store Air Handling Units in a safe, clean and dry place, off the ground and away from construction traffic and protected from weather and physical damage.
- F. Protect, pack and secure controls devices, motor control devices and other electronic equipment. Do not store electronic equipment in wet or damp areas even when they are sealed and secured.
- G. Enclose and protect control panels, electronic devices, and variable frequency drives; and pack with desiccant bags. Replace desiccant bags every 60 days. For equipment stored in an environment with a relative humidity greater than 60%, change bags every 30 days. Do not store equipment in wet or damp areas even when they are sealed and secured.
- H. Seal openings to protect against damage during shipping, handling and storage.
- I. The entire unit shall be of sectionalized (segmented) construction, if required to allow for ingress to the construction site. The individual sections shall be shipped and rigged into place on one

common perimeter base.

- J. Units with shipping segments shall be either welded or be provided with "male" and "female" connection pieces for easy field assembly. Sealant, gaskets and associated hardware shall be provided for re-connection of unit modules. Units requiring field installation must be assembled under supervision by factory instructed and employed technicians from the air unit manufacturer.
- K. Handle package units and components carefully to prevent damage. Replace damaged package units or components with new.
- L. Rig package units to comply with manufacturer's rigging and installation instructions for unloading package units, and moving them to final location.
- M. Coordinate delivery of units in sufficient time to allow movement into building.
- N. Mount a permanent nameplate on the unit to display the manufacturer, serial number, model number, date of manufacture, horsepower, current and voltage.

#### 1.14 SCHEDULING AND SEQUENCING

- A. Coordinate installation mounting pad with floor structure.
- B. Coordinate opening locations for mechanical and electrical connections.

#### 1.15 COORDINATION

- A. Coordinate installation of equipment supports, including locations for mechanical and electrical connections.

#### 1.16 WARRANTY

- A. Special Warranty: A written warranty, executed by the manufacturer, agreeing to replace (parts and labor) components that fail in materials or workmanship, within the warranty-period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
- B. Warranty Period: 3 years after date of Substantial Completion on all components.
- C. Extended warranty period of 5 years after date of Substantial Completion against corrosion of casing, walls, floor and roof panels.

#### 1.17 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Ventrol





2. Buffalo Air Handling
3. Ingenia
4. Huntair
5. Haakon
6. Mainstream
7. Or approved equal.

## 2.2 GENERAL DESCRIPTION

- A. Provide complete and fully operational, piped, wired and tested, custom designed, custom-built, factory fabricated, heavy-duty, hospital grade, indoor air-handling units to meet the performance requirements as shown on the equipment schedules, indicated on the drawings and specified herein.
- B. AH Units shall be complete (factory installed) with double-wall casings, frames, thermal breaks, access doors, fans, motors, variable frequency drives, plus accessories, including but not limited to, cooling coils, pre-heat coils, re-heat coils, heat-pipe coils, pre-filter and after-filters, mixing box, dampers (fan outlet, AHU isolation, etc.), access sections, discharge section, diffuser section, humidifier, sound attenuators, etc.
- C. Provide a unit with a total footprint size (length and width) that will not exceed the one shown on the Drawings, including the height of individual unit components.
- D. The units shall be of the draw-thru type.
- E. The units shall be provided with a fan array configuration, utilizing multiple, direct-drive, plenum fans.
- F. Coil Pressure Ratings: As described in section 23 05 00 – “COMMON REQUIREMENTS FOR HVAC WORK,” but not less than 250 psig SWP at 200 deg F.
- G. The entire unit casing (walls, floors, roof, access doors, etc.) shall be heavy-duty, high-pressure, double wall construction with insulated panels, having complete thermal break and continuous vapor barrier construction, suitable for the scheduled duty requirements.
- H. Walls shall be of the formed panel type. Panels shall be 30" wide maximum. All panels shall be removable without affecting the structural integrity of the unit. The panels are to be internally caulked to prevent water and air leakage.
- I. Casing shall comply with NFPA 90A requirements.
- J. The average thermal conductance of the unit casing shall not exceed 0.06 BTU/SQ.FT. /HR/°F.
- K. Entire casing system as well as each component (panels, walls, roof, floor, access doors, etc.) shall be guaranteed that the acoustical, thermal, cleanliness, structural, etc. performance, as specified herein, are not compromised.
- L. Provide hygienic unit design with interior suitable for washing down. The use of support members framed within the unit casing, which will allow for trapping of debris between the supports and casing will not be allowed. Unit insulation must be completely encapsulated.
- M. Units shall be provided with factory installed chilled water, glycol/water, humidifier and heating coil piping. For coil piping details, see details on drawings and specifications. The factory installed piping shall exit the unit as indicated on the drawings.

- N. The piping and fittings internal to the unit shall be as specified under another section of this work.
- O. The internal piping shall be sized to limit the overall pressure drop of the coil (including the internal piping) to that scheduled on the drawings. All internal cooling coil, heating and condensate piping shall be insulated as specified under another section of this work.
- P. Piping shall be terminated with a flanged connection and an air seal device.
- Q. Internal piping shall be internally braced to prevent any movement during shipping or field assembly.

## 2.3 UNIT BASE

- A. Units shall be constructed from structural steel channel iron around the full perimeter of the unit, with intermediate channel and angle iron supports. Units less than or equal to 20 ft long shall have a minimum 6 in channel, and units greater than 20 ft shall have a minimum 8 in channel.
- B. All internal components shall be mounted on structural steel frames, which shall be isolated from the unit floor. No internal component shall be supported on or by any external cabinet member other than the base frame.
- C. All drain connections on floor mounted air handling units shall terminate at the side of the unit.
- D. Provide clearance for proper external trapping of drain pans and steam condensate.

## 2.4 CABINET / HOUSING

- A. The unit shall be constructed out of double-walls and roof panels. The interior casing walls and roof throughout shall be made of solid 18 gauge Type 304 stainless steel with all joints and seams internally welded and shall be waterproofed.
- B. The thickness of the double wall construction shall be determined based on meeting the thermal, structural, acoustical, etc. design criteria outlined herein. Manufacturer shall submit calculations, backup data and test results to substantiate selected wall thickness.
- C. All panels shall be removable without affecting the structural integrity of the unit.
- D. The exterior casing walls and roof throughout shall be made of solid 16-gauge aluminum with all joints and seams welded. All panels shall be removable without affecting the structural integrity of the unit.
- E. The roof shall be designed to support a minimum live load of 100 #/SF, to allow safe access to the top of the unit.
- F. The interior of the unit shall be constructed and waterproofed to permit washdown by the facility.
- G. The casing panels shall be self supporting, and be capable of withstanding 150% of internal static pressure as specified without pane joints exceeding a deflection of 1/240th of the span dimension while under positive and negative pressure.
- H. Removable access panels shall be designed and constructed such that removal and replacement may be accomplished without disturbing adjacent panels. Airtight integrity must be maintained.



- I. All equipment within air handling unit shall be provided with a minimum 2" high base to raise equipment off unit floor for housekeeping. Equipment mounted directly on unit floor is unacceptable.
- J. All ferrous parts shall have a full 0.90 ounces per square foot of commercial grade galvanizing or have equivalent corrosion resistance when in an unpainted condition. Galvanizing shall be done before construction - all component parts of frame internal and external shall be galvanized. Painting and surface preparation shall be done prior to assembly. Interior and exterior surfaces shall have two (2) coats of an epoxy corrosion resistant primer, and an alkyd enamel finish.
- K. Removable panels and access doors shall be provided for easy access to interior of unit as necessary for maintenance and parts replacement. These shall be of the same thickness and construction as the wall panel units.

## 2.5 CASING FLOOR

- A. The casing floor shall be 12 gauge Type 304 stainless steel, continuously welded, no-slip (checkered) floor, with a 2" turned up lip around the perimeter, with a sub-floor of 18 gauge stainless steel.
- B. The floor shall be suitably braced to prevent oil canning. Insulation on top of the floor or screw heads on the floor surface is unacceptable. The floor shall be of the inverted pan design with standing seams and shall be designed to provide a 2" overhang around the full perimeter of the unit base frame.
- C. The unit base floor shall be designed to support a minimum live load of 100#/SF throughout the unit

## 2.6 FLOOR DRAINS

- A. Each section of the unit shall contain a minimum 1" drain to facilitate system wash down and condensate removal. Areas in the base where potential standing water cannot be removed through drains are not acceptable. Drains shall be piped underneath the topsheet of the unit exterior to allow drainage of the section. Drains shall be provided with removable caps of non-corrosive material.

## 2.7 UNIT ACCESS DOORS

- A. Access doors are constructed with a double wall construction and an extruded aluminum frame. The doorframe features a built-in no-through-metal high density resin barrier and a perimeter gasket. Door frames with no thermal break are not acceptable. The door gasket is seamed together at each corner to prevent leakage through the door. Door is attached to the unit with 3 axes adjustable stainless steel hinges. Doors shall open against higher pressure side. Where this is not feasible due to site constraints, an interlocking mechanism furnished on the fan section access door with a de-energizing switch complying with CAL-OSHA, ETL and the mechanical protection requirements of UL 1995 will be provided.
- B. All access doors shall be double wall and completely insulated between the interior and exterior panels and shall be of the same construction (and panel thickness) as panels described above. Doors shall swing freely 180° and shall under no circumstances open outward when exposed to positive pressure.
- C. All access panels shall be a minimum of 24" wide and 60" high. Access doors shall have

stainless steel frames; gaskets shall be of neoprene rubber with steel rib and shall open against unit static pressure.

- D. Access doors shall provide walk-in service to each section.
- E. All access doors shall be provided with stainless steel hinges and 2-way compression Ventlok #310 hand-locking latches with handle and keyed locking mechanism. A minimum of two (2) latches per door shall be provided. All access doors shall have solid sandwich construction.
- F. Vapor-proof marine lights with switch and convenience outlets on separate switches shall be mounted in each section (lights and outlets shall be factory pre-wired).
- G. Provide dual pane inspection windows in each access door. The windows shall be a minimum of 9" x 9" and made of two 1/4" thick tempered thermally insulated, glass panes separated by an air space. A desiccant pouch shall be placed in the air space to absorb any moisture.
- H. To minimize thermal conductivity and prevent condensation, the entire perimeter frame shall be uniformly insulated.
- I. Casing shall comply with NFPA 90A requirements.

## 2.8 INSULATION

- A. All panels, walls and roof shall have high density 3.0 lb/cu-ft full insulating fiberglass.
- B. To minimize thermal conductivity and prevent condensation, the entire casing and perimeter frame shall be uniformly insulated, with continuous vapor barrier
- C. The casing floor shall be insulated with 2" high-density 3.0 lb/cu-ft fiberglass insulation with continuous vapor barrier between the floor and sub-floor. Provide thermal break.
- D. The average thermal conductance of the unit casing shall not exceed 0.06 BTU/SQ.FT. /HR/°F.

## 2.9 THERMAL BREAK

- A. All panels (cabinet) of the units (including roof, floor, walls, etc.) shall be of continuous thermal break construction.

## 2.10 EXTERIOR FINISH

- A. All units' exterior must be painted using a system of primer and final coating. All parts to be painted shall be cleaned and degreased using a prep solution. A coat of industrial wash primer followed by two coats of exterior low gloss polyurethane must be applied. The completed coating must be able to sustain salt spray testing of 1000 hours, per ASTM 117B. Manufacturer shall confirm that paint system will meet the specification and provide test results

## 2.11 FANS – GENERAL

- A. The multiple fan array systems shall include multiple, direct drive, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified Class III as required. Class I and Class II fans are not acceptable.
- B. Fans shall be certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified

fan/motor speed.

- C. Fans shall be direct-drive Plenum Fans, designed for rugged industrial duty and suitable for continuous operation. Fans shall be furnished with an open-mesh protective enclosure screen completely enclosing all sides and the back of the fan wheel. The enclosure shall be removable to provide access to the motor, sheaves and fan wheel. A protective screen shall be mounted at the inlet cone of the fan to prevent foreign objects from entering.
- D. Fan shall be selected and supplied by air handling unit manufacturer with capacities as indicated on the schedule and fully compatible with specific air handling unit systems.
- E. Fans shall be as specified under another section of this work.
- F. All fans shall meet the air flow performance specified and shall not exceed the brake horsepower or sound power levels specified herein and on the HVAC equipment schedule.
- G. Fan capacity shall be AMCA standard 210-74 Rated.
- H. The fan casing shall be manufactured from minimum 0.20 in thick mild steel with continuously welded rolled flanges.
- I. The motor shall be supported from mild steel guide vanes or plates continuously welded to the casing.
- J. All fans shall include inlet screens.
- K. All fans shall be provided with outlet dampers, as specified herein.

## 2.12 FAN ARRAY CONSTRUCTION

- A. Fan and motor "cubes" or "cells", shall be spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein.
- B. In order to assure uniform velocity profile in the AHU cross section, the fan cube dimensions must be variable, such that each fan rests in an identically sized cube or cell, and in a spacing that must be such that the submitted array dimensions fill a minimum of 90% of the cross sectional area of the AHU air way tunnel.
- C. Each fan/motor "cube" shall include an 11 gage; A60 galvanized steel motor support plate and structure. The fan air inlet cone and motor support structure shall be powdered coated for corrosion resistance. All motors are to be compatible for inverter duty, with sealed bearings and also include shaft grounding.
- D. The fan array shall produce a uniform airflow and velocity profile within the airway tunnel of the air handling unit not to exceed the specified cooling coil and filter bank face velocity when measured 12 inches from the intake side of the fan array intake plenum wall and at a distance of 48 inches from the discharge side of the fan array intake plenum wall.
- E. There shall be no blank off plates or "spacers" between adjacent fan columns or rows to position the fans across the air way tunnel.
- F. Each fan & motor assembly shall be removable through a 30" wide, free area, access door located on the discharge side of the fan wall array without removing the fan wheel from the motor.

- G. Each fan/motor cube shall be equipped with a metal grating fan outlet guard. The manufacturer of the array shall be responsible to determine if the addition of vibration isolators are required to meet the vibration requirements within this scope of work.
- H. Fans shall be rated in accordance with AMCA 210 for performance and AMCA 300 for sound.
- I. Fan motors shall be premium efficiency and compatible for inverter duty
- J. All motors with VFDs shall be compatible with the VFD and tested at the factory. Motors shall be capable of running continuously from 0 up to 120 Hz and deliver full rated horsepower at 60 Hz to 120 Hz operating frequencies
- K. All fan/motor access doors shall open against pressure.

## 2.13 FAN ARRAY PERFORMANCE

- A. Scheduled fan performance and static efficiencies shall be based upon actual installed conditions that include the system effects associated with the actual fan mounting arrangement, enclosures around each individual fan, and the effects of any back flow prevention devices, or other appurtenances necessary for proper fan system performance in the event of disabling of one or more fans in the array. All fans in the multiple fan arrays shall be AMCA certified for performance, and that certified performance shall be corrected for system effects introduced by the mounting arrangement, enclosures, back draft dampers, and other fan appurtenances not considered when AMCA certified performance for free inlet and discharge is determined. Submitted AHU performance that does not indicate allowance for system effects for the back flow prevention device(s) and the system effect for the fan and motor enclosure in which each fan is mounted, will be returned to the contractor disapproved and will need to be resubmitted with all of the requested information included for approval.
- B. The array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit to equal the specified cooling coil and/or filter bank face velocity by +/- 5% when measured at a point 36" from the intake side of the fan array intake plenum wall, and at a distance of 72" from the discharge side of the fan array intake plenum wall.
- C. Any increase in fan system power requirements or sound power levels that exceed those as specified will be corrected at no additional expense to the City of New York. Corrections for both fan power and sound power levels shall be determined and submitted to the Commissioner for approval prior to release for production of the submitted equipment.
- D. Submittals for units providing less than the scheduled quantity of fans and/or spacing of the fans for multiple fan arrays shall submit CFD modeling of the air flow profile for pre-bid approval that indicates uniform velocity and flow across all internal components without increasing the length of the AHU unit or changing the aspect ratio of the unit casing as designed.

## 2.14 ACOUSTICAL ATTENUATORS

- A. Sound Attenuators shall be of the size, type and quantity as shown on the drawings and shall be designed, fabricated and installed by the air handling unit manufacturer..
- B. Sound attenuators are specified under another section of this work.
- C. The outlet attenuator insertion losses result in a sound power level at the discharge of the outlet attenuator, shall not exceed those listed in the sound attenuator portion of the specification.

**2.15 COILS****A. General:**

1. All cooling and heating coils shall be furnished to meet or exceed the performance requirements set forth in the schedule.
2. Coils are specified under another section of this work.
3. Minimum working-pressure/temperature ratings: 150 psig, 325 deg F.
4. The maximum air velocity across any single point along the face of the coil shall not exceed 475 FPM.
5. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coils. The coil section shall be constructed in such a manner that the coils can be removed within the unit (coil pull space not required). All coils shall be factory installed on tracks for easy removal from the air-handling unit.
6. Units that require dis-assembly of the unit for coil removal are not acceptable.
7. Install coils such that unit casings enclose headers and return bends.
8. Furnish and install factory air seals approved by the Commissioner for the coil piping penetrations at the casing.
9. Coil frames shall not be used as structural members of the coil section. ASTM a 666, type 316 stainless steel, minimum 0.0625 inch thick for flanged mounting.
10. Coil casing to be constructed of 16-gage stainless steel. Intermediate casing supports shall be provided.
11. Provide di-electric fittings to isolated joined dissimilar materials to prevent any galvanized action and stop corrosion.
12. Integral face and bypass coils are not permissible.

**B. Cooling Coils (Chilled Water)**

1. Coils to have continuous water circuits from the inlet header to the outlet header. All joints in the water circuit are to be brazed. Coils are to be of the self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Each drain and vent outlet to be fitted with a hose-end valve, packless type, and a pipe cap.
2. Cooling Coils are specified under another section of this work.

**C. Glycol/Water Cooling/Heating Coils**

1. Glycol/Water Cooling/Heating Coils are specified under another section of this work.
2. Coils to have continuous water circuits from the inlet header to the outlet header. All joints in the water circuit are to be brazed. Coils are to be of the self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header. Each drain and vent outlet to be fitted with a hose-end valve, packless type, and a pipe cap.

**D. Heating Coils (Hot Water)**

1. General: round seamless copper tubes are to be rolled into headers to form a permanent pressure tight joint. Coils are to be self-venting type. A vent connection is to be provided in the supply header and a drain connection in the return header.
2. Coil finned tube shall be fabricated to permit expansion without transmitting stresses to casing.
3. Minimum working-pressure/temperature ratings: 250 psig, 325 deg F.
4. Provide even distribution of water to each tube.



5. Heating Coils are specified under another section of this work.
6. Pre-Heating coil characteristics:
  - a. Minimum fin spacing: not more than 10-1/2 fins per inch.
  - b. Rows: not more than 2 rows.
7. Reheat coil characteristics:
  - a. Minimum fin spacing: not more than 8 fins per inch.
  - b. Rows: not more than 2 rows.

**E. Heat Pipe Wrap-Around Coils**

1. Casing: Stainless Steel flanged casing.
2. Refrigerant: R 134A.
3. Tubes: 5/8-inch- diameter, copper.
4. Fins: Copper.
  - a. Fin Spacing: 10-1/2 fins per inch.
  - b. Fin and Tube Joint: Mechanical bond.
5. Control: Pivot center of bottom of heat-pipe coil on shaft and bearings to tilt coil. Include tilt controls with electronic controller, electric actuator and linkage, thermostats and sensors for automatic supply temperature regulation, summer/winter changeover, and frost protection.
6. Provide solenoid valve for reheat control.
7. Coils are specified under another section of this work.

**2.16 PRIMARY & AUXILIARY DRAIN PAN**

- A. All Cooling Coils, Moisture Eliminators, and Humidifiers and piping subject to sweating shall be provided with full-length drain pans.
- B. Drain pan shall comply with ASHRAE 62.1- 2004.
- C. Primary and Auxiliary drain pans are specified under section 23 71 00 – AIR COILS.
- D. The drain pans shall be 12 gauge 316 stainless steel and insulated with 2" - 3 #/cu-ft insulation. The pan shall be sloped a minimum of 1" in direction of airflow and 2" in the width of the unit to minimize standing water.
- E. Drain pans shall start 2" upstream of coil and extend beyond the coil by a distance, which is at least 1/3, the height of the bottom coil (minimum 18" past coil). Total drain pan height shall be 6".
- F. Intermediate drain pans for stacked coils shall have drains on both sides piped with 1" copper tubing to the main pan. Intermediate drain pan shall be constructed with same material as main pan described above.
- G. Extend drain pans under coil headers and all exposed piping subject to sweating.
- H. Insulation shall be UL listed and shall be vapor sealed between the inner and outer pan.



- I. Multiple coils in air handling equipment shall be provided with intermediate drain pans.
- J. Coil racks, galvanized 304 stainless steel, are provided to allow independent removal of coils.

**2.17 MOISTURE ELIMINATORS**

- A. No water carry-over from cooling coils into air stream accepted. Eliminators shall be provided where required by unit manufacturer. Pressure drop across eliminator shall be maximum 0.15" W.G. at 500 FPM, face velocity.

**2.18 FAN OUTLET BACKDRAFT DAMPERS**

- A. Each individual supply and return fan in the air-handling units' fan arrays shall be provided with an integral back flow prevention device (damper) that prohibits recirculation of air in the event a fan or multiple fans become disabled or is not operating.
- B. All fans shall be provided with a back flow prevention means that produces near zero static pressure drop and/or system effect when that fan is enabled.
- C. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals.
- D. Damper performance data that is per AMCA ducted inlet and discharge arrangements will not be accepted. Damper data must be for the specific purpose of preventing back flow in any disabled fan and that is close coupled to the entering face of the inlet of each fan.
- E. AHU Manufacturers that do not manufacture the fans being submitted must provide tested and certified performance data for fans as installed in the AHU unit including the backflow prevention damper system effects introduced by close coupled back flow prevention dampers at the fan inlet.
- F. Backdraft dampers are specified under another section of this work.
- G. Dampers shall be factory installed in the air-handling units.
- H. All dampers installed in air handling units or exposed to ambient conditions shall be constructed of aluminum with stainless steel linkages, fittings, etc.

**2.19 AIR HANDLING UNIT ISOLATION DAMPERS**

- A. Air handling units shall be provided with isolation dampers at the unit inlet and discharge. The purpose is to isolate the unit to prevent migration of smoke.
- B. AHU Isolation dampers shall be smoke dampers.
- C. Dampers shall be furnished to meet the performance requirements set forth in the schedule and as specified under another section of this work.
- D. All Dampers shall be of low leak design.
- E. All dampers installed in air handling units or exposed to ambient conditions shall be constructed of aluminum with stainless steel linkages, fittings, etc.

- F. The contractor shall furnish the damper actuators for the fan isolation dampers. The actuators shall be shipped to the factory and installed by the damper manufacturer. The actuators shall be mounted outside of the airstream.
- G. There shall be two (2) end switches for each damper to indicate at the BMS and FAS full open and full closed positions.
- H. Dampers shall close when unit is not running and shall open when the unit is commanded to run. Once the damper is fully open, as sensed by the second end switch, the unit shall start.
- I. The dampers shall be connected to the FAS.

## 2.20 AIR FILTERS

- A. Filters are specified under another section of this work.
- B. All filters shall be furnished to meet the performance requirements set forth in the schedule and as specified under another section of this work. All filters shall have performance certified in accordance with ASHRAE and shall be UL Rated.
- C. The filter frames shall be constructed of stainless steel and be built as an integral part of the unit. All filter segments shall be serviceable with access doors.
- D. General Requirements for Air Filters:
  - 1. Comply with NFPA 90A.
  - 2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  - 3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
- E. An electronic, differential pressure gage shall be factory installed and flush mounted on drive side to measure the pressure drop across the filters. Coordinate with BMS.

## 2.21 HUMIDIFIERS

- A. Humidifiers shall be furnished to meet or exceed the performance requirements set forth in the schedule and as specified under another Section of this work.

## 2.22 WRAP AROUND HEAT PIPE SYSTEM

- A. Furnish a wrap-around heat pipe heat recovery system, as shown in the schedule and as specified under this scope of work.
- B. The system is to be factory installed within the air-handling units to provide enhanced dehumidification.
- C. The Wrap Around Heat Pipe System is specified under another section of this work.

## 2.23 ULTRA-VIOLET GERMICIDAL IRRADIATION SYSTEMS

- A. UV Germicidal Irradiation Systems are specified under another section of this work.

- B. Provide factory installed Ultra Violet (UV) Germicidal Irradiation lamps. UV lamps shall be located:
  - 1. Downstream of cooling coils.
  - 2. Above condensate drain pans.
  - 3. Up-stream of final filtration sections.
- C. Lamps and ballasts shall be UL listed for application in air handling systems.
- D. Lighting systems shall be moisture resistant with electronic ballasts and shall be wired using moisture resistant conduit.
- E. UV lamps shall be capable of being switched on and off at the respective AHU section access door.
- F. Lamps shall be interlocked with access door position limit switches such that they are de-energize when the doors open.
- G. Units with view port windows from which the lamps can be seen shall be labeled to warn of possible eye damage.
- H. All penetrations through AHU walls shall be thoroughly sealed to ensure no leakage. All UV susceptible materials in the AHU shall be shielded from line of sight UV. Installer shall remove all foreign matter such as dirt and metal shavings upon completion of installation.

#### 2.24 AIRFLOW MEASURING STATIONS

- A. Each fan shall be supplied with a complete airflow measuring system. Airflow measuring stations required to measure the supply & return air shall be factory installed by the air handling unit manufacturer. Airflow measuring stations shall be of heavy gauge metal construction, and shall be furnished with an air straightening section with an open face area of not less than 97%.
- B. The flow measuring station shall not obstruct the inlet of the fan and shall have no effect on fan performance (flow or static) or sound power levels
- C. Provide all materials and equipment necessary for a complete and properly operating airflow measuring station in each unit.
- D. Each airflow measuring station shall measure airflow by means of a network of static and total pressure sensors factory positioned and connected in parallel to produce an averaged velocity pressure. The measured velocity pressure converted to airflow (CFM) shall have an accuracy of 2% of the full scale throughout the velocity range from 700 to 4,000 FPM when measured under ideal laboratory conditions. The location of stations shall meet manufacturer's guidelines.
- E. The maximum resistance to airflow shall not exceed 0.6 times the velocity head. The unit shall be suitable to withstand temperatures up to 250°F.
- F. All interconnecting tubing between the air measuring and any remote metering or control shall be furnished and installed by the supplier of the station. A minimum of one static and one total pressure sensor shall be used for every 16 sq. Inches of AHU duct cross sectional area for AHU ducts up to four sq.ft. In cross section. For larger ducts, a minimum of one static and one total pressure sensor shall be used for every 36 sq. Inches of duct cross sectional area.
- G. Interconnecting sensor manifolds shall equalize and relate each type of sensor measurement into one total pressure and one static pressure metering port. The permanent system pressure

loss created by the unit shall not exceed .15 of a velocity head. Each airflow measuring station shall consist of 16-gauge sheet metal casing and an air straightening section with an open face area not less than 97%.

- H. Provide air monitor with an accuracy of + 2%, a turndown of 6 to 1, and no pressure loss across the station.
- I. Final locations to be coordinated with fan & unit manufacturer to ensure installed actual accuracy meets specifications.
- J. Airflow sensing tubes may be mounted in the fan inlet as approved by the manufacturer for AHU applications.

## 2.25 CONTROL PANELS

- A. Each fan motor shall be individually wired to a motor control panel (NEMA 3R) containing motor overloads and VFDs. VFD configuration shall be as follows:
  - 1. Each VFD (with bypass) shall control three (3) fans.
- B. AHU manufacturer will factory mount all the controls including sensors & actuators that will be supplied by the contractor. These controls shall be wired and terminated to a termination strip in the control panel mounted on the outer casing of the AHU or on the MER wall.

## 2.26 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Units shall operate on 460/3 voltage/phase, 60 Hz. as scheduled on the documents. Unit shall be guaranteed to operate continuously at that voltage plus or minus 10% without injurious overheating.
- B. Units shall require only one electrical connection, and shall include downstream overcurrent protection and disconnect means for each VFD drive and motor.
- C. The air handling unit manufacturer shall pre-wire the casing sections as required and provide code approved wiring termination enclosures to permit easy disassembly and field reassembly of the various air handling unit casing sections, fan motors, internal lights and switches, 120 volt GFI power receptacles, etc. for a complete factory pre-wired air handling unit assembly. Unit wiring shall terminal in a NEMA 1 3R enclosure terminal panel with a tagged terminal strips.
- D. Lights & GFI Receptacle
  - 1. The air handling unit manufacturer shall factory pre-wire and surface mount industrial quality service lights (marine type, 100 W, vapor tight, fully enclosed, gasketed, and rugged service light fixture) with switched junction box, in each unit segment and located inside unit adjacent to doors. The exposed metal parts shall of weatherproof, corrosion resistant surface hardened die cast aluminum.
  - 2. Lights shall be factory wired to individual switches with a 120-volt ground fault circuit interrupting utility receptacle. A separate 120-volt power connection shall be required at the GFI receptacle to provide power for the lights and receptacles. Lights are to be provided at each section accessed with door or access panel.
  - 3. Each unit section shall be provided with a minimum of two (2) service lights.
- E. Controls: Specified under another section of this work.

F. Test:

1. Energize and run test for not less than ½ hr all electrical components to prove satisfactory operation, and that all circuits are free from short circuits and unspecified ground. Each Variable speed drive unit shall be completely functionally tested under actual motor load. Test that the insulation resistance to ground of all non-grounded circuits is not less than one mega ohms at 1000 volts DC. Arrange to have units factory inspected and perform other testing as required to obtain ETL Label.

2.27 ELECTRIC MOTORS

- A. Electric motors are specified under another section of this work.
- B. All motors shall be premium efficiency.
- C. All motors shall be standard foot mounted type, TEAO motors selected at the specified operating voltage, RPM, and efficiency.
- D. Motors shall meet the requirements of NEMA MG-1 Part 31.
- E. Motors shall be as manufactured by Toshiba or Baldor for use in multiple fan arrays that operate at varying synchronous speeds as driven by an approved VFD with all features required for use in multiple fan arrays.
- F. Each motor shall be provided with an appropriately sized NEMA 3R unfused disconnect switch.
- G. Motors shall include permanently sealed bearings and shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents.
- H. Scheduled brake horsepower shall not be exceeded. The fan motor shall be factory pre-wired.
- I. The motor shall be mounted on the same isolation base as the fan. The motor shall be on a slide base to permit adjustment of belt tension. The fan and motor drive vibration isolation base shall be mounted on seismic type spring isolators selected for 2" deflection and sized for 95% isolation efficiency.
- J. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in another section of this work.
  1. Enclosure Type: Totally enclosed, fan cooled.
  2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  5. Mount unit-mounted disconnect switches on exterior of unit.
- K. Fan unloading for variable-air-volume control shall be accomplished through a variable frequency drive, as specified under another Section.
- L. After final assembly, the fan and motor assembly shall be factory balanced for 10 - 100% of design speed of the air-handling unit. Units that are balanced for a specific point of operation shall be field balanced for the entire RPM range.

**2.28 VARIABLE FREQUENCY CONTROLLERS (DRIVES)**

- A. Variable frequency controllers (drives) are specified under another section of this work.
- B. The VFD for the air-handling units shall be factory installed.
- C. For AHUs with multiple fans (fan array), one VFD will control a maximum of three (3) fans, each fan shall be provided with an independent VFD.
- D. After the air handling unit is installed, the unit VFC VFDs shall be field commissioned by a factory trained and employed service technician.
- E. See section VARIABLE FREQUENCY CONTROLLERS for additional details.

**2.29 MONORAIL SYSTEM**

- A. As part of each unit, provide a factory installed monorail system within each coil and fan section for the rigging and removal of coils, fans and motors.
- B. Monorail system shall be sized by unit manufacturer to handle maximum weight of piece of equipment (coil, motor, etc.) with safety factor to meet 2014 New York City Construction Codes.

**2.30 PERFORMANCE**

- A. Performance: Noted on schedules, to be rated as a completely assembled unit.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 INSTALLATION OF AIR HANDLING UNITS**

- A. Install air handling units where indicated on the contract drawings, in accordance with equipment manufacturer's published installation instructions.
- B. Access: Provide access space around the air-handling units for service as required and as indicated on the drawings but not less than that recommended by the manufacturer.
- C. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of New York Department of Buildings.
- D. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated, and fans have been test run under observation of the Commissioner.
- E. Arrange fans and surrounding components in such a way that poor fan performance does not result.
- F. It is the manufacturer's responsibility to verify opening dimensions and installation methods to ensure unit sections and components can be physically installed into the designated space.
  - 1. The manufacturer has the responsibility to transport sections to the Project Site and to supervise reassembling the sections together for all air handlers. Unload and hoist the



- sections onto the designated floor space.
  2. Reassemble the sections together for all air handlers in their footprint under the direction of the manufacturer.
  3. Additional unit section or component splits required for installation during construction shall be the responsibility of the manufacturer without additional expense to the City of New York.
  4. Units must be bolted together for reassembly. Drive screw construction at unit splits is unacceptable.
  5. All internal coil piping shall be extended to casing walls.
  6. The unit manufacturer shall provide a written acceptance letter to the Commissioner stating the unit was assembled and complies with manufacturer's assembly requirements.
- G. Install in conformance with ARI 435.
- H. Assemble high-pressure units by bolting segments together. Isolate fan segment with flexible duct connections.
- I. Provide for connection to electrical service.
- J. Controls devices shall be provided by the contractor and installed by the manufacturer in the factory.
- K. Field Adjustments: Adjust fan vibration isolators in accordance with manufacturer's instructions.
- L. Duct Connections: Provide ductwork, accessories, flex connection as indicated on the drawing.
- M. Install units on vibration isolation.
- N. Provide connections to chilled water piping, hot water piping, glycol/water piping and drain piping.
- O. All internal wiring shall be factory installed in accordance with the NEC Code, local code regulations and requirements using UL listed components.
- P. Supports: Provide supports and miscellaneous steel members for equipment and be responsible for coordinating this work and setting equipment in place.
1. Lubrication
    - a. Lubricate all equipment installed up to time of acceptance by Commissioner.
    - b. Lubricants shall be of grade and quality specified by equipment whose literature shall contain said data or Written specifications provided with equipment delivered.
- Q. Manufacturer's Start-Up Assistance
1. Provide the services of qualified trained field engineers to verify that equipment installation is proper and to supervise initial startup of equipment. The unit manufacturer shall provide a minimum of fifteen (15) days start-up supervision by a factory-trained technician.
- ### 3.3 FIELD PERFORMANCE TESTING
- A. All factory installed piping shall be air pressure leak tested for a minimum of 2 hours, prior to
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connection to the system piping.

- B. The contractor is responsible to coordinate that the unit is operating correctly and that all connections to the units are complete.
- C. Once each unit is installed, the following field tests shall be run by the contractor under the direct supervision of a manufacturer's representative and the Commissioner.
  - 1. A casing leakage test shall be performed as outlined under paragraph 1.06 of this section.
  - 2. A performance test on the unit shall be run, verifying airflows, water pressure losses, air pressure losses, and coil performance.
  - 3. All adjustable frequency drive driven components including motor, and fans must have vibration levels checked at all speeds between 2 and 100 percent of the driven unit's design rpm. Vibration must be checked at fan shaft bearings in radial (vertical and horizontal) and axial directions. If excessive vibration is found at any frequency, special balancing and structural changes must be provided to minimize harmonic vibrations.

### 3.4 INSTALLATION OF AIR HANDLING UNITS

- A. General: Install air handling units where indicated on the contract drawings, in accordance with equipment manufacturer's published installation instructions.
- B. Access: Provide access space around the air-handling units for service as indicated on the drawings but not less than that recommended by the manufacturer.
- C. Field Adjustments: Adjust fan vibration isolators in accordance with manufacturer's instructions.
- D. Duct Connections: Provide ductwork, accessories, flex connection as indicated on the drawing.

### 3.5 TESTING & COMMISSIONING

- A. Unit manufacturer shall provide the services of a trained technician to supervise the installation of the unit and to perform the start up of the unit. After the unit is installed, perform inspection, start-up and checkout of the equipment. Do not start up equipment until the following operations are complete:
  - 1. Confirm shipping bracket and bracing is removed.
  - 2. Confirm unit components are secured on mountings and supporting devices and verify that connections for electrical and piping are complete. Verify proper thermal overload protection is installed in motors, starters and disconnects.
  - 3. Inspect and confirm satisfactory completion of all field joints.
  - 4. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
  - 5. Lubricate bearings, pulleys, belts and other moving parts with factory recommended lubricants.
- B. Verify manual and automatic volume controls in connected ductwork systems are in the full open positions.
- C. See section 23 08 00 "Commissioning of HVAC" for commissioning requirements.

### 3.6 AERODYNAMIC PERFORMANCE TEST





- A. The flow through the unit shall be measured across the discharge and inlet. A calibrated hot wire anemometer shall be used for velocity measurement across the discharge and inlet sections. The inlet of the unit shall be covered with steel net and filter to simulate the system load. The static pressure rise across the fan shall be measured by total and static pressure probe traverse at inlet and at discharge of fan. The alternative procedure for measuring flow velocity across the coils or filters can be a face traverse as per ASHRAE TP 3359 using a rotating vane anemometer measuring velocity reading on downstream side of a coil or filter. Airflow shall be within 5% of design.

**END OF SECTION 23 73 15**



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## **SECTION 23 73 39**

### **PACKAGED, INDOOR HEATING AND VENTILATING UNITS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 13 – MOTORS FOR HVAC EQUIPMENT.
- D. Section 23 05 14 – VARIABLE FREQUENCY MOTOR DRIVES.
- E. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- F. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- G. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- H. SECTION 23 33 10 - DAMPERS
- I. Section 23 33 11 – HVAC SOUND ATTENUATION.
- J. Section 23 41 00 – AIR FILTERS.
- K. Section 23 71 00 – AIR COILS.
- L. This section is a part of each Division 23 00 00 section.

##### **1.2 SUMMARY**

- A. Furnish and install new factory-built, packaged, indoor, Heating & Ventilating ((H & V) units as herein specified and as indicated on the drawings. Units shall be completely factory assembled and tested.
- B. All units shall be capable of meeting or exceeding the scheduled capacities for cooling and heating and air delivery.
- C. All unit dimensions for each model shall be considered maximum.
- D. Each unit shall be specifically designed for outdoor applications and include weatherproof casing and cabinets. Units shall be of the modular design with factory installed access sections to provide maximum access flexibility to all components.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**



- E. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- F. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- G. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures"

#### 1.6 SUBMITTALS

- A. **Product Data:** Include rated capacities, furnished specialties, and accessories.
- B. **Shop Drawings:** Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:
  - 1. **Design Calculations:** Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  - 2. **Mounting Details:** For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 3. **Vibration Isolation Base Details:** Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
  - 4. **Wiring Diagrams:** Power, signal, and control wiring.
- C. **Coordination Drawings:** Roof-mounted units and roof-curb mounting details drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:



1. Size and location of rooftop unit mounting rails and anchor points and methods for anchoring units to curb.
  2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- D. Startup service reports.
- E. Operation and Maintenance Data: For direct-fired H&V units to include in emergency, operation, and maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York Department of Buildings, and marked for intended use.
- C. Comply with NFPA 70.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- 1.8 COORDINATION
- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size, location, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- C. Coordinate size, location and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
1. Coordinate installation of restrained vibration isolation roof-curb rails, which are specified in Section 23 05 48 "Vibration Isolation, Seismic, Flood, and Wind Load Restraints for HVAC Components".

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AAON
  2. Trane
  3. Carrier Corporation.
  4. Mammoth
  5. Or approved equal.



## 2.2 PACKAGED UNITS

- A. Furnish a complete, factory assembled and tested, packaged, roof mounted air-cooled, H & V unit of the size and capacities listed on the Contract Documents.
- B. The unit shall be constructed as per the configuration and dimensions indicated on the drawings. The unit dimensions shall not vary more than 6" in any direction. Configuration of the discharge and inlet conditions as well as the interior walls, components shall be as indicated on the drawings.
- C. Provide adequate service space and code mandated clearances for electrical equipment in each section.
- D. The minimum external static pressure noted on the schedules is exclusive of components furnished by the unit manufacturer as part of the unit, including, but not limited to, heating coil, boiler, preheat coils, air filters (dirty), unit casing, discharge plenum, intake plenum, diffusion section, humidifier, sound attenuator, dampers (inlet and discharge), etc.
- E. The internal piping shall be sized to limit the overall pressure drop of the coils (including the internal piping) to that scheduled on the drawings. All internal coils and piping shall be insulated.
- F. Internal piping shall be braced to prevent any movement during shipping or field assembly.

## 2.3 UNIT CONSTRUCTION

- A. Unit shall be specifically designed and constructed for this application. Each unit shall be completely factory assembled, factory run-tested, piped internally, wired including vapor proof lighting in each section and maintenance power receptacles in each section.
- B. The unit casing shall utilize 2-inch double wall construction. The interior wall and ceiling shall be 18-gauge galvanized steel and shall form the air seal between the conditioned air and ambient air.
- C. The unit cabinet shall be designed to operate at total static pressure of 3 in w.g.
- D. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters and coils.

## 2.4 CABINET

- A. Cabinet: Double-wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. Cabinet shall be fully weatherized for outside installation.
- B. Access Panels: Piano hinged with cam-lock fasteners for furnace and fan motor assemblies on both sides of unit.
- C. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on complete unit.
  - 1. Thickness: 2 inches
  - 2. Insulation Adhesive: Comply with ASTM C 916, Type I.



3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

D. Finish: Heat-resistant, baked enamel.

E. Roof Curb: Full-perimeter curb of sheet metal, minimum 16 inches (400 mm) high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, latest version.

## 2.5 SUPPLY-AIR FAN

A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, pillow-block bearings rated for L50 or 200,000 hours with external grease fittings.

B. Motor: Totally enclosed, single speed motor.

C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.

D. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with spring isolators.

## 2.6 OUTDOOR-AIR INTAKE

A. Outdoor-Air Hood: Galvanized steel with rain baffles, bird screen complying with ASHRAE 62.1-2004, and finish to match cabinet; and sized to supply maximum 100 percent outdoor air.

## 2.7 AIR FILTERS

A. Comply with NFPA 90A.

B. Cleanable Filters: 2-inch-0 (50-mm-) thick, cleanable metal mesh.

C. Disposable Panel Filters: 2-inch- (50-mm-) thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames, with a minimum efficiency report value of 6 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1.

1. Media: Interlaced glass fibers.

2. Frame: Galvanized steel.

## 2.8 DAMPERS

A. Outdoor-Air and Return-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. (51 L/s per sq. m) of damper area, at differential pressure of 2-inch wg (448 Pa).

B. Fan-Discharge Dampers: Galvanized-steel, opposed-blade damper.

C. Balancing/Bypass Dampers: Galvanized-steel, opposed-blade damper.

D. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.



## 2.9 CONTROLS

- A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
- B. Control Panel: Surface-mounted and/or Recessed, with trim ring, remote panel, with engraved plastic cover, and the following lights and switches:
  - 1. On-off-auto switch.
  - 2. Automatic changeover.
  - 3. Supply-fan operation indicating light.
  - 4. Heating operation indicating light.
  - 5. Damper position potentiometer.
  - 6. Thermostat.
  - 7. Cooling operation indicating light.
  - 8. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
  - 9. Safety-lockout indicating light.
- C. Refer to Section 23 09 00 "HVAC Instrumentation and Controls" for control equipment and sequence of operation.
- D. Control Devices:
  - 1. Remote Thermostat: Adjustable room thermostat with temperature readout.
  - 2. Remote Setback Thermostat: Adjustable room thermostat without temperature readout.
  - 3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
  - 4. Fire-Protection Thermostats: Fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature.
  - 5. Timers: Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.
  - 6. Timers: Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.
  - 7. Ionization-Type Smoke Detectors: 24-V dc, nominal; self-restoring; plug-in arrangement; integral visual-indicating light; sensitivity that can be tested and adjusted in place after installation; integral addressable module; remote controllability; responsive to both visible and invisible products of combustion; self-compensating for changes in environmental conditions.
  - 8. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.
- E. Fan Control: Interlock fan to start with exhaust fans. See Section 23 09 05 "Sequence of Operations for HVAC Controls" and Section 23 09 00 "HVAC Instrumentation and Controls" for exhaust fan controls.
- F. Fan Control: Timer starts and stops H&V unit and exhaust fan(s).
  - 1. Smoke detectors, located in supply and return air, shall stop fans when the presence of smoke is detected.
  - 2. Controls motor controller using static-pressure transmitter.





- G. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
- H. Outdoor-Air and Fan-Discharge Damper Control, 100 Percent Outdoor-Air Units:
  - 1. Outdoor-air damper shall open when supply fan starts, and close when fan stops.
  - 2. Fan-discharge dampers shall operate to vary the amount of outdoor air to match exhaust-fan operation.
- I. DDC: Stand-alone control module for link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Section 23 09 00 "HVAC Instrumentation and Controls".
  - 1. Provide start and stop interface relay, and relay to notify DDC system alarm condition.
  - 2. Provide hardware interface or additional sensors as follows:
    - a. Room temperature.
    - b. Discharge-air temperature.

## 2.10 MOTORS

- A. Comply with requirements in Section 23 05 13 "Motors for HVAC Equipment".

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of direct-fired H&V units.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where rooftop replacement-air units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."
- B. Install floor-mounted units on restrained spring isolators with minimum 1-inch (25-mm) static deflection; refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install controls and equipment shipped by manufacturer for field installation with direct-fired H&V units.



### 3.4 CONNECTIONS

- A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.
  - 1. Drain: Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to evaporative cooling units.
- B. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to direct-fired H&V units with flexible duct connectors.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Inspect casing insulation for integrity, moisture content, and adhesion.
  - 2. Verify that clearances have been provided for servicing.
  - 3. Verify that controls are connected and operable.
  - 4. Verify that filters are installed.
  - 5. Inspect and adjust vibration isolators and seismic restraints.
  - 6. Verify bearing lubrication.
  - 7. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  - 8. Adjust fan belts to proper alignment and tension.
  - 9. Start unit according to manufacturer's written instructions.
  - 10. Complete startup sheets and attach copy with Contractor's startup report.
  - 11. Inspect and record performance of interlocks and protective devices; verify sequences.
  - 12. Operate unit for run-in period recommended by manufacturer.
  - 13. Calibrate thermostats.
  - 14. Adjust and inspect high-temperature limits.
  - 15. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
  - 16. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
  - 17. Measure and record airflow. Plot fan volumes on fan curve.
  - 18. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:
    - a. High-limit heat.
    - b. Alarms.
  - 19. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.



- D. Prepare written report of the results of startup services.

**3.6 ADJUSTING**

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

**3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain devices. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 73 39**



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**SECTION 23 77 33****FACTORY FABRICATED DOUBLE WALL ABOVE GROUND FUEL OIL STORAGE TANK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC, FLOOD AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- D. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- E. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- F. Section 23 11 13 – FACILITY FUEL OIL PIPING.

**1.2 SUMMARY**

- A. Furnish and install all factory fabricated cylindrical double-wall steel fuel oil storage tank as specified herein and as indicated on the contract documents.
- B. All systems, equipment and materials shall be approved for use by the New York City Department of Buildings and New York City Fire Department.
- C. Tank shall be single wall steel fabricated in accordance with New York City Building code and New York State Department of Environmental Conservation Standards 6NYCRR Part 613 and 6NYCRR Part 614 for Petroleum Bulk storage latest edition.
- D. Tank shall be UL 142 approved, built to withstand 150 PSI test as per 2014 NYC Mechanical Code, Chapter 13 - Fuel Oil Piping and Storage.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"

- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 REFERENCED STANDARDS

- A. Factory fabricated tank shall be designed, manufactured and tested in accordance with the latest applicable industry standards including, but not limited to the following:
  1. UL 142 A
  2. UL 2244
  3. UL 224t
  4. 6NYCRR Part 614
  5. NFPA-30/31A
  6. AWS D1-1
  7. AWTM A 36-81a
  8. ASTM A635-81
  9. ASTM A-36-81a

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 SUBMITTALS

- A. Include in the submittal the following for each of the supplied components:
  1. Manufacturer’s name and model number
  2. Drawings with complete dimensional data
  3. Materials for construction
  4. Certified factory pressure test results.
  5. Welder Certificates signed by manufacturer certifying that welders comply with requirements specified under another section of this work under “Welding Procedures”
  6. Certification for weld radiographs
  7. Certification, performance guarantee and warranty information.
- B. Provide certified technical product data showing dimensions, weights, are capacities, required clearances, field connection details and methods of support.

**1.8 SEISMIC LOAD DESIGN**

- A. This project is located within a seismic zone requiring special provisions for the support and restraint of equipment, components and piping.
- B. Factory-installed support attachments for storage tank, including but not limited to, internal mounting frames and attachments shall withstand seismic forces defined under another section of this work.
- C. Design seismic restraints for the fuel oil storage tank, tank supports, mounting base, access platforms, structure, vibration isolators, pipe connections and connecting piping supports, including preparing comprehensive engineering analysis (signed and sealed) by a qualified professional engineer, commissioned by the tank manufacturer, using performance requirements and design criteria defined under another section of this work.
- D. Provide manufacturer's Seismic Qualifications Certification that the tank, accessories and components will withstand seismic forces as defined under another section of this work. Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outlined Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchoring provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Prior to shipment, tank shall be hydrostatically tested at the factory at 150 PSI in accordance with 2014 New York City Building code and New York City Fire Department requirements.
- C. Manufacturer's Qualifications: Manufacturer regularly engaged in the manufacture of custom, factory fabricated tank, the capacities required, whose products have been in satisfactory use in similar service for not less than 10 years.
- D. All equipment and material to be furnished and installed on this project shall be listed by Underwriters' Laboratories Inc. (UL) or ETL listed, in accordance with the requirements of the New York City Department of Buildings, and suitable for its intended use on the project.
- E. Supply all equipment and accessories in complete compliance with and in accordance with the applicable standards listed in reference standards of this division and with 2014 New York City Construction Codes.
- F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
  - 1. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- G. Thirty percent (30%) of welds shall be radiographed. by an independent company. Submit certified test results before shipping.

#### 1.10 COORDINATION

- A. In addition to the coordination requirements specified elsewhere in the contract documents, it shall be the responsibility of the Contractor to confirm all dimensions and structural details based on the latest architectural and structural drawings relating to column, beam or wall locations or any other obstructions that must be accommodated as part of the equipment layout and support or to provide proper equipment clearances.
- B. This contractor shall fully coordinate any such changes or deviations from the drawings and specifications with the Commissioner. These changes and deviations may include but are not limited to, structural steel, weight, size, electrical, and controls. Any resulting expense due to deviation or substitutions from this specification or drawings shall be the sole responsibility of the manufacturer providing the equipment. These expenses shall include but not be limited to any additional engineering, architectural, mechanical or structural expenses.
- C. Any resulting expenses due to failure to coordinate or comply with the contract document requirements shall be the sole responsibility of this contractor.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be delivered with factory installed shipping skids or lifting lugs. Items/Components that are shipped loose shall be packed in separate protective packages.
- B. Lift and support storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tank unless empty.
- C. The tank shall be fully wrapped in shrink-wrap during transport.
- D. The tank shall be shipped FOB Destination, such that the manufacturer will pay all shipping expenses and will remain responsible for the equipment until date of substantial completion.
- E. Store tank in safe, clean and away from construction traffic and protected from physical damage.
- F. Rig unit to comply with manufacturer's rigging and installation instructions for unloading package units, and moving them to final location.
- G. Coordinate delivery of units in sufficient time to allow movement into building.

#### 1.12 SCHEDULING AND SEQUENCING

- A. Coordinate installation mounting with floor and vault structure.
- B. Coordinate opening locations for mechanical and electrical connections.

#### 1.13 COORDINATION

- A. Coordinate installation of equipment supports, including locations for mechanical and electrical connections.



**1.14 WARRANTY**

- A. Warranty Period: 10 (ten) years after date of Substantial Completion on all components.
- B. Extended warranty period of 20 years against corrosion of walls (external or internal), fittings and support saddles.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products by one of the following:

- 1. Mass Tank Corporation
- 2. Highland Tank
- 3. Convault Inc.
- 4. General Industries Inc.
- 5. Or approved equal.

**2.2 GENERAL DESCRIPTION**

- A. Provide complete and fully operational, factory fabricated, 4000 Gallon aboveground, UL 142, double wall steel fuel oil storage tank as indicated on the drawings and specified herein, providing full 360-degree double containment.
- B. Tank shall bear the New York City and New York State labels, and also bear Underwriters' Label, which shall include:
  - 1. Certify the tanks conform with 6NYCRR Parts 612, 613 & 614
  - 2. The name of the manufacturer and the year of manufacture
  - 3. The standard of design by which the tank was manufactured
  - 4. The thickness of the tank plates
  - 5. Capacity of the tank
  - 6. Type of petroleum products to be stored, etc.
  - 7. MEA number
- C. Tanks shall be built to Steel Tank Institute (STI) specifications.
- D. A second label showing all the above information as well as the date of installation shall be conspicuously displayed and permanently affixed to the fill box.
- E. Tank shall be factory fabricated and tested prior to shipment, as described above.
- F. Aboveground cylindrical tank shall be built from new carbon steel plates made by the open-hearth process and known as "tank steel". Minimum inner tank thickness ¼" head and shell. Minimum outer tank thickness 10-gauge head and shell. All tanks shall be continuously welded inside and outside with either double- welded butt joints or double- welded full fillet lap joint with a minimum overlap of 1". Welding shall be in accordance with AWS D1-1 to provide a watertight tank that will not warp or deform excessively under load.
- G. The tank shall comply with one of the following classifications:

1. Comply with Specifications for structural Steel ASTM A 36- 81a.
  2. Specification for steel, Carbon (0.15 maximum percent) Hot- rolled
  3. Sheet and Strip, Commercial Quality, Heavy thickness coils (formerly plate) ASTM A635-81.
- H. Fittings to be supplied as shown on the drawings and as per jobsite requirements. All fittings to be located on the top centerline of the tank and shall be 4" NPT unless otherwise noted. Openings on the tank shall be as follows:
1. One (1) Fill line connection
  2. One (1) Vent line connection
  3. One (1) Suction line connection
  4. One (1) Return/ overflow line connection
  5. One (1) Gauge connection, must be 4" NPT for WF Float
  6. Three (3) Spare
  7. One (1) Emergency Vent connection, 8" dia. 150# RF flange.
- I. A square striker plate, 1/8" minimum thickness and 12" square shall be installed at the tank invert under each tank fitting, except vent line connection.
- J. Cylindrical tank to be factory mounted and welded to saddles. Quantity of saddles as required by tank size/ capacity. Saddles to be welded to floor to prevent floating in the event of a flood.
- K. Tank shall be provided with OSHA approved access ladder, platform and handrail on top of tank for access to fittings and connections.
- L. Exterior protective primer coating to be rustproof red oxide. Two coats minimum dry thickness of 3 mils on shell and heads.
- M. Finish coat to be black rustproof enamel. Finish coat to be a minimum dry thickness of 3 mils on shell and heads.

### PART 3 - EXECUTION

- A. Refer to DDC General Conditions for execution requirements.
- B. Install in accordance with manufacturer's instruction.
- C. Provide seismic restraints for the fuel oil storage tank, tank supports, mounting base, access platforms, structure, vibration isolators, pipe connections and connecting piping supports, commissioned by the tank manufacturer, using performance requirements and design criteria defined herein and under another section of this work.
- D. Tank shall be installed in the building cellar (lowest floor level inside the building), in a dedicated room with a 3-hour rated fire resistance construction. Base of tank room (+6'0") shall be sealed to serve as a containment area. Align tank in vault. Level and grout saddles to concrete floor.
- E. Provide all piping connections with approved fittings.
- F. Tank to be hydrostatically tested at 150 PSI in accordance with 2014 New York City Building code and New York City Fire Department requirements.



**3.2 FIELD PERFORMANCE TESTING**

- A. All factory installed piping shall be air pressure leak tested for a minimum of 2 hours, prior to connection to the system piping.
- B. Once each unit is installed, the following field tests shall be run by this contractor under the direct supervision of a manufacturer's representative and the commissioning agent.

**END OF SECTION 23 77 33**



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**SECTION 23 81 23****COMPUTER ROOM AIR-CONDITIONING UNITS (CRAC UNITS)****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 13 – MOTORS FOR HVAC EQUIPMENT.
- D. Section 23 05 14 – VARIABLE FREQUENCY MOTOR DRIVES
- E. Section 23 05 23 – VALVES FOR HVAC
- F. Section 23 05 48 – VIBRATION ISOLATION, SEISMIC AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS.
- G. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- H. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.
- I. Section 23 34 16 – HVAC FANS.
- J. Section 23 41 00 – AIR FILTERS.
- K. Section 23 71 00 – AIR COILS.
- L. This section is a part of each Division 23 00 00 section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Floor-mounted computer-room air handling units
  - 2. Ceiling Mounted computer-room air handling units

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"



- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – “Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 DEFINITION**

- A. BMS: Building Management System.

**1.6 PERFORMANCE REQUIREMENTS**

- A. **Seismic Performance:** Computer-room air conditioners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

**1.7 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

**1.8 SUBMITTALS**

- A. **Product Data:** For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. **Shop Drawings:** For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.
  1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. **Wiring Diagrams:** For power, signal, and control wiring.
- C. **Color Samples:** For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.
- D. **Coordination Drawings:** Plans, elevations, and other details, drawn to scale, using input from Installers of the items involved.
- E. **Seismic Qualification Certificates:** For computer-room air conditioners, accessories, and components, from manufacturer.



1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Warranty: Sample of special warranty.

H. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.

#### 1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set(s) for each belt-driven fan.
2. Filters: One set(s) of filters for each unit.

#### 1.10 QUALITY ASSURANCE

A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

#### 1.11 COORDINATION

A. Coordinate layout and installation of AHU computer-room air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of computer-room air conditioners with computer-room access flooring Installer.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate sizes and locations of equipment supports with actual equipment provided.

**1.12 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 FLOOR-MOUNTED UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Stulz – ATS
  - 2. Liebert Corporation
  - 3. McQuay
  - 4. Compu-Aire
  - 5. Or approved equal.
- B. Description: Packaged, factory assembled, chilled water, prewired, and pre-piped; consisting of cabinet, fans, filters, humidifier, and controls.
- C. Unit Pressure Ratings: As described in section 23 05 00 – “COMMON REQUIREMENTS FOR HVAC WORK,” but not less than 125 psig SWP at 200 deg F.
- D. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.
  - 1. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.
  - 2. Insulation: Thermally and acoustically insulate cabinet interior with 1-inch thick duct liner.
  - 3. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - 4. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color as selected from manufacturer's standard colors.
  - 5. Floor Stand: Welded tubular steel with adjustable legs and vibration isolation pads.
- E. Supply-Air Fan(s):
  - 1. Double-inlet, forward-curved centrifugal fan(s); statically and dynamically balanced.
  - 2. Drive: V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable- and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.
- F. Hydronic Cooling Coil: Seamless copper tubes expanded into copper fins with modulating two-way control valve.
  - 1. Cooling Medium: Chilled Water.
  - 2. Cooling coil is specified under another section of this work.
  - 3. Class 300
- G. Control Valve:





1. Control Valve is specified under another section of this work.
  2. Class 150 body.
  3. Maximum Pressure Drop: 3 psig at design flow rate.
  4. Close-Off (Differential) Pressure Rating: 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- H. Mount cooling coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- I. Filter:
1. MERV 7 (ASHRAE 52.2)
  2. Extended-Surface, Disposable, Panel Filter: Pleated, lofted, nonwoven, reinforced cotton fabric; supported and bonded to welded-wire grid; enclosed in cardboard frame with 2-inch-thick, disposable, glass-fiber pre-filter.
  3. Thickness: 2 inches
  4. Filters are specified under another section of this work.
- J. Mount cooling coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- K. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.
- L. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- M. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.
1. Monitor Panel: Backlighted, with no visible indicator lights until operating function is activated; indicators include cooling, humidification, loss of airflow, change filters, high temperature, low temperature, high humidity, low humidity, high head pressure (each compressor), and low suction pressure (each compressor).
  2. Temperature- and Humidity-Control Modules: Solid state, plug-in; with adjustable set point, push-to-test calibration check button, and built-in visual indicators to show mode of operation.
  3. Location: Behind hinged door in front of unit; isolated from conditioned airstream to allow service while system is operating.
- N. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.
1. Malfunctions:
    - a. Power loss.
    - b. Loss of airflow.
    - c. Clogged air filter.



- d. High room temperature.
  - e. Low room temperature.
  - f. Smoke/fire.
  - g. Water on floor.
  - h. Supply fan overload.
- 2. Digital Display:
  - a. Control power on.
  - b. Dehumidifying.
  - c. Heat operating.
  - d. Economy cooling.
- 3. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.
- 4. BMS Interface: Factory-installed hardware and software to enable the BMS to monitor, control, and display unit status and alarms.
  - a. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

## 2.2 FAN MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Motors for HVAC Equipment".
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and ceilings for suitable conditions where computer-room air conditioners will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.
- B. Computer-Room Air-Conditioner Mounting: Install using restrained spring isolators with seismic restraint. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Isolation, Seismic and Wind Load Restraints for HVAC Components"
  - 1. Minimum Deflection: 1.5 inch.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Section 22 11 16 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- D. Chilled Water Piping, Hot-Water Heating Piping: Comply with applicable requirements in Section 23 21 13 "HVAC Piping." Provide shutoff valves in inlet and outlet piping to heating coils.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. After startup service and performance test, change filters and flush humidifier.



**3.6 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.

**3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain devices. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 81 23**



## **SECTION 23 82 33**

### **HVAC HEATING RADIATORS AND CONVECTORS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. This Section includes the following:
1. Hydronic baseboard radiators.
  2. Hydronic finned-tube radiators.
  3. Hydronic convectors.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

##### **1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.6 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Plans, elevations, sections, and details.
  - 2. Details of custom-fabricated enclosures indicating dimensions.
  - 3. Location and size of each field connection.
  - 4. Location and arrangement of piping valves and specialties.
  - 5. Location and arrangement of integral controls.
  - 6. Enclosure joints, corner pieces, access doors, and other accessories.
  - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members, including wall construction, to which convection units will be attached.
  - 2. Method of attaching convection units to building structure.
  - 3. Penetrations of fire-rated wall and floor assemblies.
- D. Color Samples for Initial Selection: For units with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish required.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## PART 2 - PRODUCTS

### 2.1 HOT-WATER BASEBOARD RADIATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Sterling Inc.
  - 2. Runtal
  - 3. Rittling, a div. of Hydro-Air Components.
  - 4. Or approved equal.



- B. Performance Ratings: Rate baseboard radiators according to Hydronics Institute's "I=B=R Testing and Rating Standard for Baseboard Radiation."
- C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on polypropylene element glides. One end of tube shall be belled.
  - 1. Tube Diameter: NPS 1/2 (DN 15).
  - 2. Fin Size: 3 by 3 inches (76 by 76 mm).
  - 3. Fin Spacing: 40 per foot (131 per meter)
  - 4. Number of Tiers: 1
  - 5. Heat Output: 600 Btu/h/ft.
  - 6. Entering Air Temperature: 65 deg F (18 deg C).
  - 7. Average Water Temperature: 130 deg F (82 deg C).
  - 8. Minimum Water Velocity: 1/2 fps.
- D. Enclosures: Minimum 0.0428-inch thick steel, removable front cover.
- E. Rust-Resistant Enclosures: Minimum 0.052-inch- thick ASTM A 653/A 653M, G60 galvanized-steel, removable front cover.
  - 1. Full-height back.
  - 2. Full-length damper.
  - 3. End panel.
  - 4. End caps.
  - 5. Inside and outside corners.
  - 6. Valve access door.
  - 7. Joiner pieces to snap together.  
Finish: Baked-enamel finish in manufacturer's standard color as selected by Commissioner.
  - 8. Element Brackets: Primed and painted steel to support front panel and element.

## 2.2 HOT-WATER CONVECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Sterling.
  - 2. Vulcan.
  - 3. Indecco.
  - 4. Or approved equal.
- B. Convector Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into brass headers with inlet/outlet and air vent; steel side plates and supports. Factory-pressure-test element at minimum 100 psig (690 kPa).
  - 1. Element Height: 24"
  - 2. Element Depth: 10"
  - 3. Element Length: 60"
  - 4. Entering Air Temperature: 65 deg F (18 deg C).
  - 5. Heat Output: see schedules
  - 6. Average Water Temperature: 130 deg F (82 deg C)
  - 7. Temperature Drop: 20 deg F (11.1 deg C)
  - 8. Pressure Loss: See schedules on drawings.
  - 9. Heat Output (Square Feet EDR): See schedules on drawings.



- C. Floor-Mounting Pedestals: Conceal conduit for power and control wiring at maximum 36-inch (914-mm) spacing. Pedestal-mounting back panel shall be solid panel matching front panel.
- D. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.
- E. Insulation: 1/2-inch- (13-mm-) thick, fibrous glass on inside of the back of the enclosure.
- F. Finish: Baked-enamel finish in manufacturer's standard color as selected by Commissioner.
- G. Damper: Knob-operated internal damper.
- H. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.
- I. Enclosure Style: Flat top.
  - 1. Front Inlet Grille: Punched louver; painted to match enclosure.
  - 2. Front Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
    - a. Mill-finish aluminum.
    - b. Anodized finish, color as selected by Commissioner from manufacturer's standard colors.
    - c. Painted to match enclosure.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 BASEBOARD RADIATOR INSTALLATION

- A. Install units level and plumb.
- B. Install baseboard radiators according to Guide 2000 - Residential Hydronic Heating.
- C. Install enclosure continuously around corners, using outside and inside corner fittings.
- D. Join sections with splice plates and filler pieces to provide continuous enclosure.
- E. Install access doors for access to valves.
- F. Install enclosure continuously from wall to wall.
- G. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.



- H. Install valves within reach of access door provided in enclosure.
- I. Install air-seal gasket between wall and recessing flanges or front cover of fully recessed unit.
- J. Install piping within pedestals for freestanding units.

### 3.4 FINNED-TUBE RADIATOR INSTALLATION

- A. Install units level and plumb.
- B. Install finned-tube radiators according to Guide 2000 - Residential Hydronic Heating.
- C. Install enclosure continuously around corners, using outside and inside corner fittings.
- D. Join sections with splice plates and filler pieces to provide continuous enclosure.
- E. Install access doors for access to valves.
- F. Install enclosure continuously from wall to wall.
- G. Terminate enclosures with manufacturer's end caps, except where enclosures are indicated to extend to adjoining walls.
- H. Install valves within reach of access door provided in enclosure.
- I. Install air-seal gasket between wall and recessing flanges or front cover of fully recessed unit.
- J. Install piping within pedestals for freestanding units.

### 3.5 CONVECTOR INSTALLATION

- A. Install units level and plumb.
- B. Install valves within reach of access door provided in enclosure.
- C. Install air-seal gasketing between wall and recessing flanges or front cover of fully recessed unit.
- D. Install piping within pedestals for freestanding units.

### 3.6 CONNECTIONS

- A. Piping installation requirements are specified in Section 23 21 13 - "HVAC Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water units and components to piping according to Section 23 21 13 - "HVAC Piping".
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
  - 2. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.
- C. Install control valves as required by Section 23 09 00 – "HVAC Instrumentation and Controls".



- D. Install piping adjacent to convection heating units to allow service and maintenance. Ground electric convection heating units according to Section 26 05 26 – “Grounding and Bonding for Electrical Systems”
- E. Connect wiring according to Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables."

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper convection heating unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

**END OF SECTION 23 82 33**

**SECTION 23 82 39****UNIT HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 "Construction Waste Management and Disposal"
  2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.4 SUMMARY**

- A. Section Includes:
1. Cabinet unit heaters with centrifugal fans and hot-water coils.
  2. Propeller unit heaters with hot-water coils.

**1.5 DEFINITIONS**

- A. BAS: Building automation system.



- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Plans, elevations, sections, and details.
  - 2. Location and size of each field connection.
  - 3. Details of anchorages and attachments to structure and to supported equipment.
  - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Location and arrangement of piping valves and specialties.
  - 6. Location and arrangement of integral controls.
  - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which unit heaters will be attached.
  - 3. Method of attaching hangers to building structure.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
  - 6. Perimeter moldings for exposed or partially exposed cabinets.
- D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
- E. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
- F. Manufacturer Seismic Qualification Certification: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:



1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## 1.9 MANUFACTURER'S WARRANTY

- A. Provide full manufacturer's warranty for unit heaters, for all components that fail in materials or workmanship, for a period of three (3) years from the date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CABINET UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Airtherm; a Mestek Company.
  2. Trane.
  3. Indeeco.
  4. International Environmental Corporation.
  5. Or approved equal.
- B. Description: A factory-assembled and -tested unit complying with ARI 440.
  1. Comply with UL 2021.



- C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.
1. Thickness: 1/2 inch (13 mm).
  2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F (0.037 W/m x K at 24 deg C) mean temperature.
  3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Coil Section Insulation: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
1. Thickness: 3/8 inch (9 mm).
  2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F (0.034 W/m x K at 24 deg C) mean temperature.
  3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
  4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- E. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Commissioner.
1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- (1.35-mm thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
  2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- (1.35-mm) thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
  3. Recessing Flanges: Steel, finished to match cabinet.
  4. Control Access Door: Key operated.
  5. Base: Minimum 0.0528-inch- (1.35-mm-) thick steel, finished to match cabinet, 4 inches (100 mm) high with leveling bolts.
  6. Extended Piping Compartment: 8-inch- (200-mm-) wide piping end pocket.
  7. False Back: Minimum 0.0428-inch- (1.1-mm-) thick steel, finished to match cabinet.
- F. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated: 90 percent arrestance and 7 MERV.
- G. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
- H. Fan and Motor Board: Removable.



1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
  2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- I. Factory, Hot-Water Piping Package: ASTM B 88, Type L (ASTM B 88M, Type B) copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet and outlet.
1. Two-way, modulating control valve. Three-way valve packages shall include bypass line with manually adjustable balance device.
  2. Hose Kits: Minimum 400-psig (2758-kPa) working pressure, and operating temperatures from 33 to 211 deg F (0.5 to 99 deg C). Tag hose kits to equipment designations.
    - a. Length: 24 inches (600 mm)
    - b. Minimum Diameter: Equal to cabinet unit heater connection size.
  3. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
  4. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
  5. Automatic Flow-Control Valve: Brass or ferrous-metal body, 300-psig (2068-kPa) working pressure at 250 deg F (121 deg C), with removable, corrosion-resistant, tamperproof, self-cleaning, piston-spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig (13.8 to 552 kPa).
  6. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) threaded pipe and full-port ball valve in strainer drain connection.
  7. Wrought-Copper Unions: ASME B16.22.
- J. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- K. Basic Unit Controls:
1. Control voltage transformer.
  2. Wall-mounting thermostat with the following features.
    - a. Heat-off switch.
    - b. Fan on-auto switch.
    - c. Manual fan speed switch.
    - d. Adjustable deadband.
    - e. Concealed set point.
    - f. Concealed indication.
    - g. Deg F indication.
  3. Unoccupied period override push button.
  4. Data entry and access port.



- a. Input data includes room temperature, and occupied and unoccupied periods.
- b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

**L. DDC Terminal Controller:**

- 1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
- 2. Unoccupied Period Override: Two < hours.
- 3. Unit Supply-Air Fan Operations:
  - a. Occupied Periods: Fan runs continuously.
  - b. Unoccupied Periods: Fan cycles to maintain setback room temperature.
- 4. Heating Coil Operations:
  - a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
  - b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.
- 5. Outdoor-Air Damper Operation:
  - a. Occupied Periods: Open dampers. Delay damper opening if room temperature is more than three degrees below set point.
  - b. Unoccupied Periods: Close damper.
- 6. Controller shall have volatile-memory backup.

**M. BAS Interface Requirements:**

- 1. Interface relay for scheduled operation.
- 2. Interface relay to provide indication of fault at central workstation.
- 3. Interface shall be BAC-net compatible for central BAS workstation and include the following functions:
  - a. Adjust set points.
  - b. Cabinet unit heater start, stop, and operating status.
  - c. Data inquiry, including supply-air and room-air temperature.
  - d. Occupied and unoccupied schedules.

**N. Electrical Connection: Factory wire motors and controls for a single field connection.**

**O. Capacities and Characteristics:**

- 1. Cabinet:
  - a. Vertical, Surface Mounted: Upflow.
    - 1) Top: Flat.
    - 2) Air Inlet: Open bottom
    - 3) Air Outlet: Front





## 2.2 PROPELLER UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airtherm; a Mestek Company.
  2. Engineered Air Ltd.
  3. McQuay International.
  4. Rosemex Products.
  5. Trane.
  6. Or approved equal.
- B. Description: An assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Comply with UL 823.
- E. Cabinet: Removable panels for maintenance access to controls.
- F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- H. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- I. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.
- J. Hot-Water Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 325 deg F (163 deg C), with manual air vent. Test for leaks to 350 psig (2413 kPa) underwater.
- K. Hot-Water Coil: Cupronickel tube, minimum 0.031-inch (0.78-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 400 psig (2760 kPa) and a maximum entering-water temperature of 450 deg F (232 deg C), with manual air vent. Test for leaks to 600 psig (4137 kPa) underwater.
- L. Hot-Water Coil: Red brass tube, minimum 0.049-inch (1.24-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 260 psig (1793 kPa) and a maximum entering-water temperature of 390 deg F (199 deg C), with manual air vent. Test for leaks to 390 psig (2689 kPa) underwater.
- M. Hot-Water Coil: Steel tube, minimum 0.049-inch (1.24-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum



working pressure of 400 psig (2760 kPa) and a maximum entering-water temperature of 450 deg F (232 deg C), with manual air vent. Test for leaks to 600 psig (4137 kPa) underwater.

- N. Hot-Water Coil: Vertical steel tube, minimum 0.065-inch (1.65-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 400 psig (2760 kPa) and a maximum entering-water temperature of 450 deg F (232 deg C), with steel headers at top and bottom. Test for leaks to 600 psig (4137 kPa) underwater.
- O. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- P. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Type: Permanently lubricated, variable speed.
- Q. Control Devices:
  - 1. Unit-mounted fan-speed switch.
  - 2. Wall-mounting thermostat.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07 92 00 "Joint Sealants".
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hanger and seismic restraints. Vibration isolators and seismic restraints are specified in Section 23 05 48 Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Vibration hangers are specified in 23 05 48 Vibration Isolation, Seismic, Flood and Wind Load Restraints for HVAC Components.
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

- G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 23 21 13 - "HVAC Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 23 31 13 – "Metal Ducts".
- E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Section 23 21 13 - "HVAC Piping".
- F. Ground equipment according to Section 26 05 26 – "Grounding and Bonding for Electrical Systems".
- G. Connect wiring according to Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

### 3.5 ADJUSTING

- A. Adjust initial temperature set points in coordination with Commissioner.

### 3.6 DEMONSTRATION

- A. Engage a service representative that is properly trained by the manufacturer to instruct the City of New York's service operators to adjust, operate, and service cabinet unit heaters. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 23 82 39**



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**SECTION 23 82 50****MISCELLANEOUS MECHANICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 23 05 00 – COMMON REQUIREMENTS FOR HVAC WORK.
- C. Section 23 05 23 – VALVES FOR HVAC.
- D. Section 23 21 13 – HVAC PIPING.
- E. Section 23 05 93 – TESTING, ADJUSTING AND BALANCING.
- F. Section 23 09 00 – HVAC INSTRUMENTATION AND CONTROLS.

**1.2 SUMMARY**

- A. Section includes:
  - 1. Expansion Tanks
  - 2. Air Separators
  - 3. Buffer Tanks
  - 4. Miscellaneous Mechanical Systems.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints, and Coatings for LEED Buildings", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

**1.5 SUBMITTALS**

- A. Product data – for each product type specified, describing all dimensions and compliance with all requirements.
- B. Shop drawings – indicating piping plans, wiring diagrams.
- C. Product warranty – for all buffer and expansion tanks.
- D. Operation and maintenance data – for all buffer and expansion tanks.

**1.6 REFERENCE STANDARDS**

- A. ASHRAE 55
- B. ASTM – 653
- C. ASTM-B209
- D. ASTM-C1071-05
- E. ASTM- E84 25/50
- F. UL 94 V-0
- G. UL 2043
- H. UL 181
- I. AHRI 410

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”
- B. Drawings indicating size, profiles, and dimensional requirements.
- C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York City Department of Buildings, and marked for intended use.

**1.8 COORDINATION**

- A. Coordinate layout and installation of chilled beams and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, lab utility panels, HVAC equipment, fire-suppression system, and partition assemblies.



**1.9 MANUFACTURER'S WARRANTY**

- A. Buffer tanks shall have a 5-year warranty starting from date of Substantial Completion, covering manufacturing or material defects and/or leaks.
- B. Expansion tanks shall have a 7-year warranty starting from date of Substantial Completion, covering manufacturing or material defects and/or leaks.

**PART 2 - PRODUCTS**

**2.1 EXPANSION TANKS/ AIR SEPARATORS MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Taco, Inc.
- 2. ITT Bell & Gossett
- 3. Amtrol
- 4. Trox
- 5. Or approved equal.

- B. GENERAL

- 1. Tank Construction: Closed, welded steel, tested and stamped in accordance with Section VIII, Division 1, of ANSI/ASME Boiler and Pressure Vessel Code.
- 2. Supplied with rating from National Board Form U-1, rated for working pressure of 150 psi, with flexible heavy duty butyl rubber bladder. Bladder shall be able to accept the full volume of the expansion tank and shall be removable and replaceable.
- 3. Clean, prime coat, and supply with steel support saddles. Supply with renewable heavy duty butyl rubber bladder. Construct tank with tappings for installation of accessories.
- 4. Provide with quick connect air charging valve connection (standard tire valve) tank drain.
- 5. Provide automatic cold water fill assembly complete with pressure relief valve, pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker and valved bypass.
- 6. Set expansion tank pressure relief valve and pressure reducing valve at pressures indicated on Drawings.
- 7. Tank dimensions are as scheduled on Drawings.

- C. STRAINERS

- 1. There shall be approved strainers in the inlet connections to each bucket or combination float and thermostatic steam trap, each water feeder and make-up connection, each water regulating valve, each pump, each vent and each valve. The intention is to protect, by strainers, all apparatus of an automatic or manual character whose proper functioning would be interfered with by dirt on the seat, or by scoring of the seat.
- 2. All strainers in waterlines (including all pump inlets) and in steam lines shall be Y-pattern, set in a horizontal (or vertical downward) run of pipe. Where this is not feasible, strainers may be of the enlarged cross-section type. Strainers shall be arranged so as not to "trap" pipes and to facilitate disconnection and opening up for cleaning. Unless otherwise indicated, strainers shall be line size.
- 3. Provide approved valved and capped dirt blow off connection for each strainer.
- 4. All strainers shall be provided with flanged covers for screen removal in lieu of screwed covers for screen removal wherever obtainable.
- 5. All strainer screens 6" and above shall be reinforced for the operating conditions.
- 6. Y-Pattern Strainers:



- a. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
  - b. End Connections: Threaded ends for strainers 2" and smaller; flanged ends for strainers 2-1/2" and larger.
  - c. Strainer Screen: Stainless-steel mesh strainer, and stainless steel basket - perforated (1/32" for steam and condensate and for water: 1/16" for sizes up to 3" and 1/8" for sizes above 4")
  - d. Tapped blowoff plug.
  - e. CWP Rating: 300-psig working steam pressure.
7. Basket Strainers:
- a. Body: ASTM A 126, Class B high-tensile cast iron, with bolted cover and bottom drain connection.
  - b. End Connections: Threaded ends for strainers 2" and smaller; flanged ends for strainers 2-1/2" and larger.
  - c. Strainer Screen: Stainless steel, mesh strainer, and perforated (1/32" for steam and condensate and for water: 1/16" for sizes up to 3" and 1/8" for sizes above 4") stainless-steel basket.
8. CWP Rating: 300-psig working steam pressure

**D. AIR CONTROL DEVICES**

1. Expansion Tanks:
- a. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - b. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
  - c. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
  - d. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch diameter gage glass, and slotted-metal glass guard.
2. Diaphragm-Type Expansion Tanks:
- a. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - b. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
  - c. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.





## 2.2 SEPARATORS

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
  - 1. Bruner
  - 2. Culligan
  - 3. Cuno
  - 4. Dollinger
  - 5. Honeywell
  - 6. Or approved equal.
- B. Maximum Working Pressure: As specified in Section – 23 05 00 – “Common Requirements for HVAC Work”.
- C. Maximum Operating Temperature: Up to 300 deg F.
- D. Tangential-Type Air Separators:
  - 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. Bell & Gossett Type RL
    - b. Armstrong
    - c. Amtrol
    - d. Taco
    - e. Or approved equal.
  - 2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
  - 3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
  - 4. Tangential Inlet and Outlet Connections: Threaded for 2” and smaller; flanged connections for 2-1/2” and larger.
  - 5. Blowdown Connection: Threaded.
  - 6. Size: Match system flow capacity.
- E. In-Line Air Separators:
  - 1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
  - 2. Cartridge type impingement filter, with replaceable 100 micron or 300 micron filter media. Size and capacity shall be as indicated on drawings.

## 2.3 BUFFER TANKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Lochinvar,
  - 2. Niles,
  - 3. John Wood,
  - 4. Or approved equal.
- B. Buffer tank Summary and Configuration:



1. Furnish and install as shown on plans, an A.S.M.E. compliant Buffer Tank. The tank must be and MAWP stamped for pressure rating 250 psi @ -20F to 450F in accordance with section VIII, Division I of the A.S.M.E. Boiler and Pressure Vessel code and registered with the National Board of boiler and pressure vessel inspections.
2. The buffer tank shall be painted with 1 coat of red oxide shop primer paint.
3. A manufacturers data report for pressure vessels, Form U-1A as required by the provisions of the A.S.M.E. Boiler and Pressure Vessel code shall be furnished for each buffer tank.
4. Tanks shall be either vertical and horizontal, as indicated on drawings. Tanks shall be equipped with an internal central baffle and with flanged connections at the top and bottom. Horizontal tanks are not required to have internal baffles.
5. Grooved pipe end fittings are not acceptable, provide flanged connections.

C. Buffer tank Construction:

1. Buffer Tank Construction: Closed, welded steel, tested and stamped in accordance with Section VIII, Division 1, of ANSI/ASME Boiler and Pressure Vessel Code.
2. Provide buffer tank with center baffle plate with inlet and outlet on upper shell, With FNPT port at top of tank for air vent; and FNPT drain port at bottom of the tank.
3. Provide manway on top of tank on all closed loop systems.
4. Inlet connection shall be located at the top of the side wall.
5. Grooved end piping systems (including piping, couplings, fittings, valves and accessories) is not acceptable
6. Type "M" copper tubing is not permitted.

D. Buffer tank options, details, and accessories:

1. Shell: Carbon Steel with exterior gray primer finish
2. Center baffle plate: Carbon Steel
3. Inlet/outlet connections: Flanged
4. Vent and drain connections: 1" FNPT
5. Standard angle legs provide 16" clearance from the bottom of the head to the floor
6. Provide 12" x 16" manhole inspection opening.
7. Tank shall be insulated with 2-part, 2" closed cell high-density foam insulation with vapor barrier to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. Insulation shall be suitable for outdoor applications.
8. Factory applied protective white semi-gloss finish for use over insulation — suitable for indoor and outdoor applications.
9. Unless specified otherwise, all steel piping shall be Type ASTM-A-53-Grade B seamless or ERW. Furnace butt weld pipe is not acceptable.
10. Grooved end piping systems (including piping, couplings, fittings, valves and accessories) is not acceptable.

## 2.4 BAKED PHENOLIC COATINGS

- A. All equipment as indicated hereinafter shall receive three (3) base coats of Heresite P-403 or an equivalent product by Metcoat, Delta Coatings, or approved equal, general purpose coating and applied over with two (2) additional coats of Heresite L-66 403 or approved equal baked industrial coating providing a hard and glossy surface (minimum thickness of 5 mils) having anti-stick qualities and ease of cleaning properties.
- B. The finish coating shall have a temperature resistance of up to 450% F and a dielectric strength of 300 volts per mil of thickness.
- C. All coatings shall be applied in accordance with manufacturer's recommendations.



## 2.5 EPOXY PHENOLIC COATED STEEL SHEET

- A. Base material to be black steel sheet with continuous welded seams and free of pits and undercutting. Duct joints to be flanged. Sand blast to white metal finished and apply first coat within 24 hours.
- B. Apply epoxy phenolic cold set coating to minimum 7 mils dry film thickness (DFT).

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas to receive chilled beams for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hot- and chilled-water piping to verify actual locations of piping connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Maintain sufficient clearance for normal services, maintenance, or in accordance with construction drawings and manufacturers recommendations.
- B. Coordinate layout and installation of chilled beams and suspension-system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communications system, security system, and partition assemblies.
- C. Seismic Restraints: Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration Isolation, Seismic, Flood and Wind Load Restraints For HVAC Components".
- D. Comply with requirements for general-duty valves specified in Section 23 05 23 "Valves for HVAC Piping".
- E. Install continuous-thread hanger rods of size required to support chilled-beam weight.
- F. Comply with NECA 1.
- G. Piping installation requirements are specified in other Division 23 Sections. Drawings indicated general arrangement of piping, fittings, and specialties.
- H. Install piping adjacent to active or passive beams to allow service and maintenance.
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

- J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening.
- K. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- L. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

#### 3.4 CONNECTIONS

- A. Comply with requirements for piping as specified under section 232113 of this work. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. This scope of work shall include the complete coordination of the piping and connections.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.5 IDENTIFICATION

- A. Identify electrical-system components, wiring, cabling, and terminals. Comply with requirements for identification as specified under section 230553.
- B. Identify hydronic piping and valves. Comply with requirements as specified under section 230523.

#### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test. Inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Prepare test and inspection reports.

#### 3.7 CLEANING AND PROTECTION

- A. Clean all visible surfaces of equipment; touch up as required.
- B. Protect all units before, during and after installation. Damage materials due to improper protection shall be cause for rejection.

**END OF SECTION 23 82 50**

## **SECTION 26 05 00**

### **COMMON REQUIREMENTS FOR ELECTRICAL WORK**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. This Section includes general requirements for electrical installations. These requirements are applicable to all Division 26 work. The following requirements are included in this Section to expand the requirements specified in DDC General Conditions:
  - 1. Submittals.
  - 2. Coordination drawings.
  - 3. Record documents.
  - 4. Maintenance manuals.
  - 5. Rough-ins.
  - 6. Electrical installations.
  - 7. Cutting and patching.
  - 8. Codes, Permits and Inspections.
  - 9. Definitions and Interpretations.

- B. This section is part of each Division 26 00 00 Section.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

1.7 SUBMITTALS

- A. Additional copies may be required by individual sections of these Specifications.
- B. Prior to assembling or installing the work, the following shall be submitted for review:
  - 1. Scale drawings indicating insert and sleeve locations

1.8 COORDINATION DRAWINGS

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination drawing requirements.
  - 1. Indicate the proposed locations of major raceway systems, equipment, and materials on coordination and record drawings. Include the following:
    - a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
    - b. Exterior wall and foundation penetrations.
    - c. Fire-rated wall and floor penetrations.
    - d. Equipment connections and support details.
    - e. Sizes and location of required concrete pads and bases.
  - 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
  - 3. Prepare floor plans, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.9 RECORD DRAWINGSS

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for record drawing requirements.
  - 1. A complete set of "as-built" or record electric drawings shall be made up and delivered to the Commissioner.
  - 2. The drawings shall show:
    - a. All electric work installed exactly in accordance with the original design.
    - b. All electric work installed as a modification or addition to the original design.



- c. The dimensional information necessary to delineate the exact location of all circuitry and wiring runs (other than lighting and appliance branch circuitry and small control, signal and communications runs) which are so buried or concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.
- d. The numbering information necessary to correlate all electrical energy consuming items (or outlets for same) to the panel or switchboard circuits from which they are supplied.

#### 1.10 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with DDC General Conditions. In addition to the requirements specified in DDC General Conditions, include the following information for major equipment items such as engine generator set(s), UPS equipment, alarm system(s), communications systems, switchboards, Panelboards, automatic transfer switches, lighting fixtures, and other items as specified elsewhere.
  - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, restore, and reassembly; aligning and adjusting instructions.
  - 4. Servicing instructions.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

#### 1.12 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the latest requirements of the NYC Building Code 2014 and NYC Electrical Code 2014.
- B. All work shall meet or exceed the latest requirements of the NYC Department of Buildings. These include, but are not limited to the following:
  - 1. 2014 New York City Construction Codes
  - 2. NFPA National Fire Codes
- C. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.
- D. Any portion of the work which is not subject to the requirements of the NYCEC shall be governed by the National Electrical Code and other applicable sections of the National Fire Code, as published by the National Fire Protection Association.
- E. Equipment, material, layout and installation provided as part of the electrical work shall conform to the applicable requirements of:
  - 1. The Advisory Board of the Bureau of Electrical Control (Department of Buildings),



2. The Mechanical Equipment Acceptance Division of the Building Department (MEA),
3. The Board of Standards and Appeals (BSA),
4. Fire Department of New York (FDNY).
5. Include as part of the electrical work all required filings and submissions for approval.
6. Equipment furnished separate from - but installed as part of - the electrical work, which does not have all necessary approvals, shall not be installed until approvals are obtained by the parties furnishing the equipment.
7. Controlled and special inspection(s) for certain portions of the work as called for in the New York City Building Code 2014, Section C27-132 and Section C27-136 and the filing of all necessary reports for approval, Form TR-1 and TR-8, with the Building Department shall be included as part of the electric work. The name of the registered Professional Commissioner licensed in the State of New York who will be responsible for making the inspections on Form TR-1 and TR-8 shall be submitted for approval as soon as possible but not more than 90 days of the award of the contract.

- F. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

#### 1.13 DEFINITIONS

- A. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the electrical work, shall be understood to have the specific meanings ascribed to them in the following list:
- B. "Circuitry" -- Any electric work (not limited to light and power distribution) which consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.
- C. "Wiring" -- Same as Circuitry.
- D. "Circuit" -- Any specific run of circuitry.
- E. "Branch Circuit" -- Any light and power distribution system circuit which, at its load end, is directly connected to one or more electrical energy consuming items with no overcurrent protection devices interposed, other than (where required) those protecting the energy consuming items from overloading or overheating.
- F. "Appliance Panel" -- Any panel, used in a light and power distribution system, containing single pole and/or multipole branches rated in various sizes.
- G. "Lighting Panel" -- Any panel used in a light and power distribution system, having all (or the majority) of its branches single pole and rated the same.
- H. "Lighting and Appliance Branch Circuitry" -- All or any portion of branch circuits outgoing from a lighting or appliance panel or panelette.
- I. "Feeder" -- Any item of light and power circuitry used in a distribution system which is not lighting and appliance branch circuitry.
- J. "Main Feeder" -- Any feeder which, at its supply end, is connected through its own overcurrent protection (and switching) device, and none other, directly to a main service or a main service overcurrent protection (and switching) device.



- K. "Branch Feeder" -- A feeder, other than a main feeder, which complies with the definition of a branch circuit.
- L. "Submain Feeder" -- Any feeder which is neither a main feeder nor a branch feeder.
- M. "Distribution Panel" -- Any panel, used in a light and power distribution system, containing only multi-pole branches and with all (or the majority) of its branches used for feeders supplying other panels. "Power Panel" -- Same as distribution panel, except with all (or the majority) of its branches used for feeders which do not supply other panels.
- N. "Motor Power Circuit" -- Any circuit which operates nominally at 100 volts or more, and which carries electrical input energy to a motor.
- O. "Motor Control Circuit" (used in conjunction with a motor for which a magnetic starter is supplied) -- Any circuit (other than a motor power circuit), which operates nominally at 100 volts or more, and which carries current intended for directing or indicating the performance of a motor starter. "Motor Control Circuit" (used in conjunction with a motor for which a manual starter is supplied) -- Any circuit containing an extension of power circuit wires, other than those constituting the direct connection between source of supply, starter and motor.
- P. "Motor Control Actuating Device" -- Any device which performs a switching function in a motor control circuit (pushbuttons, automatic contacting devices, etc.).
- Q. "Motor Control Actuated Device" -- Any device which functions in response to voltage received from a motor control circuit (pilot lights, solenoids, etc.)
- R. "Package Unit" -- An item of equipment having one or more motors or other electric energy consuming elements integrally factory mounted on a single base, complete with all associated control devices and interconnecting wiring.
- S. "Low Voltage" -- Below 50 volts.
- T. "Process Control System" -- An overall control and/or logging system of a low voltage, electronic or pneumatic type available as a fully installed "package" from specialty manufacturers (commonly referred to as a "Temperature Control System" or an "Automatic Control System" or a "Building Management System" where used in conjunction with air conditioning).
- U. "Grade Slab" -- A building floor slab which is in contact with or directly over grade (earth). "Building Confines" -- The extent of a building, as defined by the outside surfaces of its peripheral walls, the top surface of its roof, and the underside surface of its grade slab.
- V. "Distribution Switch" -- Any switch used in a light and power system other than a tumbler, toggle or specialty switch in the "wiring device" category.
- W. "Normal Electric Work Conditions" -- Locations within building confines which are neither damp, wet nor hazardous and which are not used for air handling.
- X. "Underground" -- Subsurface and exterior to building foundations.
- Y. "At Underside of Grade Slab" -- Under a grade slab and integrated into it.
- Z. "Below Grade Slab" -- Under a grade slab but not integrated into it.



- AA. "Standard" (as applied to wiring devices) -- Not of a separately designated individual type. "Raceway" -- Any pipe, duct, extended enclosure, or conduit (as specified for a particular system) which is used to contain wires, and which is of such nature as to require that the wires be installed by a "pulling in" procedure.
- BB. "Concealed" (as applied to circuitry) -- Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.
- CC. "Exposed" (as applied to circuitry) -- Not covered in any way by building materials.
- DD. "Subject to Mechanical Damage" -- Exposed within seven feet of the floor in mechanical rooms, manufacturing spaces, vehicular spaces, or other spaces where heavy items (over 100 pounds) are moved around or rigged as a common practice or as required for replacement purposes.
- EE. "Secondary" (as applied to light and power distribution) -- Under 600 volts.
- FF. "Assembly" -- A defined set of elements of electric work.
- GG. Where the word "conduit" is used without specific reference to type, it shall be understood to mean "raceway."
- HH. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the drawings and specifications for electrical work carries with it the instruction to furnish, install and connect the item as part of the electrical work regardless of whether or not this instruction is explicitly stated.
- II. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- JJ. No exclusion from or limitation in, the symbolism used on the drawings for electrical work or the language used in the specifications for electrical work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.
- KK. The drawings for electrical work utilize symbols and schematic diagrams which have no dimensional significance. The work shall, therefore, be installed to fulfill the diagrammatic intent expressed on the electrical drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades. In particular, information as to the exact size, location and electrical connection points for mechanical equipment shall be derived by reference to HVAC and Plumbing documents.
- LL. Certain details appear on the drawings for electrical work which are specific with regard to the dimensioning and positioning of the work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated work.
- MM. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.
- NN. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.



- OO. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

#### 1.14 INTERPRETATION OF THE DRAWINGS AND SPECIFICATIONS

- A. The drawings show the general layout of the various items of equipment. However, the drawings, in general, are diagrammatic and indicate sizes, general locations and equipment connections and do not necessarily indicate every required fitting, support or similar items required for a complete installation. Provide all necessary offsets, fittings, hangers, supports, valves, drains as required for a complete and fully operational mechanical system.
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. The contractor shall follow the drawings in laying out the work and check drawings of all trades to verify spaces in which work will be installed. Maintain maximum headroom and where space conditions appear inadequate, the Commissioner shall be notified before proceeding with the installation.
- D. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- E. No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.
- F. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- H. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans and are diagrammatic only, but with the intention that such details shall be incorporated in full.
- I. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- J. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

#### 1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Deliver, store and handle all materials to keep clean and protected from damage.



- C. Equipment shall be shipped with all listed items and control wiring factory installed unless specified otherwise herein and specifically noted on the submittals as a substitution.
- D. Ship materials and equipment in crated sections of sizes to permit passing through available spaces, where required. Store products in shipping containers and maintain in place until installation.
- E. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- F. The Vendor shall shrink-wrap all electronic equipment and spare parts prior to shipping.
- G. Store products in shipping containers and maintain in place until installation.
- H. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of floor.
- I. Protect flanges, fittings, and piping specialties from moisture and dirt.
- J. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.
- K. Protect equipment and other materials from damage after installed from construction debris and other damage.
- L. The Contractor shall check all materials and equipment upon their arrival on the Project Site and verify their condition and compliance with the Contract documents.

#### 1.16 PROTECTION AND CLEANING

- A. The inlet and discharge opening of all terminal units as well as all duct and pipe openings (end pieces) shall be kept capped until all local plastering, parging, etc. is completed, and the units are ready to run.
- B. Equipment and material if left in the open and damaged shall be replaced, repainted, or otherwise refurbished at the discretion of the Commissioner. Equipment and material is subject to rejection and replacement if in the opinion of the Commissioner, or in the opinion of the manufacturer's engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use is questionable, or that its normal life expectancy has been curtailed.
- C. During the erection, protect all ductwork, duct lining, insulation, piping, and equipment from damage and dirt. Cap the openings of all ductwork and piping installed. After completion of project, clean the exterior and interior surface of all equipment.

#### 1.17 FIRE AND SMOKE DETECTION

- A. The ductwork and sheet metal work in this project provide suitable openings (as recommended the Smoke Detection System Manufacturer) in sheet metal for sensing elements of the building's specified fire and smoke detection systems. See Section 28 31 11 "Fire Alarm and Integrated Audio/Visual Evacuation System.
- B. Provide access doors to make all such detection heads accessible. See Section 08 31 13 "Access Doors and Frames" for access door requirements.

- C. Provide bracing for smoke detections sampling tubes which exceed 48" in length.

#### 1.18 ACCESS PANELS

- A. See Section 08 31 13 "Access Doors and Frames" for access door requirements.
- B. Locate access panels to access valves, traps, control valves or devices, dampers, damper motors, etc. Access panels shall be sized as necessary for ample access, or as indicated on drawings, but no smaller than 18" x 18" where devices are within easy reach of operator, and at least 24"x24" when operator must pass through opening in order to reach the devices.
- C. Access panels in fire rated walls or ceilings must be U.L. labeled for intended use.

#### 1.19 GUARANTEES AND CERTIFICATIONS

- A. All work shall be guaranteed to be free from leaks or defects. Any defective materials or workmanship as well as damage to the work of all trades resulting from same shall be replaced or restored as directed for the duration of stipulated guaranteed periods.
- B. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use. For example, in the case of refrigeration systems, it means that the plant has a cooling load. Similarly, for all other systems.
- C. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.
- D. Non-durable replaceable items such as air filter media do not require replacement after the date of acceptance. If received in writing, requests to have earlier acceptance dates established for these items will be honored.
- E. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of heating and air conditioning equipment.

#### 1.20 SEISMIC AND WIND RESTRAINTS DESIGN

- A. It shall be understood that the requirements of this seismic section are complementary to requirements delineated elsewhere for the support and fastening of equipment and, piping work nothing on the drawings or specifications shall be interpreted as a reason to waive the requirements of this seismic section.
- B. This project requires special provisions for the support and restraint of equipment, piping, ductwork, etc., in the event of earthquake or wind condition so as to comply with the latest edition of the NYCBC 2014.
- C. Contractor shall provide all required design services, labor, materials, tools and equipment necessary for a complete seismic and wind restraint system for all isolated and non-isolated equipment as indicated in these documents or which may be reasonably implied as essential, whether mentioned in the drawings and specifications or not.
- D. It is the intent of the seismic section of this specification to keep all HVAC building system components in place during a seismic or wind event and operational after the seismic event.



- E. As part of the work, Contractor shall engage the services of a professional engineer, licensed in the State of New York, with experience in the field of equipment support, wind and seismic restraints. He shall select and coordinate the restraints and supports based on the final coordinated drawings showing exact location of piping and equipment and shall coordinate with the Commissioner to ascertain that the connections to the structure will resist the wind and seismic forces to which they might be subjected.
- F. Seismic and wind support and restraints are specified on the drawings as well as under another section of this work.

## **PART 2 - PRODUCTS**

- 2.1 As Herein Specified in Division 26 Sections.

## **PART 3 - EXECUTION**

### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

### **3.2 ROUGH-IN**

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications for rough-in requirements.

### **3.3 ELECTRICAL INSTALLATIONS**

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate electrical systems, equipment, and materials installation with other building components.
  - 2. Verify all dimensions by field measurements.
  - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
  - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  - 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  - 7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of the Commissioner of NYC Dept. of Bldgs., franchised service companies, and controlling agencies. Provide required connection for each service.
  - 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Commissioner.



9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install electrical equipment to facilitate servicing, maintenance, and restore or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

### 3.4 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with DDC General Conditions. In addition to the requirements specified in DDC General Conditions, the following requirements apply:
  1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover Work to provide for installation of ill-timed Work.
    - b. Remove and replace defective Work.
    - c. Remove and replace Work not conforming to requirements of the Contract Documents.
    - d. Upon written instructions from the Commissioner, uncover and restore Work to provide for the Commissioner's observation of concealed Work.
  2. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

### 3.5 ESSENTIAL ELECTRICAL SYSTEM

- A. This project will be supplied at 208/120 volts, 3-phase, 4-wire, 60 HERTZ from Con Edison.
  - B. Power shall be delivered from normal and emergency switchboards.
  - C. The facility will be backed-up by a diesel driven engine generator set.
  - D. Emergency power distribution shall be accomplished through circuit breaker type Panelboards(s).
  - E. Power will be transferred automatically via automatic transfer switch(s).
- B. Those items to be connected to the emergency power system will generally be indicated on the drawings, however, the following items shall be connected to the emergency power system shall include, but not be limited to, the following:
1. Life Safety Branch:
    - a. Lighting at:
      - 1) All exit signs
      - 2) Fixtures on all stair landings
      - 3) Selected fixtures in corridors and main routes of egress
      - 4) Selected fixtures in conference rooms

### 3.2 Voltage

- A. 120/208V system shall be utilized for

1. All lighting
  2. Office equipment and receptacles
  3. Motors
- B. Electric service is being provided by a Con Edison REACH, at 208/120 volt, 3-phase, 4-wire via an underground electric service.
- C. Division of responsibilities shall be as follows:
1. Utility company i.e. Con Ed shall
    - a. Provide 208/120v service feeders (REACH) to property line box and connections at same.
- D. Contractor shall provide:
1. All work and installation associated with property line box (P.L.B.) i.e. disconnect manhole, service crabs and service drop from crabs to service end box, service end box and conduits from P.L.B. and service switchboard.
  2. All work shall be in conformance with these specifications and appropriate Con Edison specifications and drawings as hereinafter listed and/or as indicated on construction documents.
- |    | Document  | Description  |
|----|-----------|--|
| a. | EO-1005   | Cementations Water Proofing for Distribution Structure   |
| b. | EO-1007   | Membrane Method of Waterproofing Electrical Distribution Structures                                |
| c. | EO-1008   | Plain and Reinforced Concrete  |
| d. | EO-1121   | Structural Design Procedures for Manholes and Vaults   |
| e. | EO-2113   | Transfer of Load From Company's Supply to Customer's Emergency Generators                          |
| f. | EO-4082   | Operation and Maintenance – Conduit Systems, Cables and Equipment – Private Prop Lt Meter Install. |
| g. | EO-4152   | Buildings During Extreme Emergencies   |
| h. | EO-5089   | Performance Specification for Duct Sealing Compounds.  |
| i. | EO-8413-A | Mounting Details and Wiring for 1000-4000 AMP. Window Type Current Transformers                    |

### 3.3 MISCELLANEOUS SYSTEMS

- A. Mechanical Equipment Power Requirements
1. Mechanical equipment for this project will generally be operated at 208 volts, 3-phase.
  2. Power for the mechanical equipment shall be derived from both the normal building power and emergency power.
  3. Power shall be supplied from the main distribution panel and building power panels.
  4. Motors shall operate on 208 3-phase or 120 volts, 1-phase.
  5. Fire pump controllers shall be as supplied under Fire Protection Scope Division and shall be connected as follows:
    - a. Normal building power shall be provided from normal distribution system, sized to be capable of carrying the locked rotor current of the fire pump motor indefinitely.
    - b. Emergency building power shall be provided from the emergency system, to the fire pump controller which shall have an automatic transfer switch integral to the





- fire pump controller which is furnished under the fire protection system.
- c. Emergency power feeder to the fire pump ATS controller shall be full weight rigid galvanized and provided with 1 hr fire protection enclosure.
- d. Normal power feeder run to the fire pump/ATS controller shall be installed in galvanized steel rigid conduit encased in 2-hour concrete envelope or equivalent alternate system.

**B. Electrical Connections to Equipment and Systems**

1. Wiring shall be provided under this scope of work, except the following, which shall be provided by under another Division:
  - a. Wiring and devices necessary for control and sequence of operation shall be supplied, wired, installed and connected under Division 23, unless noted elsewhere.
  - b. Associated temperature control wiring.
2. Starters, disconnect switches, and combination fused starter disconnect switches, and motor control centers shall be furnished, wired and installed under Division 26. Where equipment is specified to be supplied factory installed or shipped loose with the equipment, the furnishing and installation shall come under Division 23 with the power wiring under 26.
3. Fuses, overload elements, control transformers, and accessories shall be supplied and installed under the Division supplying the starters, disconnect switches, and other control devices.
4. The Division responsible for furnishing the equipment to be controlled shall furnish all control devices required for the equipment to operate, regardless of whether the device is to be wired in a control or power circuit.
5. The horsepower rating of starters shall be checked against the actual motor to be controlled before installation, and correct size overload elements shall be provided in starters based on name plate and manufacturer's recommendations.

**C. Boiler Plant Wiring:**

1. Responsibility for wiring shall be divided as follows:
  - a. Under Electrical Work wiring from power source to local disconnect switch adjacent to boiler panel and wiring from break-glass switches to boiler control panel.
2. Under HVAC Work
  - a. Wiring beyond local disconnect switch

**D. Fire Smoke Dampers**

1. Furnish transformer, conduit and wire for smoke and fire damper release system for systems. Smoke and fire damper units shall be provided under another Division 23 of the specification. Contractor shall make complete connections between fire and smoke damper power supplies and respective BMS control panel.
2. Contractor shall coordinate secondary voltage of transformers with voltage of smoke and fire damper units as finally purchased. Transformer shall be mounted in recessed cabinets with hinged door and shall be a maximum of 4 inches deep.
3. Wiring shall be installed in conduit as specified for light and power.



E. Refrigeration Plant Wiring

1. Under Division 26:

- a. Wiring from power source to controllers and motors.
- b. Wiring from break-glass switches to unit control panels, and refrigeration room exhaust fans.

2. Under Division 23

- a. Wiring from unit control panels to and between refrigeration unit control devices.
- b. Break-glass switches.

F. HVAC Control Wiring

- 1. In accordance with applicable wiring diagrams and schedules, the following work shall be provided:
  - a. All control wiring interlocks between starters on Motor Control Centers.
  - b. All control wiring for smoke detection and control systems.
  - c. Mounting of starters and auxiliary electrical devices.
  - d. Power supply for Mechanical control panels.

G. Elevators

- 1. Refer to Division 26 05 12 and DDC General Conditions 4 10 00 for scope of work.

3.4 TESTING ADJUSTING AND BALANCING

A. All tests shall be performed prior to acceptance of equipment and or systems.

B. All tests shall be performed in accordance these specifications and applicable and or at least these codes:

- 1. NYC Electrical code (NFPA 70 2005)
- 2. NFPA 110
- 3. NFPA 99
- 4. NFPA 72
- 5. International Testing Association
- 6. NETA

C. In addition to specific test requirements for systems indicated hereinafter all equipment components and systems shall be tested as follows:

D. Polarity: A verification of polarity shall be made, and it shall be ensured that all fuses, circuit breakers and control devices are connected in the line side (hot) conductors only. Bayonet and Edison socket lamp holders shall have their outer shell connected to the neutral. Polarity of all receptacles shall be verified.

E. Ground Continuity Test: A ground continuity test shall be made between main ground system and equipment frame, and system neutral. A minimum of 10 amps D.C. shall be used between ground reference and each ground point tested. Resistance shall be calculated and shall not exceed 25 ohms.



F. Insulation:

1. This test shall be made before the installation is completed. The installation may be divided into sections containing up to 50 outlets. D.C. voltage of 1000 VDC shall be applied for the measurement of insulation resistance.
2. When insulation resistance must be determined with all switchboards, panelboard's, fuse holders, switches, and Overcurrent devices in place, the insulation resistance, when tested at 500 DVC shall be no less than 1 megohm for No.14 and No.12 AWG and 250k ohm for circuits 25 amps and above. Perform insulation resistance test of each cable with respect to ground and adjacent cable.
3. Wherever practicable, so that all parts of the wiring may be tested, all lamps shall be removed and all current using apparatus shall be closed; where the removal of lamps and/or the disconnection of current using apparatus are impracticable, the local switches controlling such lamps and/or apparatus shall be open. This test is not applicable to ground concentric wiring system.
4. Where apparatus is disconnected for the tests, the insulation resistance between the case or framework and all live parts of each item of fixed apparatus shall be measured separately and shall be not less than 0.5 megohm.

G. Phase Balancing: All feeders and branch circuits shall be connected to panelboards main distribution panels, and switchboard, so that loads are distributed equally on all phases.

H. Ground electrode Resistance

1. Prior to installing the ground electrode system, the contractor shall carry out ground resistance tests for all relevant locations.
2. The total resistance of each ground electrode system shall be 25-ohm maximum between earth and ground.

I. Switchboard and Panels

1. Test the switchboards, panels and cubicle type equipment as follows:
  - a. 1000 volt D.C. insulation test.
  - b. Current transformer polarity test.
  - c. Polarity test on main connection using 1000-volt megger test –phase-phase.
  - d. 1000-volt megger test –phase- earth.
  - e. Simulation of all control functions.
  - f. Trip and close operations.
2. The entire switchboard shall be subjected, after completed assembly, to a high potential test of the switchboard to rated voltage plus 1000 volts. Any defects which develop shall be corrected and the manufacturer shall certify that the equipment has been subjected to the high potential test and no ground or crosses are indicated.

J. Distribution Cables

1. All main distribution cables shall be subjected to 1000-volt megger tests between phase – phase, and phase – earth. The minimum resistance acceptable shall be 1 megohm measured under damp conditions.
2. Tests on cables shall be carried out after installation and joining.

K. Lighting



1. Demonstrate to Commissioner that all lighting, ballasts, wiring and equipment are in proper condition. All fixtures shall be complete with clean and undamaged components.

**L. Fire Alarm System**

1. Wiring shall be checked and tested by the Contractor in accordance with the instructions provided by the manufacturer to assure that the system is free of grounds, opens and shorts.
2. Upon completion of the installation, a factory-instructed technician shall perform necessary electrical test and adjustments and demonstrate the operation of the system to Commissioner and NYC Building Department.
3. Every manual station shall be tested.
4. Every smoke detector shall be tested by manufacturer's properly trained tester and approved methods.
5. Sprinkler and dry pipe systems shall be tested by flowing water, closing valves, and testing air pressure on dry systems.
6. All circuits shall be opened at two locations to test for supervision.
7. Speakers shall be checked for proper sound levels.
8. Telephone jacks and phones shall be tested.
9. Stair Pressurization System.
10. Smoke doors and hatch operation.

- M.** At the completion of this installation, the manufacturer shall issue a letter to Commissioner and the Contractor certifying that the system is installed and operating in accordance with the contract documents and requirements of NYC Building Department.

**3.5 ADJUSTMENTS**

- A.** Adjustments of the system(s) shall be accomplished to the complete satisfaction of The Commissioner at the time installation is completed.

**3.6 PAINTING**

- A.** Painting of electrical systems, equipment, and components is specified in Section 09 91 00 "Painting".
- B.** Damage and Touchup: Restore marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

**3.7 CONCRETE BASES**

- A.** Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.



6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Coordinate concrete base height with air handling unit manufacturer to assure proper coil condensate drainage.

**END OF SECTION 26 05 00**

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**SECTION 26 05 19****LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**PART 2 - PRODUCTS****2.1 CONDUCTORS AND CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alcan Products Corporation; Alcan Cable Division.
  2. Alpha Wire.
  3. Belden Inc.
  4. Encore Wire Corporation.
  5. General Cable Technologies Corporation.
  6. Southwire Incorporated.
  7. Or approved equal.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2, Type XHHW-2, Type UF, Type USE, and, Type SO as required by location.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type A, metal-clad, Type MC, mineral-insulated, metal-sheathed cable, Type MI, Type SO and Type USE with ground wire.

**2.2 CONNECTORS AND SPLICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Hubbell Power Systems, Inc.
  3. Ideal Industries, Inc.
  4. IlSCO; a brand of Bardes Corporation.
  5. NSI Industries LLC.
  6. O-Z/Gedney; a brand of the EGS Electrical Group.
  7. 3M; Electrical Markets Division.
  8. Tyco Electronics.
  9. Or approved equal.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

**2.3 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

**PART 3 - EXECUTION**



### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.



**3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

**3.7 FIRESTOPPING**

- A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 10 "Firestopping."

**3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding distribution panelboards.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Training Specification. Certify compliance with test parameters.
  - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No.3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test and Inspection Reports: Prepare a written report to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Cables will be considered defective if they do not pass tests and inspections.

**END OF SECTION 26 05 19**

**SECTION 26 05 26****GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products by one of the following:

1. Burndy; part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation
4. O-Z/Gedney; a brand of the EGS Electrical Group.
5. Siemens Power Transmission & Distribution, INC.
6. Or approved equal.

**2.2 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL467 for grounding and bonding materials and equipment.

**2.3 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by New York City Electrical Code 2014.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

**2.4 CONNECTORS**

- A. Listed and labeled by an NRTL acceptable to New York City Building Code 2014 and New York City Electrical Code 2011 for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression - type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad 3/4 inch by 10 feet
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts
  - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
  - 2. Backfill Material: Electrode manufacturers recommended material.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.3 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.4 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

### 3.5 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Instruct conductor's level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.6 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, and Heat-Tracing, Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.



- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.
  - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
  - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
  - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

### 3.7 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to impact or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.



1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

**F. Grounding and Bonding for Piping:**

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

**G. Bonding Interior Metal Ducts:** Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

**H. Grounding for Steel Building Structure:** Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

**I. Ground Ring:** Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column as indicated and extending around the perimeter of building.

1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

**J. Concrete-Encased Grounding Electrode (Ufer Ground):** Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

**K. Concrete-Encased Grounding Electrode (Ufer Ground):** Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

**3.8 FIELD QUALITY CONTROL**

**A. Testing Agency:** Shall be selected and approved by the Commissioner a qualified testing agency to perform tests and inspections.



- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
  - 3. Substations 5 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Commissioner promptly and include recommendations to reduce ground resistance.

**END OF SECTION 26 05 26**

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**SECTION 26 05 29****HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. This Section includes the following:
1. Hangers and supports for electrical equipment and systems.
  2. Construction requirements for concrete bases.
- B. Related Sections include the following:
1. Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic and vibration criteria.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

1.7 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. Thomas & Betts Corporation.
    - e. Unistrut; Tyco International, Ltd.
    - f. Or approved equal.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: Clevis hangers, riser clamps, conduit straps, threaded C clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
  - 1. Fasteners: Types, materials, and construction features as follows:
  - 2. Expansion Anchors: Carbon steel wedge or sleeve type.
  - 3. Toggle Bolts: All steel springhead type.
- C. Power Driven Threaded Studs: Heat treated steel, designed specifically for the intended service.
  - 1. Conduit Sealing Bushings: Factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.



2. U Channel Systems: 16 gage steel channels, with 9/16-inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U channel and are of the same manufacture.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
      - 5) Or approved equal.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
      - 6) Or approved equal.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  5. Toggle Bolts: All-steel springhead type.
  6. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NYC Electrical Code. Minimum rod size shall be 1/4-inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.3 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or



greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 09 91 00 "Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-restore paint to comply with ASTM A 780.

**END OF SECTION 26 05 29**



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**SECTION 26 05 33****RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.7 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

**PART 2 - PRODUCTS****2.1 METAL CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a TYCO International Ltd. Co.
  - 3. O-Z/Gedney; a brand of EGS Electrical Group.
  - 4. Robroy Industries.
  - 5. Southwire Company.
  - 6. Thomas & Betts Corporation.
  - 7. Western Tube and Conduit Corporation.
  - 8. Wheatland Tube Company; a division of John Maneely Company.
  - 9. Or approved equal.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.



- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew or compression.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70 2014, by New York City Electrical Code 2011 for use in conduit assemblies and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric
  - 5. Or approved equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, Type 12 as required unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type or Flanged-and-gasketed type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.



## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL %. Manufacturer's standard enamel finish in color selected by Commissioner.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Panduit Corp.
    - b. Wiremold/Legrand.
    - c. Clark
    - d. Or approved equal.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
  - 1. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 2. EGS/Appleton Electric.
  - 3. Wiremold/Legrand.
  - 4. Hoffman; a Pentair company.
  - 5. Hubbell Incorporated; Killark Division.
  - 6. Thomas & Betts Corporation.
  - 7. Or approved equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Devices Box: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Metal Floor Boxes:
  - 1. Material: Cast metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.



- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- L. Gangable boxes are allowed.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 depending on location with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
  - 1. NEMA 250, Type 1, Type 3R, or Type 12 depending on location galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panel boards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
- O. Cast-Metal/Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

## 2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis
    - e. Oldcastle Precast, Inc.; Christy Concrete Products.
    - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
    - g. Or approved equal.



2. Standard: Comply with SCTE 77.
  3. In "Cast-Metal Outlet and Device Boxes" Paragraph below, aluminum boxes are suitable for use with steel raceways in most environments. Type FD is a device box with extra depth. Many other configurations are available.
  4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
  5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  6. See Editing Instruction No. 2 in the Evaluations for a discussion of floor boxes.
  7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  8. Cover Legend: Molded lettering, "ELECTRIC".
  9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  10. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete, reinforced concrete, cast iron or fiberglass.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armorcast Products Company
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis.
    - e. Nordic Fiberglass Inc.
    - f. Oldcastle Precast, Inc.; Christy Concrete Products.
    - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
    - h. Or approved equal.
  2. Standard: Comply with SCTE 77.
  3. Color of Frame and Cover: Gray.
  4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
  5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  7. Cover Legend: Molded lettering, "ELECTRIC".
  8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.

## PART 3 – EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: RNC, Type EPC-40-PVC and RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, Type EPC-80-PVC.
4. Connection to Vibrating Equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

- B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: RNC identified for such use.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

- a. For traffic of mechanized carts, forklifts, and pallet-handling units.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LMFC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMW 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.

- C. Minimum Raceway Size: 3/4 –inch (21 mm) trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- G. Install surface raceways only where indicated on Drawings.



- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NYCEC limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Commissioner for each specific location.
  - 5. Change from ENT to GRC or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.





- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Retain one of first two paragraphs below to exceed NFPA 70 requirements. NFPA 70 requires insulated bushings or other smooth, rounded entry provisions for conduit terminations at all locations where conductors are No. 4 AWG and larger, regardless of the environment. NFPA 70 requires bonding of all service conductors, but does not require bonding to be accomplished with grounding bushings. See Evaluations for further discussion.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Install raceway sealing fittings at accessible locations according to NYCEC and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NYCEC.
- V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NYCEC.



- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.



- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.4 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

### 3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.



- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 10 "Firestopping."

### 3.8 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Restore damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Restore damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 26 05 33**

## **SECTION 26 05 43**

### **UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Direct-buried conduit, ducts, and duct accessories.
  - 2. Concrete-encased conduit, ducts, and duct accessories.
  - 3. Handholes and boxes.
  - 4. Manholes.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

##### **1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

##### **1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.7 DEFINITIONS**

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

**PART 2 - PRODUCTS****2.1 CONDUIT**

- A. See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."
- B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

**2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cantex, Inc.
  2. CertainTeed Corp.; Pipe & Plastics Group.
  3. Condux International, Inc.
  4. Electri-Flex Company.
  5. Lamson & Sessions; Carlon Electrical Products.
  6. Manhattan/CDT; a division of Cable Design Technologies.
  7. Spiraduct/AFC Cable Systems, Inc.
  8. Or approved equal.
- B. Duct Accessories:
1. Duct Separators: Factory-Fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
  3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 600-psi concrete.
    - a. Color: Red dye added to concrete during batching.
    - b. Mark each plank with "ELECTRIC" in 2-inch high, 3/8-inch deep letters.

**2.3 PRECAST CONCRETE HANDHOLES AND BOXES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carder Concrete Products.
  2. Christy Concrete Products.
  3. Elmhurst-Chicago Stone Co.



4. Oldcastle Precast Group.
  5. Riverton Concrete Products; a division of Cretex Companies, Inc.
  6. Utility Concrete Products, LLC.
  7. Utility Vault Co.
  8. Wausau Tile, Inc.
  9. Or approved equal.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Description: Factory-Fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
  3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
    - a. Cover Hinges: Concealed with hold-open ratchet assembly.
    - b. Cover Handle: Recessed.
  5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  6. Cover Legend: Molded lettering, "ELECTRIC."
  7. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
  8. Extensions and Slabs: Designed to match with bottom of enclosure. Same material as enclosure.
    - a. Extension shall provide increased depth of 12 inches.
    - b. Slab: Same dimensions as bottom of enclosure and arranged to provide closure.
  9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
    - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    - c. Window openings shall be framed with at least two additional No.4 steel reinforcing bars in concrete around each opening.
  10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.



- a. Type and size shall match fittings to duct or conduit to be terminated.
- b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

### A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

### B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. CDR Systems Corporation.
  - d. NewBasis.
  - e. Or approved equal.

### C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company
  - b. Carson Industries LLC.
  - c. Christy Concrete Products.
  - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
  - e. Or approved equal.

### D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of cast iron.





1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carson Industries LLC.
  - b. Christy Concrete Products.
  - c. Nordic Fiberglass, INC.
  - d. Or approved equal.

## 2.5 PRECAST MANHOLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carder Concrete Products.
  2. Christy Concrete Products.
  3. Elmhurst-Chicago Stone Co.
  4. Oldcastle Precast Group.
  5. Riverton Concrete Products; division of Cretex Companies, Inc.
  6. Utility Concrete Products, LLC.
  7. Utility Vault Co.
  8. Wausau Tile, Inc.
  9. Or approved equal.
- B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.
  1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
    - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
    - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    - c. Window openings shall be framed with at least two additional No.4 steel reinforcing bars in concrete around each opening.
    - d. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
  2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    - a. Type and size shall match fittings to duct or conduit to be terminated.
    - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.
- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## 2.6 CAST-IN-PLACE MANHOLES

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C 858 and with Section 033000 "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

## 2.7 UTILITY STRUCTURE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bilco Company (The).
  - 2. Campbell Foundry Company.
  - 3. Carder Concrete Products.
  - 4. Christy Concrete Products.
  - 5. Oldcastle Precast Group.
  - 6. Osburn Associates, Inc.
  - 7. Pennsylvania Insert Corporation.
  - 8. Riverton Concrete Products; a division of Cretex Companies, Inc.
  - 9. Utility Concrete Products, LLC.
  - 10. Utility Vault Co.
  - 11. Wausau Tile, Inc.
  - 12. Or approved equal.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
  - 1. Frame and Cover: Weatherproof, grey cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inches
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
  - 2. Cover Legend: Cast in, selected to suit system.
    - a. Legend: "ELECTRIC-LV" for duct systems with power wire and cables for systems operating at 600 V and less.
    - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
    - c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
  - 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for Quantities less than 2.0 cu. Ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch diameter eye, and 1-by-4-inch bolt.
  - 1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
  - 1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep. Flared to 1-1/4 inches minimum at base.
  - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Expansion Anchors for Installation after Concrete is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 68000-lbf rated shear strength.
- I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.
  - 1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.
  - 2. Arms: 1-1/2-inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
  - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
  - 1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for an arm attachment.
  - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
- K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation, materials, and common metals.
- L. Fixed Manhole Ladders: Arranged for attachment to wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

- M. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches (900 mm).
- N. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N) and greater. Two required.

## 2.8 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by an independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer licensed in the State of New York shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Commissioner if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Commissioner.
- C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 31 10 00 "Site Clearing, Removals, and Preparation". Remove and stockpile topsoil for reapplication according to Section 31 10 00 "Site Clearing, Removals, and Preparation."

### 3.3 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80 PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80 PVC, in direct-buried duct bank unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank unless otherwise indicated.

- D. Underground Ducts Crossing Paved Paths, Walks, Driveways and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

### 3.4 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
  - 4. Units Subject to Light-Duty Pedestrian Traffic Only: High-density plastic, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
  - 5. Cover design load shall not exceed the design load of the handhole or box.
- B. Manholes: Precast or cast-in-place concrete.
  - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
  - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### 3.5 EARTHWORK

- A. Excavation and Backfill: Comply with Section 31 00 00 "Earthwork" but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 32 91 13 "Planting Soils".

### 3.6 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.



- E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
  - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
  - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch.
  - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- I. Pulling Cord: Install 100-lbf test nylon cord in empty ducts.
- J. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 31 00 00 "Earthwork" for pipes less than 6 inches in nominal diameter.
  - 2. Width: Excavate trench 12 inches wider than duct bank on each side.
  - 3. Width: Excavate trench 3 inches wider than duct bank on each side.
  - 4. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  - 5. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  - 6. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 7. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
  - 8. Elbows: Use manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.



9. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
  10. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  11. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  12. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 2 inches on each side of duct bank.
  13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
  14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 03 30 00 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- K. Direct-Buried Duct Banks:
1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 31 00 00 "Earthwork" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
  2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  3. Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
  4. Depth: Install top of duct bank at least 36 inches below finished grade unless otherwise indicated.
  5. Set elevation of bottom of duct bank below frost line.
  6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
  7. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.



8. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.
    - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
  9. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
    - a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
    - b. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.
  - L. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.
  - M. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- 3.7 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES
- A. Cast-in-Place Manhole Installation:
    1. Finish interior surfaces with a smooth-troweled finish.
    2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
    3. Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.
  - B. Precast Concrete Handhole and Manhole Installation:
    1. Comply with ASTM C 891 unless otherwise indicated.
    2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
    3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
  - C. Elevations:





1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
  2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
  3. Install handholes with bottom below frost line.
  4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
  5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071353 "Elastomeric Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 07 10 00 "Foundation Waterproofing" After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- 3.8 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
  - B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
  - C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.

- D. Install handholes and boxes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.9 GROUNDING

- A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

### 3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
  - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

### 3.11 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

**END OF SECTION 26 05 43**

**SECTION 26 05 44****SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16-inch thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

#### 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:



- a. Advance Products & Systems, Inc.
  - b. CALPICO, Inc.
  - c. Metraflex Company (The).
  - d. Pipeline Seal and Insulator, Inc.
  - e. Proco Products, Inc.
  - f. Or approved equal.
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel or Plastic Stainless steel.
  4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Presealed Systems.
    - b. Advance Products & Systems, Inc.
    - c. CALPICO, Inc.
    - d. Or approved equal.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  2. Sealant shall have VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."



- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall, so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.



### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION 26 05 44**

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## **SECTION 26 05 48**

### **VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. This Section includes the following:
1. Isolation pads.
  2. Spring isolators.
  3. Restrained spring isolators.
  4. Channel support systems.
  5. Restraint cables.
  6. Hanger rod stiffeners.
  7. Anchorage bushings and washers.
- B. Related Sections include the following:
1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.



1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

1.7 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ace Mountings Co., Inc.
  - 2. Isolation Technology, Inc.
  - 3. Mason Industries.
  - 4. Vibration Eliminator Co., Inc.
  - 5. Vibration Isolation.
  - 6. Vibration Mountings & Controls, Inc.
  - 7. Or approved equal.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
  - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
  - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.



5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
  6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  2. Restraint: Seismic or limit-stop as required for equipment and New York City Building Code 2014.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
  2. Hilti Inc.
  3. Mason Industries.
  4. TOLCO Incorporated; a brand of NIBCO INC.
  5. Unistrut; Tyco International, Ltd.
  6. Or approved equal.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports an agency acceptable to New York City Building Code 2014.
- C. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.



- G. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchors and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.3 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to New York City Building Code 2014.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.4 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.
  - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
  - 3. Install seismic-restraint devices using methods approved by an agency acceptable to New York City Building Code 2014 providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Commissioner if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.



### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to New York City Building Code 2014.
  - 2. Schedule test with The City of New York, through the Commissioner, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain the Commissioner's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by the Commissioner.
  - 5. Test to 90 percent of rated proof load of device.
  - 6. Measure isolator restraint clearance.
  - 7. Measure isolator deflection.
  - 8. Verify snubber minimum clearances.
  - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### 3.7 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.8 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. Supported or Suspended Equipment:
  - 1. Equipment Location:
  - 2. Pads:
    - a. Material: Neoprene.
  - 3. Isolator Type:
    - a. Component Importance Factor: 1.0.
    - b. Component Response Modification Factor: 1.5



- c. Component Amplification Factor: 1.0

**END OF SECTION 26 05 48**



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**SECTION 26 05 53****IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Identification for raceways.
  2. Identification of power and control cables.
  3. Identification for conductors.
  4. Underground-line warning tape.
  5. Warning labels and signs.
  6. Instruction signs.
  7. Equipment identification labels.
  8. Miscellaneous identification products.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

## PART 2 - PRODUCTS

### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type indicate where served from and what is being fed.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.015-inch-thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field indicate where fed from and what it's serving.
  - 2. Legend: Indicate voltage and system.
- C. Colors for Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER HIGH VOLTAGE WIRING."
- D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.
- F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

## 2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- F. Write-On Tags: Polyester tag, 0.010-inch-thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

- G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

## 2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.015-inch-thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

## 2.5 FLOOR MARKING TAPE

- A. 2-inch wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## 2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:



1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils (0.1 mm).
3. Weight: 18.5 lb/1000 sq. ft..
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

D. Tag: Type II:

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 12 mils.
3. Weight: 36.1 lb/1000 sq. ft..
4. 3-Inch Tensile According to ASTM D 882: 400 lbf, and 11,500 psi.

E. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

F. Tag: Type IID:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 8 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 34 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 300 lbf and 12,500 psi.

## 2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:



1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. Other warning labels required for Arc Flash, multiple services, etc.

## 2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. inches and 1/8-inch-thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

**2.10 CABLE TIES**

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

**2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.



- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### 3.3 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
  - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to raceways concealed within wall.
  - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 60 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.





2. Power

- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
    - a. Color shall be factory applied for sizes larger than No. 8 AWG.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags, self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- H. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
- I. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- K. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- L. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.



- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- N. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, Stenciled legend 4 inches high.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Emergency system boxes and enclosures.
    - g. Motor-control centers.
    - h. Enclosed switches.
    - i. Enclosed circuit breakers.
    - j. Enclosed controllers.
    - k. Variable-speed controllers.
    - l. Push-button stations.
    - m. Power transfer equipment.
    - n. Contactors.
    - o. Remote-controlled switches, dimmer modules, and control devices.



- p. Battery-inverter units.
- q. Battery racks.
- r. Power-generating units.
- s. Monitoring and control equipment.

**END OF SECTION 26 05 53**



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**SECTION 26 05 72****OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"



## 1.7 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

## PART 2 - PRODUCTS

### 2.1 COMPUTER SOFTWARE

- A. Available Computer Software Developers: Subject to compliance with requirements companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
  - 1. CGI CYME
  - 2. EDSA MICRO Corporation
  - 3. ESA Inc.
  - 4. Or approved equal.
- B. Comply with IEEE 399 and IEEE 551.
- C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

### 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Motor and generator designations and kVA ratings.
  - 4. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.



E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Calculated asymmetrical fault currents:
    - 1) Based on fault-point X/R ratio.
    - 2) Based on calculated symmetrical value multiplied by 1.6.
    - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Obtain all data necessary for the conduct of the study.
  - 1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of the Commissioner.
  - 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the contractor's professional engineer licensed in the State of New York in charge of performing the study who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Obtain electrical power utility impedance at the service.
  - 3. Power sources and ties.
  - 4. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  - 5. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  - 6. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  - 7. Motor horsepower and NEMA MG 1 code letter designation.
  - 8. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

**3.3 SHORT-CIRCUIT STUDY**

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.





- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
  - 1. Electric utility's supply termination point.
  - 2. Incoming switchgear.
  - 3. Unit substation primary and secondary terminals.
  - 4. Low-voltage switchgear.
  - 5. Motor-control centers.
  - 6. Control panels.
  - 7. Standby generators and automatic transfer switches.
  - 8. Branch circuit panelboards.
  - 9. Disconnect switches.

#### 3.4 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

#### 3.5 DEMONSTRATION

- A. Instruct the City of New York's service operators to adjust, operate, and service devices. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 26 05 72**



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**SECTION 26 05 73****OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

- 1. Study results shall be used to determine coordination of series-rated devices.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

- 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

- 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.7 DEFINITIONS**

- A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

**PART 2 - PRODUCTS****2.1 COMPUTER SOFTWARE DEVELOPERS**

- A. Software Developers: Subject to compliance with requirements, provide software by one of the following:
  - 1. ESA Inc.
  - 2. Operation Technology, Inc.
  - 3. Power Analytics, Corporation.
  - 4. SKM Systems Analysis, Inc.
  - 5. Or approved equal.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1. Optional Features:
    - a. Arcing faults.
    - b. Simultaneous faults.
    - c. Explicit negative sequence.
    - d. Mutual coupling in zero sequence.

**2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS**

- A. Executive summary.



- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Motor and generator designations and kVA ratings.
  - 4. Switchgear, switchboard, motor-control center, and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study:
  - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
    - a. Phase and Ground Relays:
      - 1) Device tag.
      - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
      - 3) Recommendations on improved relaying systems, if applicable.
    - b. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - c. Fuses: Show current rating, voltage, and class.
- G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
  - 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
  - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
  - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  - 4. Plot the following listed characteristic curves, as applicable:
    - a. Power utility's overcurrent protective device.



- b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  - c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
  - d. Cables and conductors damage curves.
  - e. Ground-fault protective devices.
  - f. Motor-starting characteristics and motor damage points.
  - g. Generator short-circuit decrement curve and generator damage point.
  - h. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

#### 3.3 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.



G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
  - a. Inrush current when first energized.
  - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
  - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

### 3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
  - 1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
  - 2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
  - 3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

### 3.5 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

### 3.6 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the overcurrent protective device study.
  - 1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of the Commissioner.
  - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by contractor's professional engineer licensed in the State of New York who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Electrical power utility impedance at the service.
  - 3. Power sources and ties.
  - 4. Short-circuit current at each system bus, three phase and line-to-ground.
  - 5. Full-load current of all loads.
  - 6. Voltage level at each bus.





7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Maximum demands from service meters.
11. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
12. Motor horsepower and NEMA MG 1 code letter designation.
13. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
14. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
  - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
  - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

### 3.7 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

**3.8 DEMONSTRATION**

- A. Instruct the City of New York's service operators in the following:
1. Acquaint operators in the fundamentals of operating the power system in normal and emergency modes.
  2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
  3. Adjust, operate, and service overcurrent protective device settings.

**END OF SECTION 26 05 73**

**SECTION 26 05 74****OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which facility staff could be exposed during work on or near electrical equipment.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.7 DEFINITIONS**

- A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

**PART 2 - PRODUCTS****2.1 COMPUTER SOFTWARE DEVELOPERS**

- A. Software Developers: Subject to compliance with requirements, provide software by one of the following:
  - 1. ESA Inc.
  - 2. Operation Technology, Inc.
  - 3. Power Analytics, Corporation.
  - 4. SKM Systems Analysis, Inc.
  - 5. Or approved equal.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

**2.2 ARC-FLASH STUDY REPORT CONTENT**

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Motor and generator designations and kVA ratings.
  - 4. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.



- E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."
- G. Arc-Flash Study Output:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
  - 1. Arcing fault magnitude.
  - 2. Protective device clearing time.
  - 3. Duration of arc.
  - 4. Arc-flash boundary.
  - 5. Working distance.
  - 6. Incident energy.
  - 7. Hazard risk category.
  - 8. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

## 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
  - 1. Location designation.
  - 2. Nominal voltage.
  - 3. Flash protection boundary.
  - 4. Hazard risk category.
  - 5. Incident energy.
  - 6. Working distance.
  - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

**3.3 ARC-FLASH HAZARD ANALYSIS**

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:
  - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
  - 2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
  - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where facility staff could perform work on energized parts.
- E. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- G. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
  - 1. When the circuit breaker is in a separate enclosure.
  - 2. When the line terminals of the circuit breaker are separate from the work location.

- H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.4 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
  - 1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of the Commissioner.
  - 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers licensed in the State of New York.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by contractor's professional engineer licensed in the State of New York who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Obtain electrical power utility impedance at the service.
  - 3. Power sources and ties.
  - 4. Short-circuit current at each system bus, three phase and line-to-ground.
  - 5. Full-load current of all loads.
  - 6. Voltage level at each bus.
  - 7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  - 8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  - 9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  - 10. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  - 11. Motor horsepower and NEMA MG 1 code letter designation.
  - 12. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

### 3.5 LABELING

- A. Apply one arc-flash label for 208-V ac panelboards and disconnects and for each of the following locations:
  - 1. Motor-control center.
  - 2. Low-voltage switchboard.
  - 3. Switchgear.
  - 4. Medium-voltage switch.



5. Control panel.

### 3.6 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

### 3.7 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist Engage a factory-authorized service representative to instruct the City of New York's service operators in potential arc-flash hazards. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 26 05 74**



**SECTION 26 08 00****COMMISSIONING OF ELECTRICAL****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 SUMMARY**

- A. This section includes commissioning process requirements for Electrical systems, assemblies, and equipment.
- B. Related Sections:
  - 1. DDC General Conditions Section "General Commissioning Requirements" for general commissioning process requirements.

**1.3 DESCRIPTION**

- A. Commissioning is a systematic process of confirming that all building systems perform interactively according to the Commissioner's Project Requirements and the Basis of Design and continuing through construction, acceptance and the warranty period with actual verification of performance.
- B. The Commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.
- C. The CxA directs and coordinates the commissioning activities and reports to the Commissioner. All members in the construction process work together to fulfill their contracted responsibilities and meet the objectives of the Commissioner's Project Requirement's as detailed in the Contract Documents.

**1.4 DEFINITIONS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for definitions.

**1.5 SUBMITTALS**

- A. The CxA will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment



specifications. The CxA will notify the Contractor, or Commissioner as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

- B. The CxA will receive a copy of the final approved submittals.
- C. In addition, the contractor is to provide the following:
  - 1. Certificates of readiness
  - 2. Certificates of completion of installation, prestart, and startup activities.
  - 3. O&M manuals
  - 4. Test reports
- D. Refer to DDC General Conditions Section “General Commissioning Requirements” for general commissioning submittal requirements.

## **1.6 QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer’s calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

## **1.7 COORDINATION**

- A. Commissioning Kick-Off Meeting – Construction Team: Contractors will attend a meeting of the Commissioning Team, chaired by the CxA, to review the scope of commissioning process activities and the Commissioning Plan with discussions on milestones, activities, and assignments of responsibilities. The flow and type of documents and the amount of submittal data given to the CxA will be determined. Meeting minutes will then be distributed to all parties by the CxA.
- B. Commissioning Meetings: Contractors will attend coordination meetings with the Commissioning Team, chaired by the CxA, to review progress on the Commissioning Plan, construction deficiencies, scheduling conflicts, and to discuss strategies and processes for upcoming commissioning process activities.
- C. Miscellaneous Construction Meetings: The CxA attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in the commissioning process.
- D. Pre-testing Meetings: Contractors will attend pretest meetings with the Commissioning Team, chaired by the CxA, to review startup reports, pre-test inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers’ authorized service representative services for each system, sub-system, equipment, and component to be tested.

- E. Testing: Contractors will coordinate with testing personnel and agencies for timing and access for CxA to witness test.
- F. Manufacturers' Inspection and Startup Services: Contractors will coordinate services of manufacturers' inspection and startup services.
- G. Testing, Adjusting and Balancing: Contractors will coordinate with plan and schedule for testing, adjusting and balancing for timing and access for CxA to witness process.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the contractor shall ultimately be responsible for all standard testing equipment for the electrical systems and controls systems in Division 26. A sufficient quantity of two-way radios shall be provided by each contractor.
- B. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the City of New York upon completion of the commissioning process.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems
- B. Red-lined Drawings (As-Builts): The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.



- C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
- D. Demonstration and Orientation: Contractor will provide demonstration and orientation as required by the specifications. A complete orientation plan and schedule must be submitted by the Contractor to the CxA four weeks (4) prior to any orientation. A orientation agenda for each orientation session must be submitted to the CxA one (1) week prior the orientation session

### **3.2 CONTRACTOR'S RESPONSIBILITIES**

- A. Refer to DDC General Conditions Section “General Commissioning Requirements” for general contractor’s responsibilities.
- B. Attend construction phase controls coordination meetings.
- C. Provide information requested by the CxA for final commissioning documentation.
- D. Prepare preliminary schedule for Electrical system orientations and inspections, operation and maintenance manual submissions, orientation sessions, equipment start-up and task completion for The City of New York. Distribute preliminary schedule to commissioning team members.
- E. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- F. Provide detailed startup procedures.
- G. Provide a written list of all user adjustable set-points and reset schedules with a brief discussion of the purpose of each and the range of reasonable adjustments with energy implications
- H. Provide a written schedule frequency to review the various set-points and reset schedules to ensure they are current relevant and efficient values.
- I. Respond to provided new deficiencies and/or responses within five (5) business days
- J. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- K. Coordinate with the CxA to provide 48-hour advanced notice so that the witnessing of equipment and system start-up and testing can begin.
- L. Notify the CxA a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- M. Provide written notification to the Commissioner and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
  - 1. Electrical equipment including switchgear, panel boards, motor control centers, lighting, receptacles, dimmers and all other equipment furnished under this Division.
  - 2. Emergency generators, ATS switches, UPS systems, and emergency power systems.



3. Solar Photovoltaic Systems

- N. The equipment supplier shall document the performance of his equipment.
- O. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- P. Equipment Suppliers
  - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the City of New York, to keep warranties in force.
  - 2. Assist in equipment testing per agreements with Contractors.
  - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

### **3.3 CxA'S RESPONSIBILITIES**

A. Roles and Responsibilities

- 1. Refer to DDC General Conditions Section “General Commissioning Requirements” for general CxA responsibilities.

B. Cx Team Meetings

- 1. Commissioning during construction will begin with a ‘Commissioning Kick-Off Meeting – for Construction Team’ conducted by the CxA where the commissioning process is reviewed with all of the commissioning team members.
- 2. Additional meetings will be required throughout construction, and will be scheduled by the CxA on a weekly basis with necessary parties of the commissioning team attending, in order to plan, scope, coordinate, and schedule future activities and resolve problems.

C. Coordination and Scheduling

- 1. Coordinate and direct commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications, and consultations with all necessary parties.
- 2. Coordinate commissioning work with the Commissioner to ensure that commissioning activities are being scheduled into the master project schedule.
- 3. Coordinate with the Commissioner to witness tests, inspections, and systems startup.

D. Commissioning Progress

- 1. Perform site visits to observe component and system installations.
- 2. Report deficiencies to the Commissioner including but not limited to issues related adequate accessibility required for component maintenance replacement and repair.
- 3. Attend selected planning and jobsite meetings to obtain information on construction progress.
- 4. Review construction meeting minutes for revisions/substitutions relating to the commissioning process.

E. Pre-Functional Checks

- 1. Verify proper installation of components, equipment, systems and assemblies. Sampling procedures may NOT be employed on systems and equipment.

F. Equipment and System Startup and Verification



1. Review and approve component, equipment, system, and assembly startup plan developed and submitted by the Contractor.
2. Approve system startup by reviewing startup reports, if contracted; and by selected site observation.
3. Review the Testing, Adjusting and Balancing execution plan for the project, which shall be submitted by the Contractor.
4. Verify and document the accuracy of the air and water systems balancing by spot testing the air and water reported field values with Contractor and by reviewing completed reports.

**G. Functional Performance Testing**

1. With assistance from the Contractor, write Functional Performance Testing procedures for all components, equipment or systems to be commissioned.
2. With the assistance of the Contractors, coordinate Functional Performance Testing. Witness and approve Functional Performance Testing performed by the Contractors.
3. With the assistance of the Contractors, coordinate retesting as necessary until satisfactory performance is achieved.
4. Witness seasonal or deferred Functional Performance Testing as necessary.

**H. Issue/Deficiency Logs**

1. The CxA shall prepare a formal, ongoing, online record of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process.
2. Issues will be recorded on an online Commissioning Issues Log for the contractors to resolve to the satisfaction of the Commissioner. Issues will be added by the CxA. Team members are required to post their own responses to issues pertaining to their work. Team members are required to respond to issues added to the list within five (5) working days of being added by the CxA.
3. Issues will be revisited one (1) time to verify that the proper corrections have been made.
4. When issues are resolved, they will be closed on the Issues Log by the CxA

**I. Operation and Maintenance Data**

1. The CxA shall review of the documentation submitted by the Contractor as required by the Specifications for completeness and accuracy. This commissioning review supplements, but does not replace, the Commissioner's review.
2. Review equipment warranties.

**J. Instruction**

1. The Contractor will provide all documentation and qualified instruction personnel for instruction.
2. The CxA will verify through the Contractor's plan and schedule, instruction agendas, and select observations that proper instruction procedures were followed on all commissioned systems.
3. The CxA will verify that Instruction Video Recordings are executed, collected, and provided to the Commissioner.
4. See appropriate section below pertaining to instruction.

**K. Systems Manual Requirements**

1. Index of Systems Manual with notation as to content storage location if not in actual manual.
2. Executive Summary
3. A list of recommended operational record keeping procedures at the facility level, including sample forms, trend logs, or others, and a rationale for each.
4. Maintenance procedures, schedules and recommendations.



5. Ongoing Optimization
6. Other Attachments

**L. Post Occupancy Review**

1. The CxA will return to the site within the 12-month warranty period to address the following: review current building operations with facility staff and address outstanding issues related to the Commissioner's Project Requirements; Interview facility staff and identify problems or concerns with operating the building; Identify problems covered under warranty or under the original construction contract.
2. The CxA will make suggestions for improvements in the content of the O&M Manuals. Any required changes shall be made by the contractor responsible for that section.
3. The CxA shall assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

**M. Commissioning Final Report**

1. The CxA shall provide a final report following the completion of all Functional Performance Testing. The report is to outline compliance and non-compliance to the construction documents, as well as identify concerns relative to future performance.

### **3.4 TESTING PREPARATION**

- A. Certify in writing to the CxA that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### **3.5 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Electrical testing shall include the entire Electrical installation, from the incoming power equipment throughout the distribution system. Testing shall include measuring, but not limited to resistance, voltage, and amperage of system(s) and devices.



- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the contractor shall prepare detailed testing plans, procedures, and checklists for Electrical systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Commissioner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.6 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 26 sections. Provide submittals, test data, inspector record, infrared camera and certifications to the CA.
- B. Electrical Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 26 Sections "Instrumentation and Control" and "Sequence of Operations" Assist the CxA with preparation of testing plans.
- C. Emergency Generator Testing and Acceptance Procedures: Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested. –
- D. Electrical Distribution System Testing: Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested
- E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- F. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:

- 1. Automatic temperature controls integrated with the electrical systems





2. Automatic Transfer Switch
3. Emergency Generator
4. Emergency Power System
5. Uninterruptible Power Supplies
6. Motor Control Center
7. Panelboard
8. Power Distribution System
9. Switchboard
10. Transformer
11. Lighting Controls
12. Occupancy Sensors
13. Solar Photovoltaic Array Systems
14. VFDs

### **3.7 DEFICIENCIES/NON-CONFORMANCE, FAILURE DUE TO MANUFACTURER DEFECT**

#### **A. Deficiencies/Non-Conformance**

1. The CxA will record the results of the functional test on the test form. All deficiencies or non-conformance items shall be noted and reported to the Commissioner and Contractors on a standardized form.
2. The Contractor shall respond to new deficiencies within five (5) business days. The response shall either indicate the issue will be corrected with anticipated date of completion indicated or the response should clearly indicate why the Contractor disputes the claim while referencing the contract document in dispute or request further information to clarify the concern.
3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA.
4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
5. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing Contractor.
6. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it, the CxA documents the deficiency and the Contractor's response and intentions or corrections. The CxA and Contractor then proceed to another test or sequence. Once the Contractor corrects the deficiency, the test is rescheduled and repeated in the anticipation of correct operation or function.
7. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the CxA documents the deficiency and the Contractor's response. The deficiency is then forwarded to parties assumed to be responsible for the deficiency. Resolutions are made at the lowest management level possible. Other parties are brought into the discussion as needed. Final interpretive authority is with the Commissioner. Final acceptance authority is with the Commissioner and CxA. The CxA will then document the resolution process. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency. The CxA then reschedules the test as stated in the section above.

#### **B. Failure due to Manufacturer Defect**

1. If 10% or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable only by the Commissioner. In such case, the Contractor shall provide the Commissioner with the following.
  - i. Within one week of notification from the Contractor the manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Commissioner within two weeks of the original notice.



- ii. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
- iii. The Commissioner will determine whether a replacement of all identical units or a repair is acceptable.
- iv. Two examples of the proposed solution will be installed by the Contractor and the Contractor will be allowed to test the installations for up to one week, upon which the Commissioner will decide whether to accept the solution.
- v. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

### **3.8 APPROVAL**

- A. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA. The CxA recommends acceptance of each test to the Commissioner using a standard form.

### **3.9 DEFERRED TESTING**

- A. Unforeseen Deferred Testing – If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Commissioner. These tests will be conducted in the same manner as the seasonal tests, as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing – During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Contractors, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and record documents due to seasonal testing will be made by the Contractor.

### **3.10 MANUFACTURER'S MANUALS**

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in DDC General Conditions.
- B. The specific content and format requirements for the standard O&M manuals are detailed in DDC General Conditions. Special requirements for the controls contractor and TAB contractor are found in Division 26.
- C. CxA Review and Approval – Prior to substantial completion, the CxA shall review the O&M manuals, documentation and record documents for systems that were commissioned to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the Contractor, or Commissioner, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the Commissioner. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated.



### **3.11 INSTRUCTION OF NEW YORK CITY PERSONNEL**

- A. The Contractor shall be responsible for instruction coordination, scheduling, and ultimately for ensuring that instruction is completed.
- B. The CxA shall oversee the instruction of the City of New York for commissioned equipment and systems.
  - 1. The CxA shall interview the City of New York to determine the special needs and areas where instruction will be most valuable. The Commissioner and CxA shall decide how rigorous the instruction should be for each piece of commissioned equipment. The CxA shall communicate the results to the Contractor, who will in turn communicate to the subcontractors and vendors who also have instruction responsibilities.
  - 2. In addition to these general requirements, the specific instruction requirements of the City of New York by Contractors, subcontractors and vendors are specified in the individual sections listed in Section 1.2 – SUMMARY.
  - 3. Each Sub and vendor responsible for instruction will submit a written instruction plan to the Contractor for review and approval prior to instruction. The Contractor will submit one comprehensive instruction plan to the CxA and the Commissioner.
  - 4. The plan will be reviewed by the CxA and the Commissioner. Comments pertaining to its deficiencies will be forwarded to the Contractor. The instruction plan will be rewritten until approved by the CxA and the Commissioner. The final approved instruction plan will cover the following elements:
    - a. Equipment (included in instruction)
    - b. Intended audience
    - c. Location of instruction
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of instruction on each subject
    - g. Qualified instructor for each subject
    - h. Instructor qualifications
    - i. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
  - 5. For the primary equipment, the Contractor shall provide a discussion of the control of the equipment during the instruction conducted by each subcontractor or vendor.
  - 6. Instruction documentation shall include the following items:
    - a. Copy of the instruction plan, including schedule, syllabus, and agenda.
    - b. Copy of the Commissioner's Project Requirements.
    - c. Copy of the Basis of Design.
    - d. Compiled operations manuals.
    - e. Compiled maintenance manuals.
    - f. Completed manufacturer instruction manuals.
    - g. Red-lined drawings.
    - h. Other pertinent documents.
  - 7. The CxA develops criteria for determining that the instruction was satisfactorily completed, including attending some of the instruction, etc. The CxA recommends approval of the instruction to the Commissioner using a standard form. The Commissioner signs the approval form/letter template.



8. At one of the instruction sessions, the CxA presents a presentation discussing the use of the blank functional test forms for re-commissioning equipment
9. Videotaping of the instruction sessions in DVD format will be provided by the CxA.

**3.12 FUNCTIONAL BUILDING SYSTEMS DEMONSTRATION TEST (72 HOURS)**

- A. Refer to Addendum to the General Conditions Section “General Commissioning Requirements” for requirements pertaining to 72-Hour Functional Building Systems Demonstration Testing.

**END OF SECTION 260800**

## **SECTION 26 09 43**

### **LIGHTING CONTROL SYSTEM**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

##### **1.2 SUMMARY**

- A. Types: Types of control systems in this Section shall include the following:
  - 1. Architectural lighting control systems
  - 2. Auxiliary equipment and control systems associated with lighting
- B. Related Sections: Provide a system in accordance with the requirements specified under this section, as shown on the Contract Drawings and as required for the lighting system to comply with 2014 New York City Electrical Code. Refer to the following sections for related requirements:
  - 1. Section 23 09 00 "HVAC Instrumentation and Controls"
  - 2. Section 26 05 53 "Identification for Electrical Systems"
  - 3. Section 26 05 00 "Common Requirements for Electrical Work"
  - 4. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables"
  - 5. Section 26 05 33 "Raceway and Boxes for Electrical Systems"
  - 6. Section 26 08 00 "Commissioning of Electrical"
  - 7. Section 26 24 13 "Panelboards."
  - 8. Section 26 27 26 "Wiring Devices"
  - 9. Section 26 51 00 "Interior Lighting" and
  - 10. Section 26 56 00 "Exterior Lighting."
- C. The extent of lighting control work includes, but is not limited to, the furnishing and installation of all lighting control components into complete and working lighting control systems as specified in this section, on the drawings, and as required by job conditions. System components include, but are not limited to:
  - 1. Factory pre-assembled and pre-wired networkable lighting control panelboards for dimmed control of 0-10VDC dimmed and switching control of non-dimmed loads.
  - 2. Control stations, including wall mounted low voltage remote controls.
  - 3. Control system network low voltage wiring and/or fiber cabling for interconnection of lighting control panelboards, remote switches and master control stations.
  - 4. Photosensor(s) and timeclock(s) for operation of selected circuits.
  - 5. Permanently installed terminal(s) and master control stations for system programming and feedback.
  - 6. Control system shall be suitable to integrate with the Niagara AX Framework.
  - 7. Conformance: System shall be manufactured in strict accordance with the Contract Drawings and Specifications.
  - 8. Important: Information regarding circuit designation, sizes and quantities is indicated elsewhere. Circuiting indicated in this section is included only to specify dimmer sizes and

control capacities. Do not use this information for sizing branch circuit breaker panelboards, wiring or any other work not included in this section.

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – Construction Waste Management and Disposal
  - 2. Section 01 81 13 – Sustainable Design Requirements for LEED Buildings
  - 3. Section 01 81 19 – Indoor Air Quality Requirements for LEED Buildings
- C. LEED Building Performance Requirements: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "Indoor Air Quality Management", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

### 1.4 LEED BUILDING SUBMITTALS

- A. LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

### 1.6 SUBMITTALS

- A. Product Data: Provide catalog cut sheets for each type of product indicated. Catalog submittals lacking sufficient detail to indicate compliance with contract documents shall not be acceptable.
- B. Shop Drawings: Submit dimensioned drawings of control system components. Submit shop drawings with proposed component and accessories clearly indicated on each sheet. Shop drawings must be submitted for review before fabrication. Fabrication details may vary slightly from those shown on drawings provided those changes do not adversely affect ease of installation, durability, performance or suitability.
- C. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
  - 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements in complete facility floor plans indicating location of all components raceways and wiring of the lighting control system.
  - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components.

3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
- D. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
  2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
  3. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.
- E. Provide a load schedule which indicates the actual connected load and load type per circuit, circuits and their respective control zones, circuits that are on emergency, and the capacity, phase, and corresponding circuit numbers (per the electrical drawings).
- F. Manuals: Prior to final inspection, provide six (6) complete sets of operating and maintenance manuals. Include technical data sheets and parts ordering information. Include testing and maintenance requirements and instructions for emergency transfer components.
- G. Shop drawings shall be submitted in reproducible form. Fixture fabrication details shall be drawn at either full size or half size scale. Fabrication details shall illustrate a minimum of three (3) critical views indicating all fabrication and assembly methods, materials, material gauges and finishes to be employed.
- H. Catalogue submittals lacking sufficient detail to indicate compliance with contract documents shall not be acceptable.
- I. Complete facility floor plans indicating location of all components raceways and wiring of the lighting control system.
- J. Refer to control intent diagram for occupancy sensor/photocell sensor intent. Submit complete occupancy sensor/photocell sensor layout.

#### 1.7 QUALITY ASSURANCE

- A. All lighting control systems and components and sub-components shall be manufactured, furnished and installed in compliance with the requirements of 2014 New York City Construction Codes and the Fire Department of New York. All fixtures shall bear the appropriate UL (or ETL) and IBEW identifications. Panelboards and integral Lighting Control Chassis are to be UL listed under UL 916 Energy Management Equipment, UL 67 Panelboard Interiors and UL 5 panelboard box.
1. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
  2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to New York City Department of Buildings, and marked for intended use.
  3. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- B. Manufacturers: The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment

provided by the manufacturer must have been in satisfactory service for not less than five (5) years.

- C. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code," 2017 as applicable to construction and installation of interior building lighting fixtures and emergency lighting.
- D. Regulatory Requirements: Cabinets and all related switch components and subsystems shall comply with the following regulatory requirements.
  - 1. National Electric Code (N.E.C) Article 100 2017
  - 2. National Electrical Manufacturer's Association (N.E.M.A)
  - 3. Underwriter's Laboratories, Inc. (UL) or (ETL)
  - 4. 2014 New York City Construction Codes
- E. Regulatory Requirements: Cabinets and all related components and subsystems shall comply with regulatory requirements including NFPA 70 National Electric Code (NEC), NFPA 110 – Emergency and Standby Power systems, National Electrical Manufacturer's Association (N.E.M.A), NEMA ICS 10 – AC Transfer Switch Equipment, Underwriter's Laboratories, Inc. (UL) or (ETL), UL924- EM Bypass Relays, as well as 2014 New York City Electrical Code.
- F. Manufacturers: All manufacturers must comply with the following:
  - 1. Refer to Quality Assurance Requirements and DDC General Conditions.
  - 2. Samples: Upon request, Manufacturers shall submit a prototype sample of each control station for review by the Commissioner. Prototype control station samples shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.
  - 3. Single Line Diagrams: All manufacturers' control system submission must include a single line diagram for all key project areas both interior and exterior demonstrating understanding of all critical project requirements as identified in the Contract Documents.
- G. All major system components for products specified in this section shall be manufactured and supplied by one company.
- H. Manufacturer shall have their quality system registered to the ISO 9001 Quality Standard.
- I. Lighting control system shall meet IEC801-2, tested to withstand a 15kV electrostatic discharge without damage or loss of memory.

## 1.8 COORDINATION

- A. Coordinate lighting controls. Design display graphics showing building areas controlled by this system; include the status of lighting controls in each area.
- B. Coordinate lighting control components specified in this Section with components specified in Section 26 24 13 "Panelboards".
- C. Coordinate general and electrical trades in terms of installation sequencing and installation of site lighting control equipment to be located in buildings. See Electrical Drawings.

## 1.9 MANUFACTURER'S WARRANTY



- A. **Manufacturer's Warranty:** Manufacturer's standard form in which manufacturer agrees to restore or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
    1. Failures include, but are not limited to, the following:
      - a. Software: Failure of input/output to execute switching commands.
      - b. Failure of modular relays to operate under manual or software commands.
      - c. Damage of electronic components due to transient voltage surges.
  - B. **Warranty Period:** Bear all expenses to restore or replace malfunctioning parts for five (5) years from date of substantial completion.
    1. **Extended Warranty Period:** Expenses of replacement parts that failed in service due to transient voltage surges (in-panel transient surge suppression device rated for 5A at 277VAC) (materials only, f.o.b. the nearest shipping point to Project site) for eight years
    2. **Extended Warranty Period:** Expenses to restore or replace electrically / mechanically held relays for 10 years from date of Substantial Completion.
  - C. **Extended Warranty Period:** Expenses of replacement parts that failed in service due to transient voltage surges (in-panel transient surge suppression device rated for 5A at 277VAC) (materials only, f.o.b. the nearest shipping point to Project site) for eight years.
  - D. **Extended Warranty Period:** Expenses to restore or replace electrically / mechanically held relays for 10 years from date of final written acceptance by the Commissioner
  - E. Warranty shall ensure that the Lighting Control System manufactured and supplied will be the kind and quality described in the specification and will be free of defects in workmanship and material.
- 1.10 **TECHNICAL AND ADMINISTRATIVE REQUIREMENTS**
- A. Ensure that the lighting control system manufacturer shall keep on file and make available for review by the Commissioner complete Quality Control and Quality Assurance records for all phases of production for all lighting equipment to be supplied under this project.
  - B. Submit for review itemized (line item) unit equipment expenses for all equipment to be provided under the Scope of this Contract.
  - C. The Contractor shall be solely responsible for coordinating and expediting the timely procurement and delivery for the lighting control system, equipment and related components for the project.
  - D. Specifications and drawings are intended to convey the salient features, function and character of the control system only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings nor specified, but that are necessary or normally required for the proper execution, completion, installation and operation of the control systems shall be included, the same as if they were herein specified or indicated on the drawings.
  - E. The Commissioner shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be normally required in the production of the lighting control equipment. The full and complete responsibility for accurately fabricating and providing the control systems described herein to the fulfillment of those specifications shall rest solely with the Contractor and the control system manufacturer.

#### 1.11 SAMPLES

- A. Submit for review one representative sample of each lighting control station required under this Contract. After sample acceptance, the control station shall be sent to the project for final installation. In the event the submission is rejected, the control station will be returned to the manufacturer who shall immediately make a new submission which meets the contract requirements.
- B. Shipping: The samples must be actual working devices to be supplied and shall be submitted complete, ready for energizing and examining and shall be shipped (prepaid) by Contractor to the Commissioner or as otherwise specified or directed by Commissioner.

#### 1.13 PROJECT/SITE CONDITIONS

- A. The lighting controls must operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F) and 90% non-condensing relative humidity without the requirement of a regularly scheduled maintenance program for air filtration components. Where lighting control equipment is to be located outdoors, such equipment must be housed in an approved NEMA 4X rated temperature and humidity regulated enclosure to be provided by the Contractor. Provide to the Commissioner cutsheets of enclosure and air conditioning/heating unit for review and consideration.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following (listed alphabetically):

- |                                    |                            |
|------------------------------------|----------------------------|
| 1. Acuity Brands New York Digital: | New York, NY 212-462-0088  |
| 2. Eaton:                          | Cleveland, OH 800-386-1911 |
| 3. ETC Architectural:              | New York, NY 212-397-8080  |
| 4. Or approved equal.              |                            |

#### 2.2 FUNCTIONAL SYSTEM DESCRIPTION

- A. General
  - 1. The lighting control system is a networked system that shall be compatible with a Niagara AX Framework. The system must be able to communicate with fully digital centralized relay panels, dimming relay panels, digital switches, photocells, various interfaces and shall include all operational software. The intent of the specification is to integrate all lighting control into one system, except for areas controlled by a single motion sensor such as rooms with a single luminaire. Lighting control system shall include all hardware and software. Software to be resident within the lighting control system. System shall provide local access to all programming functions at the master LCP and remote access to all programming functions via dial up modem and through the Niagara AX Framework. Desktop computers are not part of this section and will be provided by others.
  - 2. System software shall provide real time status of each relay, each zone and each group.
  - 3. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable.



4. All programs, schedules, time of day, etc., shall be held in non-volatile memory for a minimum of 10 years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
5. System shall be capable of flashing lights Off/On any relay or any zone prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.
6. The lighting control system shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem and via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback. Lighting control panels shall be able to be programmed and managed through a Niagara AX graphical user interface, which will be accessible utilizing a standard web browser by any authorized individual with the proper security credentials.
7. System may consist of centralized or distributed relays, dimmers, digital switches, photocells, and various digital interfaces. Verify exact components specified. All control devices shall communicate as one network via RS485. Global functionality relative to the lighting control system, such as building schedules, data logging, and alarm configuration will reside on the Niagara AX network, and will be accessible and fully configurable from a web page.
8. All software required for network programming and configuration will be resident on the Niagara AX manager, eliminating the need for manufacturer specific software, and a dedicated PC. The software shall be licensed to and shall be fully accessible via a standard browser as noted above.
9. Lighting control system start-up and initial programming of lighting control system software shall be provided by a technician authorized by the lighting controls manufacturer. Niagara AX integration & programming shall be provided by BMS manufacturer or the Contractor.
10. Contractor to provide stainless steel coverplates for all manual switches. Multi-gang switch stations should be grouped under a single stainless steel coverplate.

## 2.3 SYSTEM PERFORMANCE REQUIREMENTS

### A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (1) networkable intelligent lighting control devices, (2) standalone lighting control zones using distributed intelligence, (3) optional system backbone for remote, time based and global operation between control zones.
2. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
3. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for each type of network connection, wired or wireless).
4. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy



and/or photocell) and manual control from local wallstations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”

Lighting control zones (wired and wireless) of at least 128 devices per zone shall be supported.

5. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type.
6. Networked luminaires and intelligent lighting control devices shall support individual (unique) configuration of device settings and properties.
7. Networked luminaires and intelligent lighting control devices shall have distributed intelligence programming stored in non-volatile memory such that following any loss of power the lighting control zones shall operate according to their defined default settings and sequence of operations.
8. Lighting control zones shall be capable of being networked with a higher-level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software interface.
9. The system may include one or more system controllers that provide time-based control and global system control across multiple control zones and backbone network segments. The system controller also provides a means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP protocol.
10. The system may include “communication bridge” devices that route communication from lighting control zones (wired or wireless) to and from the system controller, for purposes of decreasing system wiring requirements.
11. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.

**B. Wired Networked Control Zone Characteristics**

1. Connections to devices within a wired networked lighting control zone and to backbone components shall be with a single type of low voltage network cable, which shall be compliant with CAT5e specifications or higher. To prevent wiring errors and provide expenses savings, the use of mixed types of low voltage network cables shall not be permitted.
2. Devices in an area shall be connected via a “daisy-chain” topology; requiring all individual networked devices to be connected back to a central component in a “hub-and-spoke” topology shall not be permitted, so as to reduce the total amount of network cable required for each control zone.
3. System shall provide the option of having pre-terminated plenum rated low voltage network cabling supplied with hardware so as to reduce the opportunity for improper wiring and communication errors during system installation.
4. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
5. Once software is installed, system shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
6. All networked devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup staff.
7. Networked control devices intended for control of egress and/or emergency light sources shall not require the use of additional, externally mounted UL924 shunting and/or 0-10V disconnect devices, so as to provide a compliant sequence of operation while reducing the



overall installation and wiring expenses of the system. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:

- a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
- b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.

**C. Supported Sequence of Operations**

1. The following characteristics and performance requirements shall apply to wired and wireless control zones provided by the system.
2. Control Zones
  - a. Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) shall be capable of transmitting and tracking occupancy sensor, photocell sensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within the area. These shall also be referred to as local control zones.
  - b. Networked luminaires and intelligent lighting control devices located in different areas shall be able to transmit and track occupancy, photocell, and switch information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. These shall also be referred to as global control zones.
3. Wallstation Capabilities  
Wallstations shall be provided to support the following capabilities:
  - a. On/Off of a local control zone and global control zone simultaneously, as required.
  - b. Continuous dimming control of light level of a local control zone and global control zone simultaneously, as required.
  - c. Preset Scenes that can activate a specific combination of light levels across multiple local and global channels, as required.
  - d. Profile Scenes that can modify the sequence of operation for the devices in the area (group) in response to a button press. This capability is defined as supporting "Local Profiles" and is used to dynamically optimize the occupant experience and lighting energy usage. Parameters that shall be configurable and assigned to a Local Profile include light level, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wallstations.
  - e. 3-way / multi-way control: multiple wallstations shall be capable of controlling the same local and global control zones, so as to support "multi-way" switching, dimming, preset scene, and profile scene control.
  - f. Electrical contractor to provide low-voltage Panic Push Button (in red color) per specification for connection to dry-contact input on lighting control system to manually activate Disorder Control Lights.
4. Occupancy Sensing Capabilities
  - a. Local and global control: Occupancy sensors shall be configurable to control a local and global zone simultaneously, as required.



- b. Multi-sensor control: multiple occupancy sensors shall be capable of controlling the same local and global control zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zone addresses.
  - c. System shall support the following types of occupancy sensing sequence of operations:
    - i. On/Off Occupancy Sensing
    - ii. Partial-On Occupancy Sensing
    - iii. Partial-Off Occupancy Sensing
    - iv. Vacancy Sensing (Manual-On / Automatic-Off)
  - d. On/Off, Partial-On, and Partial-Off Occupancy Sensing modes shall function according to the following sequence of operation:
    - i. Occupancy sensors automatically turn lights on to a designated level when occupancy is detected. To support fine tuning of Partial-On sequences the designated occupied light level shall support at least 100 dimming levels.
    - ii. Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. To support fine tuning of Partial-Off sequences the designated unoccupied dim level shall support at least 100 dimming levels.
    - iii. To provide additional energy savings the system shall also be capable of combining Partial-Off and Full-Off operation by dimming the lights to a designated level when vacant and then turning the lights off completely after an additional amount of time.
    - iv. Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under Photocell Sensing Capabilities.
    - v. The use of a wallstation shall change the dimming level or turn lights off as selected by the occupant. The lights shall remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
5. Vacancy Sensing mode (also referred to as Manual-On / Automatic-Off) shall function according to the following sequence of operation:
- a. The use of a wallstation is required turn lights on. The system shall be capable of programming the zone to turn on to either to a designated light level or the previous light level. Initially occupying the space without using a wallstation shall not result in any change in light level.
  - b. Occupancy sensors shall automatically turn lights off when vacancy occurs is detected. To provide an enhanced occupant experience the system shall also be capable of dimming the lights when vacant and then turning the lights off completely after an additional amount of time.
  - c. To minimize occupant impact in case the area or zone is still physically occupied following dimming or shutoff of the lights due to detection of vacancy, the system shall support an “automatic grace period” immediately following detection of vacancy, during which time any detected occupancy shall result in the lights reverting to the previous level. After the grace period has expired, the use of a wallstation is required to turn lights on.
  - d. Photocell readings, if enabled in the Occupancy Sensing control zone, shall be capable of automatically adjusting the light level as necessary to further reduce energy usage. Additional requirements and details for photocell sensing capabilities are indicated under Photocell Sensing Capabilities.



- e. At any time, the use of a wallstation shall change the dimming level or turn lights off as selected by the occupant. The lights shall remain in this manually-specified light level until the zone becomes vacant; upon vacancy the normal sequence of operation, as defined above, shall proceed.
  - f. To accommodate different types of environments, vacancy time delays before dimming or shutting off lights shall be specifiable for control zones between 15 seconds to 2 hours.
- 6. Photocell Sensing Capabilities (Automatic Daylight Sensing)
  - a. Photocell sensing devices shall be configurable to control a local and global zone simultaneously, as required.
  - b. The system shall support the following types of photocell-based control:
    - i. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
    - ii. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.
- 7. Schedule and Global Profile Capabilities
  - a. The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, RS-232/RS-485 command, BACnet input command, and demand response signal. This capability is defined as supporting "Global Profiles" and is used to dynamically optimize the occupant experience and lighting energy usage.
  - b. Scheduling. Global profiles may be scheduled with the following capabilities:
    - i. Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
    - ii. Global Profile time of day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after "n" recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
    - iii. Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
    - iv. Blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible "blink warning" 5 minutes prior to the end of the schedule. Wallstations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.
    - v. Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.
  - c. System Global Profiles shall have the following additional capabilities:



- i. Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed input devices, and software management interface.
    - ii. Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.
    - iii. Parameters that shall be configurable and assigned to a Global Profile include light level, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wallstations.
  - d. A backup of Local and Global Profiles shall be stored on the software's host server such that the Profile backup can be applied to a replacement system controller or wallstation.
8. Automated demand response capabilities. Profiles created for automated demand response events shall support automatic reduction of light level to programmable values. At least four levels of demand response profiles shall be supported by the system.

## 2.4 SYSTEM SOFTWARE INTERFACES

### A. Historical Database and Analytics Interface

1. System shall provide a historical database that stores device operational history and calculates energy usage for all networked luminaires and intelligent control devices.
2. System shall be capable of reporting lighting system events and performance data back to the historical database for display and analysis.
3. Historical database shall be capable of recording historical data for up to 20,000 networked devices for a period of at least 1 calendar year.
4. An "Energy Scorecard" shall be displayed that shows calculated energy savings in dollars, kWh, or CO<sub>2</sub>.
5. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc.).
6. Energy savings data shall be calculated for the system as a whole or for individual zones.
7. A time scaled graph showing all relay transitions shall be presented.
8. A time scaled graph showing a zones occupancy time delay shall be presented
9. A time scaled graph showing the total light level shall be presented.
10. User shall be able to customize the baseline run-time hours for a space.
11. User shall be able to customize up to four time-of-day billing rates and schedules.
12. Historical data shall be exportable from the Historical Database via a "CSV" type of file format.

### B. Visualization Interfaces

1. System shall provide a web-based visualization interface that displays graphical floorplan.
2. Graphical floorplan shall offer the following types of system visualization:
  - a. Full Device Option - A master graphic of the entire building, by floor, showing each control device installed in the project with zones outlined to include but not be limited to the following:
    - i. Controls embedded light fixtures
    - ii. Controls devices not embedded in light fixtures
    - iii. Daylight Sensors
    - iv. Occupancy Sensors
    - v. Wall Switches and Dimmers
    - vi. Scene Controllers
    - vii. Networked Relays





- viii. Bridges
- ix. System Controllers
- x. Panels
- xi. Zone outlines
- b. Zone Only Option - A master graphic of the entire building, by floor, showing control zones:
  - i. Zones outlined
- c. Allow for pan and zoom commands so smaller areas can be displayed on a larger scale simply by panning and zooming each floor's master graphic.
- d. A mouse click on any control device shall display the following information (as applicable):
  - i. The device catalog number.
  - ii. The device name and custom label.
  - iii. Device diagnostic information.
  - iv. Information about the device status or current configuration is available with an additional mouse click.

**C. Personal Control Applications**

- 1. Software interface shall support personal control software applications that provide user-specific control of individual luminaires, control zones, and scene presets.
- 2. Personal control applications shall support control of dimming output or definition of dimming presets for luminaires and devices that are dimmable.
- 3. The system administrator shall be capable of defining personal control permissions for each user account.
- 4. Software interface shall provide a Microsoft Windows operating system taskbar application for personal lighting control.
- 5. Software interface shall provide an Apple iOS operating system application (supported by mobile phones and mobile tablet devices) for personal lighting control.

**D. Smartphone Programming Interface for Wired Devices**

- 1. Application interface shall be provided for both Apple iOS and Android operating systems that allows configuration of lighting control settings.
- 2. The application shall support the configuration of wired networked control devices via a Bluetooth Low Energy (BLE) Programming Device.
  - a. Application shall support a security pin-code to access the zone of lighting control devices.
  - b. The application shall provide indication of signal strength where multiple Bluetooth Low Energy Programming Devices are available for configuration.
  - c. The application shall indicate the number of wired networked control devices. The application shall indicate the number of wired networked control devices.
- 3. Programming capabilities through the application shall include, but not be limited to, the following:
  - a. Switch/occupancy/photosensor group configuration
  - b. Manual/automatic on modes
  - c. Turn-on dim level
  - d. Occupancy sensor time delays
  - e. Dual technology occupancy sensors sensitivity
  - f. Trim level settings

## 2.5 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

### A. Network System Controller

1. System Controller shall be multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall have 32-bit microprocessor operating at a minimum of 1 GHz.
3. System Controller shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases.
4. System Controller shall perform the following functions:
  - a. Facilitation of global network communication between different areas and control zones.
  - b. Time-based control of downstream wired and wireless network devices.
  - c. Linking into an Ethernet network.
  - d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
  - e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
5. System Controller shall have an integral web server to support configuration, diagnostics and hosting of software interfaces.
6. Device shall have option for a graphical touch screen to support configuration and diagnostics.
7. Device shall have three RJ-45 networked lighting control ports for connection to any of the following:
  - a. The graphical touch screen
  - b. Wired communication bridges
  - c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port)
8. Device shall be capable of communicating with wireless mesh network bridges and software interfaces via LAN connection.
9. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
10. Device shall have a standard internal time clock.
11. Device shall have 2 switched RJ-45 10/100 BaseT Ethernet ports for local area network (LAN) connection
  - a. Ethernet connection shall support daisy chain wiring to other lighting control system LAN devices, such as other system controllers and wireless mesh networked communication bridges.
  - b. Ethernet connection shall support IPv4 and shall be capable of using a dedicated static or DHCP assigned IP address.
12. Device shall have 2 x USB 2.0 Expansion ports for
  - a. 802.11 Wi-Fi Adapter enabling wireless connectivity including:
    - i. Hot Spot
    - ii. Access Point
    - iii. Client
    - iv. Spanning Tree Protocol



13. Each System Controller shall be capable of managing and operating at least 1500 networked devices (wired or wireless).
  - a. Multiple System Controllers may be networked together via LAN connection to scale the system up to 20,000 networked devices.
14. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
  - a. BACnet/MSTP shall support up to minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
  - b. BACnet/MSTP shall support 9600 to 115200 baud.
  - c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
15. Shall contain a “FIPS 140-2 Level 1 Compliant” cryptographic module.

## 2.6 WIRED NETWORK DEVICES

### A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. All switches shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
4. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
5. Devices with mechanical push-buttons shall be made available with custom button labeling.
6. Wall switches & dimmers shall support the following device options:
  - a. Number of control zones: 1, 2 or 4
  - b. Control Types Supported: On/Off or On/Off/Dimming
  - c. Colors: Ivory, White, Light Almond, Gray, Black, Red
7. Scene controllers shall support the following device options:
  - a. Number of scenes: 1, 2 or 4
  - b. Control Types Supported:
    - i. On/Off
    - ii. On/Off/Dimming
    - iii. Preset Level Scene Type
    - iv. Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
    - v. Selecting a lighting profile to be run by the system’s upstream controller so as to implement a selected lighting profile across multiple zones
    - vi. Colors: Ivory, White, Light Almond, Gray, Black, Red

### B. Wired Networked Graphic Wall Stations

1. Device shall surface mount to single-gang switch box.
2. Device shall have a 3.5” full color touch screen.
3. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
4. Device shall have a micro-USB style connector for local computer connectivity.
5. Communication shall be over standard low voltage network cabling with RJ-45 connectors.



6. Device shall enable user supplied screen saver image to be uploaded within one of the following formats: jpg, png, gif, bmp, tif.
7. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
8. Graphic wall stations shall support the following device options:
  - a. Number of control zones: Up to 16
  - b. Number of scenes: Up to 16
  - c. Colors: Ivory, White, Light Almond, Gray, Black

**C. Wired Networked Auxiliary Input / Output (I/O) Devices**

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½ in knockout.
2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
3. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
  - a. Contact closure input
    - i. Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
  - b. 0-10V analog input
    - i. Input shall be programmable to function as a daylight sensor.
  - c. RS-232/RS-485 digital input
    - i. Input supports activation of local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
  - d. 0-10V dimming control output, capable of sinking up to 20mA of current
    - i. Output shall be programmable to support all standard sequence of operations supported by system.

**D. Wired Networked Occupancy and Photosensors**

1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR / Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR / Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive, meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.



7. All sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  8. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
  9. Network system shall have ceiling, fixture, recessed & corner mounted sensors available, with multiple lens options available customized for specific applications.
  10. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
  11. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
  12. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
  13. Photosensor shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
  14. Photosensor and dimming sensor’s set-point and deadband shall be automatically calibrated through the sensor’s microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.
  15. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
  16. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The secondary daylight zone shall be capable of being controlled as an “offset” from the primary zone.
- E. Wired Networked Wall Switch Sensors
1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
  2. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
  3. All wall switch sensors shall have the ability to detect when it is not receiving valid communication and blink its LED in a pattern to visually indicate a potential wiring issue.
  4. Devices with mechanical push-buttons shall provide tactile user feedback.
  5. Wall switches sensors shall support the following device options:
    - a. User Input Control Types Supported: On/Off or On/Off/Dimming
    - b. Occupancy Sensing Technology: PIR only or Dual Tech acoustic
    - c. Daylight Sensing Option: Inhibit Photosensor
    - d. Colors: Ivory, White, Light Almond, Gray
- F. Wired Networked Embedded Sensors
1. Network system shall have embedded sensors consisting of occupancy sensors and/or dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
  2. Occupancy sensor detection pattern shall be suitable for 7.5 ft. to 20 ft. mounting heights. USC
  3. Embedded sensors shall support the following device options:
    - a. Occupancy Sensing technology: PIR only or Dual Tech acoustic
    - b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
- G. Wired Networked Power Packs and Secondary Packs



1. Power Packs shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC) and carry a plenum rating.
3. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power.
4. Power Supplies shall provide system power only, but are not required to switch line voltage circuit.
5. Auxiliary Relay Packs shall switch low voltage circuits only, capable of switching 1 amp at 40 VAC/VDC (resistive only).
6. Communication shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors. Secondary packs shall receive low voltage power via standard low voltage network cable.
7. Power Pack programming parameter shall be available and configurable remotely from the software and locally via the device push-button.
8. Power Pack shall securely mount to junction location through a threaded ½ in chase nipple or be capable of being secured within a luminaire ballast/driver channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
9. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
10. Power/Secondary Packs shall be available with the following options:
  - a. Power Pack capable of full 16-Amp switching of all normal power lighting load types, with optional 0-10V dimming output capable of up to 100mA of sink current.
  - b. Secondary Pack with UL924 listing for switching of full 16-Amp Emergency Power circuits, with optional 0-10V dimming output capable of up to 100mA of sink current.
  - c. Power and Secondary Packs capable of full 20-Amp switching of general purpose receptacle (plug-load) control.
  - d. Secondary Pack capable of full 16-Amp switching of all normal power lighting load types.
  - e. Secondary Pack capable of 5-Amps switching and dimming 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
  - f. Secondary Pack capable of 5-Amps switching and dimming of 120/277 VAC magnetic low voltage transformers.
  - g. Secondary Pack capable of 4-Amps switching and dimming of 120 VAC electronic low voltage transformers.
  - h. Secondary Pack capable of louver/damper motor control for skylights.
  - i. Secondary Pack capable of providing a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
  - j. Secondary Pack capable of switching 1 amp at 40 VAC/VDC (resistive only) with the intent to provide relay signal to auxiliary system (e.g. BMS).
  - k. Power Supply capable of providing auxiliary bus power (no switched or dimmed load).

**H. Wired Networked Communication Bridge**

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.



3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply, or powered via low voltage network connections from powered lighting control devices (e.g. power packs).
5. Wired Bridge shall be capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

## 2.7 TOUCH PANEL CONTROLS

### A. Touch Screen Control Station

### B. Preset lighting scene controller

1. General Requirements:
  - a. 7" full color multi-touch capacitive touchscreen for controlling lighting and system components
  - b. Control up to 65,000 zones of lighting/shades per system
  - c. Control up to 72 lighting channels/scenes per touch screen that include on/off, dimming, tunable white, RGB, and/or shade control
  - d. Link up to 24 touch screens for a possibility of 864 lighting zones/scenes
  - e. Connect up to 128 network devices per touch screen
  - f. On screen lighting design
  - g. Lighting zones/scenes can be comprised of lighting intensity, color, color temperature, and luminaire position
  - h. Modify color and color temperature using a digital color palette and dUV rating scale
  - i. Proximity screen sensor for auto "wake-up"
  - j. Auto dimming and user adjustable backlight
  - k. User programmable screen lock limiting access to all feature control and programming
  - l. Full alpha-numeric scene and zone naming
  - m. Configurable interface to reflect project requirements
  - n. Lighting zones/scenes support control of forward/reverse phase dimming, 0-10v, RGB, certain types of control enabled luminaires, DMX, DALI, tunable white and moving fixtures
  - o. Integral astronomical time clock enables lighting scenes
  - p. Partition status control and visualization
  - q. Direct DMX control for a single universe (512 slots)
  - r. Connect up to 128 enabled devices
  - s. Digital motion sensor control
  - t. Digital daylight harvesting response
  - u. RS-232/contact closure capable for 3rd party integration
  - v. Local wireless Bluetooth connectivity with mobile app
  - w. Compatible with Fresco Lighting Management Panels (LMP)
  - x. Frame Color: White
2. Electrical:
  - a. Fresco Input: 24VDC
  - b. Fresco Power Supply: 120-277V AC
  - c. RS-485 network terminal
  - d. RJ-45 ports (in/out)
  - e. CAT5e Ethernet network terminal
  - f. (DMX/RDM network terminal)



3. Mounting:
  - a. Installs in a standard triple gang US back box
  - b. Remote mounted power supply
  - c. Plug in wire harness for RS-485 and DMX connections
4. Protocols:
  - a. RS-485
  - b. IEEE 802.15 Bluetooth compliant
  - c. (Controller is compliant to industry standard ANSI E1.11 - 2008, USITT DMX512-A)
  - d. (Supports extended RDM capability as defined by ANSI E1.20)
  - e. IEEE 802.11 Ethernet compliant
  - f. Network digital communication
  - g. BACnet/IP ISO 16484-5

## 2.8 MOBILE CONTROL

- A. iPad Device Application
- B. Allows mobile control and programming of the Touchscreen Controller
  1. General requirements:
    - a. Mobile Apple device supports Bluetooth communication protocol
    - b. Provides user control and edit capability of lighting scenes and zones
    - c. Edit intensity, color, color temperature, and movement
    - d. Edit lighting schedules
    - e. Restrict number of users able to connect to touchscreen
    - f. Restrict access to making system changes
    - g. No PC required for mobile operation

## 2.9 SYSTEM DESIGN CRITERIA

- A. See electrical drawings for location of all panelboards and devices.
- B. The number of circuits and control groups, as well as type of control shall be as indicated on the electrical drawings. All controls shall be remote as described in the specifications.
- C. System shall consist of:
  1. Relay Panel
  2. Dimming Interface
  3. Photocell
  4. Occupancy Sensor
  5. Master Control Station
  6. Remote Station
- D. The system shall be designed to control the building's exterior and interior lighting fixtures and provide a link to BMS and Fire Alarm Control Panel to monitor the status of each of the buildings lighting areas.

The following types of control will be required:

1. Site:
  - a. General: All lights control by photocell and astronomical timeclock override (except





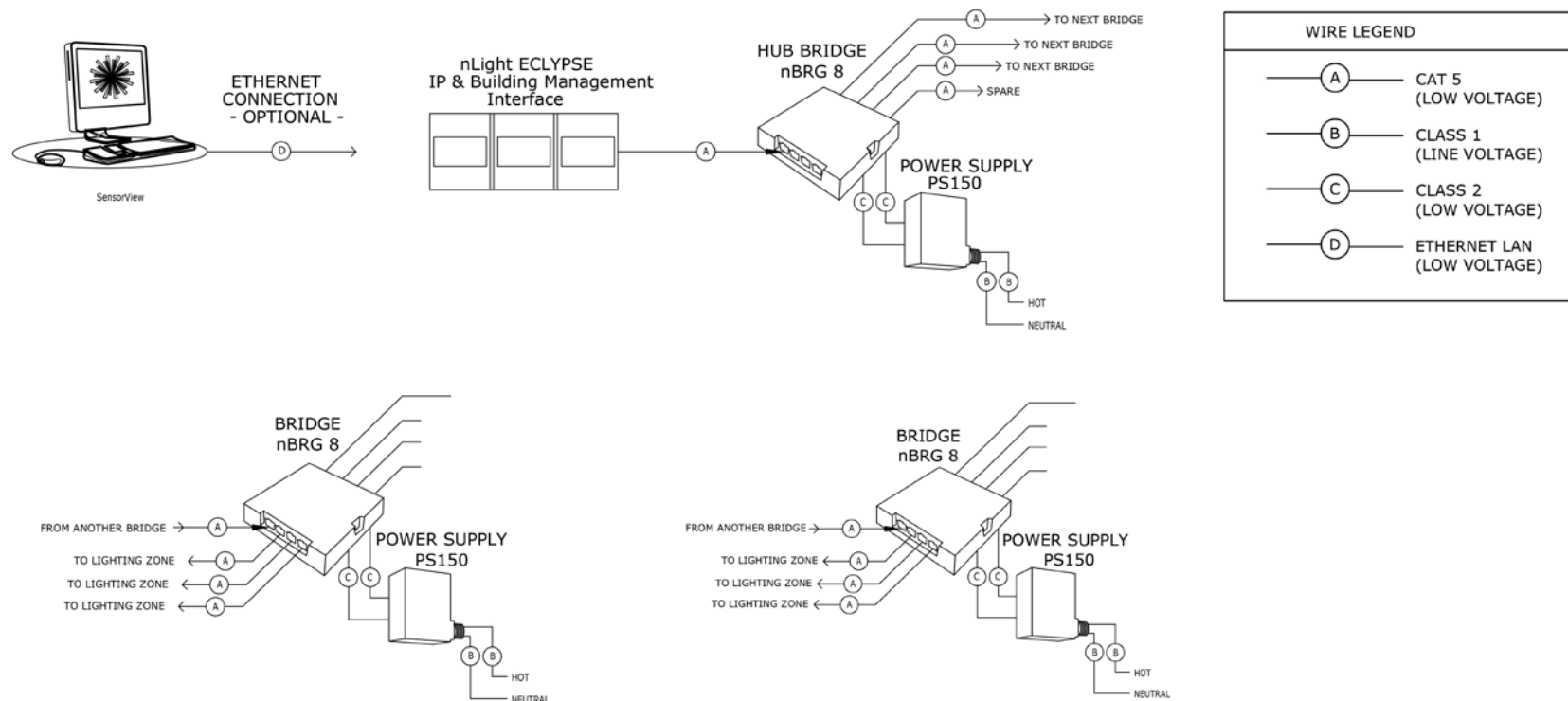
- the disorder control lights)
- b. Disorder Control Lights: Control by Push Bottom (locate at the 1<sup>st</sup> FL Main Desk Area).

2. Interior Spaces:

- a. All interior lights connect to EM Generator.
- b. 1<sup>st</sup> FL Vestibule & Entry/Lobby: Daylight dimming and local switch override.
- c. 1<sup>st</sup> FL Reception: Local dimmer switch override
- d. Lightwell above Main Desk Area: Daylight dimming and local dimmer switch override
- e. Corridor (Typical): Occupancy sensor with dimming
- f. Stairway (Typical): Occupancy sensor with dimming
- g. 1<sup>st</sup> FL Community Room: Daylight dimming, occupancy sensor with dimming and local dimmer switch override
- h. 1<sup>st</sup> FL Muster/Community Training Room: Occupancy sensor with dimming and local dimmer switch override
- i. Conference Room (Typical): Vacancy sensor and local dimmer switch override
- j. 2<sup>nd</sup> FL Staff Lounge: Occupancy sensor with dimming
- k. Offices with Exterior Windows (Typical): Daylight dimming, vacancy sensor and local dimmer switch override
- l. Offices without Windows (Typical): Vacancy sensor and local dimmer switch override
- m. 1<sup>st</sup> FL Hazardous Cleanup: Occupancy Sensor with Dimming
- n. Property Room (Typical): Local switch
- o. Camera Room (Typical): Occupancy sensor with dimming
- p. 1<sup>st</sup> FL Prisoner Processing (cells): Local dimmer switch
- q. 1<sup>st</sup> FL Prisoner Processing Restroom: Local switch
- r. Video Booking (Typical): Local dimmer switch
- s. Debriefing Interview/ Juvenile Interview (Typical): Local dimmer switch
- t. Detective Detention Arrest Processing: Local switch
- u. Corridor (anti-crime viewing) (Typical): Local switch
- v. Locker Room/ Changing Room (Typical): Occupancy sensor with dimming
- w. Rest Area (Typical): Local dimmer switch
- x. Common/ Group Toilets and showers (Typical): Occupancy sensor with dimming
- y. Individual Toilet and shower (Typical): Vacancy sensor switch
- z. Cellar FL Stress Reduction: Occupancy sensor with dimming
- aa. Cellar FL Maintenance Workshop: Vacancy sensor and local dimmer switch override
- bb. Storage/Equipment Room/Janitor Closet (Typical): Vacancy sensor switch
- cc. Electrical/ Mechanical Rooms (Typical): Occupancy Sensor with dimming
- dd. Cellar FL Gas Meter Room and Fuel Oil Tank: Time Switch with 2 minutes Shut Down Waring
- ee. 1<sup>st</sup> FL Evidence Vehicles: Occupancy Sensor with dimming and dimmer switch override

## 2.10 SINGLE LINE DIAGRAM

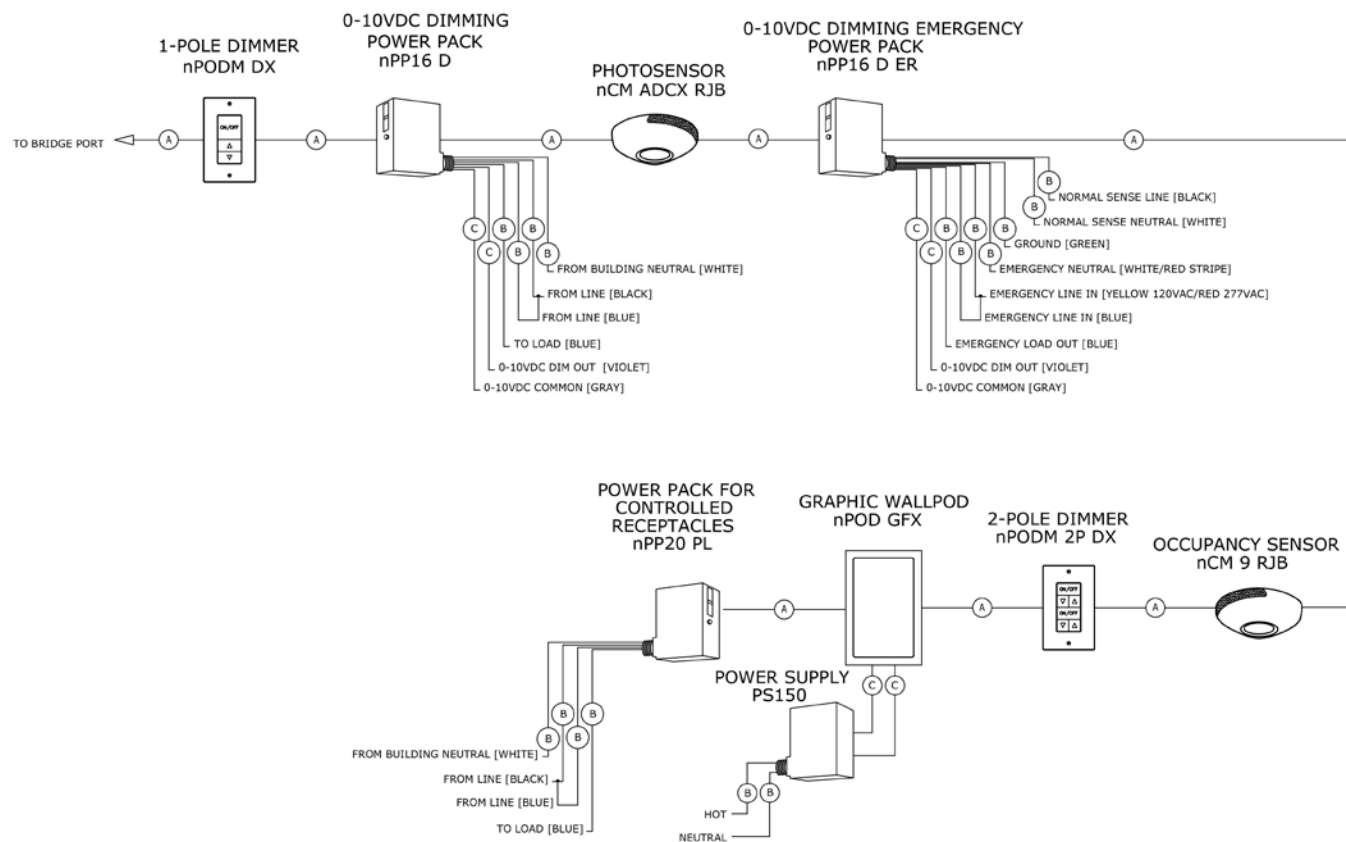
- A. Network Backbone Single Line Diagram (For Connection with Building Management System):  
Refer to Electrical Drawings for full size single line diagram and load schedule.



### Note:

1. For information regarding emergency lighting systems and interface to UPS panel see riser diagram on electrical drawings.
2. See electrical drawings for complete panelboard schedule and load information.
3. See electrical drawings for device quantity and power pack dimming types.

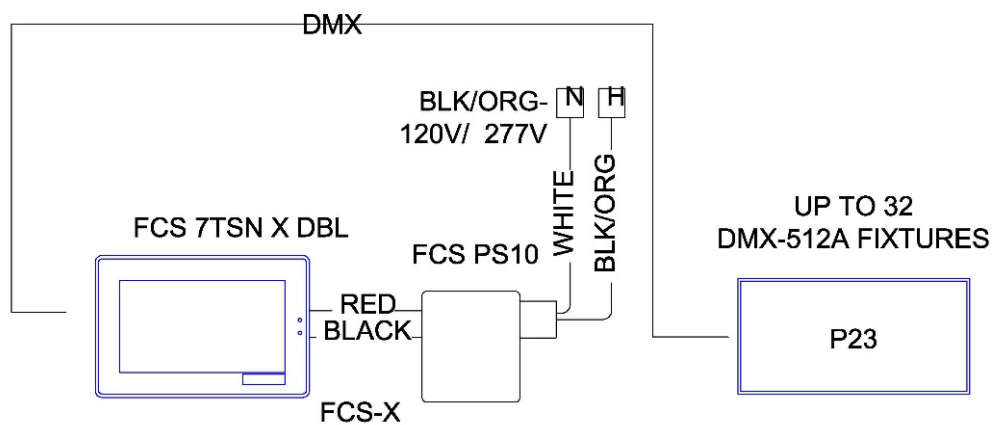
- B. Typical Distributed Zone Wiring Diagram (For Connection with Building Management System):  
Refer to Electrical Drawings for full size single line diagram and load schedule.



**Note:**

1. For information regarding emergency lighting systems and interface to UPS panel see riser diagram on electrical drawings.
2. See electrical drawings for complete panelboard schedule and load information.
3. See electrical drawings for device quantity and power pack dimming types.

- C. DMX Distributed Zone Wiring Diagram (For Connection with Building Management System):  
Refer to Electrical Drawings for full size single line diagram and load schedule.



**Note:**

1. For information regarding emergency lighting systems and interface to UPS panel see riser diagram on electrical drawings.
2. See electrical drawings for complete panelboard schedule and load information.
3. See electrical drawings for device quantity and power pack dimming types.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 INSTALLATION**

- A. **Delivery Storage Handling:** Deliver products to the job site in manufacturer's original containers marked with job name, Contractor's name and labeling that clearly indicates the contents. Deliver, store and handle products in accordance with manufacturer's written admonishments.
- B. **Job Conditions:** Maintain job site conditions in accordance with manufacturer's recommendations.
- C. **Reject and do not install any damaged or unsatisfactory equipment.** Replace unsatisfactory equipment with new equipment that is satisfactory if so directed by the Commissioner.
- D. The system shall be installed utilizing complete manufacturer's shop drawings and in accordance with these specifications.
- E. Install Control Stations only after "wet" work such as plastering and painting is complete and the area is cleaned.
- F. The breaker cabinets and controls shall be stored in their original cartons or crates in a dry location free from dirt and dust until ready to install. Provide protection and protective coverings as appropriate to prevent damage to the equipment during installation and until the Commissioner accepts. Restore or replace damaged equipment as directed.
- G. Mount equipment at locations and heights indicated on approved shop drawings, or as directed by the Commissioner. Locations indicated on the electrical drawings are general and approximate - carefully verify locations with Commissioner's plans prior to installation. Check for adequacy of headroom and clearance with other equipment such as ducts, pipes and openings. Bring all conflicts to the attention of the Commissioner prior to proceeding with the work.
- H. Upon completion of the installation, test all line voltage and control wiring for continuity and accuracy of all connections.
- I. Upon completion of the installation, the lighting control equipment shall operate per specifications and be free from defects in condition and finish. Moveable parts must operate freely and with uniform friction throughout their range. Any components damaged prior to the final inspection must be replaced by the Contractor prior to inspection.
- J. Ensure that the manufacturer makes any calibrations and adjustments necessary for proper operation of the system.

**3.3 SYSTEM START-UP**

- A. Upon completion of the installation, the system shall be checked out and started up by a factory instructed technician. Contractor to have completed and tested all wiring, installed all controls and lamped all fixtures before start up.
- B. Upon completion of system start up, the factory instructed technician shall demonstrate the operation of the system to the Contractor and the Commissioner. Contractor to advise Commissioner prior to scheduling start up so all persons designated by the Commissioner are present for instruction. See Paragraph 3.4 of this section. The following system start-up services shall be supplied by a factory instructed Technician during a single site visit.

1. Check installation of all Lighting Control Panelboards
  2. Test operation of all Breakers and Lighting Breakers
  3. Test operation of all Low Voltage Inputs
  4. Test operation of all Telephone Override Lines
  5. Test operation of all Network Communication
  6. Test operation of Lighting or Building Management Station and Associated Printer
  7. Load Application Specific Software Control Modules and test operation
  8. Restore or replace any defective component
  9. Test operation of complete Lighting or Building Management System
- C. Equipment manufacturer to provide six (6) bound copies of a "Maintenance and Operation Manual" to the Commissioner. Manuals shall contain "As Built" shop drawings, wiring diagrams, description of all control functions, all instruction sheets for all components, calibration and adjustment procedures for all applicable components, maintenance procedures and instructions, component specifications, copy of warranty, address and phone contacts for troubleshooting and service help. Manufacturer's start up engineer to review contents of manual with the Commissioner.
- D. The Commissioner will schedule a final inspection with the Contractor. The Contractor will make any necessary adjustments and calibrations, whether the inspection is scheduled within or outside normal working hours, at no additional expense to the City of New York.
- E. If deficiencies that can be corrected immediately are apparent, correct them as soon as possible and schedule another final inspection with the Commissioner. System must be approved prior to acceptance by the Commissioner.

### 3.4 INSTRUCTION

- A. Factory technician will schedule, in coordination with the Commissioner, an instruction period for the City of New York's staff or designated appointees. This instruction period to be a minimum of 3 hours. Instruction shall encompass entire scope of the system including operation, adjustment, maintenance and troubleshooting until completely understood. Manufacturer shall submit names and period of attendance of those instructed to Commissioner.
- B. The following system instruction services shall be supplied by Contractor's factory Field Engineer licensed in the State of New York during a single site visit:
1. System review of all Hardware Components and their functions
  2. System review of all software Components and their function
  3. Hands-On "Operator" instruction to develop experience with Supplied Control Functions
  4. Hands-On "Building Engineer" instruction to develop experience with system Software Programming
  5. Walk through of User's Guide and Programmer's Guide

### 3.5 SYSTEM PROGRAMMING

- A. The following system programming services shall be supplied by Contractor's factory Field Engineer licensed in the State of New York during a single site visit:
1. Advise the Commissioner on developing a control scenario for each application
  2. Program the Commissioner supplied control scenario into the lighting management system
  3. Review the programmed information with the Commissioner and the City of New York's staff and walk through the operation of the program.
  4. Submit electronic files of the control program to the Commissioner.

**3.6 DOCUMENTATION**

- A. The following documentation shall be supplied:
1. System Single-Line Diagram: show system components and quantities including panelboards, breakers, low-voltage switches and sensors, dataline, telephone override lines and Lighting or Building Management Station.
  2. Panelboard Configuration Diagram: Show PC board configuration, breaker configuration and power supply location.
  3. Panelboard Wiring Schedule: Show breaker/load relationship with direct switch override if applicable.
  4. Wiring Diagram: Show typical wiring application diagram for each system component supplied.
  5. Installation Guide: Provide instructions as to how to install system components.
  6. Manual: Provide User's Guide and Programmer's Guide in a loose leaf three ring binder with step by step illustrated instructions.
  7. Riser Diagram: Provided by specifier along with reflected ceiling plans showing control schematic.

**3.7 CONTRACTOR'S QUALITY CONTROL REQUIREMENTS**

- A. Comply with applicable provisions of DDC General Conditions "Quality Requirements" for requirements for Contractor's Quality Control Program.

**END OF SECTION 26 09 43**



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**SECTION 26 24 13****SWITCHBOARDS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Service and distribution switchboards rated 600 V and less.
  2. Transient voltage suppression devices.
  3. Disconnecting and overcurrent protective devices.
  4. Instrumentation.
  5. Control power.
  6. Accessory components and features.
  7. Identification.
  8. Mimic bus.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**PART 2 - PRODUCTS****2.1 MANUFACTURED UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Siemens Energy & Automation, Inc.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  4. All City Switchboard
  5. Atlas
  6. Electrotech
  7. Lincoln Electric
  8. Or approved equal.
- B. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Panel mounted.
  2. Branch Devices: Panel mounted.
  3. Sections front and rear aligned.
- C. Front- and Side-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
  2. Branch Devices: Panel mounted.
  3. Sections front and rear aligned.
- D. Nominal System Voltage: 208Y/120V.
- E. Main-Bus Continuous: 2000 A.
- F. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- G. Indoor Enclosures: Steel, NEMA 250, Type 1.
- H. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- I. Barriers: Between adjacent switchboard sections.
- J. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.



- K. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- L. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.
- M. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- N. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- O. Pull Box on Top of Switchboard:
  - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
  - 2. Set back from front to clear circuit-breaker removal mechanism.
  - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
  - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
  - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- P. Buses and Connections: Three phase, four wire unless otherwise indicated.
  - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated aluminum or copper feeder circuit-breaker line connections.
  - 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
  - 3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, or tin-plated, high-strength, electrical-grade aluminum alloy.
  - 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
  - 5. Ground Bus: 1/4-by-2-inch Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
  - 6. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
  - 7. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.



- 8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- 9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

- Q. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- R. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
- S. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

## 2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Siemens Energy & Automation, Inc.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 4. All City Switchboard
  - 5. Atlas
  - 6. Electrotech
  - 7. Lincoln Electric
  - 8. Or approved equal.
- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
  - 1. Fuses, rated at 200-kA interrupting capacity.
  - 2. Fabrication using bolted compression lugs for internal wiring.
  - 3. Integral disconnect switch.
  - 4. Redundant suppression circuits.
  - 5. Redundant replaceable modules.
  - 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  - 7. LED indicator lights for power and protection status.
  - 8. Audible alarm, with silencing switch, to indicate when protection has failed.
  - 9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
  - 10. Six-digit, transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
- D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.



- E. Protection modes and UL 1449 SVR for grounded wye circuits with 208/120V, three-phase, four-wire circuits shall be as follows:
  - 1. Line to Neutral: 700 V for 208Y/120.
  - 2. Line to Ground: 1200 V for 208Y/120.
  - 3. Neutral to Ground: 1000 V for 208Y/120.
- F. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
  - 1. Line to Neutral: 700 V, 800 V from high leg.
  - 2. Line to Ground: 700 V.
  - 3. Neutral to Ground: 1000 V.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - c. Pringle Electrical Manufacturing Company, Inc.
    - d. Boltswitch, Inc.
    - e. Or approved equal.
  - 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
  - 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing
    - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
    - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
  - 4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
  - 5. Service-Rated Switches: Labeled for use as service equipment.
  - 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).



7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

B. Fused Switch: NEMA KS 1, Type HD; quick-make, quick-break, trip free type with clips to accommodate specified fuses; lockable handle.

C. Fuses are specified in Section 262813 "Fuses."

## 2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
  - a. Phase Currents, Each Phase: Plus or minus 1 percent.
  - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
  - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
  - d. Megawatts: Plus or minus 2 percent.
  - e. Megavars: Plus or minus 2 percent.
  - f. Power Factor: Plus or minus 2 percent.
  - g. Frequency: Plus or minus 0.5 percent.
  - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
  - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
  - j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.

1. Meters: 4-inch diameter or 6 inches square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

D. Instrument Switches: Rotary type with off position.



1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
  2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- E. Feeder Ammeters: 2-1/2-inch minimum size with 90 or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.
- F. Watt-Hour Meters and Wattmeters:
1. Comply with ANSI C12.1.
  2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
  3. Suitable for connection to three- and four-wire circuits.
  4. Potential indicating lamps.
  5. Adjustments for light and full load, phase balance, and power factor.
  6. Four-dial clock register.
  7. Integral demand indicator.
  8. Contact devices to operate remote impulse-totalizing demand meter.
  9. Ratchets to prevent reverse rotation.
  10. Removable meter with drawout test plug.
  11. Semiflush mounted case with matching cover.
  12. Appropriate multiplier tag.
- G. Impulse-Totalizing Demand Meter:
1. Comply with ANSI C12.1.
  2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
  3. Cyclometer.
  4. Four-dial, totalizing kilowatt-hour register.
  5. Positive chart drive mechanism.
  6. Capillary pen holding a minimum of one month's ink supply.
  7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
  8. Capable of indicating and recording 30-minute integrated demand of totalized system.

## 2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Control Circuits: V dc.
- D. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- E. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

- F. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

## 2.7 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
  - 1. Nameplate: At least 0.032-inch thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
  - 1. Nameplate: At least 0.0625-inch thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
- C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
- D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.



- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
- C. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3. Install anchor bolts to elevations required for proper attachment to switchboards.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- E. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- F. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- G. Install filler plates in unused spaces of panel-mounted sections.
- H. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
  - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- I. Install spare-fuse cabinet.
- J. Comply with NECA 1.

### 3.4 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Section 260536 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

### 3.5 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

- G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

### 3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

**END OF SECTION 26 24 13**

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**SECTION 26 24 16****PANELBOARDS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Distribution panelboards.
  2. Lighting and appliance branch-circuit panelboards.
  3. Electronic-grade panelboards.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

1.7 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface -mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.



4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
  7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- G. Incoming Mains Location: Top and bottom, refer to drawings.
- H. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
  3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
  4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  6. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
  7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- J. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- K. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include six and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

- M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

## 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Siemens Energy & Automation, Inc.
  - 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
  - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 4. All City Switchboard.
  - 5. Electrotech.
  - 6. Lincoln Electric.
  - 7. Or approved equal.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike with 511s Locks. Door within a Door Construction. Provide two (2) #47 keys per panel.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker, Fused switch, as indicated on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller:
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.
- H. Contactors can be incorporated to switch the entire panelboard or only a portion of the circuits. Coordinate with Drawings and schedules to indicate contactor connections, type, quantity of circuits controlled, current ratings, external control circuits, and number of poles. Verify with manufacturers for their respective limitations on short-circuit ratings and availability of contactors, which may not be available in all sizes or from all manufacturers.
- I. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.





1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

Panelboards, as specified in this article, comply with requirements of "Lighting and Appliance Branch-Circuit Panelboards" in NEMA PB 1.

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Siemens Energy & Automation, Inc.
  2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
  3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  4. All City Switchboard.
  5. Atlas.
  6. Electrotech.
  7. Lincoln Electric.
  8. Or approved equal.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
  1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
  2. External Control-Power Source: 120-V branch circuit. Retain one or both "Doors" paragraphs below to describe the type of door required. If retaining both indicate on the Drawings which door type applies to each panel.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike with 511 Locks. Door within a door construction. Provide two (2) #47 keys per panel.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Siemens Energy & Automation, Inc.
  2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
  3. Eaton Electrical Inc.; Cutler – Hammer Business Unit.
  4. All City Switchboard.
  5. Atlas.
  6. Electrotech.



7. Lincoln Electric.
  8. Or approved equal.
- B. Molded Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal- Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Circuit Breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
    - 1) Instantaneous trip.
    - 2) Long- and short-time pickup levels.
    - 3) Long and short time adjustments.
    - 4) Ground-fault pickup level, time delay, and I squared T response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Communication Capability: Circuit-breaker-mounted Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
    - h. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    - i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    - k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    - l. Multipole units enclosed in a single housing factory assembled to operate as a single unit.
    - m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.



- n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  - 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
  - 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
  - 3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

## 2.6 ACCESSORIES AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, service, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Or Section 033053 "Miscellaneous Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties and labeling tags after completing load balancing.
- K. Comply with NECA 1.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Commissioner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.



1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  - c. Instruments and Equipment:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform the Commissioner of effect on phase color coding.
  1. Measure loads during period of normal facility operations.
  2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Commissioner. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.



4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.7 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION 26 24 16**

**SECTION 26 24 19****MOTOR-CONTROL CENTERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes MCCs for use with ac circuits rated 600 V and less and having the following factory-installed components:
1. Incoming main lugs and OCPDs.
  2. Full-voltage magnetic controllers.
  3. Reduced-voltage magnetic controllers.
  4. Reduced-voltage, solid-state controllers.
  5. Multispeed controllers.
  6. VFCs.
  7. Feeder-tap units.
  8. Instrumentation.
  9. Auxiliary devices.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”

#### 1.7 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. GFCI: Ground fault circuit interrupting.
- F. IGBT: Insulated-gate bipolar transistor.
- G. LAN: Local area network.
- H. LED: Light-emitting diode.
- I. MCC: Motor-control center.
- J. MCCB: Molded-case circuit breaker.
- K. MCP: Motor-circuit protector.
- L. NC: Normally closed.
- M. NO: Normally open.
- N. OCPD: Overcurrent protective device.
- O. PCC: Point of common coupling.
- P. PID: Control action, proportional plus integral plus derivative.
- Q. PT: Potential transformer.
- R. PWM: Pulse-width modulated.
- S. RFI: Radio-frequency interference.
- T. SCR: Silicon-controlled rectifier.
- U. TDD: Total demand (harmonic current) distortion.



V. THD(V): Total harmonic voltage demand.

W. VFC: Variable-frequency controller.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Energy & Automation, Inc.
2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Or approved equal.

B. General Requirements for MCCs: Comply with NEMA ICS 18 and UL 845.

### 2.2 FUNCTIONAL FEATURES

A. Description: Modular arrangement of main units, controller units, control devices, feeder-tap units, instruments, metering, auxiliary devices, and other items mounted in vertical sections of MCC.

B. Controller Units: Combination controller units.

1. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
2. Equip units in Type B and Type C MCCs with pull-apart terminal strips for external control connections.

C. Feeder-Tap Units: Through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

D. Future Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

E. Spare Units: Installed in compartments indicated "spare."

### 2.3 INCOMING MAINS

A. Incoming Mains Location: Top.

B. Main Lugs Only: Conductor connectors suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.

C. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.



1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
  6. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    - f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    - i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
    - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- D. Insulated-Case Circuit Breaker: 80 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
  2. Two-step, stored-energy closing.
  3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time time adjustments.
    - c. Ground-fault pickup level, time delay, and  $I^2t$  response.



4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: 40-V dc.

## 2.4 COMBINATION CONTROLLERS

### A. Full-Voltage Controllers:

1. General Requirements for Full-Voltage Enclosed Controllers: Comply with NEMA ICS 2, general purpose, Class A.
2. Magnetic Controllers: Full voltage, across the line, electrically held.
  - a. Configuration: Nonreversing and reversing.

### B. Reduced-Voltage Magnetic Controllers:

1. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed transition; adjustable time delay on transition.
2. Reduced-Voltage Magnetic Controllers: Reduced voltage, electrically held.
  - a. Configuration:
  - b. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
  - c. Part-Winding Controller: Separate START and RUN contactors, field-selectable for one-half or two-thirds winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
  - d. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.

### C. Reduced-Voltage, Solid-State Controllers:

1. General Requirements for Reduced-Voltage, Solid-State Controllers: Comply with UL 508.
2. Reduced-Voltage, Solid-State Controllers: An integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium-induction motors.
  - a. Configuration: Standard duty.
  - b. Starting Mode: Voltage ramping.
  - c. Stopping Mode: Coast to stop.
  - d. Shorting (Bypass) Contactor: Operates automatically when full voltage is applied to motor and bypasses the SCRs. Solid-state controller protective features shall remain active when the shorting contactor is in the bypass mode.
  - e. Shorting and Input Isolation Contactor Coils: Pressure-encapsulated type; manufacturer's standard operating voltage, matching control power or line voltage,



- depending on contactor size and line-voltage rating. Provide coil transient suppressors.
- f. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
  - g. Adjustable acceleration-rate control using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.
  - h. SCR bridge shall consist of at least two SCRs per phase, providing stable and smooth acceleration with external feedback from the motor or driven equipment.
  - i. Keypad, front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:
    - j. Adjusting motor full-load amperes, as a percentage of the controller's rating.
    - k. Adjusting current limitation on starting, as a percentage of the motor full-load current rating.
    - l. Adjusting linear acceleration and deceleration ramps, in seconds.
    - m. Initial torque, as a percentage of the nominal motor torque.
    - n. Adjusting torque limit, as a percentage of the nominal motor torque.
    - o. Adjusting maximum start time, in seconds.
    - p. Adjusting voltage boost, as a percentage of the nominal supply voltage.
    - q. Selecting stopping mode and adjusting parameters.
    - r. Selecting motor thermal-overload protection class between 5 and 30.
    - s. Activating and de-activating protection modes.
    - t. Selecting or activating communications modes.
    - u. Digital display, front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:
      - v. Controller Condition: Ready, starting, running, stopping.
      - w. Motor Condition: Amperes, voltage, power factor, power, and thermal state.
      - x. Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted SCRs, line or phase loss, phase reversal, and line frequency over or under normal.
    - y. Controller Diagnostics and Protection:
      - z. Microprocessor-based thermal protection system for monitoring SCR and motor thermal characteristics and providing controller overtemperature and motor overload alarm and trip; settings selectable via the keypad.
    - aa. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency over or under normal.
    - bb. Input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component, or when the motor is stopped.
    - cc. Shunt trip that opens the disconnecting means when the controller diagnostics detect a faulted solid-state component.
    - dd. Remote Output Features:
      - ee. All outputs prewired to terminal blocks.
      - ff. Form C status contacts that change state when controller is running.
      - gg. Form C alarm contacts that change state when a fault condition occurs.
    - hh. Optional Features:
      - ii. Analog output for field-selectable assignment of motor operating characteristics; 0 to 10-V dc.
    - jj. Additional field-assignable Form C contacts for alarm outputs.
    - kk. Surge suppressors in solid-state power circuits providing three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  - ll. Full-voltage bypass contactor operating automatically. Power contacts shall be totally enclosed, double break, and silver-cadmium oxide; and assembled to allow inspection and replacement without disturbing line or load wiring.



**D. Multispeed Magnetic Controllers:**

1. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
2. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held. Compelling relay to ensure that motor will start only at low speed.
  - a. Configuration: Nonreversing.
  - b. Compelling relays shall ensure that motor starts only at low speed.
  - c. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
  - d. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
  - e. Antiplugging timer relays shall ensure a time delay when transferring from FORWARD to REVERSE and back.

**E. Disconnecting Means and OCPDs:**

1. Fusible Disconnecting Means:
  - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J and Class L fuses.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
2. MCP Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
  - d. NC alarm contact that operates only when MCP has tripped.
  - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
3. MCCB Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
  - e. NC alarm contact that operates only when MCCB has tripped.
4. Molded-Case Switch Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with in-line fuse block for Class J or L power fuses (depending on ampere rating), providing an interrupting capacity to



comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.

- b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- c. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
- d. NC alarm contact that operates only when molded-case switch has tripped.

**F. Overload Relays:**

**1. Melting-Alloy Overload Relays:**

- a. Inverse-time-current characteristic.
- b. Class 10 tripping characteristic.
- c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

**2. Bimetallic Overload Relays:**

- a. Inverse-time-current characteristic.
- b. Class 10 tripping characteristic.
- c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
- d. Ambient compensated.
- e. Automatic resetting.

**3. Solid-State Overload Relays:**

- a. Switch or dial selectable for motor running overload protection.
- b. Sensors in each phase.
- c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- e. Analog communication module.

- 4. NC isolated overload alarm contact.
- 5. External overload reset push button.

**G. Control Power:**

- 1. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 50 VA.

**2.5 VFCS**

- A. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- B. Application: Constant torque.
- C. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent



and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
  2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to New York City Electrical Division.
  4. Listed and labeled for single-phase use by an NRTL acceptable to New York City Electrical Division
  5. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- E. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
  2. Input AC Voltage Unbalance: Not exceeding 5 percent.
  3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
  4. Minimum Efficiency: 96 percent at 60 Hz, full load.
  5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
  6. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
  7. Starting Torque: Minimum of 100 percent of rated torque from 3 to 60 Hz.
  8. Speed Regulation: Plus or minus 5 percent.
  9. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
  10. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- F. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- G. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
  2. Signal: Pneumatic.
- H. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 0.1 to 999.9 seconds.
  4. Deceleration: 0.1 to 999.9 seconds.
  5. Current Limit: 30 to a minimum of 150 percent of maximum rating.
- I. Self-Protection and Reliability Features:



1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  2. Loss of Input Signal Protection: Selectable response strategy including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
  3. Under- and overvoltage trips.
  4. Inverter overcurrent trips.
  5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
  6. Critical frequency rejection, with three selectable, adjustable deadbands.
  7. Instantaneous line-to-line and line-to-ground overcurrent trips.
  8. Loss-of-phase protection.
  9. Reverse-phase protection.
  10. Short-circuit protection.
  11. Motor overtemperature fault.
- J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- O. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
  2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
  3. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
  4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
  5. NC alarm contact that operates only when circuit breaker has tripped.

## 2.6 VFC CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.





4. Line fault.
  5. Overcurrent.
  6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
  2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Running log of total power versus time.
  2. Total run time.
  3. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters, including, but not limited to:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (V dc).
  9. Set point frequency (Hz).
  10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
    - a. A minimum of two programmable analog inputs: 0- to 10-V dc.
    - b. A minimum of six multifunction programmable digital inputs.
  2. Pneumatic Input Signal Interface: 3 to 15 psig.
  3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
    - a. 0- to 10-V dc.
    - b. 4- to 20-mA dc.
    - c. Potentiometer using up/down digital inputs.
    - d. Fixed frequencies using digital inputs.



4. Output Signal Interface: A minimum of one programmable analog output signal(s) 0- to 10-V dc, which can be configured for any of the following:
    - a. Output frequency (Hz).
    - b. Output current (load).
    - c. DC-link voltage (V dc).
    - d. Motor torque (percent).
    - e. Motor speed (rpm).
    - f. Set point frequency (Hz).
  5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set point speed reached.
    - c. Fault and warning indication (overtemperature or overcurrent).
    - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
1. Number of Loops: One.
- G. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display VFC status and alarms and energy usage. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.
1. Network Communications Ports: Ethernet and RS-422/485.
  2. Embedded DDC system for HVAC Protocols for Network Communications: ASHRAE 135 BACnet, Siemens System 600 APOGEE; protocols accessible via the communications ports.

## 2.7 VFC LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD at input terminals of VFCs to less than 5 percent and THD(V) to 3 percent.
- B. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD and THD(V) at the defined PCC per IEEE 519.
- C. Input Line Conditioning:
- D. VFC Output Filtering:
- E. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.
- F. EMI/RFI Filtering:



## 2.8 VFC BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes, and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.
- C. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.
- D. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
  - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
  - 2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
  - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- E. There is some concern among various listed manufacturers that the input isolating contactor of the three-contactor bypass, without an isolating switch and a barrier between the power converter and the bypass, may not comply with NFPA 70 requirements for safe isolation of the power converter during energized maintenance, because the contactor is not a positive, lockable disconnecting means, and lack of a barrier can lead to accidental contact with live parts in the bypass. Consult Commissioner if this is a concern.
- F. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
  - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
  - 2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
  - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- G. Bypass Contactor Configuration: Full-voltage (across-the-line) type.
  - 1. NORMAL/BYPASS selector switch.
  - 2. HAND/OFF/AUTO selector switch.
  - 3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
  - 4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.



- a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
- 6. CPT Spare Capacity: 50 VA.
- H. Overload Relays: NEMA ICS 2.
  - 1. Melting-Alloy Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - 2. Bimetallic Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - d. Ambient compensated.
    - e. Automatic resetting.
  - 3. Solid-State Overload Relays:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - e. Analog communication module.
    - f. NC isolated overload alarm contact.
    - g. External overload reset push button.

## 2.9 OPTIONAL VFC FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications, when overload protection activates.
  - 1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.
  - 2. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.
  - 3. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.

- B. Damper control circuit with end of travel feedback capability.
- C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.
- D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.
- E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, this password-protected input:
  - 1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
  - 2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
  - 3. Forces VFC to transfer to Bypass Mode and operate motor at full speed.
  - 4. Causes display of Override Mode on the VFC display.
  - 5. Reset VFC to normal operation on removal of override signal automatically.
- F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- G. Remote digital operator kit.
- H. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

## 2.10 FEEDER-TAP UNITS

- A. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
  - 6. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.



- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
  - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
  - f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
  - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses with lockable handle.
- C. Fuses are specified in Section 26 28 13 "Fuses."

## 2.11 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
- 1. PTs: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
  - 3. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.
  - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
- 1. Listed or recognized by a nationally recognized testing laboratory.
  - 2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
  - 3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
    - e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.



- f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
    - j. Contact devices to operate remote impulse-totalizing demand meter.
  - 4. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
  - 1. Meters: 4-inch diameter or 6 inches square, flush or semiflush, with antiparallax 250-degree scale and external zero adjustment.
  - 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- D. Instrument Switches: Rotary type with off position.
  - 1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and phase-to-neutral voltages where a neutral is included.
  - 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- E. Feeder Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for feeder circuits, unless otherwise indicated.
- F. Watt-Hour Meters and Wattmeters:
  - 1. Comply with ANSI C12.1.
  - 2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
  - 3. Suitable for connection to three- and four-wire circuits.
  - 4. Potential indicating lamps.
  - 5. Adjustments for light and full load, phase balance, and power factor.
  - 6. Four-dial clock register.
  - 7. Integral demand indicator.
  - 8. Contact devices to operate remote impulse-totalizing demand meter.
  - 9. Ratchets to prevent reverse rotation.
  - 10. Removable meter with drawout test plug.
  - 11. Semiflush mounted case with matching cover.
  - 12. Appropriate multiplier tag.
- G. Impulse-Totalizing Demand Meter:
  - 1. Comply with ANSI C12.1.
  - 2. Suitable for use with MCC watt-hour meter, including two-circuit totalizing relay.
  - 3. Cyclometer.
  - 4. Four-dial, totalizing kilowatt-hour register.
  - 5. Positive chart drive mechanism.
  - 6. Capillary pen holding a minimum of one month's ink supply.
  - 7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
  - 8. Capable of indicating and recording five-minute integrated demand of totalized system.

## 2.12 MCC CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from CPT.
- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Control Circuits: 24-V dc.
- D. Electrically Interlocked Main and Tie Circuit Breakers: Two CPTs in separate compartments, with interlocking relays, connected to the primary side of each CPT at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- E. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- F. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

## 2.13 ENCLOSURES

- A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 1 unless otherwise indicated to comply with environmental conditions at installed location.
- B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- C. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners. Interlocks on units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
- D. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- E. Wiring Spaces:
  - 1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
  - 2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

## 2.14 AUXILIARY DEVICES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
    - a. Push Buttons: Covered types; maintained contact unless otherwise indicated.
    - b. Pilot Lights: LED types; Red; push to test.





- c. Selector Switches: Rotary type.
  - 2. Elapsed-Time Meters: Heavy duty with digital readout in hours; resettable.
  - 3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy with selector switches having an off position.
  - B. NC contactor auxiliary contact(s).
  - C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
  - D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
  - E. Space heaters, with NC auxiliary contacts, to mitigate condensation in enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
  - F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
  - G. Cover gaskets for Type 1 enclosures.
  - H. Terminals for connecting power factor correction capacitors to the line or load side overload relays as directed by Commissioner.
  - I. Spare control-wiring terminal blocks; unwired.
  - J. Spare-Fuse Cabinet: Identified and compartmented steel box.
- 2.15 CHARACTERISTICS AND RATINGS
- A. Wiring: NEMA ICS 18, Class I.
  - B. Wiring: NEMA ICS 18, Class II.
  - C. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
  - D. Nominal System Voltage: 208/120 V, three phase, four wire.
  - E. Short-Circuit Current Rating for Each Unit: Combination series rated; 22, 42, 65, 100 kA.
  - F. Short-Circuit Current Rating of MCC: Combination series rated with its main overcurrent device; 22, 42, 65, 100 kA.
  - G. Environmental Ratings:
    - 1. Ambient Temperature Rating: Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C), with an average value not exceeding 95 deg F (35 deg C) over a 24-hour period.
    - 2. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
    - 3. Humidity Rating: Less than 95 percent (noncondensing).

4. Altitude Rating: Not exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.
- 
- H. Main-Bus Continuous Rating: 1000, 1200, 1600 A.
  - I. Vertical-Bus Minimum Continuous Rating: 1200 A.
  - J. Horizontal and Vertical Bus Bracing (Short-Circuit Current Rating): Match MCC short-circuit current rating.
  - K. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions from both ends.
  - L. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
  - M. Phase and Neutral Bus Material: Hard-drawn copper of 98 percent conductivity, silver plated.
  - N. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  - O. Ground Bus: Minimum size required by UL 845, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit equipment grounding conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
  - P. Front-Connected, Front-Accessible MCCs:
    1. Main Devices: Fixed mounted.
    2. Controller Units: fixed mounted.
    3. Feeder-Tap Units: fixed mounted.
    4. Sections front and rear aligned.
  - Q. Bus Transition and Incoming Pull Sections: Matched and aligned with basic MCC.
  - R. Pull Box on Top of an MCC:
    1. Adequate ventilation to maintain temperature in pull box within same limits as MCC.
    2. Set back from front to clear circuit-breaker removal mechanism.
    3. Removable covers forming top, front, and sides. Top covers at rear easily removable for drilling and cutting.
    4. Insulated bottom of fire-resistive material with separate holes for cable drops into MCC.
    5. Cable supports arranged to facilitate cabling and adequate to support cables, including those for future installation.
    6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
  - S. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of unit.
  - T. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

- U. Fungus Proofing: Permanent fungicidal treatment for OCPDs and other components including instruments and instrument transformers.

## 2.16 SOURCE QUALITY CONTROL

- A. MCC Testing: Inspect and test MCCs according to requirements in NEMA ICS 18.
- B. VFC Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
  - 1. Test each VFC while connected to its specified motor.
  - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- C. MCCs will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 HARMONIC ANALYSIS STUDY

- A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at the defined PCC to specified levels.
- B. Prepare a harmonic analysis study report complying with IEEE 399 and NETA Acceptance Testing Specification.

### 3.4 INSTALLATION

- A. Coordinate layout and installation of MCCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Floor-Mounting Controllers: Install MCCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.



2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible switch.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Install power factor correction capacitors. Connect to the line side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.
- J. Comply with NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label MCC and each cubicle with engraved nameplate.
  3. Label each enclosure-mounted control and pilot device.
  4. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.
- B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

### 3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's DDC system for HVAC. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.



1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.7 CONNECTIONS

- A. Comply with requirements for installation of conduit in Section 26 05 33 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Commissioner to engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- E. Tests and Inspections:
  1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  2. Test insulation resistance for each enclosed controller element, component, connecting motor supply, feeder, and control circuits.
  3. Test continuity of each circuit.
  4. Verify that voltages at controller locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify the Commissioner before starting the motor(s).
  5. Test each motor for proper phase rotation.
  6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed

- controller. Remove front panels so joints and connections are accessible to portable scanner.
      - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.
      - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
    - 10. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.
  - F. Enclosed controllers will be considered defective if they do not pass tests and inspections.
  - G. Prepare test and inspection reports, including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.9 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service.
    - 1. Complete installation and startup checks according to manufacturer's written instructions.
- 3.10 ADJUSTING
- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
  - B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
  - C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Commissioner before increasing settings.
  - D. Set the taps on reduced-voltage autotransformer controllers at 50 percent.
  - E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.
  - F. Program microprocessors in VFCs for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
  - G. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.11 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and service enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage, solid-state controllers.

**END OF SECTION 26 24 19**



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**SECTION 26 26 53****ELECTRIC VEHICLE CHARGING EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes EV charging equipment that provides Level 2 EV charging.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 DEFINITIONS**

- A. EV: Electric vehicle.
- B. EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.
- C. EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.
- D. EV Charger or EV Charging Equipment: See "EVSE".
- E. EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.



- F. EV Coupler: A mating EV inlet and connector set.
- G. EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.
- H. EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) and electrical wiring pulled to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.
- I. EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For EV charging equipment.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of mounting assemblies for EV charging equipment.
  - 4. Include diagrams for power, signal, and control wiring.
  - 5. Include verification of wireless communications service at each location of EV charging equipment.
- C. Product Schedule: For EV charging equipment. Match designations on electrical drawings.

#### 1.8 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Area plans and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members to which equipment will be attached.
  - 2. Electrical service.
  - 3. Communications service, including wireless communications equipment.
  - 4. Items penetrating concrete pad surface.
- B. Seismic Qualification Certificates: For charging equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

#### 1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For EV charging equipment to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Online instruction and help documentation.
2. Station activation sticker.

#### 1.10 QUALITY ASSURANCE

A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

B. Installer Qualifications: An authorized representative who is properly trained by the manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

D. Comply with UL 2231-1, UL 2231-2, UL 2594, and NEC Article 625.

E. Comply with SAE J1772.

F. Comply with FCC Part 15 Class A.

#### 1.11 FIELD CONDITIONS

A. Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.

B. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not exceeding minus 22 to plus 122 deg F.
2. Altitude: Not exceeding 6600 feet.

C. Rate Equipment for non-operation under the following conditions:

1. Ambient Temperature: Not exceeding minus 40 to plus 140 deg F.
2. Altitude: Not exceeding 6600 feet.

- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by the City of New York or Long Island Railroad unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Commissioner no fewer than two days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Commissioner's written permission.

## 1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ChargePoint CT4000 family of electric vehicle charging stations, or an equivalent product from one of the following approved manufacturers:
  - 1. Bosch
  - 2. Electric Motor Werks, Inc.
  - 3. Or approved equal.
- B. Source Limitations: Obtain EV charging equipment from single manufacturer.

### 2.2 EV CHARGING EQUIPMENT DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. ADA compliant.
- D. Metering: +/- 2 percent from 2 percent to full scale of output (30 A).
- E. EV Charging Equipment Mounting: Bollard mount.
- F. Enclosures:
  - 1. Rated for environmental conditions at installed location.
    - a. NEMA 250, Type 3R.
    - b. Aluminum and UV-resistant plastic.
    - c. Paint and Anodized.
    - d. Charging components protected by security screws.
    - e. Charging connectors in locking holsters.
    - f. Meter, modem, and CPU, tamper resistant.

G. EV Cable and Connectors:

1. SAE J1772 connector.
2. One connector with locking holster.
3. 23-foot cable with cable management system.

H. Status Indicators:

1. LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.

I. Display Screen:

1. VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.
2. Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.

J. Networking:

1. WAN Communications: Cellular GSM/GPRS and CDMA.
2. LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.
3. Capable of remote configuration, diagnostics and reporting.
4. Capable of remote software updates (future proof).

K. Payment System:

1. RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.
2. PCI (Payment Card Industry) compliant.
3. Capable of remote control and authorization including mobile phone application or toll free phone number.

L. Charging Network: Compatible with the EV manufacturer's charging network.

1. Multiple units shall independently connect to charging network.
2. Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.
3. Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

## 2.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

B. Surge Withstand: 6 kV at 3000 A.

C. Integral GFCI.

D. Auto-GFCI fault retry.

E. Input Power:

1. Two 40A, 208/240-V ac, 60 Hz, single phase per charger.



2. Dual circuits do not need to be interlocked.

F. EV Charging Levels:

1. Single vehicle: AC Level 2 at up to 7.2 kW (CT4000) or up to 7.7 kW (CPF25) per vehicle.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.
- C. Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with NECA 1 and NECA 413.
- B. Concrete Base Mounting:
  1. Install EV charging equipment on 6-inch nominal-thickness concrete base. Base should be 24-inch (minimum 12-inch from the center located conduit stub-up). Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete".
    - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
    - b. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - d. Install anchor bolts to elevations required for proper attachment to supported equipment.



- e. Secure EV charging equipment to concrete base according to manufacturer's written instructions.
  - C. Bollard Mounting:
    - 1. Allow a minimum of 24 inches of clearance around EV charging equipment.
    - 2. EV charging equipment receptacles or holders shall be not less than 24 inches and not more than 4 feet above finished grade.
    - 3. Mount EV charging equipment plumb and rigid without distortion of enclosure.
    - 4. Secure EV charging equipment according to manufacturer's written instructions.
  - D. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."
  - E. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.
    - 1. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
    - 2. Comply with requirements for underground raceways and enclosures specified in Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems."
  - F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
  - G. Wiring within Enclosures: Bundle, lace, and fix conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
  - H. Circuit Breakers: Comply with Section 26 28 16 "Enclosed Switches and Circuit Breakers."
  - I. Secure covers to enclosure.
- 3.4 CONNECTIONS
- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
  - B. Comply with grounding requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
  - C. Comply with requirements for installation of conduit in Section 26 05 33 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
  - D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- 3.5 IDENTIFICATION
- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."



**3.6 FIELD QUALITY CONTROL**

- A. Manufacturer's Startup Field Service: Engage a service representative that is properly trained by the manufacturer to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with a service representative that is properly trained by the manufacturer.
- C. Tests and Inspections:
  - 1. For each unit of EV charging equipment, perform the following tests and inspections:
    - a. Unit self-test.
    - b. Operation test with load bank.
    - c. Network communications test.
- D. EV charging equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**3.7 INSTRUCTION**

- A. Refer to the DDC General Conditions for instruction requirements.
- B. Contractor shall engage a factory-authorized service representative to instruct City of New York's service operators to adjust, operate, and service electric vehicle charging equipment.

**END OF SECTION 26 26 53**



**SECTION 26 27 13****ELECTRICITY METERING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes equipment for electricity metering.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.7 DEFINITIONS**

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

**PART 2 - PRODUCTS****2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY**

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

**2.2 EQUIPMENT FOR ELECTRICITY METERING BY THE CITY OF NEW YORK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal.
  - 1. E-Mon; a division of Hunt Power.
  - 2. General Electric.
  - 3. Eaton.
  - 4. Electro Industries.
  - 5. Or approved equal.
- B. General Requirements for The City of New York's Meters:
  - 1. Comply with UL 1244.
  - 2. Meters used for billing shall have an accuracy of 0.5 percent of reading, complying with requirements in ANSI C12.20.
  - 3. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
  - 4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
  - 6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
    - a. Type: Split and solid core.
  - 7. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
  - 8. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
- C. Kilowatt-hour Meter: Electronic three phase meters, measuring electricity used.



1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
  2. Display: LCD with characters not less than 0.25-inch-high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.
  3. Display: Digital electromechanical counter, indicating accumulative kilowatt-hours.
- D. Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
  2. Display: LCD with characters not less than 0.25-inch-high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.
- E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 26 05 23 "Control-Voltage Electrical Power Cables."
- F. Software: PC based, a product of meter manufacturer, suitable for calculation of utility fee allocation.
1. Utility Fee Allocation: Automatically import energy-usage records to allocate energy fees for the following:
    - a. At least 100 tenants.
  2. Tenant or Activity Billing Software: Automatically import energy-usage records to automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand. Maintain separate directory for each tenant's historical billing information. Prepare summary reports in user-defined formats and time intervals.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

#### 3.3 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."



1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

### 3.4 FIELD QUALITY CONTROL

#### A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

#### B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

#### C. Electricity metering will be considered defective if it does not pass tests and inspections.

#### D. Prepare test and inspection reports.

**END OF SECTION 26 27 13**

**SECTION 26 27 26****WIRING DEVICES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Isolated-ground receptacles.
4. Tamper-resistant receptacles.
5. Weather-resistant receptacles.
6. Snap switches and wall-box dimmers.
7. Solid-state fan speed controls.
8. Wall-switch and exterior occupancy sensors.
9. Communications outlets.
10. Pendant cord-connector devices.
11. Cord and plug sets.
12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

#### 1.7 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles. Subject to compliance with requirements, manufacturers whose products can be incorporated into the work include:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand (Pass & Seymour).
  - 5. Or approved equal.
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

#### 2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, and NYC Electrical Code, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70 and 2014 NYC Electrical Code.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:



1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

## 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 5351 (single), HBL5352 (duplex).
- b. Hubbell; HBL5351 (single), HBL5352 (duplex).
- c. Leviton; 5891 (single), 5352 (duplex).
- d. Pass & Seymour, 5361 (single), 5362 (duplex).
- e. Or approved equal.

- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; IG5362RN.
- b. Hubbell; IG5362.
- c. Leviton; 5362-IG.
- d. Pass & Seymour; IG5362.
- e. Or approved equal.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; TR8300.
- b. Hubbell; HBL8300SGA.
- c. Leviton; 8300-SGG.
- d. Or approved equal.

## 2.4 GFCI RECEPTACLES

- A. General Description:

1. Straight blade, non-feed -through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:



- a. Cooper; VGF20.
- b. Hubbell; GFR5352L.
- c. Pass & Seymour; 2095.
- d. Leviton; 7590.
- e. Or approved equal.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Hubbell; GFTR20.
- b. Pass & Seymour, 2095TR.
- c. Leviton, equal product to Hubbell GFTR20,
- d. Or approved equal.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

- a. Cooper Crouse-Hinds.
- b. EGS/Appleton Electric.
- c. Killark; Division of Hubbell Inc.
- d. Or approved equal.

2.5 TWIST-LOCKING RECEPTACLES

B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; CWL520R.
- b. Hubbell; HBL2310.
- c. Leviton; 2310.
- d. Pass & Seymour; L520-R.
- e. Or approved equal.

C. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; IGL520R.
- b. Hubbell; IG2310.
- c. Leviton; 2310-IG.
- d. Pass & Seymour; IG4700.
- e. Or approved equal.





2. Description:

- a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
- b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:
  - a. Cooper; AH1221.
  - b. Hubbell; HBL1221.
  - c. Leviton; 1221-2.
  - d. Pass & Seymour; CSB20AC1.
  - e. Or approved equal.
2. Two Pole:
  - a. Cooper; AH1222.
  - b. Hubbell; HBL1222.
  - c. Leviton; 1222-2.
  - d. Pass & Seymour; CSB20AC2.
  - e. Or approved equal.



3. Three Way:
    - a. Cooper; AH1223.
    - b. Hubbell; HBL1223.
    - c. Leviton; 1223-2.
    - d. Pass & Seymour; CSB20AC3.
    - e. Or approved equal.
  4. Four Way:
    - a. Cooper; AH1224.
    - b. Hubbell; HBL1224.
    - c. Leviton; 1224-2.
    - d. Pass & Seymour; CSB20AC4.
    - e. Or approved equal.
- C. Pilot-Light Switches, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; AH1221PL for 120 and 277 V.
    - b. Hubbell; HBL1201PL for 120 and 277 V.
    - c. Leviton; 1221-LH1.
    - d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
    - e. Or approved equal.
  2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- D. Key-Operated Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; AH1221L.
    - b. Hubbell; HBL1221L.
    - c. Leviton; 1221-2L.
    - d. Pass & Seymour; PS20AC1-L.
    - e. Or approved equal.
  2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 1995.
    - b. Hubbell; HBL1557.
    - c. Leviton; 1257.
    - d. Pass & Seymour; 1251.
    - e. Or approved equal.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.



1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 1995L.
    - b. Hubbell; HBL1557L
    - c. Leviton; 1257L.
    - d. Pass & Seymour; 1251L.
    - e. Or approved equal.
- 2.9 DECORATOR-STYLE DEVICES
- G. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 6252.
    - b. Hubbell; DR15.
    - c. Leviton; 16252.
    - d. Pass & Seymour; 26252.
    - e. Or approved equal.
- H. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TR6252.
    - b. Hubbell; DR15TR.
    - c. Pass & Seymour; TR26252.
    - d. Or approved equal.
  2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
- I. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TWRBR15.
    - b. Hubbell; DR15TR.
    - c. Leviton; TRW15.
    - d. Pass & Seymour; TRW26252.
    - e. Or approved equal.
  2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.
- J. GFCI, Non-Feed-Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
1. Products: Subject to compliance with requirements, provide one of the following:



- a. Cooper; VGF15.
  - b. Hubbell; GF15LA.
  - c. Leviton; 8599.
  - d. Pass & Seymour; 1594.
  - e. Or approved equal.
- K. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TWRVGF15.
    - b. Hubbell; GFTR15.
    - c. Pass & Seymour; 1594TRWR.
    - d. Or approved equal.
  - 2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
- L. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 7621 (single pole), 7623 (three way).
    - b. Hubbell; DS115 (single pole), DS315 (three way).
    - c. Leviton; 5621-2 (single pole), 5623-2 (three way).
    - d. Pass & Seymour; 2621 (single pole), 2623 (three way).
    - e. Or approved equal.
- M. Lighted Toggle Switches, Square Face, 120 V, 15 A: Comply with NEMA WD 1 and UL 20.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 7631 (single pole); 7633 (three way).
    - b. Hubbell; DS120IL (single pole), DS320 (three way).
    - c. Leviton; 5631-2 (single pole), 5633-2 (three way).
    - d. Pass & Seymour; 2625 (single pole), 2626 (three way).
    - e. Or approved equal.
  - 2. Description: With neon-lighted handle, illuminated when switch is "off."

## 2.10 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider or toggle switch; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off

switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."

- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.11 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: 0.035-inch- (1-mm- thick, satin-finished, Type 302 stainless steel or as required by the Commissioner.
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.12 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

## 2.13 FINISHES

- A. Device Color:
  1. Wiring Devices Connected to Normal Power System: As selected by the Commissioner unless otherwise indicated or required by NFPA 70 or device listing.
  2. TVSS Devices: Blue.
  3. Isolated-Ground Receptacles: Orange.
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION



- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.
  - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
  - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Restore wall finishes and remount



outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.3 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.4 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

D. Wiring device will be considered defective if it does not pass tests and inspections.



- E. Prepare test and inspection reports.

**END OF SECTION 26 27 26**



**SECTION 26 28 13****FUSES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Motor-control centers.
  - c. Panelboards.
  - d. Switchboards.
  - e. Enclosed controllers.
  - f. Enclosed switches.
2. Spare-fuse cabinets.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

## 1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Bussmann, Inc.
  - 2. Edison Fuse, Inc.
  - 3. Ferraz Shawmut, Inc.
  - 4. Lihel Fuse, Inc.
  - 5. Or approved equal.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### 2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
  - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
  - 2. Finish: Gray, baked enamel.
  - 3. Identification: "SPARE FUSES" in 1-1/2-inch high letters on exterior of door.
  - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

**PART 3 - DEXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 FUSE APPLICATIONS**

- A. Cartridge Fuses:
  - 1. Service Entrance: Class L, fast acting, Class L, time delay, Class RK1, fast acting, Class RK1, time delay, Class J, fast acting, Class J, time delay, Class T, fast acting.
  - 2. Feeders: Class L, fast acting, Class L, time delay, Class RK1, fast acting, Class RK1, time delay, Class RK5, fast acting, Class RK5, time delay, Class J, fast acting, Class J, time delay.
  - 3. Motor Branch Circuits: Class RK1, Class RK5, Class CC, motor duty, time delay.
  - 4. Large Motor Branch (601-4000 A): Class L, time delay.
  - 5. Power Electronics Circuits: Class J, high speed, Class T, fast acting.
  - 6. Other Branch Circuits: Class RK1, time delay, Class RK5, time delay, Class J, fast acting, Class J, time delay, Class CC, fast acting.
  - 7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  - 8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

**3.4 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by the Commissioner.

**3.5 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION 26 28 13**



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**SECTION 26 28 16****ENCLOSED SWITCHES AND CIRCUIT BREAKERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. Fusible switches.
  2. Nonfusible switches.
  3. Receptacle switches.
  4. Shunt trip switches.
  5. Molded-case circuit breakers (MCCBs).
  6. Molded-case switches.
  7. Enclosures.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

1.7 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

**PART 2 - PRODUCTS**

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. All City Switchboard.
  - 5. Atlas.
  - 6. Electrotech.
  - 7. Lincoln Electric.
  - 8. Or approved equal.
- B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 240, 600 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 240, 600 -V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 240, 600 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:



1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac derived from power feed.

## 2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. All City Switchboard.
  5. Atlas.
  6. Electrotech.
  7. Lincoln Electric.
  8. Or approved equal.
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600 -V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.



4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

## 2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Bussman, Inc.
  2. Ferraz Shawmut, Inc.
  3. Littelfuse, Inc.
  4. Or approved equal.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
  1. Oiltight key switch for key-to-test function.
  2. Oiltight green ON pilot light.
  3. Isolated neutral lug; 100 percent rating.
  4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  5. Form C alarm contacts that change state when switch is tripped.
  6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
  7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

## 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler – Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Or approved equal.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.



- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and  $I^2t$  response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
  - 6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - 8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - 9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
  - 10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - 11. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
  - 12. Electrical Operator: Provide remote control for on, off, and reset operations.
  - 13. Accessory Control Power Voltage: Integrally mounted, self-powered, 120-V ac.

## 2.5 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler – Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Or approved equal.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
  - 1. Standard frame sizes and number of poles.
  - 2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
  - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - 6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
  - 7. Alarm Switch: One NO contact that operates only when switch has tripped.
  - 8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
  - 9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
  - 10. Electrical Operator: Provide remote control for on, off, and reset operations.
  - 11. Accessory Control Power Voltage: Integrally mounted, self-powered, 120-V ac.

## 2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.



3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9.

## **PART 3 - EXECUTION**

### **3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

### **3.2 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.3 INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

### **3.4 IDENTIFICATION**

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.



D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

**END OF SECTION 26 28 16D**

**SECTION 26 29 13****ENCLOSED CONTROLLERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes the following enclosed controllers rated 600 V and less:
1. Full-voltage manual.
  2. Full-voltage magnetic.
  3. Reduced-voltage magnetic.
  4. Reduced-voltage solid state.
  5. Multispeed.
- B. Related Section:
1. Section 26 29 23 "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.7 DEFINITIONS**

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

**PART 2 - PRODUCTS****2.1 FULL-VOLTAGE CONTROLLERS**

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. Configuration: Two speed.
  - 3. Surface mounting.
  - 4. Red pilot light.
  - 5. Additional Nameplates: HIGH and LOW for two-speed switches.
  - 6. Or approved equal.



- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - e. Or approved equal.
  2. Configuration: Two speed.
  3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type
  4. First option in first subparagraph below is available only with NEMA 250, Type 1 enclosures but not from all listed manufacturers. Consult manufacturers for availability of flush enclosures and finishes for flush cover plates because each manufacturer offers different types.
  5. Surface mounting.
  6. Red pilot light.
  7. Additional Nameplates: HIGH and LOW for two-speed controllers
  8. One-, two-, and three-pole integral horsepower manual controllers are suitable for use with single- and three-phase ac motors up to 10 hp at 208-V ac. See "Integral Horsepower Manual Controllers" Article in the Evaluations for additional guidance on their use.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - e. Or approved equal.
  2. Configuration: Two speed.
  3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
  4. Surface mounting.
  5. Red pilot light.
  6. Additional Nameplates: HIGH and LOW for two-speed controllers.
  7. N.O. auxiliary contact.
- E. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - e. Or approved equal.
  2. Configuration: Non-reversing.
  3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  5. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 100VA.
  6. Melting Alloy Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  7. Bimetallic Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - d. Ambient compensated.
    - e. Automatic resetting.
  8. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - e. Analog communication module.
  9. N.O., isolated overload alarm contact.
  10. External overload reset push button.
- F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.





- b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - e. Or approved equal.
  - 2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J, Class R or indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - 3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 4. Non-fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 5. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.O. alarm contact that operates only when MCP has tripped.
    - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
  - 6. MCCB Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
    - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
    - e. N.O. alarm contact that operates only when MCCB has tripped.
- 2.2 REDUCED-VOLTAGE MAGNETIC CONTROLLERS
- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.
  - B. Reduced-Voltage Magnetic Controllers: Reduced voltage, electrically held.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Siemens Energy & Automation, Inc.
  - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - c. Rockwell Automation, Inc.; Allen-Bradley brand.
  - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - e. Or approved equal.
2. Configuration:
  - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
  - b. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
  - c. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral over temperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
  - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses with CPT control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 100 VA.
6. Melting Alloy Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 10 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
7. Bimetallic Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 10 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
8. Solid-State Overload Relay:
  - a. Switch or dial selectable for motor running overload protection.
  - b. Sensors in each phase.
  - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
  - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
  - e. Analog communication module.

9. N.O., isolated overload alarm contact.
  10. External overload reset push button.
- C. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - e. Or approved equal.
  2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J or indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  3. Non-fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  4. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.C., N.O. alarm contact that operates only when MCP has tripped.
    - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
  5. MCCB Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
    - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
    - e. N.C., N.O. alarm contact that operates only when MCCB has tripped.

## 2.3 REDUCED-VOLTAGE SOLID-STATE CONTROLLERS

- A. General Requirements for Reduced-Voltage Solid-State Controllers: Comply with UL 508.
- B. Reduced-Voltage Solid-State Controllers: An integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. Configuration: Standard duty; nonreversible.
  - 3. Starting Mode: Voltage ramping; field selectable.
  - 4. Stopping Mode: Adjustable braking; field selectable.
  - 5. Shorting (Bypass) Contactor: Operates automatically when full voltage is applied to motor, and bypasses the SCRs. Solid-state controller protective features shall remain active when the shorting contactor is in the bypass mode.
  - 6. Shorting and Input Isolation Contactor Coils: Pressure-encapsulated type; manufacturer's standard operating voltage, matching control power or line voltage, depending on contactor size and line-voltage rating. Provide coil transient suppressors.
  - 7. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
  - 8. Control Circuits: 24-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 100 VA.
  - 9. Adjustable acceleration-rate control using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.
  - 10. SCR bridge shall consist of at least two SCRs per phase, providing stable and smooth acceleration with external feedback from the motor or driven equipment.
  - 11. Keypad, front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:
    - a. Adjusting motor full-load amperes, as a percentage of the controller's rating.
    - b. Adjusting current limitation on starting, as a percentage of the motor full-load current rating.
    - c. Adjusting linear acceleration and deceleration ramps, in seconds.
    - d. Initial torque, as a percentage of the nominal motor torque.
    - e. Adjusting torque limit, as a percentage of the nominal motor torque.
    - f. Adjusting maximum start time, in seconds.
    - g. Adjusting voltage boost, as a percentage of the nominal supply voltage.
    - h. Selecting stopping mode, and adjusting parameters.
    - i. Selecting motor thermal overload protection class between 5 and 30.
    - j. Activating and de-activating protection modes.
    - k. Selecting or activating communication modes.
  - 12. Digital display, front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:



- a. Controller Condition: Ready, starting, running, stopping.
- b. Motor Condition: Amperes, voltage, power factor, power, and thermal state.
- c. Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted SCRs, line or phase loss, phase reversal, and line frequency over or under normal.

13. Controller Diagnostics and Protection:

- a. Microprocessor-based thermal protection system for monitoring SCR and motor thermal characteristics, and providing controller over temperature and motor-overload alarm and trip; settings selectable via the keypad.
- b. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency over or under normal.
- c. Input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component or when the motor is stopped.
- d. Shunt trip that opens the disconnecting means when the controller diagnostics detect a faulted solid-state component.

14. Optional Features:

- a. Analog output for field-selectable assignment of motor operating characteristics; 0 to 10-V dc.
- b. Additional field-assignable Form C contacts, as indicated, for alarm outputs.
- c. Surge suppressors in solid-state power circuits providing three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
- d. Full-voltage bypass contactor operating manually, with NORMAL/BYPASS selector switch. Power contacts shall be totally enclosed, double break, and silver-cadmium oxide; and assembled to allow inspection and replacement without disturbing line or load wiring.
- e. Melting Alloy Overload Relays:
  - 1) Inverse-time-current characteristic.
  - 2) Class 10 tripping characteristic.
  - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
- f. Bimetallic Overload Relays:
  - 1) Inverse-time-current characteristic.
  - 2) Class 10 tripping characteristic.
  - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - 4) Ambient compensated.
  - 5) Automatic resetting.
- g. Solid-State Overload Relay:
  - 1) Switch or dial selectable for motor running overload protection.
  - 2) Sensors in each phase.
  - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.



- 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
  - 5) Analog communication module.
  - h. N.O., isolated overload alarm contact.
  - i. External overload reset push button.
- C. **Combination Reduced-Voltage Solid-State Controller:** Factory-assembled combination of reduced-voltage solid-state controller, OCPD, and disconnecting means.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. **Fusible Disconnecting Means:**
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J, Class L or as indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 3. **MCP Disconnecting Means:**
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.O. alarm contact that operates only when MCP has tripped.
    - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
  - 4. **MCCB Disconnecting Means:**
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
    - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
    - e. N.O. alarm contact that operates only when MCCB has tripped.
  - 5. **Molded-Case Switch Disconnecting Means:**



- a. UL 489, NEMA AB 1, and NEMA AB 3, with in-line fuse block for Class J or L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
- b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- c. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
- d. N.O. alarm contact that operates only when molded-case switch has tripped.

## 2.4 MULTISPEED MAGNETIC CONTROLLERS

- A. General Requirements for Multispeed Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Multispeed Magnetic Controllers: Two speed, full voltage, across the line, electrically held.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. Configuration: Non-reversing; two winding.
  3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  4. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  5. Control Circuits: 24V ac; obtained from integral CPT, with primary and secondary fuses, with CPT control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 100 VA.
  6. Compelling relays shall ensure that motor will start only at low speed.
  7. Accelerating timer relays shall ensure properly timed acceleration through speeds lower than that selected.
  8. Decelerating timer relays shall ensure automatically timed deceleration through each speed.
  9. Anti-plugging timer relays shall ensure a time delay when transferring from forward to reverse and back.
  10. Melting Alloy Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  11. Bimetallic Overload Relays:
    - a. Inverse-time-current characteristic.



- b. Class 10 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
- 12. Solid-State Overload Relay:
  - a. Switch or dial selectable for motor running overload protection.
  - b. Sensors in each phase.
  - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
  - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
  - e. Analog communication module.
- 13. N.O., isolated overload alarm contact.
- 14. External overload reset push button.
- C. Combination Multispeed Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Siemens Energy & Automation, Inc.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - e. Or approved equal.
  - 2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J or indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 3. Non-fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, non-fusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  - 4. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.O. alarm contact that operates only when MCP has tripped.





- e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
5. MCCB Disconnecting Means:
- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
  - e. N.O. alarm contact that operates only when MCCB has tripped.

## 2.5 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
- 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Wash-Down Areas: Type 4X stainless steel.
  - 4. Other Wet or Damp Indoor Locations: Type 4.
  - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
  - 6. Hazardous Areas Indicated on Drawings: Type 9.

## 2.6 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
- 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil-tight type.
    - a. Push Buttons: Covered types; momentary as indicated.
    - b. Pilot Lights: LED types; colors as indicated; push to test.
    - c. Selector Switches: Rotary type.
  - 2. Elapsed Time Meters: Heavy duty with digital readout in hours; non-resettable.
  - 3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4, Type 4X, Type 9 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R, Type 4X, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- H. Cover gaskets for Type 1 enclosures.
- I. Terminals for connecting power factor correction capacitors to the line side of overload relays.
- J. Spare control wiring terminal blocks, quantity as indicated; unwired

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.



- C. Seismic Bracing: Comply with requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 28 13 "Fuses."
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Install power factor correction capacitors. Connect to the line side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.
- J. Comply with NECA 1.

### 3.4 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.



- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  - 3. Test continuity of each circuit.
  - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify the Commissioner before starting the motor(s).
  - 5. Test each motor for proper phase rotation.
  - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**3.7 ADJUSTING**

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Commissioner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 50 percent.
- E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- F. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

**3.8 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

**3.9 DEMONSTRATION**

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

**END OF SECTION 26 29 13**



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**SECTION 26 29 23****VARIABLE-FREQUENCY MOTOR CONTROLLERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Related Requirements:
  - 1. Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”

**1.7 DEFINITIONS**

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. LED: Light-emitting diode.
- F. NC: Normally closed.
- G. NO: Normally open.
- H. OCPD: Overcurrent protective device.
- I. PID: Control action, proportional plus integral plus derivative.
- J. RFI: Radio-frequency interference.
- K. VFC: Variable-frequency motor controller.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cerus Industrial, Inc.
  - 2. Danfoss Inc; Danfoss Drives Div.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Rockwell Automation, Inc; Allen-Bradley Brand.
  - 5. Schneider Electric USA, Inc.
  - 6. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Business Unit.
  - 7. Yaskawa Electric America, Inc.
  - 8. Or approved equal.

**2.2 SYSTEM DESCRIPTION**

- A. General Requirements for VFCs:
  - 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508, UL 508C.
- B. Application: Constant torque and variable torque.





- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
  2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to New York City Electrical Division.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
  2. Input AC Voltage Unbalance: Not exceeding 3 percent.
  3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
  4. Minimum Efficiency: 96 percent at 60 Hz, full load.
  5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
  6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
  7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
  8. Humidity Rating: Less than 95 percent (noncondensing).
  9. Altitude Rating: Not exceeding 3300 feet.
  10. Vibration Withstand: Comply with NEMA ICS 61800-2.
  11. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
  12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
  13. Speed Regulation: Plus or minus 5 percent.
  14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
  15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical
- I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 0.1 to 999.9seconds.
  4. Deceleration: 0.1 to 999.9seconds.



5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:
1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
  2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
  3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
  4. Under- and overvoltage trips.
  5. Inverter overcurrent trips.
  6. VFC and Motor-Overload/Over temperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC over temperature and motor-overload alarm and trip; settings selectable via the keypad.
  7. Critical frequency rejection, with three selectable, adjustable deadbands.
  8. Instantaneous line-to-line and line-to-ground overcurrent trips.
  9. Loss-of-phase protection.
  10. Reverse-phase protection.
  11. Short-circuit protection.
  12. Motor-over temperature fault.
- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
  2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
  3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
  4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
  5. NO alarm contact that operates only when circuit breaker has tripped.



## 2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 2.4 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
  - 1. Power on.
  - 2. Run.
  - 3. Overvoltage.
  - 4. Line fault.
  - 5. Overcurrent.
  - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
  - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
  - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
  - 1. Real-time clock with current time and date.
  - 2. Running log of total power versus time.
  - 3. Total run time.
  - 4. Fault log, maintaining last eight faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
  - 1. Output frequency (Hz).
  - 2. Motor speed (rpm).
  - 3. Motor status (running, stop, fault).
  - 4. Motor current (amperes).
  - 5. Motor torque (percent).
  - 6. Fault or alarming status (code).
  - 7. PID feedback signal (percent).
  - 8. DC-link voltage (V dc).
  - 9. Set point frequency (Hz).



10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
  1. Electric Input Signal Interface:
    - a. A minimum of two programmable analog inputs: 0- to 10-V dc
    - b. A minimum of six multifunction programmable digital inputs.
  2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).
  3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
    - a. 0- to 10-V dc.
    - b. 4- to 20-mA dc.
    - c. Potentiometer using up/down digital inputs.
    - d. Fixed frequencies using digital inputs.
  4. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:
    - a. Output frequency (Hz).
    - b. Output current (load).
    - c. DC-link voltage (V dc).
    - d. Motor torque (percent).
    - e. Motor speed (rpm).
    - f. Set point frequency (Hz).
  5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set point speed reached.
    - c. Fault and warning indication (over temperature or overcurrent).
    - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
  1. Number of Loops: One.
- G. BAS Interface: Factory-installed hardware and software shall interface with BAS to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
  1. Hardwired Points:
    - a. Monitoring: On-off status,
    - b. Control: On-off operation,
  2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with BAS to remotely control and monitor lighting from a BAS operator workstation. Control



features and monitoring points displayed locally at lighting panel shall be available through the BAS.

## 2.5 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. Output Filtering:
- C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.
- D. EMI/RFI Filtering:

## 2.6 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.
- C. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.
- D. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
  - 1. Bypass Contactor: Load-break, IEC-rated contactor.
  - 2. Output Isolating Contactor: Non-load-break, IEC-rated contactor.
  - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- E. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
  - 1. Bypass Contactor: Load-break, IEC-rated contactor.
  - 2. Input and Output Isolating Contactors: Non-load-break, IEC-rated contactors.
  - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- F. Bypass Contactor Configuration: Full-voltage (across-the-line) type.



1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
  - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 100VA.
6. Overload Relays: NEMA ICS 2.
  - a. Melting-Alloy Overload Relays:
    - 1) Inverse-time-current characteristic.
    - 2) Class 10 tripping characteristic.
    - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - b. Bimetallic Overload Relays:
    - 1) Inverse-time-current characteristic.
    - 2) Class 10 tripping characteristic.
    - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - 4) Ambient compensated.
    - 5) Automatic resetting.
  - c. Solid-State Overload Relays:
    - 1) Switch or dial selectable for motor-running overload protection.
    - 2) Sensors in each phase.
    - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - 5) Analog communication module.
  - d. NO isolated overload alarm contact.
  - e. External overload, reset push button.

## 2.7 OPTIONAL FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it and generates fault indications when overload protection activates.



1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.
  2. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.
  3. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.
- B. Damper control circuit with end-of-travel feedback capability.
- C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.
- D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.
- E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, this password-protected input:
1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
  2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
  3. Forces VFC to transfer to bypass mode and operate motor at full speed.
  4. Causes display of override mode on the VFC display.
  5. Reset VFC to normal operation on removal of override signal manually.
- F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- G. Remote digital operator kit.
- H. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

## 2.8 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1
  2. Outdoor Locations: Type 3R or Type 4X or as indicated.
  3. Wash-Down Areas: Type 4X, stainless steel.
  4. Other Wet or Damp Indoor Locations: Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

## 2.9 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.



1. Push Buttons: Covered.
  2. Pilot Lights: Push to test.
  3. Selector Switches: Rotary type.
  4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. NO bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- E. Supplemental Digital Meters:
1. Elapsed-time meter.
  2. Kilowatt meter.
  3. Kilowatt-hour meter.
- F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4, Type 4X, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R, Type 4X, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- H. Cooling Fan and Exhaust System: For NEMA 250, Type 1, Type 12; UL 508 component recognized: Supply fan, with stainless-steel intake and exhaust grills and filters; 120V ac; obtained from integral CPT.
- I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- J. Spare control-wiring terminal blocks; wired.
- 2.10 SOURCE QUALITY CONTROL
- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
1. Test each VFC while connected to its specified motor.
  2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.



**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 72 inches (1829 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base (where possible). Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 72 inches (1829 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
  - 1. Curbs and roof penetrations are specified in Section 07 72 00 "Roof Accessories."
  - 2. Structural-steel channels are specified in Section 26 05 29 "Hangers and Supports for Electrical Systems."
- D. Seismic Bracing: Comply with requirements specified in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."



- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Install fuses in each fusible-switch VFC.
- G. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 28 13 "Fuses."
- H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- J. Comply with NECA 1.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
  - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

### 3.5 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFC with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify the Commissioner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Commissioner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges in accordance with Overcurrent Protective Device Coordination Study.
- F. Set field-adjustable pressure switches.

### 3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to instruct the City of New York's service operators to adjust, operate, reprogram, and maintain VFCs.

**END OF SECTION 26 29 23**

**SECTION 26 31 00****PHOTOVOLTAIC COLLECTORS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Description: A 74.25 kW-DC (kilowatt) photovoltaic system made up of solar collector panels, and inverters. The system will be owned by the City of New York.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

## 1.7 WARRANTY AND SERVICE

- A. Provide a complete manufacturer's warranty of all components including replacement labor extending 5 years after date of Substantial Completion.

## 1.8 SUBMITTALS

### A. Product Data

1. PV Module manufacturer's catalog data, MSDS, cut sheets, performance data and detailed shop drawings.
2. Inverter manufacturer's catalog cut sheets, performance data and detailed drawings.
3. Disconnect switch manufacturer's catalog cut sheets and detailed drawings.
4. Complete list of materials and catalog cuts of all balance of system components being provided, including wire and terminations.

### B. Shop Drawings and submittals (1 hardcopy and 1 electronic copy) (include 2 copies of installation manual with submittals)

1. Complete as-built detailed 1-Line wiring diagram of the system. Signed and sealed by a qualified professional engineer licensed in the state of New York.
2. Complete as-built three-line wiring diagrams for the PV system. Signed and sealed by a qualified professional engineer licensed in the state of New York.
3. A complete scaled drawing showing the exact system layout including detailed shop drawings of all components and accessories being provided or required for operation as specified herein.
4. Drawings shall include the functional relationship of various equipment and shall include weights and dimensions of each unit.
5. If at least 10 percent of module locations vary from "Basis of Design", contractor shall provide a detailed shading study using shading analysis tools such as Solmetric SunEye, Solar Pathfinder, Helioscope or approved as equal. An updated production estimate meeting the requirements of the performance guarantee shall also be provided.
6. List of preventive service routines.
7. Wind and Snow Load Design Calculations: Signed and sealed by a qualified professional engineer licensed in the state of New York.
8. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria.
9. Service Data: For system components and for each PV system and accessories to include in service manuals specified in DDC General Conditions

### C. Interconnection and Net Metering Application and Submittals.

1. Contractor is responsible for registering the project with Con Edison's Project Center and initiating, filing and submitting all required information and documents through New York State Standard Interconnection Requirement (SIR) for review and approval. Submittals shall include, but are not limited to:
  - a. New York State Standardized Acknowledgement of Property
  - b. Description / Narrative of the project and site proposed.
  - c. System Three-Line diagram, signed and sealed by a NYS licensed engineer.
  - d. All required product and equipment manufacturer data sheets.
  - e. Certificates of UL compliance for all required equipment.
  - f. Copy of the manufacturer's verification test procedures, if required.
  - g. Any additional information required by Con Edison.

- h. Complete Net metering application and all necessary documents.

## 1.9 QUALITY ASSURANCE

### A. General Requirements

1. Comply with 2014 New York City Construction Codes and FDNY regulations.
2. Coordinate with the Utility Company and file all forms required for Net Metering and Interconnection between the utility grid and PV system.
  - a. Reverse Power Relay will not be required for this project.
3. It is the responsibility of the Contractor to provide an energy-modeled estimate of the performance of the system in PV Watts.
4. Installation crew must follow OSHA regulations, including but not limited standard 1926 - Safety and Health Regulations for Construction.
5. Where additional details or instructions are required to complete the work, the Solar Contractor is deemed to have made an allowance in the bid for the completing of such work, consistent with adjoining or similar details and/or the best accepted practices of the trade, whichever is more expensive.
6. Purchase the equipment and material required in accordance with field measurements taken at the proper time during the construction process.
7. Prior to commencement of any work, Contractor is required to file and obtain all permits.
8. At completion of work, Contractor is required to provide all required signoffs from the New York City Building Department for the work specified in this document.
9. The Contractor shall be responsible for payments of all fees necessary to obtain required permits and sign-offs.

### B. Codes, Standards and Permits

All work shall be in strict accordance with the following codes and standards:

1. 2014 New York City Construction Codes, and zoning laws.
2. Con Edison's technical requirements for interconnection with solar energy systems
3. All applicable Solar PV-specific standards set forth by the Solar America Board for Codes and Standards
4. IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power
5. IEEE 519 "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems"
6. IEC-61-215
7. UL-1741 "Inverters, Converters, and Interconnection System Equipment for Use with Distributed Energy Resources"
8. UL-1703 "Flat-Plate Photovoltaic Modules and Panels"
9. All products shall be UL listed or certified by other Nationally Recognized Testing Laboratory (NRTL) whenever possible.
10. NFPA 70: National Electrical Code 2008
  - a. Article 690, Solar Electric Systems
  - b. Article 705, Interconnected Electrical Power Production Sources
11. ANSI C12.1 "Code for Electricity Metering"
12. FCC electromagnetic Interference (EMI) Part 15 A & B

### C. Simulation

1. If submitting a design, provide a simulation using PVWatts.
  - a. URL of PVWatts is <http://pvwatts.nrel.gov/pvwatts.php>.
2. PVWatts DC to AC Derate Factor: determined by Contractor and subject to performance requirements given below, and acceptance by Commissioner.

**D. Waste Removal**

1. Refer to the DDC General Conditions for construction waste management and disposal requirements.
2. Contractor shall be responsible for the removal and on-site disposal of any and all materials considered waste during the course of the work.
3. In the event there is damage to any portion of the building exterior or interior, to the sidewalk, to the stairs, and/or any area affected by the work. Promptly restore, clean and restore to the full satisfaction of the Commissioner any and all damage at no additional expense or delay to The City of New York.

**1.10 PROJECT INFORMATION**

**A. Electrical**

1. Service voltage: 120/208V 3-PHASE 4W
2. Metering: CONED Meter new not know at this time
3. Interconnection: Refer to Electrical Drawings

**B. Roof: SBS with granular cap sheet. Refer to Section 07 52 16 "SBS Modified Bituminous Membrane Roofing".**

**C. Structural: concrete slab on steel deck, concrete and concrete masonry curbs.**

**D. Find as-built structural details on architectural drawings**

**E. Roof membrane and warranty: Refer to Section 07 52 16 "SBS Modified Bituminous Membrane Roofing".**

**F. Pitch: less than 5 degrees.**

**1.11 SOLAR SYSTEM**

**A. Solar system nameplate: 74.25 kW-DC**

1. Quantity of modules: refer to drawings – 265W Monocrystalline
2. Quantity of inverters: refer to drawings – 9kW-AC
3. Quantity of transformers: N/A

**B. Solar system location: Southern, Western, Eastern and Northern sections of the three East, West and South roofs.**

**C. PV performance display monitor: The Contractor will install and program a display monitor to display the PV system's production information and related environmental sensors captured by the Data Monitoring System (DMS). The Contractor is required to provide infrastructure and coordinate with the Commissioner for the display.**



## PART 2 - PRODUCTS

### 2.1 PHOTOVOLTAIC MODULES

- A. Procure and install modules with the following requirements:
  - 1. 265 Watt, 60 cell, multicrystalline.
  - 2. Modules shall be listed by Underwriters Laboratories (certified UL1703), ETL or other NRTL for electrical and fire safety for use in systems up to 600 VDC.
  - 3. Total nominal system capacity must be greater than or equal to the specified capacity.
- B. Manufacturers:
  - 1. JA Solar #JAM6(K)-60-265/4BB (Basis-of-Design)
  - 2. Yingli Solar, 270 Watt, #YL270P-8.77b
  - 3. Longi Solar, 295 Watt, #LR6-60
  - 4. Or approved equal.

### 2.2 INVERTERS

- A. Procure and install inverters at each site with the following requirements:
  - 1. 9kWAC transformer-less string inverter.
    - a. 208 VAC 3-phase
    - b. Integrated DC and AC disconnects
    - c. Integrated shade cover
  - 2. Inverter(s) shall be installed in the location as per Contract Drawings.
  - 3. Inverter(s) shall have a CEC Weighted Efficiency of greater than 96.0%; UL listed, utility interactive, matched to phase, voltage, voltage and current requirements of PV system with maximum power point tracking (MPPT) and electronics.
  - 4. Inverter(s) shall meet and be certified to all UL 1741 and IEEE 1547 requirements, including but not limited to:
    - a. Over and under voltage trip points and times
    - b. Over and under frequency trip points and time
    - c. Total harmonic distortion control IEEE 519
    - d. Anti-islanding protection
    - e. DC ground-fault detection and interruption
    - f. Inverter shall have automatic start-up, shut-down and self-diagnosis.
    - g. Inverters must be Rapid-Shutdown compliant.
    - h. Inverter Decibel (dBA) rating not to exceed 50 dBA @ 3 meters.
- B. The inverters shall be compatible with Solar PV Systems' array outputs and sized accordingly.
- C. Wiring shall follow the three-line diagram included in Contract Drawings
- D. Manufacturers:
  - 1. SOLAREEDGE SE 9kus inverter (Basis-of-Design),
  - 2. Solectria, 14.4kWAC, 208VAC 3-phase, #PVI 14TL Inverter,
  - 3. Fronius, 15kWAC, 208VAC 3-Phase, #Symo 15.0-3 208,



4. Or approved equal.

## 2.3 OPTIMIZER

- A. Procure and install optimizer at each location with the following requirements:

1. 600W optimizer
2. MPPT operating range: 12.5 – 80 VDC
3. Max short circuit current: 10 Amps Iscc
4. Max DC input current: 12.5 Amps
5. Max efficiency: 99.5%
6. Max output current: 15 Amps
7. Max output voltage: 85 Volts
8. Dimensions: 5.97" x 1.69"
9. Weight: 2.05 lb
10. Connector type: MC4 compatible

- B. Manufacturers:

1. SOLAREEDGE Model P600 (Basis-of-Design)
2. Tigo Energy, Inc. Model TS4
3. Or approved equal.

## 2.4 MOUNTING SYSTEM

- A. Procure and install solar mounting system with the following requirements:

1. All modules shall be secured to roof via a ballasted racking solution.
2. No roof penetrations are authorized on this roof.
3. Include wind and snow load design calculations signed and sealed by a qualified professional engineer licensed in the state of New York.
4. 10-degree tilt angle on panel racks.

- B. All structural components shall be installed in a manner commensurate with attaining a minimum 25-year design life.

- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DynoRaxx (Basis-of-Design)
2. Ecolibrium
3. Unirac
4. Preformed Line Products / DPW Solar
5. Or approved equal.

## 2.5 BALANCE OF SYSTEMS COMPONENTS (BOS)

- A. Procure and install BOS components with the following requirements:

1. Follow requirements described on three-line diagram.
2. Conduit pull boxes as required by installer.

- B. Solar array combiner boxes: UL listed, series fusing or circuit breakers for solar roof panel source circuits in NEMA enclosure rating as required by installation location.



- C. Solar array DC disconnect switches: UL listed, blade-type, heavy duty fused safety switches on the output of the solar array in NEMA enclosure rating as required by installation location or may be integrated to the Inverters.
- D. AC disconnect switches: UL listed, blade-type, heavy duty fused safety switches on the output of Inverter(s) in NEMA enclosure as required by installation location or may be integrated to the Inverter.

## 2.6 DATA MONITORING SYSTEM (DMS)/ DATA ACQUISITION SYSTEM (DAS)

- A. Contractor is responsible for coordinating with facility IT staff to connect DMS to the existing internet service. The inverter may be used as the DMS as long as it meets the requirements below.
- B. Provide a Data Monitoring System (DMS) capable of collecting, recording, and displaying Solar PV System energy generation. The DMS shall provide the following features:
  - 1. Follow requirements described on three-line diagram.
  - 2. Capable of directly-acquiring energy production data from inverter.
  - 3. DMS shall be capable of capturing 15-minute data from Solar PV System. This meter system shall be installed with remote communication abilities and make all data available on a web interface.
  - 4. The DMS shall monitor the status of the inverters, capture inverter fault codes, and provide immediate e-mail notification if communication is lost or any errors are reported by the inverters.
  - 5. The DMS shall monitor the status of the system energy production and provide immediate email notification if energy production drops below expected levels.
  - 6. Educational information from the DMS shall be made available to the school's students, teachers and visitors through a display monitor located in the hallway of the first floor. Information shall also be available to administrators and educators through a common web portal supplied by inverter manufacturer.
- C. Contractor is responsible for installing the data monitoring system and paying the up-front expenses associated with the data monitoring system.
- D. Data monitoring system includes, but is not limited to:
  - 1. Data logger: Solrenview Datalogger used in design. Fully compatible with inverters and internet monitoring system.
    - a. Integrated DC powered by inverter
    - b. Outdoor rate NEMA4X enclosure
    - c. Connection: Modbus RS-485 daisy chained to inverters
    - d. LAN connection: Ethernet, TCP/IP
    - e. Networking connection: DHCP or Static IP
  - 2. Display Monitor: Fixed to wall with low profile adjustable tilt bracket. Minimum specifications:
    - a. Size: Nominal 42 inch (diagonal)
    - b. Display type: LED, 4K color
    - c. Resolution: High Definition
    - d. Sound: Built in speakers

- e. Network compatibility: Ethernet

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 GENERAL

- A. Install and wire the entire PV system as shown on the Contract Drawings, as indicated in all of the various system components manufacturer's instructions and as required for a neat, workmanlike and fully integrated and operational system. Ensure that all required and recommended clearances are maintained.
- B. Pre-installation Conference: Before beginning construction, conduct a pre-installation conference at the project site with the installer, the Commissioner, The City of New York and other interested parties to review procedures schedules, and coordination of the installation with other elements of the Work.
- C. Before installing or wiring PV modules, read all safety instructions in the product manual and these specifications.

### 3.3 INSTALLATION

- A. All PV module strings shall be field-tested to verify electrical integrity and specified performance per the manufacturer's recommendations. All PV module strings shall be tested, under good, clear weather conditions, for open circuit voltage (Voc) after ten minutes of sunlight exposure. The PV measurements and PV module serial numbers are to be recorded and the results shall be compared with values provided by PV module manufacturer.
- B. In the event the measurements are out of the expected ranges, the PV module shall be deemed defective and a replacement from the manufacturer shall be provided and installed.
- C. A copy of all of the measurements that are taken shall be included in the Operation and Maintenance Manual as described herein.
- D. Inspection – Examine the roof and the conditions under which the work is to be installed and notify the Commissioner in writing of any conditions deemed detrimental to the proper and timely completion of the work. Be very careful as not to cover any roof drains or other type of penetrations, to allow for future maintenance. Do not proceed with the work until unsatisfactory conditions have been corrected in the manner acceptable to the Commissioner.

### 3.4 ELECTRICAL ENGINEERING SERVICES

- A. All engineering services shall be provided by Contractor's professional engineer licensed in the State of New York and submitted for review and approval by Commissioner.
- B. Follow requirements described on Three Line Diagram.
- C. For multiple inverter systems tied into a single utility meter, Contractor's electrical



engineering services shall include the combination of AC outputs of inverters within Electrical PV AC Combiner Panel.

- D. Design shall include DC Disconnect Switches in accordance with Specification Supporting Documents.
- E. Grounding Conductors shall be sized and selected as per National Electrical Code and 2014 New York City Electrical Code.
- F. The PV DC system ground shall be connected directly to the base building AC grounding electrode.
- G. Comply with NYC 2014 Electrical Code, article 690.47(C).
- H. The PV System's DC system ground shall be installed per 2014 New York City Construction Codes.

### 3.5 WIRING

- A. Wiring practices and grounding shall be completed in a neat and workmanlike fashion and conform to 2014 New York City Construction Codes and NEC. Sealant shall be used as directed by manufacturer, subject to review by Commissioner.
- B. Wiring shall be contained in an organized and functional wire management system.
- C. All module to module wiring shall be secured to the back of the modules and rails with UV-resistant and anti-corrosive stainless steel straps, clamps, or ties. Care shall be taken to ensure as little slack in the exposed wire as possible, so as to limit damage from wind and abrasion.
- D. Cable running under PV panels shall be continuously supported and shall not make contact with roof surface.

### 3.6 LABELING

- A. Install signage posted at site, including at least the following but also any signage required by the NEC and 2014 New York City Electrical Code:
  - 1. Laminated Diagrams including:
    - a. AC and DC disconnect locations for the system indicated on a site plan.
    - b. Electrical one-line diagram of system
  - 2. All signage required shall be mounted in appropriate and visible locations
- B. All equipment shall be appropriately identified with permanent, self-adhesive labels.
- C. Each DC disconnect shall be labeled with label material described above for operating DC current (Imp), system operating DC voltage (Vmp), maximum string DC voltage (Voc), and maximum system DC current (Isc).
- D. The PV system interconnection point (as described in Electrical Drawings) shall be labeled as such indicating the PV system AC voltage, current, and the PV array rating in Watts DC and Watts AC.

### 3.7 INSTALLATION INSPECTIONS

- A. Conduct an in-depth inspection to ensure that the PV system is installed in a workmanlike manner and consistent with industry practice, National Electrical Code and 2014 New York City Electrical Code.
- B. Maintain a photo-record of the installation and major components, including PV modules, inverters, transformers and combiners. Photos will show connections within all installed enclosures.
- C. Provide a copy of the photos in the Operation and Maintenance Manual described herein.

### 3.8 ACCEPTANCE TEST/COMMISSIONING

- A. Notify the Commissioner writing when the entire PV system is correctly installed and properly wired. Actual acceptance of the system will only take place after the system passes all parts of the Acceptance Test, work successfully during a 30-day conditioning and system rating period, and meets the contractual system peak power rating. The contractor is required to perform start-up and validation of the system in the field prior to Commissioner's site acceptance test.
- B. Acceptance Test
  - 1. Array Tests
    - a. Test each PV string for Voc and Isc under good, clear weather conditions and follow the PV manufacturer's instructions when conducting tests. The measurements are to be recorded and compared to the manufacturer's specification.
    - b. Grounding: Resistance between ground connection and accessible conductive part should be less than 0.1 Ohm, tested with 25 A current.
    - c. Insulation resistance testing shall be performed (at the combiner boxes) on disconnected homerun string circuits during system commissioning. If string resistance measurement is less than 1 MegaOhm at 500 VDC, then test on each module individually to check for faulty connections. System Commissioner reserves the right to approve measured string resistance if no faulty connections are found.
    - d. Insulation resistance testing also serves as a baseline for maintenance checks during system operation.
    - e. All measurements taken shall be documented and included in the Operation and Maintenance Manual described herein.
  - 2. Inverter Operational Tests
    - a. Refer to and explicitly follow the Manufacturer's Instruction Manual for the particular testing requirements of the model inverter being tested.
    - b. Test each inverter independently and document the results of the tests.
    - c. Check that the AC and DC voltages, at the line side of the open inverter disconnect switches, are within manufactures specification.
    - d. Close the AC and DC disconnect switches and observe the inverter startup process. Refer to the Manufacturer's Instruction Manual for the correct sequence.
    - e. After successful completion of the inverter tests, the AC and DC disconnects shall be left open until the PV system is ready for commissioning.

**3.9 INITIAL START-UP**

- A. Prior to initial start-up tests, testing as described in the previous sections shall be satisfactorily completed.
- B. The goals of the commissioning process are as follows:
  - 1. Certification that the systems meet the requirements set forth in the specification.
  - 2. Review results of the inspection, array and inverter tests.
  - 3. Provide demonstration of PV system performance.
  - 4. Facilitate successful project closeout and warranty transition.
- C. The following PV system performance tests will be conducted at the project site by the Contractor and witnessed by commissioning team:
  - 1. Turn on the PV system and verify that it is working as specified.
  - 2. Verify proper system shutdown for loss of grid voltage via the AC disconnect switch.
  - 3. Verify proper system operation following loss of grid voltage.
- D. Verify proper operation of Monitoring System by viewing system operating parameters on the Monitoring System's web page.
- E. Provide manufacturer's operations manual for the inverters and be available to answer questions concerning proper system operating procedures.

**3.10 INSTRUCTION**

- A. Contractor shall be responsible for the instruction of The City of New York's service operators for both the equipment and systems pertaining to this installation.
- B. Instruction shall consist of a minimum of (2) 4-hour sessions. Instruction sessions and demonstration sessions shall not be consecutive and are separate and apart from start-up. Instruction shall consist of both classroom and in-the-field instruction. All instruction materials and a curriculum unique to this project will be presented to the Commissioner 2 months in advance of the on-site instruction. Instruction will commence only after the approval of the curriculum and agenda by the Commissioner.
- C. Refer to the DDC General Conditions for instruction requirements.

**END OF SECTION 26 31 00**



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**SECTION 26 32 13****ENGINE GENERATORS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Specification Sections:
  - 1. Division 26, Section 26 05 48 "Vibration Isolation, Seismic, Wind & Flood Load Restraints for Electrical Components".
- C. Drawings:
  - 1. Electrical Drawings: All electrical project drawings are part of this project and are required for a complete and accurate price for this work.

**1.2 SUMMARY**

- A. The contractor is directly responsible for providing all services and equipment within the scope of this specification to include the following:
  - 1. Provide the Engine Generator and all specified accessories and equipment.
  - 2. Perform a factory test of all equipment. The test shall be witnessed by the Commissioner as specified.
  - 3. Refer to Section 26 08 00 "Commissioning of Electrical" for commissioning requirements.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 "Construction Waste Management and Disposal"
  - 2. Section 01 81 13 "Sustainable Design Requirements for LEED Buildings"
  - 3. Section 01 81 19 "Indoor Air Quality Requirements for LEED Buildings"
- C. **LEED BUILDING PERFORMANCE REQUIREMENTS:** The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SYSTEM DESCRIPTION**

- A. Generator System Requirements - The intent of this specification is to describe the requirements for one Engine-Generator with the following ratings and or classifications:
  - 1. Emergency Standby Power Rating per ISO-8528-1 of 600KW / 750KVA.
  - 2. EPA Tier (2) Emissions Rating.
  - 3. Rated Voltage of 208Y/120V, 3 phase, 4 wire.
  - 4. Rated Frequency 60Hz
  - 5. NFPA 110 EPSS Level 1 system.
  - 6. NFPA 110 EPSS Type 10 system, or power restoration in 10 seconds. The type defines the maximum time, in seconds that the EPSS will permit the load terminals of the downstream transfer switch to be without acceptable electrical power
  - 7. Minimum generator transient performance standards shall be per the latest ISO 8528-5 Performance Class G2
- B. Generator System Equipment - In general the Engine-Generator defined in this specification includes the following subsystem assemblies:
  - 1. Diesel Engine
  - 2. Generator (Alternator)
  - 3. Engine mounted Radiator.
  - 4. Radiator Mounted Load Bank
  - 5. Fuel System.
  - 6. Standalone Fuel Oil Cooler
  - 7. Generator Output Protection.
  - 8. Vibration Isolation System.
  - 9. Battery Chargers
  - 10. Starting Batteries and associated Racks.
  - 11. Dual Jacket Water Heaters
  - 12. Dual Starters.
  - 13. Generator Control Panel
  - 14. Generator Exhaust and Silencer system.
  - 15. Fuel Oil Base Tank
  - 16. Spare Parts
- C. The Engine Generator manufacturer shall be responsible for the performance of the entire Engine Generator. This responsibility extends to all component parts of vendors that provide sub systems that together make a functioning engine generator set. If any sub system causes the performance of the engine generator to fail at the factory or site performance test, it's the generator manufacturer's responsibility to replace or fix the non performing component until the performance of the engine generator system meets all specified performance requirements with no additional expenses to the City of New York.

**1.6 DEFINITIONS**



- A. As used in the drawings and specifications for electrical work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the General Conditions or other documents governing the electric work.
1. EPSS - Emergency Power Supply Systems.
  2. BHP –Brake HorsePower is the horsepower of an engine measured by the degree of resistance offered by a brake, that represents the useful power that the machine can develop.
  3. Generator – Used interchangeably with alternator throughout the specification. A single non-redundant device consisting of all the necessary components to convert mechanical energy to electrical energy and provide an AC voltage source to the load.
  4. Engine - A single mechanical device that utilizes internal combustion to convert liquid fuels to mechanical energy efficiently. This machine serves as the prime mover for the generator.
  5. Governor - An electromechanical feedback control system that regulates the steady state speed (RPM) of the Engine by controlling air and fuel input into the engine. The synchronous speed of the generator derives the frequency and voltage output of the system.
  6. Voltage Regulator – An electrical feedback control system that controls that excitation current of the generator to regulate the steady state output Voltage
  7. Emergency Standby Power Rating – In accordance with ISO-8528-1 the emergency standby power rating is applicable to emergency power applications where power is supplied for the duration of normal power interruption. This rating is only applicable to variable loads with an average load factor of 70% over 24 hours of the standby rating for a maximum of 200 hours of operation per year. This rating only applies to generators that serve as a back up to the normal utility source. No prolonged operation in parallel with utility is permitted with this rating.
  8. Prime Power Rating (Unlimited Hours) – In accordance with ISO-8528-1 the prime power rating is defined as being the maximum power which a generating set can deliver continuously whilst supplying a variable load. Continuous operation is limited to the average power output shall not exceed 70% of the Prime Power rating over 24 hours for an unlimited number of hours per year.
  9. Continuous Power Rating (Base Load Rating) – In accordance with ISO-8528-1 the continuous power rating is defined as being the maximum power which the generating set is capable of delivering continuously whilst supplying a constant electrical load. The constant load shall be capable of being served for an unlimited amount of hours by engine generator. Prolonged operation in parallel with utility is permitted with continuous power rating.
  10. Rated Frequency (Declared Frequency) – The engine generator frequency at 100% of the power rating of the engine generator.
  11. Frequency Droop – Frequency difference between rated no-load frequency and the rated frequency (expressed in percentage) at the declared engine generator set power rating.
  12. Transient Frequency Difference from Initial Frequency – The reduction in initial frequency from no load to 100% load or the increase in initial frequency from 100% load to no load. Initial frequency is defined as the frequency at the beginning of a transient event.
  13. Transient Frequency Deviation from Rated Frequency – The reduction in rated frequency from no load to 100% load or the increase in initial frequency from 100% load to no load.
  14. Rated Voltage – Line-to-Line voltage at the terminals of the engine generator at rated frequency and at rated power rating. Rated voltage is the voltage used for operating and performance characteristics.
  15. Power Output Rating – Gross electrical power output of diesel engine generator set minus total power requirements of cooling fans pumps and other accessories.
  16. RPM – Revolutions Per Minute.
  17. BHP –Break HorsePower, the maximum power an engine can supply to an Alternator.
  18. in<sup>3</sup> – Cubic inches.



19. Steady State Voltage Modulation – the uniform cyclical variation of voltage within the operational bandwidth, expressed in hertz.
20. Operational Bandwidth - The total variation from the lowest to the highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
21. the expenses of the required service in the price of Engine – Generator.
22. UL – Underwriter Laboratories

#### 1.7 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures."

#### 1.8 SUBMITTALS

- A. Provide completely dimensioned outline drawings (minimum scale  $\frac{1}{4}" = 1'-00"$ ) of all Engine Generator equipment to include the Engine Generator Set, Heat Exchanger, Silencer, Generator Output Section and Breakers and Starting Batteries. Provide detailed dimensional information suitable for use as an installation drawing.
- B. Provide a completely dimensioned top view, right side view, and left side view of the proposed Engine Generator Unit (scale  $\frac{1}{4}" = 1'-00"$ ). All views shall indicate relative location of all circuit breakers, output cable landings, auxiliary fans, output bus work, and auxiliary equipment.
- C. Provide data sheets for the alternator proposed. Include rated capacities, transient, and sub-transient reactance, maximum short circuit output. In addition, include the following:
  1. Thermal Alternator damage curve to protect the alternator.
  2. Time-current characteristic curves for generator protective device.
- D. Engine Generator Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified. Detailed plan view, front elevation, side
  2. Design Calculations: Signed and sealed by a qualified professional engineer licensed in the State of New York. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer licensed in the State of New York. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
  4. Wiring Diagrams: Show details of power and control connections and differentiating between factory-installed and field-installed wiring. Complete system point-to-point external wiring from diesel generators, output box, control cabinet and mimic panel. All wiring diagrams shall be clearly labeled and numbered to indicate exact actual termination points as required by this specific project. Connections to equipment not provided by this vendor shall be updated to include all terminal numbers and connections required for the final installation.
  5. Ratings make and model of diesel engine and generator.
  6. CO, CO<sub>2</sub>, NOX emission level at 25-50-75-100% loads in lbs. /hour, based on different fuel types. Provide a matrix indicating various values. The emission level must follow local and State environmental standards and requirements.



7. Battery sizing calculations shall be provided with the battery shop drawing to validate the battery size based on the number of cranking cycles, duration of cranking cycles and the required accessories to be powered during engine starting.
8. Provide data sheets for engine mounted radiators to display the temperature ratings vs static pressure.
9. Catalog sheets indicating features, specifications, noise level, application data, cooling, controllers and accessories.
10. Schedule with Milestone Dates for shop drawing submittal, factory test, fabrication and delivery to site.
11. Transient response data and curves indicating compliance with ISO 8528-5.
12. Exits exhaust gas temperature, gas flow and maximum back pressure.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Emergency Response: The manufacturer shall maintain a service center capable of emergency maintenance and repairs at the project site within 4 hours' maximum response time on site.
- C. Source Limitations: Obtain engine generator set and auxiliary components specified in this Section through one source from a single manufacturer with the responsibility for the entire system.
- D. References and Standards: The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below:
  1. International Standards Organization
    - a. ISO 8528 1 through 7
  2. NEMA MG-1-22
  3. Underwriters Laboratory
    - a. UL 508
    - b. UL2200
    - c. UL142
  4. National Fire Protection Association (NFPA)
    - a. NFPA 70(2008) "National Electric Code" with (2011) New York City Amendments.
    - b. NFPA 99
    - c. NFPA 110
    - d. NFPA 30 Flammable and Combustible Liquids Code
    - e. NFPA 37 "Installation and Use of Stationary Combustion Engines and Gas Turbines.
- E. Engine Exhaust Emissions: Comply with 2014 New York City Construction Codes and NYCDEP requirements.
- F. All electrical components shall be listed and labeled per NFPA – 70.
- G. Warranty - Provide 5-year manufacturer's warranty for the generator sets beginning on the date of Substantial Completion.



1. Include all parts required to restore the engine should engine defects in workmanship, or components arise.
2. Include all labor required associated with engine restoration. Labor provided for all restorations shall be provided by a factory trained technician who is thoroughly familiar with the type of Engine Generator being provided.
3. Include all factory upgrades to the Engine Generator at no expense to the City of New York within the warranty period.

**1.10 DELIVERY STORAGE & HANDLING**

1. The Contractor shall provide the engine generator system in its entirety, including transport of the Engine Generator equipment to the project site, rigging, and installation, and shall be responsible for all associated permits and fees.
2. Protection – The manufacturer shall provide the following protection during shipping the equipment:
  - a. Shrink wrap all switchgear prior to leaving the factory.
  - b. Label all equipment and palates with a unique label indicating the equipment in the palate which shall be correlated to a bill of lading.
  - c. Provide tipping indicators for all equipment with a maximum tipping angle of 15 degrees or less.
  - d. All items that will be loose shipped to the third-party rigging company shall be placed on a palate and shrink wrapped together.
3. Corrosion Protection – In the event that the Engine Generator will be stored for more than three months the manufacturer shall provide corrosion protection for the Engine Generator when shipping from the factory. Additionally, in the event of a three-month storage or longer all cylinders shall be borescoped prior to start up to ensure that the cylinders and pistons are not corroded. Pay all expenses associated with the testing.
4. Provide a detailed shipping manifest detailing each component of the shipment and which truck it will be shipped in.
5. Shipping – The generator and associated equipment covered by this specification, shall be shipped after the Commissioner formally accepts the switchgear at the conclusion of the factory witness test.
6. All switchgear in this order shall be shipped via a dedicated truck which shall not make any stops aside from the switchgear for this project.
7. Provide tie downs and bracing for each individual section and under no circumstance can any component in this shipment be allowed to tip beyond 15 degrees.
8. The manufacturer is responsible for selecting the route to ship the equipment from the factory to the third-party enclosure manufacturer. Any damage to the equipment during shipment from the factory to the third-party rigger is the responsibility of the manufacturer.
9. The manufacturer is responsible for obtaining all state, local, and federal approvals for shipping the switchgear and outdoor enclosure over state lines. Pay all fees required to complete the shipment of this equipment.
10. In the case of wide loads the manufacturer shall provide all necessary leading and trailing vehicles required by New York City, New York State and Federal departments of transportation to accompany a wide load shipment of the nature required.
11. Responsibilities for Damages During Shipping
  - a. In the event of damage of the outdoor enclosure due to hitting an overpass or other physical damage the manufacturer shall return the enclosure to the manufacturer's factory. Under no circumstance may a manufacturer continue the delivery of a damaged piece of equipment.



- b. It is the sole right of the Commissioner to accept or reject equipment that has been damaged during shipment. If the Commissioner rejects a damaged piece of equipment the manufacturer shall arrange for shipment of the equipment back to the factory to correct the damage at no expense to the City of New York.
  - c. Any structural damage to any equipment shall result in reconstruction of the entire piece of equipment.
  - d. In the case of any damaged equipment that needs to be returned to the manufacturer's factory the manufacturer shall assume the expense of all shipping expenses back to the factory. Once damage has been corrected the expense of shipment back to the site is the responsibility of the manufacturer.
12. The manufacturer shall insure all shipments against damage during shipment to the new value of the equipment being shipped.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers - Subject to compliance with this specification, the manufacturers listed in this section are approved for use in the engine generator.
- B. Engine Generator Sets – The completed engine generator set shall be supplied by the Manufacturer's authorized distributor only. The generator set suppliers listed in the approved generator set manufacturers have been prequalified to work dimensionally and from as systems engineering standpoint to coordinate with the MEP design of the project.
  - 1. Caterpillar, Inc (Generator Set C18, Supplier H.O. Penn),
  - 2. Kohler (Generator Set 600REOZVB, Supplier Cooper Power Systems),
  - 3. MTU / Onsite Power. (MTU12V1600DS6, Supplier Stewart & Stevenson Power Products),
  - 4. Or equivalent product from an approved equal manufacturer.
- C. Radiator Mounted Load Bank
  - 1. Avtron.
  - 2. Simplex
  - 3. Or approved equal.
- D. Exhaust Silencer
  - 1. Maxim
  - 2. Nelson
  - 3. Harco
  - 4. Or approved equal.
- E. Vibration Isolators
  - 1. Mason Industries
  - 2. Vibration Eliminator Co.
  - 3. Cooper industries
  - 4. Or approved equal.
- F. Starting Batteries



1. Lamarche
2. Nife
3. Charles
4. Or approved equal.

G. Battery Charger

1. Lamarche
2. Nife
3. Charles
4. Or approved equal.

H. Jacket Water Heaters

1. Kim
2. Chromalux
3. Clifford
4. Or approved equal.

I. Governors

1. Woodward
2. Westerbeke
3. Aspire
4. Or approved equal.

J. Alternators

1. Century
2. Kato
3. Marathon
4. Or approved equal.

K. Voltage Regulators

1. Caterpillar VRS
2. Basler
3. Kohler
4. Or approved equal.

2.2 OPERATING ENVIRONMENT

A. Prototype Environment: The generator set control shall be prototyped tested and certified to the following environmental conditions:

1. -40°C to +70°C Operating Range
2. 95% humidity non-condensing, 30 °C to 60 °C
3. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
4. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
5. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
6. Shock: withstand 15G





- B. Project Specific Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: -40C to 70C
  - 2. Relative Humidity: Zero to 95 percent.
  - 3. Altitude: Sea level to 500 feet
- C. Oversizing of engine or generator with respect to the rated power output of the engine may be required to meet certain performance requirement.
  - 1. Unusual Service Conditions – Unusual service conditions affecting the generator may affect the general stated performance. Unusual service conditions for the purposes of this specification are high or low ambient temperature areas of operation, elevations over 500 feet, high dust or dirt environment.
  - 2. Generator Nameplate: For oversized generators, show ratings required by the Contract Documents that are consistent with engine capacity rather than component oversize ratings.
  - 3. Usable Generator Capacity: The generator shall be sized to provide the published rated generator capacity to the load. The generator shall be provided with additional generator capacity if necessary, to run generator auxiliaries such as fans, pumps, and/or remote radiators during operation.

## 2.3 ENGINE GENERATOR-SET PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Engine-generator set housing, engine-generator set, batteries, battery racks, silencers, load banks, and sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
  - 1. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst case normal levels
  - 2. Component Importance Factor: 1.5.
- B. ASME Compliance: Comply with ASME B15.1.
- C. ISO 8528 “Performance Class G2 Operating Parameters” govern the overall Engine Generator performance metrics for this project. Project specific performance requirements are as follows:
  - 1. Frequency Droop: 0% electronic isochronous frequency control required by the governor specification.
  - 2. Transient frequency difference from initial frequency prior to 100% sudden power decrease: +12% deviation from the initial frequency prior to the deviation.
  - 3. Transient frequency difference from initial frequency prior to 100% sudden power increase: -10% deviation from the initial frequency prior to the deviation.
  - 4. Frequency recovery time: Transient frequency recovery from 100% load addition or subtraction to recovery to initial frequency 5 seconds.
  - 5. Transient voltage difference from initial voltage prior to 100% sudden power decrease: +25% from initial voltage prior to deviation.
  - 6. Transient voltage difference from initial voltage prior to 100% sudden power increase: -20% from initial voltage prior to deviation.
  - 7. Voltage recovery time: Transient voltage recovery from 100% load addition or subtraction to recovery to initial voltage 6 seconds.
  - 8. Steady-State Voltage regulation: Less than  $\pm 0.25\%$  of nominal from no load to full load.
  - 9. Steady state Frequency regulation: Less than 0.25Hz from no load to full load.

10. Unbalanced Load: Shall be capable operating continuously with a negative phase sequence current up to and including 10% of the rated current.

D. Miscellaneous Performance Requirements:

1. Output Waveform: At no load, harmonic content measured line-to-neutral does not exceed 2.0 percent total with no slot ripple. The telephone influence factor (TIF), determined according to NEMA MG 1, does not exceed 50.
2. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at the system output terminals, the system will supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or any other generator system component.
3. Nonlinear Load Performance: System performance is not degraded from that specified in this Article by continuous operation, with full-load current having a minimum total harmonic content of 40 percent RMS, with a minimum single harmonic magnitude of 25 percent RMS.

- E. Starting Time: Given the project specific Operating Environment the maximum total time period for a cold start, is 10 seconds as defined in NFPA 110.

## 2.4 ENGINE

- A. The engine utilized for this project shall be a Diesel Engine. The following engine performance metrics are a combination of the approved manufacturers for this project. The generator room that this Engine Generator set is going into has been designed to the requirements indicated below. The engine provided shall be provided with the following capacities, ratings, and flows.

1. Fuel: Diesel fuel oil grade DF-2.
2. Engine Type – 4 cycle
3. Minimum Engine Cylinders – Minimum allowed 6 cylinders
4. Engine Revolutions Per Minute – 1,800 RPM.
5. Minimum Engine Break Horsepower – No less than 896 BHP.
6. Minimum Engine Total Displacement – No less than 984 in<sup>3</sup>.
7. Maximum Fuel Consumption at Full Load – No greater than 43 GPH.
8. Maximum Total Fuel Flow – No greater than 107 GPH.
9. Radiator Mounted Air Flow – No greater than 28,357 CFM
10. Radiator Mounted Temperature Rating 122°F @ 0.50 H<sub>2</sub>O
11. Radiator Mounted Temperature Rating: 118°F @ 0.75 H<sub>2</sub>O
12. Combustion Air Flow – No greater than 1,937 CFM.

- B. Positive Crankcase Ventilation - Provide crank case emissions redemption device. Include a redemption system that pipes the crankcase emissions to filtration canister, where emissions are filtered and sent back to the engine intake combustion filter assembly. Collected lube oil is drained back to the engine oil sump or provide drain provisions.

- C. Lubrication System: Pressurized by a positive-displacement pump driven from engine crankshaft. The following items are mounted on the engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 microns and smaller while passing full flow.
2. Fuel Oil Cooler: Fuel shall be piped from the filter/water separators to the intake of the engine fuel pump, and then to the engine. Excess fuel shall be piped through a self-contained electric motor fan cooled fuel cooler and returned to the main fuel tank. The



- fuel cooler shall be capable of exchanging heat rejected at full load with the cooling medium, including 10% reserve to accommodate fouling.
3. Thermostatic Control Valve: Controls flow in system to maintain optimum oil temperature. Unit is capable of full flow and is designed to be fail-safe.
  4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without the use of pumps or siphons or special tools or appliances.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Coordinate the heater voltage with the available voltage from the generator accessories panel.
- E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Radiator – A rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at rated load at the maximum temperatures indicated in paragraph 2.4 (A).
  2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  5. Coolant Hose: Steel braided flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
  6. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and non-collapsible under vacuum.
  7. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- F. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
  2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.
- G. Air-Intake Filter: Heavy duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator shall be provided.
- 2.5 Engine Starting System:
- A. Provide a dual Lead Acid battery system complete with dual chargers, starters, batteries and battery racks. Each battery shall be capable of starting the battery without the assistance of the second battery.
  - B. 24V electric, with negative ground.
  - C. Components: All cable and components shall be sized so they are not damaged during a full engine-cranking cycle within maximum ambient temperature at maximum specified in "Operating Environment" Article of this section

- D. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
- E. Cranking Cycle: A complete cranking cycle shall consist of an automatic crank period of 15 seconds followed by a 15 second rest period. The batteries shall be sized to allow for 5 unsuccessful cranking attempts then start the engine on the next start.
- F. Battery: Lead Acid with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle without recharging.
- G. Battery Cable: Size as required for to allow for maximum engine starting current and the number of required cranking cycles and the length of battery conductors. Battery conductors shall be stranded Diesel Locomotive Cable with compression connectors for all terminations.
- H. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
- I. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
- J. Battery Charger: Current-Limiting, automatic-equalizing and float-charging type designed for Lead Acid batteries. Unit shall comply with UL 1236 and include the following features:
  - 1. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
  - 2. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
  - 3. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
  - 4. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- K. Enclosure and Mounting: Provide a two tier battery rack for the batteries. NEMA 250, Type 1, wall-mounted cabinet.

## 2.6 Engine Fuel System

- A. Integral Injection Pumps: Driven by engine camshaft. Pumps are adjustable for timing and cylinder pressure balancing.
- B. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
- C. Fuel Oil Filters: Primary and secondary. Primary filter to include water separator. Provide Racor 79/1000 series or equivalent product from an approved manufacturer listed above. Include bypass isolation valves to allow for filter element change during operation.



- D. Relief/Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- E. Continuous reading analog fuel gage at fuel oil input to the engine.
- F. Self-contained electric motor driven air-cooled fuel oil cooler, mounting by contractor
- G. Fire valve for emergency fuel shutoff in event of a fire.

## 2.7 ENGINE COOLING SYSTEM

- A. Provide a unit mounted radiator. Radiator shall have an ambient capability of 114°F at .5" H2O. Radiator design shall include a minimum of 7°F Rise above ambient. Include OSHA approved safety guards for all drive belts and rotating components. Include a radiator duct mounting flange. Provide low coolant level sensor.

## 2.8 FUEL SUPPLY SYSTEM

- A. Comply with NFPA 30 and NFPA 37.
- B. Fuel Oil Piping and Fuel Oil Storage Tank: Provided as part of this specification. Fuel oil tank shall be sub base tank sized for one-day fuel capacity. Provide all required accessories, pumps, pipes, valves, appurtenances, etc. Construction must comply with NYC MC 2014 1305.14 Alternate tank design and construction standards.
- C. Interior Fuel Oil Piping: Include required field installed piping between the fuel system and the engine.

## 2.9 ENGINE EXHAUST SYSTEM

- A. The exhaust silencer shall be a super critical grade low profile silencer with the capacity to attenuate engine exhaust sound at a rate to meet all required sound frequency attenuation levels as specified.
- B. Exhaust sound level shall be as required to achieve the attenuation rating in the enclosure specification section.
- C. The exhaust back pressure loss through the silencer shall not exceed ten inches of water column.
- D. The silencer shall be constructed with an interior fiberglass pack lining with a minimum thickness of 2.0 inches along the interior top, bottom, and side walls in order to facilitate high frequency sound attenuation. The exhaust silencer shall be of double walled construction, with the required thickness of fiberglass pack lining secured between the perforated inner shell and plate steel outer shell. The surface temperature of the silencer shall not exceed 180 Degree F when the engine is in operation.
- E. The silencer shall be constructed of 0.25-inch-thick, heavy gauge, all welded plate steel. The silencer shall be furnished with a rust resistant primer undercoating and an outer coating capable of withstanding temperatures of up to 1200 Degree F.
- F. The exhaust silencer shall be a super critical grade type.
  - 1. Subject to compliance with requirements, provide products by one of the following:



- a. HARCO
  - b. SILEX
  - c. GT Exhaust.
  - d. Or approved equal.
2. The Contractor shall provide detailed silencer performance data detailing the overall exhaust noise insertion loss, maximum silencer backpressure, exhaust noise reduction by octave band center (63 Hz to 8,000 Hz), and a detailed octave band Db to overall DbA calculation. Overall DbA level shall not exceed 83 DbA @ 23 feet. This data must be based on the specific silencer model being offered in as it would function on a specific engine.
- G. Expansion joints shall be installed between the engine exhaust outlets and silencer inlets in order to prevent transmission of mechanical vibration thru the exhaust system as well as absorbing all thermal growth. The expansion joint shall be designed with the capability to absorb concurrently up to 2.00 inches of axial compression and up to 0.25 inches of lateral offset. The expansion joint shall be designed for a minimum of 10,000 cycles. The expansion bellows component of the assembly shall be two ply and fabricated from Type 321 Stainless Steel. The expansion joint shall be designed in accordance with the standards of the Expansion Joint Manufacturers Association. All welding required in the manufacture of the expansion joint assembly shall be in accordance with ASME Code - Section IX. The expansion joint assembly shall be designed with a floating flange at one end with the capability of being rotated 360 degrees and shall be secured to the body of the expansion joint assembly in a Van Stone configuration. The Van Stone assembly shall be fabricated as an integral part of the expansion bellows. The use of welded necks, rings, or lips in securing the flange to the expansion joint assembly will not be accepted.
- H. Connections from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.
- 2.10 GOVERNOR
  - A. Type: Adjustable electronic isochronous load sharing type, with speed droop provisions. It shall include isolation and filtering. The control section of each governor shall be installed in the generator control switchgear.
- 2.11 VIBRATION/SEISMIC ISOLATORS
  - A. Engine generator set shall be furnished with suitable heavy-duty spring seismic vibration isolator 1" deflection a minimum of 95% absorption.
  - B. All isolation devices shall be selected for a uniform deflection (minimum ½") under imposed load, where unequal distribution of weight occurs.
  - C. The engine/generator manufacturer shall be responsible for the selection of all vibration eliminators for the local seismic zone that the generators sets will be installed.
- 2.12 ALTERNATOR, EXCITER, AND VOLTAGE REGULATOR
  - A. Comply with NEMA MG 1 and specified performance requirements.

- B. Drive: Generator shaft is directly connected to engine shaft. Exciter is rotated integrally with generator rotor.
- C. Alternator Temperature Rating: Alternator temperature rise shall be limited to NEMA MG1 temperature limit of 130C measured at a 40C ambient.
- D. Alternator Insulation: Class H, 130C.
- E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- F. Construction prevents mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 100 percent of rated capacity.
- G. Excitation uses no slip or collector rings, or brushes, and is arranged to sustain generator output under short-circuit conditions as specified.
- H. Enclosure: Drip-proof.
- I. Generator Specifications: The generator shall be a synchronous, three phase, four pole, 2/3 pitch, random wound, single or double bearing, and IP23 drip proof. Bearing(s) shall be double shielded and maintenance free. The insulation system shall meet NEMA MG 1 and UL1446 standards for Class H insulation. Generator temperature rise shall be limited to NEMA MG1 temperature limit of 130C measured at a 40C ambient or as required to meet UL2200 criteria. The excitation system shall enable the generator to sustain 300% of rated current for ten seconds at rating during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. Excitation shall be permanent magnet type.
- J. The generator together with its associated voltage regulator, exciter, instrumentation and controls shall be of a type which is suitable for applications where the load to be supplied consists of substantial amounts of non-linear (i.e., harmonic producing) equipment. Isolation transformers, complete with filtering equipment, shall be provided to minimize the effect of distortion on the voltage regulator power supply and sensing circuits, on governor control and supply circuits, on instrumentation and relaying and on other voltage sensing components. Voltage and current sensing devices shall sense true RMS values, and frequency sensing devices shall sense zero crossover.
- K. Excitation System: The generator shall be equipped with a permanent magnet generator excitation system. The output of the PMG shall be used to supply power to the voltage regulator and to effectively isolate the regulator power circuits from the distortion that occurs when the generator supplies large non-linear loads. Under short circuit conditions, the system shall be capable of sustaining 300 percent of rated current for 10 seconds. The rotating rectifier shall use a three-phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a surge protector.
- L. Voltage Regulator: The voltage regulator shall be completely solid-state digital voltage regulator. The voltage regulator shall be provided with the following:
  - 1. The voltage regulator encapsulated for protection against vibration and atmospheric deterioration.
  - 2. The regulator shall include three phase RMS sensing, true volts per hertz operation with adjustable cut in and provisions for parallel operation.
  - 3. The voltage regulator shall incorporate all features necessary for synchronizing and paralleling of the generator set with other sets.



4. The regulator shall be installed in the generator control switchgear specified hereinbefore complete with provisions for manual adjustment.
5. A voltage adjusting rheostat shall be provided on the control panel to permit a  $\pm 10$  percent adjustment in generator voltage.
6. The voltage regulator shall also include circuits that provide loss of sensing voltage shutdown and over excitation shutdown with inverse time characteristic to protect the generator and the connected load from abnormal voltages. Loss of sensing shutdown shall not activate if a short circuit condition were to occur.

M. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

N. Windings: Two-thirds pitch stator form wound, winding and fully linked amortisseur winding.

O. Subtransient Reactance: 12 percent, maximum.

## 2.13 GENERATOR OUTPUT BOX & OUTPUT CIRCUIT BREAKER SWITCHBOARD

A. The generator output shall be supplied with an output box for connection of the facility loads to the generator. Provide three separate copper phase (A, B, C) and one copper neutral bus. The generator output box shall be sized to fit all specified busses in the box. Box size shall comply with all NEMA sizing for energized surfaces to ground depending on the voltage.

1. NEMA Drilling - The phase and neutral busses shall be provided with NEMA drilling for two-hole compression lugs. The quantity of holes for the cables to be connected to the phase busses shall be provided with at a minimum of two additional holes per phase (Refer to the One Line Diagram for cable size and quantity).
2. Bus Capacity - All phase and neutral busses shall be sized to sustain 700 amps per square inch.
3. Phase & Neutral Isolation – All neutral busses shall be isolated from the box enclosure with fiberglass isolation standoffs.
4. Alternator Wiring - The alternator manufacturer shall extend the alternator wiring without splice from the alternator output to the copper phase and neutral busses, which shall be located in a generator output box. All manufacturer alternator terminations shall be with compression lugs.
5. Ground Bus – Provide a 25% copper ground solidly connected to the generator output box.
6. Lowest Bus – The lowest energized bus in the generator output box shall be no lower than 12 inches from the enclosure floor.

B. Main Generator Circuit Breaker – Provide a main generator circuit breaker to protect the generator damage curve of the alternator and the facility load conductors. The breaker shall be a 100% continuous rated insulated case circuit, breaker provided with a microprocessor based electronic trip unit. The circuit breaker shall be provided with the following features:

1. Independent Support – Provide independent support of the generator circuit breaker. The breaker shall not be dependent on the generator output box, or generator skid for support in any direction. Provide flexible collar between the generator output box and the generator breaker.
2. Breaker Options
  - a. Lock Open - The breaker shall be provided with the ability to lock the breaker in the open position.





- b. Overall Plastic Cover - Provide a clear plastic cover over the entire front of the breaker not just the trip unit to prevent the breaker from being inadvertently tripped or opened during operation.
  - c. Auxiliary Contacts - Provide all auxiliary contacts required for generator operation. In addition to the required auxiliary contacts provide (2) Auxiliary A and (2) Auxiliary B contacts for generator annunciation.
  - d. Power Conductor Termination - The circuit breaker shall be provided with long barrel compression lugs.
  - e. Shunt Trip – Provide a shunt trip relay for the breaker that is powered from the breaker line side.
- 3. Electronic Trip Unit
  - a. The trip unit shall be provided with electronically adjustable long time, long time delay, short time, short time delay, and instantaneous settings.
  - b. The trip unit shall provide ground fault alarm, with the ability to change from ground fault alarm to ground fault trip without and circuit breaker modifications.
  - c. The trip unit shall be provided with a plastic cover over the trip unit to allow sealing of the trip unit after the breaker has been set.
  - d. Indicate Line to Line Voltage Vab, Vbc, and Vca
  - e. Indicate Line to Neutral Voltage Van, Vbn, and Vcn
  - f. Indicate Phase current Ia, Ib, and Ic
  - g. Indicate KW, KVA, and KVAR.
  - h. The trip unit shall be provided with the ability to operate the LCD display at 0% load by separate power supply. Provide all necessary wire and accessories to provide a complete back lit display at 0%.
- C. Load Bank Circuit Breaker – Provide a thermal magnetic molded case circuit breaker to provide NEC required overcurrent protection for the load bank and conductors feeding the load bank. The full load of the load bank shall be no more than 80% of the selected trip unit size.
  - 1. Independent Support – Provide independent support of the load bank circuit breaker. The breaker shall not be dependent on the generator output box for support in any direction. Provide flexible collar between the generator output box and the generator breaker.
  - 2. Breaker Options
    - a. The breaker shall be provided with the ability to lock the breaker in the open position.
    - b. Provide a means of tripping the load bank in the event of a legitimate call to start comes from a transfer switch in the emergency power system. Trip the load bank circuit breaker by means of an auxiliary shunt trip coil, and wire to provide a complete load bank tripping command.
    - c. Provide all auxiliary contacts required for load bank operation. In addition to the required auxiliary contacts provide (2) Auxiliary A and (2) Auxiliary B contacts for generator annunciation.
- D. Fire Pump Circuit Breaker - Provide a thermal magnetic molded case circuit breaker with adjustable instantaneous trip to provide NEC required overcurrent protection for the fire pump and conductors feeding the fire pump. The breaker shall be sized per the included one line. A. The fire pump shall be provided with the following features.
  - 1. Independent Support – Provide independent support of the load bank circuit breaker. The breaker shall not be dependent on the generator output box for support in any



direction. Provide flexible collar between the generator output box and the generator breaker.

2. Breaker Options

- a. The breaker shall be provided with a Red overall enclosure cover.
- b. The breaker shall be provided with a thermal magnetic trip unit with an adjustable magnetic trip.
- c. Provide auxiliary contacts. In addition to the required auxiliary contacts provide (2) Auxiliary A and (2) Auxiliary B contacts for generator annunciation.

E. Fire Alarm Circuit Breaker - Provide a thermal magnetic molded case circuit breaker with adjustable instantaneous trip to provide NEC required overcurrent protection for the fire pump and conductors feeding the fire pump. The breaker shall be sized per the included one line. The fire pump shall be provided with the following features.

1. Independent Support – Provide independent support of the load bank circuit breaker. The breaker shall not be dependent on the generator output box for support in any direction. Provide flexible collar between the generator output box and the generator breaker.

2. Breaker Options

- a. The breaker shall be provided with a Red overall enclosure cover.
3. Breaker shall be lockable in the closed position.
4. The breaker shall be provided with a thermal magnetic trip unit.

F. Separation of Life Safety – All life safety circuit breakers shall be installed in a separate physical section of the generator output switchboard. The separation shall include a sheet metal separation between all non-life safety circuit breaker in the switchboard.

2.14 CONTROLS PROTECTION & MONITORING

A. General - Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939. The controls, protection, and monitoring systems of the generator set and its operation shall be the responsibility of the generator set manufacturer. All subsystem components, interfaces, and logic shall be compatible with engine mounted devices.

B. Environmental

1. The generator set control shall be tested and certified to the following environmental conditions:
  - a. -40°C to +70°C Operating Range
  - b. 100% condensing humidity, 30°C to 60°C
  - c. IP22 protection for rear of controller; IP55 when installed in control panel
  - d. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
  - e. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
  - f. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)



- g. Shock: withstand 15GWiring – The manufacturer shall provide all wiring, and electronic sensors to provide indicated alarms, warnings and operational parameters.
- C. Cycle Cranking: A cycle crank timer shall provide (5) five 15 second cranking periods separated by 10-second rest periods.
- D. Functional Requirements
  - 1. The control shall include a minimum 64 x 240 pixel, 28mm x 100mm, white backlight graphical display with text-based alarm/event descriptions
  - 2. The control shall include a minimum of 3-line data display
  - 3. Audible horn for alarm and shutdown with horn silence switch
  - 4. Standard ISO labeling
  - 5. Multiple language capability
  - 6. Remote start/stop control
  - 7. Local run/off/auto control integral to system microprocessor
  - 8. Cool down timer - Engine Cool down: A cool down timer shall provide an adjustable 0-30 minute engine-running period before shutdown after removal of load.
  - 9. Speed adjust
  - 10. Lamp test
  - 11. Push button emergency stop button
  - 12. Voltage adjust
  - 13. Voltage regulator V/Hz slope – adjustable
  - 14. Password protected system programming
- E. Digital Monitoring Capability - The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.
  - 1. Engine
    - a. Engine oil pressure
    - b. Engine oil temperature
    - c. Engine coolant temperature
    - d. Engine RPM
    - e. Battery volts
    - f. Engine hours
    - g. Engine crank attempt counter
    - h. Engine successful start counter
    - i. Service interval
    - j. Real time clock
    - k. Oil filter differential pressure
    - l. Fuel temperature
    - m. Fuel pressure
    - n. Fuel filter differential pressure
    - o. Fuel consumption rate
    - p. Total fuel consumed
    - q. Engine intake manifold temperature
    - r. Engine intake manifold pressure
    - s. Engine crankcase pressure
    - t. Air filter differential pressure
    - u. Boost pressure
    - v. Oil filter differential pressure
    - w. Engine exhaust stack temperature
    - x. Engine main bearing temperature



2. Generator / Alternator

- a. Generator AC volts (Line to Line, Line to Neutral and Average)
- b. Generator AC current (Avg and Per Phase)
- c. Generator AC Frequency
- d. Generator kW (Total and Per Phase)
- e. Generator kVA (Total and Per Phase)
- f. Generator kVAR (Total and Per Phase)
- g. Power Factor (Avg and Per Phase)
- h. Total kW-hr
- i. Total kVAR-hr
- j. % kW
- k. % kVA
- l. % kVAR
- m. Voltage Regulation
- n. Excitation voltage
- o. Excitation current

F. Alarms and Shutdowns - The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

1. Engine Alarm/Shutdown
2. Low oil pressure alarm/shutdown
3. High coolant temperature alarm/shutdown
4. Loss of coolant shutdown
5. Overspeed shutdown
6. Overcrank shutdown
7. High intake manifold temperature alarm/shutdown
8. High exhaust manifold temperature alarm/shutdown
9. High crankcase pressure alarm/shutdown
10. High air inlet temperature alarm/shutdown
11. Emergency stop depressed shutdown
12. Low coolant temperature alarm
13. Low battery voltage alarm
14. High battery voltage alarm
15. Control switch not in auto position alarm
16. Battery charger failure alarm

G. Generator Alarm / Shutdown – The controller shall perform shutdowns for the following generator faults:

1. Generator overvoltage
2. Generator undervoltage
3. Generator overfrequency
4. Generator underfrequency
5. Generator reverse power
6. Generator overcurrent

H. Voltage Regulator Alarm /Shutdown

1. Loss of excitation alarm/shutdown
2. Instantaneous over excitation alarm/shutdown
3. Time over excitation alarm/shutdown



4. Rotating diode failure
  5. Loss of sensing
  6. Loss of PMG
- I. Remote Communications - The controller shall be provided with the ability to communicate via Modbus RTU and Ethernet TCP/IP. The manufacturer shall provide all required adapters and converter modules to provide this capability.
- J. Miscellaneous Local and Remote Annunciation Requirements
1. Local Annunciator (NFPA 99/110, CSA 282): Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.
  2. Annunciators shall be networked directly to the generator set control
  3. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
  4. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn
  5. Ability to be located up to 800 ft. from the generator set
  6. Provide the following individual light indications for protection and diagnostics
    - a. Overcrank (Shutdown/lockout after 5 attempts)
    - b. Low coolant temperature
    - c. High coolant temperature warning
    - d. High coolant temperature shutdown
    - e. Low oil pressure warning
    - f. Low oil pressure shutdown
    - g. Overspeed
    - h. Low coolant level
    - i. EPS supplying load
    - j. Control switch not in auto
    - k. High battery voltage
    - l. Low battery voltage
    - m. Battery charger AC failure
    - n. Emergency Stop
- K. Provide one (1) remote annunciator that is NFPA 110 level 1 compliant for the generator set. Provide all necessary media converter for remote locations of greater than 300 feet. Include copper to fiber conversion as required.
- L. Inputs and Outputs – Provide interface signals for the purpose of providing discrete generator indications to the BMS system, to open the air intake louvers when the generator starts or Fire Alarm indications. At a minimum provide the following the City of New York accessible inputs or outputs.
1. Programmable Digital Inputs: The Controller shall include the ability to accept programmable 16 digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.
  2. Programmable Relay Outputs: The control shall include the ability to operate 16 programmable relay output signals. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.
  3. Programmable Discrete Outputs: The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which can sink up to 300mA.

2.15 LOAD BANK

- A. General: The load bank shall be radiator mounted. The load bank shall include all resistive load elements, load control devices, protective devices, and a remote wall mounted control panel to be located near switchgear. The load bank shall be UL listed.
  - 1. The load bank shall be listed and labeled for use as a radiator mounted load bank. Refer to the drawings for location and size of the load bank.
  - 2. The load bank shall be listed and labeled for use as a standalone load bank. Refer to the drawings for location and size of the load bank.
  - 3. Ambient Temperature of Operation: -20°F to 120°F.
- B. Construction
  - 1. Capacity: The load bank shall be a 3-phase, 3-wire, 60Hz, resistive load bank which is sized to be 50% of the KW size of the engine-generator.
  - 2. Operating Altitude; 3000ft
  - 3. Relative humidity; 0-100%
  - 4. Tolerance: 5% nominal
  - 5. Cooling Failure
  - 6. A failure circuit shall be provided to monitor the load bank exhaust and to disconnect the load steps to prevent damage.
  - 7. A temperature switch in the load chamber exhaust shall be provided to monitor for excessive exhaust temperature and signal upon sensing an air temperature greater than 275°F. Fuses
  - 8. Each 50 KW resistor branch circuit is to be protected by 200,000AIC fuses.
  - 9. Fuses shall be provided for protection of the control power transformer and wiring.
- C. Load Bank Resistive Elements:
  - 1. The load elements shall be helically wound coils made of corrosion resistant chromium alloy that are continuously supported. If the resistor alloy should fail, the resistor material shall be held captive to prevent contact with surrounding resistors or ground.
  - 2. The resistors continuous support shall consist of segmented ceramic tubes assembled on stainless steel rods with fastening provided to compensate for thermal expansion of the ceramic tubes
  - 3. The resistors shall not require a cool down period. Normal shutdown or failure of the cooling fan during operation shall not cause any damage or shorten the life expectancy of the resistors.
- D. Control Panel - The control panel and protective circuits shall operate at 120 volts and be serviced internally from the main load bus utilizing an integral control power transformer.
  - 1. Control panel to include the following:
  - 2. Master load switch
  - 3. Load step switch
  - 4. Remote Load dump circuit to allow use of remote dry contacts (close to run) to trip load bank off line in the event of remote contact opening.
  - 5. Load step active indicator
  - 6. Control power indicator
  - 7. Normal operation indicator
  - 8. Cooling Failure indicator



9. Controls - The load bank controls shall be integrated with the Switchboard controls to load the generator(s) sequentially enabling the load bank to come on line @50kw increments.

## 2.16 FUEL OIL STORAGE

- A. General: The manufacturer shall provide a belly tank for the local generator set fuel storage suitable for the storage of 330 gallons of Diesel Fuel. The tank shall be located below the generator between the skid rails. This tank shall be listed and labeled for use in New York City, compliant with 2014 New York City Construction Codes, and shall comply with UL 142 and NFPA 37.
- B. Construction: The tank shall be constructed of reinforced 10-gauge steel with continuously welded seams throughout, and channel side supports.
- C. System shall include at a minimum:
  1. Fire Safety Valve: Provide a fusible link carbon steel Emergency Shut-Off Valve constructed per API 607 at pump set supply and at all equipment supply connections and as indicated on drawings. Provide fusible link package and limit switch assembly to monitor the valve position. Switches shall be tied into the fuel control/monitoring system
  2. Electric Solenoid Fill Valve: Direct Acting, carbon steel or stainless steel body, "0" PSIG pressure differential, normally closed, NEMA 4, watertight, threaded pipe and conduit connections. Provide manual over-ride switches for the solenoid fill valve and fuel return pump in the control panel.
  3. Deadman By-pass Valve: Provide a carbon steel spring-return valve constructed per API 607 at each day tank fill valve as a manual bypass and as indicated on drawings.
- D. Day Tank Level Controller. Level Controls shall have five (5) float operated switches rated at 100 watts and factory installed in the day tank. Levels of control: emergency high-level alarm and total pump shutdown (90% capacity), pump off (80% capacity), pump on (50% capacity), and emergency low-level secondary pump on and annunciation (40% capacity) and 10% Engine shutdown (direct to engine panel). Unit shall be suitable for pressures to 150 psi and shall be made entirely of non-ferrous material. Electrical connections shall be contained in a factory installed weatherproof junction box. Level Control shall be Preferred Model PLS- 5- Z1121.
- E. Electric Solenoid Fill Valve: Direct Acting, carbon steel or stainless-steel body, "0" PSIG pressure differential, normally closed, NEMA 4, watertight, threaded pipe and conduit connections. Provide manual over-ride switches for the solenoid fill valve and fuel return pump in the control panel.
- F. Deadman By-pass Valve: Provide a carbon steel spring-return valve constructed per API 607 at each day tank fill valve as a manual bypass and as indicated on drawings.
- G. Overfill Prevention Valve: Each main tank compartment shall include an overfill prevention valve in the re-fueling connection port to automatically stop the flow of fuel into the tank at 90% of maximum tank capacity. The valve shall be a two stage, float operated and suitable for either above grade or below grade tanks as required by project conditions. Tanks 3,000 gallons and smaller shall have a 2" valve, larger tanks shall have a 3" valve. Valve assembly shall be UL listed and include a drop tube extended to within 6" of tank bottom
- H. Vent Sensor. Provide and factory install a leak detector for alarming and fuel supply pump shut down via detection of oil in the vent line. Unit to be lever float operated and magnetically actuated with redundant vapor and fluid provisions. Electrical connections shall be contained in a factory installed weatherproof junction box. Switch shall be a Preferred Model RBS.



- I. Rupture Basin: The Belly tank shall be equipped with a fuel containment in the event of a leak of the fuel compartment. The containment basin shall be a tank in tank arrangement with the fuel compartment inside. The containment basin shall be sized to contain 200% of the volume of the fuel compartment that it protects contains.
- J. Leak Detection: Day Tank Leak Sensor. Provide and factory install a rupture basin leak detector for alarming and fuel supply pump shut down. Electrical connections shall be contained in a factory installed NEMA 4X weatherproof junction box. Switch shall be a Preferred Model RBS.
- K. Tank Fittings for Alarms & Piping: All piped with reinforced, welded pipe adapters. Fuel fill, inlet and return must be supplied with factory installed drop tubes to prevent surging and foaming in the day tank. shall Include:
  - 1. 2" NPT Generator Fuel Supply w/Fire Link Valve, provided with factory installed drop tubes within 6" of the bottom of the tank.
  - 2. 2" NPT Normal Vent
  - 3. 2" NPT Generator Fuel Return.
  - 4. 2" NPT Manual Fuel Fill provided with factory installed drop tubes within 6" of the bottom of the tank.
  - 5. 2" NPT Rupture Basin Alarm Fuel inlet.
  - 6. 2" NPT 90% High Fuel alarm.
  - 7. 2" NPT 80% High Fuel warning.
  - 8. 2" NPT 40% Emergency Low Fuel alarm.
  - 9. 2" NPT 10% Emergency Low shutdown.
  - 10. Provide 4 2" NPT Spare fittings for future use.
  - 11. 8" NPT Emergency Vent (Containment Basin Space)
  - 12. 8" NPT Emergency Vent (Fuel Tank Space)
- L. Level Control Wiring. Level Controls shall have five (5) float operated switches rated at 100 watts and factory installed in the belly tank.:
  - 1. Emergency high-level alarm and all fuel oil pumps shutdown (90% capacity)
  - 2. Pump Off (80% capacity), pump on (50% capacity)
  - 3. Emergency Low-Level secondary pump on and annunciation (40% capacity)
  - 4. Engine shutdown at 10% capacity (direct to engine control panel).
  - 5. Floats shall be suitable for pressures to 150 psi and shall be made entirely of non-ferrous material.
  - 6. Electrical connections shall be contained in a factory installed weatherproof junction box.
- M. Indications and annunciation:
  - 1. The fuel tank shall be fitted with a low fuel level alarm, which shall be wired to an indicating light on the generator control panel of the generator set. This switch shall activate whenever the fuel level in the tank is 40% or less remaining.
  - 2. The fuel tank shall be fitted with a high fuel level alarm, which shall be wired to an indicating light on the generator control panel of the generator set. This switch shall activate whenever the fuel level in the tank is 100% or more remaining.
  - 3. The fuel tank shall be fitted with a rupture basin leak alarm, which shall be wired to an indicating light on the generator control panel of the generator set. This switch shall activate whenever the fuel level in the rupture tank is 5% or more remaining.
  - 4. The Belly Tank located in the generator enclosure is part of a fuel oil system from the basement. The Contractor shall provide all the necessary wiring and conduit for the following tank indications from the belly tank to the fuel oil tank in the basement:
  - 5. Low fuel level alarm.





6. High fuel level alarm.
7. Rupture basin fuel alarm

- N. Factory Testing. Hydrostatic testing is required to ensure tightness prior to shipment. The minimum pressure for testing the tank shall be five (25) PSI. The hydrostatic pressure shall be maintained until all joints and connections have been visually inspected for leaks, but in no case for less than two hours. The tank shall not show any permanent deformation as a result of the test. The Rupture basin shall be hydrostatic tested prior to shipment. A copy of the test procedures shall be made available. The City of New York, the Commissioner, at their discretion, shall observe this and all other tests. All travel expenses to attend the factory testing shall be borne by the manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 FACTORY TEST

- A. General – The factory witness test is intended to prove to the extent possible that the Engine Generator Set is working and properly and meets all requirements of this specification.
- B. Factory Test Observation by Commissioner – The manufacturer shall include in their pricing all expenses associated with the demonstrating the Engine-Generator at the factory for the benefit of the Commissioner. Include the following for the factory witness testing:
1. Should the switchgear fail the testing the manufacturer shall include in their pricing all required travel & accommodations to bring the Commissioner, and up to 4 service operators designated by the Commissioner, back to the factory to conclude witnessing of testing.
- C. Test Preparation –
1. Create a written test procedure for the required testing at least 14 days prior to the planned testing date.
  2. Six full sets of paper generator switchgear drawings shall be printed and provided one to each anticipated attendee. Copies shall be printed prior to the factory witness test and be available for factory witness test.
  3. Prior to the testing provide each attendee of the testing a copy of the final approved shop drawings for review prior to testing.
  4. The manufacturer shall be available for answering questions for the entire duration of the test. Provide sufficient manpower to efficiently complete the test in one day.
  5. Provide all fuel and associated temporary fuel oil piping during testing.
  6. Provide all temporary power cable necessary for performing the indicated testing.
- D. Factory Tests: The following tests are the minimum acceptable number of tests for the Factory Witness Testing:
1. Cold Crank Test – Defeat the ability of the engine generator to start. Attempt to start the engine 5 consecutive times with 15 second rest periods. After the fifth attempt restore the engines ability to start and allow the engine to start. Perform this test with both starting battery systems.
  2. Load Bank Testing: After the cold crank test perform a 4-hour Burn in Test at 100% rated load. The burn in testing shall be run for 4 hours and 15 minutes. The first 15 minutes



will be a 25% to warm up the engine, and 4 hours at 100% rated load (600kW / 750 kVA). During the testing record the following engine parameters:

- a. Voltage line to line, and line to neutral.
  - b. Current per phase with a balanced load.
  - c. Fuel consumption at the input to the fuel oil filters. Install a calibrated analog fuel flow gauge for the reading.
  - d. Radiator Air flow averaged over 4 locations across the radiator with an anemometer.
  - e. Engine temperature read from the engine controller.
  - f. Coolant temperature read from the engine controller
3. Alarms: Test all alarms available via the Engine Controller shall be demonstrated. Alarms may be simulated via a technician's laptop if they are impractical to simulate or will harm the engine in anyway.
- a. Engine Alarm/Shutdown
  - b. Low oil pressure alarm/shutdown
  - c. High coolant temperature alarm/shutdown
  - d. Loss of coolant shutdown
  - e. Overspeed shutdown
  - f. Overcrank shutdown
  - g. High intake manifold temperature alarm/shutdown
  - h. High exhaust manifold temperature alarm/shutdown
  - i. High crankcase pressure alarm/shutdown
  - j. High air inlet temperature alarm/shutdown
  - k. Emergency stop depressed shutdown
  - l. Low coolant temperature alarm
  - m. Low battery voltage alarm
  - n. High battery voltage alarm
  - o. Control switch not in auto position alarm
  - p. Battery charger failure alarm
4. Steady State Loading: Perform tests demonstrating the accuracy and calibration of the generator metering, and to demonstrate no load to full load frequency, and voltage regulation. Record the following values at 0%, 50%, 75% & 100% load:
- a. Voltage line to line, and line to neutral.
  - b. Current per phase with a balanced load.
  - c. 10% Unbalanced phase current load. Phase A, 100%, Phase B 90%, Phase C 80%.
  - d. Fuel consumption at the input to the fuel oil filters. Install a calibrated analog fuel flow gauge for the reading.
  - e. Radiator Air flow averaged over 4 locations across the radiator with an anemometer.
  - f. Engine temperature read from the engine controller.
  - g. Coolant temperature read from the engine controller
5. Transient Testing – Record the Engine Generator sets voltage and frequency response to block loads with a calibrated disturbance analyzer. All transients shall be performed with a load bank provided by the manufacturer at a power factor of 0.8. Perform and record the following transients and document the results in the final Factory Test report.
- a. 0 – 25% load step (0 kW / 0 kVA) – (150kW/ 187 kVA)
  - b. 0 – 50% load step (0 kW / 0 kVA) – (300kW/ 375 kVA)



- c. 0 – 75% load step (0 kW / 0 kVA) – (450kW/ 562 kVA)
    - d. 0 – 75% load step (0 kW / 0 kVA) – (600kW/ 750 kVA)
  - 6. Alarms
  - 7. Steady State Loading
  - 8. Transient Testing
  - 9. Load Bank Testing
- E. Test Equipment: Use instruments calibrated within the previous 12 months and with accuracy directly traceable to the National Institute of Standards and Technology.
- F. Provide a report of the Factory Witness Test documenting all the required tests have been performed.

### 3.3 INSTALLATION

- A. Install generator sets, generator control switchgear, load bank, and other components as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure proper performance in accordance with the specifications. Comply with applicable NEMA standards pertaining to installation of engine-generator sets and accessories.
- B. The engine-generator sets shall be provided with a structural steel base. The base shall have sufficient rigidity for spring type isolators in quantities as required between enclosure floor and generator. Mounting shall incorporate a leveling device, vertical stops, and three layers of neoprene acoustical pad, with each layer separated by a steel plate. The mountings shall be installed directly under the structural steel base and shall be positioned to accept the weight and weight distribution for uniform mounting deflection. Spring isolators provide a minimum static deflection of 1" and be similar to Mason Industries, Inc., Type SLR, or as approved. Neoprene pads shall be similar to Mason Industries, Inc., Type W, or as approved.
- C. Coordinate with the work of other trades including fuel tanks, pumps, piping, ductwork and accessories as necessary to provide a complete operational system.
- D. Include the installation, local generator circuit breakers, control and monitoring and panels, battery chargers, remote annunciator panels, batteries and racks and other appurtenances to the extent that such appurtenances are not factory installed and wired.
- E. Include panel and control wiring between generators, generator output circuit breakers and disconnect switches.
- F. Include field inter-wiring and power supply and control connections for load bank, batteries, battery chargers, pumps, heaters, float switches, solenoid valves, damper operators and other miscellaneous items as required in accordance with manufacturers wiring diagrams. Such wiring shall include (but not be limited to):
- 1. Wiring between battery and engine control panels and battery chargers and power supplies thereto.
  - 2. Power supply wiring and control wiring for engine jacket water heaters.
  - 3. Power supply wiring and control wiring for fuel pumps, fuel tanks, float switches, valves and other fuel supply system components.
  - 4. Power supply and control wiring for automatic louver damper operators.
  - 5. Emergency stop break glass switch mounted outside generator room and control wiring run to generator control switchgear.



6. "Manual start" switch located in Emergency Electric Switchgear Room and control wiring to generator control switchgear.
  7. Remote annunciator panels mounted where directed complete with power supply and alarm inter-wiring to generator control switchgear.
- G. Include the installation of the load bank, complete with all required power, control, sensing and devices as required to comply with the functional requirements of Part 2 of this Section. Circuitry and devices shall be included - but not limited to - the following:
1. Power circuit connection tapped to the circuit breaker generator control switchgear bus. Tap shall be protected by OCD sized at 125% of load bank rating. Tap conductors shall be sized to match OCD and shall be run in conduit.
  2. Fan resistor control power supply conductors run in conduit from an available 3-pole circuit incorporated as part of a "hot" emergency panel (i.e., panel connected to load side of an ATS).
  3. Load sensing circuitry extension run in conduit from generator current transformers to load bank control panel.
  4. "Normal" power sensing circuitry run in conduit from each ATS to load bank control panel.
  5. Three phase "generator voltage" sensing circuitry run from generator control switchgear to load bank control panel.
  6. "Remote" control panel circuitry extension in conduit to load bank control panel.
  7. Any inter-wiring necessitated by a load bank configuration which separates out equipment items indicated as being integrally mounted.

### 3.4 SITE STARTUP & COMMISSIONING

- A. Provide on-site supervision / technical support for receiving equipment at site, installation and wiring of the system supplied and full commissioning of the system in accordance with this document.
- B. Provide all required fuel for onsite start-up and acceptance testing. At the completion of the acceptance testing the generator manufacturer shall fill the diesel generator fuel tanks to 100% capacity.
- C. Load Bank – Provide a resistive load bank that is capable of providing enough resistive load to provide 100% KW load of the generator for commissioning. The load bank shall be provided with all required Diesel Locomotive Cable for this test. Include all expenses associated with renting, operating, installing, and operating this load bank for the duration of the testing.
- D. COMMISSIONING - The Contractor shall coordinate with and provide all access and manpower required to allow The Commissioner to verify the proper operation of the generator during Testing & Commissioning of the Generator. Refer to Section 26 08 00 "Commissioning of Electrical" for commissioning requirements. As part of commissioning process:
  1. Create a Test Plan of the Diesel Generator Testing included in this specification. Within the Test Plan include a Gant Chart of expected completion of Generator system component.
  2. Create and manage the completion of Pre-Functional, and Functional test forms of the entire generator system. Include the following Pre-Functional, and Functional forms:
    - a. Engine Generator
    - b. Generator.
    - c. Fuel Oil System.



3. Hold at least two meetings to coordinate startup and testing of the generator. Keep meeting minutes and track action items to insure testing schedule is adhered to.
  4. Provide test equipment and accessories to include all required meters to accomplish the testing requirements of this specification.
    - a. Disturbance Analyzer for transient testing.
    - b. Power Meter capable of keeping KVA, KVAR, KW, Volts, Amps, PF.
    - c. Provide all meter leads and accessories to safely testing the generator.
  5. Manage the generator testing for the duration of the planned testing to include the following tasks.
    - a. No load testing alarm testing.
    - b. Generator Enclosure Testing.
    - c. Steady State engine testing.
    - d. Transient Testing.
    - e. Burn in Testing.
  6. Create a testing punch list and identify any items that did not pass the specified testing. Maintain the testing punch list until all items on the list have been resolved. Assist the City of New York in determining the corrective actions required and manage all retests as required.
  7. Provide a final testing report with the following minimum information.
    - a. Executive Summary of the testing.
    - b. Completed Pre-Functional test forms.
    - c. Completed Functional test forms.
    - d. All issues of the Punch Lists to show tracking of the know issues found during testing.
    - e. All metering data.
- E. **MANUFACTURERS STARTUP** - Provide the services of a factory trained diesel generator technician to perform the following diesel generator and enclosure start up service prior to testing and commissioning.
1. Exhaust System Check List
    - a. For leaks
    - b. For exhaust restriction
    - c. For smoke condition
    - d. Heat radiation
    - e. Condensate drains
    - f. For loose hardware and connections
  2. Starting Battery and Control System Check List
    - a. Battery charger voltage before and after the test
    - b. Battery electrolyte level before and after the test
    - c. Specific gravity
    - d. Battery voltage
    - e. Cranking current and voltage levels
  3. Generator System Check List
    - a. Air inlet and output for restriction



- b. Generator winding resistance before the test
  - c. Electrical connection
  - d. Bearing lubrication
- 4. Circuit Breaker Check List
  - a. Automatic start switch
  - b. Panel instrumentation
  - c. Distribution cables
  - d. Circuit Breakers
  - e. Voltage and current transformers
- 5. Operation Without Load Check List
  - a. Starting time
  - b. Coast down time
  - c. Unusual noise during start or stop
  - d. Voltage build up
  - e. Frequency stability during start
  - f. Engine and generator vibration
- 6. Lubrication system Check List
  - a. For leaks
  - b. Engine oil level
  - c. Change engine oil after the 24hour system test
- 7. Cooling System Check List
  - a. For leaks
  - b. For radiator air restriction
  - c. Operation of coolant heater
  - d. Hose and connections
  - e. Coolant level
  - f. Anti-freeze concentration
  - g. Belt condition and tension
  - h. Fan hub, drive pulley, water pump
  - i. Motor operated louvers
  - j. Clean cooling system C flush and add new antifreeze
  - k. Analyze anti-freeze before changing after 36-hour system test
- 8. Air Inlet System Check List
  - a. For leaks
  - b. Air cleaner restrictions
  - c. Generator room ventilation
  - d. Piping and/or ducts
  - e. Clean crankcase breather before and after 36-hour test
  - f. Change air inlet element before and after 36 hour systems tests
- 9. Fuel System Check List
  - a. For leaks
  - b. Day tank size and fuel level
  - c. Governor linkage



- d. Fuel lines and connections
- e. Fuel transfer pump
- f. Water contamination in day tank
- g. Fuel from main tank for analysis
- h. Sample sediments from tanks or separators
- i. Check fuel filters for discoloration

### 3.5 CLEANING

- A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

### 3.6 INSTRUCTION

- A. Instruction: Engage a factory-authorized service representative to demonstrate adjustment, operation, and service of system and to instruct the City of New York's service operators as specified below.
  - 1. Conduct a minimum of 8 hours of training.
  - 2. Schedule training with at least 7 days' advance notice.
  - 3. Refer to DDC General Conditions for instruction requirements.

**END OF SECTION 26 32 13**



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**SECTION 26 36 00****TRANSFER SWITCHES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. This Section includes transfer switches rated 600 V and less, including the following:
1. Automatic transfer switches.
  2. Remote annunciation systems.
- B. Related Sections include the following:
1. Section 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for automatic transfer switches for fire pumps.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.



1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.6 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Contactor Transfer Switches:
    - a. Caterpillar; Engine Div.
    - b. Emerson; ASCO Power Technologies, LP.
    - c. Onan/Cummins Power Generation; Industrial Business Group.
    - d. Russelectric, Inc.
    - e. Spectrum Detroit Diesel.
    - f. Or approved equal.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
  2. Switch Action: Double throw; mechanically held in both directions.



3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- J. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- K. Battery Charger: For generator starting batteries.
  1. Float type rated 10 A.
  2. Ammeter to display charging current.
  3. Fused ac inputs and dc outputs.
- L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
  1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- N. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.



- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- H. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- I. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- J. Automatic Transfer-Switch Features:
  - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
  - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  - 5. Test Switch: Simulate normal-source failure.
  - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  - 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  - 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.



9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is not available.

## 2.4 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
  1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  2. Switch position.
  3. Switch in test mode.
  4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
  1. Indicating Lights: Grouped for each transfer switch monitored.
  2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
  3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
  4. Lamp Test: Push-to-test or lamp-test switch on front panel.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
  - 1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

### 3.3 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional fee to the City of New York if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
  - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    - a. Check for electrical continuity of circuits and for short circuits.
    - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    - c. Verify that manual transfer warnings are properly placed.
    - d. Perform manual transfer operation.



5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
  - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
  - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
  - a. Verify grounding connections and locations and ratings of sensors.

**B. Testing Agency's Tests and Inspections:**

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
  - a. Check for electrical continuity of circuits and for short circuits.
  - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
  - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.



- a. Verify grounding connections and locations and ratings of sensors.

- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
  - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

- A. Engage a factory-authorized service representative to instruct the Commissioner's service operators to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to DDC General Conditions for instruction requirements.
- B. Coordinate this instruction with that for generator equipment.

TRANSFER SWITCHES  
26 36 00 - 8



**SECTION 26 41 13****LIGHTNING PROTECTION FOR STRUCTURE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Work included in this section: Lightning protection system.

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.4 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.5 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"



- B. A national testing laboratory (Underwriters Laboratories or Applied Research Laboratories) shall list the components and provide certification of the lightning protection system installation (inspect and certify) for compliance with applicable standards.
- C. The system shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Heary Bros. Lightning Protection Co., Inc., Springville, New York (Basis-of-Design)
  - 2. LightningMaster Corp.
  - 3. Thompson Lightning Protection
  - 4. Or approved equal.

### 2.2 STANDARD

- A. All equipment shall be new, the product of a single manufacturer as outlined above, and of a design and construction to suit the application where it is used in accordance with accepted industry standards.

### 2.3 EQUIPMENT

- A. All components shall be aluminum and of the size, weight and construction to suit the application where used in accordance with requirements for Class I structures.
- B. Roof conductors shall be aluminum, 24 strands 14-gauge, 98,600 circular mils, net weight 110 lbs. / 1000 ft.
- C. Down conductors shall be copper, 29 strands 17-gauge, 65,600 circular mils, net weight 190 lbs./1000ft.
- D. Air terminals shall be solid round aluminum bar 1/2" x 12" minimum and shall project 10" minimum above the object to be protected.
- E. Air terminal bases shall be aluminum with bolt pressure cable connectors and shall be securely mounted with stainless steel screws or bolts.
  - 1. Offset type bases shall be used at parapets and secured with stainless steel screws or anchors.
  - 2. Adhesive type bases shall be secured with an adhesive compound which is compatible with the roofing system. The roofing manufacturer shall approve the adhesive compound.
- F. Ground rods shall be 5/8" x 10'-0" minimum. They shall be connected to the system with a two-bolt copper clamp having a minimum length of 1-1/2" and employing stainless steel cap screws.
- G. Cable fasteners shall be substantial in construction, galvanically compatible with the conductor and mounting surface.

- H. Bonding devices, cable splicers and connectors shall be of aluminum with bolt pressure cable connectors.
- I. Equipment on stacks and chimneys shall be protected from corrosion and sized in accordance with requirements.
- J. Bolts, nuts and screws shall be stainless steel.

## **PART 3 – EXECUTION**

### **3.1 EXECUTION REQUIREMENTS**

- B. Refer to DDC General Conditions for execution requirements.

### **3.2 INSTALLATION**

- A. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible.
- B. Provide complete cable network on the roof including; air terminals, splices, bonding connectors and cable downleads to ground rods. Down conductors shall run in 1" PVC conduit concealed within the building construction to ground.
- C. The contractor shall furnish and install all necessary PVC conduit and junction boxes.
- D. A bimetal transition fitting shall be used where aluminum roof conductor and copper down conductor are spliced together.

### **3.3 COORDINATION**

- A. Work with other trades to insure a correct, neat and unobtrusive installation.
- B. Assure a sound bond to the main water service and to assure interconnection with other building ground systems, including both telephone and electrical.
- C. Install proper arresters on the power and telephone service as applicable.

### **3.4 COMPLETION**

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.

**END OF SECTION 26 41 13**



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## **SECTION 26 51 00**

### **INTERIOR LIGHTING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).

##### **1.2 SUMMARY**

- A. This Section includes light fixtures, lamp module and driver requirements for the following:
  - 1. Interior lighting fixtures:
    - a. Light Emitting Diodes (LEDs)
  - 2. Lighting fixture supports
- B. Refer to other Sections for the following:
  - 1. Section 04 20 00 "Unit Masonry"
  - 2. Section 05 50 00 "Metal Fabrications"
  - 3. Section 05 52 13 "Pipe and Tube Railings"
  - 4. Section 06 40 23 "Interior Architectural Woodwork"
  - 5. Section 09 29 00 "Gypsum Board"
  - 6. Section 09 51 13 "Acoustical Panel Ceilings"
  - 7. Section 26 05 53 "Identification for Electrical Systems"
  - 8. Section 26 05 00 "Common Requirements for Electrical Work"
  - 9. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables"
  - 10. Section 26 05 33 "Raceway and Boxes for Electrical Systems"
  - 11. Section 26 27 26 "Wiring Devices."
  - 12. Section 26 24 16 "Panelboards"
  - 13. Section 26 29 13 "Enclosed Controllers"
  - 14. Section 26 56 00 "Exterior Lighting"

##### **1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – Construction Waste Management and Disposal
  - 2. Section 01 81 13 – Sustainable Design Requirements For LEED Buildings
  - 3. Section 01 81 19 – Indoor Air Quality Requirements For LEED Buildings
- C. LEED Building Performance Requirements: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 “Indoor Air Quality Management”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting fixture, including driver housing if provided.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 SUBMITTALS

- A. General:
  1. Reviews of submittals are to establish general conformance to design intent and do not waive contract requirements. Contractor is responsible for all dimensions, quantities, mounting accessories, methods of construction, and compliance with the Contract Documents.
  2. The contents of the shop drawings shall be prepared by the Manufacturers. Shop drawings prepared solely by the Contractor will not be acceptable.
- B. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Submit manufacturer’s data on features, accessories, finishes, and the following, in reproducible form:
  1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters. Submit dimensioned drawings of lighting fixtures.
  2. Details of luminaire attachments and accessories.
  3. Details of installation and construction.
  4. Luminaire materials.
  5. Photometric Data: Supply complete photometric data for each fixture. Photometric reports shall be rendered by an independent testing laboratory developed according to methods of the Illuminating Engineering Society (IESNA) of North America as follows:
    - a. Luminaire description and dimensions



- b. Candela distribution data, presented graphically and numerically in no more than 5 degree increments (5, 10, 15, etc.). Data developed for up and down quadrants normal, parallel and at 22.5, 45, 167.5 degrees to fixture axis if light output is asymmetric.
  - c. Zonal lumens stated numerically in 10 degree increments (5, 15, etc.) and fixture efficiency.
  - d. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of LED fixtures or fixtures with asymmetric distribution.
  - e. Coefficients of utilization table.
  - f. Driver UL listing, volts, input and output wattage, drive current.
  - g. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
- 6. Lamp Module: All manufacturer data to include LED module information, including but not limited to:
  - a. Manufacturer of the LED module with part number or other device identifier.
  - b. LED module drive current, voltage, power.
  - c. LED module lumen depreciation curves, life, CCT, CRI at an ambient temperature of 25 degrees Celsius.
  - d. Board temperature of the LED module installed in the luminaire with proper heat sink, when the luminaire is operating at an ambient temperature of 25 degrees Celsius.
  - e. The color bin, CCT, and color shift variation of the LED module at the operating board temperature.
  - f. Color rendering index at the operating board temperature.
- C. Shop Drawings: Include scalable plans, elevations, sections, details, and attachments to other work:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Design calculations (as requested), certified by a qualified professional engineer licensed in the state of New York, indicating strength of mechanical connections.
  - 3. Wiring Diagrams: For power, signal, and control wiring.
  - 4. Warranty: Sample of special warranty.
- D. Submittals or shop drawings lacking sufficient detail to indicate clear and complete compliance with contract documents shall be rejected. Include plans, elevations, sections, details, and attachments to other work.
- E. Field quality-control reports.
- F. Provide Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Lighting fixtures
  - 2. Suspended ceiling components
  - 3. Structural members to which suspension systems for lighting fixtures will be attached.
  - 4. Other items in finished ceiling including the following:
    - a. Air outlets and inlets
    - b. Speakers



- c. Sprinklers
- d. Smoke and fire detectors
- e. Occupancy sensors
- f. Access panels
- g. Perimeter moldings

G. Samples: Submit for review one representative sample for each or any lighting fixture required under this Contract:

- 1. The samples must be actual working unit of fixtures to be supplied and shall be submitted complete with cord and plug, wired for 120 volt operation.
- 2. All substitutions shall be provided as samples for review and approval prior to fabrication.
- 3. After sample acceptance, the fixture shall be sent to the project for use as a standard. In the event the submission is rejected, the fixture will be returned to the manufacturer who shall immediately make a new submission which meets the contract requirements.

H. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

#### 1.8 QUALITY ASSURANCE

A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".

B. Equipment Qualifications For Products Other Than Those Specified:

- 1. At the time of submission provide written notice to the Commissioner of the intent to propose an "or equal" for products other than those specified. Make the "or equal" submission in a timely manner to allow the Commissioner sufficient time to review the proposed product, perform inspections and witness test demonstrations.
- 2. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
  - a. Make arrangements with the test facility for the Commissioner to witness test demonstrations. Also obtain the services of the Lighting Manufacturer's Product Manager/Engineer for the proposed product to be present at the test facility. Notify the Commissioner a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
- 3. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

C. All lighting fixtures shall be manufactured, furnished, and installed in compliance with NFPA 70, "National Electrical Code" 2017, and 2014 New York City Construction Codes. All fixtures shall bear the appropriate UL (or ETL) and IBEW identifications.

D. Materials and equipment, as well as workmanship shall conform to the highest commercial standards and shall be as specified and/or as indicated on the drawings. Parts not specifically identified shall be made of materials most appropriate for their intended use.

E. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as



defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Comply with NFPA 70, "National Electrical Safety Code" 2017.
- H. Mockups: Provide interior lighting fixtures for in situ mockups complete with power and control connections; the specific design requirements of several building conditions mandates the necessity of full scale on site mockups prior to final authorization (release) to fabricate.
  - 1. Obtain Commissioner's approval of fixtures for mockups before starting installations.
  - 2. Installation of all luminaire types subject to mockup requirements may not proceed until mockup is accepted by Commissioner.
  - 3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
  - 4. Approved fixtures in mockups may become part of the completed work if undisturbed at time of Substantial Completion.
  - 5. Mockups of the following fixture types shall be provided by the Contractor in the following configurations:

Type	Location	Magnitude (Extent)
P2	Lobby	2 fixtures (nom. 4'-0" unit) run continuously
P5	Training Room	2 fixtures (nom. 4'-0" unit) run continuously
P9	Reception Desk - toe kick	1 fixture (nom. 12'-0" unit) with mounting track as a complete assembly
P17	Community Room - cove	3 fixtures (nom. 4'-0" unit) run continuously with miter corner as a complete assembly
P18	Lightwell - uplight	3 fixtures (nom. 4'-0" unit) run continuously with miter corner as a complete assembly
P18a	Main Desk Area	3 fixtures (nom. 4'-0" unit) run continuously with miter corner as a complete assembly
P23	Entrance Door	1 fixture with temporary power, DMX controller, Data enabler and cabling as a complete assembly
P25	Reception Desk	2 fixtures (nom. 4'-0" unit) run continuously

- I. National Electrical Manufacturers Association (NEMA): Comply with applicable requirements of NEMA LE 4, "Recessed Luminaires, Ceiling Compatibility" pertaining to recessed luminaires.
- J. Manufacturer Requirements:
  - 1. Experience: The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
  - 2. Custom luminaires: Manufacturers shall submit a prototype (pre-fabrication sample) of each fixture for review by the Commissioner. Prototypes shall be sufficiently detailed and

operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.

#### 1.9 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction industry standards have the same force and effect as if found in or copied directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference.
  - 1. Referenced standards (standards referenced directly in the contract documents) take precedence over standards that are not referenced but generally recognized in the industry for applicability to the work.
  - 2. Unreferenced standards are not directly applicable to the work, except as a general requirement of whether the work complies with recognized construction industry standards.
- B. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with the latest standard in effect as of date of Contract Documents.

#### 1.10 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Each fixture shall be labeled with the appropriate circuit description to coordinate with electrical drawings.
- C. Each fixture connected to Emergency power supply shall be provided with a visible (1/4" diameter) red dot on the exposed fixture trim.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  - 1. Warranty Period for LED Entire Luminaires (fixture components can be field replaceable): Entire fixture shall carry a minimum 1 year warranty from the date of substantial completion.
  - 2. Warranty Period for LED Entire Luminaires (fixture components cannot be field replaceable): Entire fixture shall carry a minimum 5 years warranty from the date of substantial completion.
  - 3. Warranty Period for LED Modules and Drivers: five (5) years from the date of Substantial Completion.

#### 1.12 DELIVERY, STORAGE & HANDLING

- A. Each fixture shall be labeled the appropriate circuit description to coordinate with electrical plans.
- B. Each fixture connected to Emergency power supply shall be provided with a visible (1/4" diameter) red dot on the exposed fixture trim.



- C. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.
- D. Deliver materials in manufacturer's original, unopened, protective packaging.
- E. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.
- F. Handle in a manner to prevent damage to finished surfaces.
- G. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

#### 1.13 TECHNICAL & ADMINISTRATIVE REQUIREMENTS

- A. All information identified in the Contract Documents shall be considered to form a complete and integrated specification for lighting fixtures.
- B. Specifications and drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings nor specified, but that are necessary or normally required for the proper execution, completion, installation and operation of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
- C. The Commissioner shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be normally required in the production of the lighting fixtures. The full and complete responsibility for accurately purchasing, fabricating and installing the lighting fixtures described herein to the fulfillment of those specifications including compliance with all regulatory bodies (i.e. UL) shall rest solely with the Contractor and the fixture manufacturer.
- D. The Contractor shall be solely responsible for verifying all fixture quantities, lengths and clearances required and shall inform the Commissioner of job conditions at variance with fixtures as specified or detailed which affect installation or location while is made.
- E. The Contractor shall be solely responsible for coordinating and expediting the timely procurement and delivery for all lighting equipment, lamps, ballasts and related components for the project.
- F. Ensure that the lighting fixture manufacturer shall keep on file and make available for review by the Commissioner complete Quality Control and Quality Assurance records for all phases of production for all lighting fixtures to be supplied under this project.

#### 1.14 SUPPLEMENTAL PRODUCTS AND SUBMITTALS

- A. Special Tools:
  - 1. Provide two tools to remove and install each type and size of fasteners on fixtures equipped with vandal resistant fasteners (S-Types).
- B. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all LED types and modules used on Project, and manufacturers' codes.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Refer to the Lighting Fixture Schedule on the Lighting Drawings.
- B. Subject to compliance with requirements, provide the Basis-of-Design product and manufacturer, or an equivalent product from an approved equal manufacturer, for each lighting fixture type. The Basis-of-Design product and manufacturer for each lighting fixture type, as well as approved equal manufacturers for each lighting fixture type, are provided on the Lighting Fixture Schedule of the Lighting Drawings.

**2.2 GENERAL**

- A. Comply with NEMA LE 4 for recessed fixtures. All recessed fixtures to be installed in insulated ceilings shall be provided with UL listed thermocouple protection.
- B. LED Luminaires: Lighting fixtures shall conform to IES LM-79-08 and LM-80-08 standards. All fixtures shall be RoHS compliant.
- C. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high reflectance enamel with non-yellowing binder and high pigment to binder ratio, with semi-gloss finish. Ferrous parts shall be prepared for finish by industry standard finishing process (see Finishes). Nonferrous metals (i.e. aluminum) unless otherwise noted be treated with a semi-gloss polyester powder coat enamel finish.
- D. Recessed, surface or pendant lighting fixtures shall be suspended from structural members or ceiling structure members of minimum 1-1/2" channels, by standard bar hangers, or other approved means. Fixture locations shall be coordinated with ceiling patterns. Refer to architectural reflected ceiling plan for exact location of fixtures and architectural rooms finish schedule for ceiling construction details and mounting heights. Provide all structural steel and related supports as required or necessary to properly and safely install and support the fixtures.
- E. Fixture wiring shall be suitable for the temperature rating of the fixture; wiring through LED channels shall be done with Type SFF2 wire U.O.N by manufacturer. Where a junction box is required, to change from branch circuit to fixture wiring, use approved feed through, pre-wired fixture wiring, and install a separate junction box. The junction box shall be fully accessible after installation of covering materials. Where flexible conduit or portable cord is used, a grounding jumper shall be installed. All fixtures shall be grounded. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing fixtures from their mountings, or disassembling adjacent construction.
- F. All recessed, pendant and surface mounted lighting fixtures unless otherwise noted or directed shall be UL listed for through-wiring and shall be furnished complete with all required integral wiring and all required flexible conditions, pigtails and related accessories necessary for suitable operation and installation.
- G. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final written acceptance of the work by the Commissioner.
- H. Where surface mounted junction boxes are called for, the lighting manufacturer shall provide a canopy cover which completely covers the entire junction box.



- I. Castings: All aluminum, iron or composite casting shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly finished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished casting will accurately fit in their designated locations. Unless otherwise noted, for cast aluminum components use copper-free 319 or 443 aluminum alloy only. For cast iron components use ASTM Spec A48-83 Class 30 gray iron.
- J. Mounting frames and rings: if ceiling system requires, each recessed fixture shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one piece or constructed with electrically welded butt joints and of sufficient size and strength to sustain the weight of the fixture.
- K. Yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels, suitable ceiling members or other structure shall be furnished and installed by the Contractor.
- L. Provide each fixture with LED modules as indicated in the lighting fixture schedule.
- M. Metal Parts: Free of burrs and sharp corners and edges. All sheet metal work shall be free from tool marks and dents.
- N. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- O. Housings: Rigidly formed, min. no. 20 gauge cold rolled steel weather- and light-tight enclosures that will not warp, sag, or deform in use. Refer to the Lighting Fixture Schedule for specific housing requirements and gauges.
- P. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- Q. For steel and aluminum fixtures all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. Whenever possible all fasteners shall be captive type. Where indicated provide security head Torx center pin tamper resistant fasteners.
- R. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.
- S. All extruded aluminum fixtures shall be fabricated of 6063-T3 alloy (min. wall thickness .120 unless otherwise noted on the Contract Drawings) and in all cases shall be provided with heavy gauge internal alignment brackets in order to assure tight joints and a clean level and continuous appearance after installation. Unless otherwise noted, all end plates shall be continuously welded, filled and ground prior to application of final paint finishes so as to present a clean, seamless and monolithic appearance. Miter cuts shall be accurate. Joints shall be flush and without burrs. Cuts shall maintain alignment with the light fixture located in its final position.
- T. Exposed fasteners on end plates are prohibited.



- U. All fixtures with removable louvers, lenses, reflectors, refractors, cones or other shielding devices shall be supplied with integral safety chains/cables. Contractor shall be responsible for insuring that all safety chains/cables are securely fastened to shielding device and fixture housing.
- V. Exposed Fasteners: All fasteners at every product and assembly exposed to view or accessible with the inpatient environment shall be security head Torx center pin tamper resistant, and stainless steel.
- W. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- X. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 92 percent
  - 2. Specular Surfaces: 87 percent
  - 3. Diffusing Specular Surfaces: 83 percent
- Y. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of support materials.
- Z. Factory-Applied Labels: Labels shall be located where they will be readily visible to service staff, but not seen from normal viewing angles when trims/lenses are in place. Equip each fixture with a label, located conspicuously inside of fixture, which states the type of LED module required for the fixture.
- AA. Additional Components: Equip fixtures with the following additional components, as applicable:
  - 1. Additional drivers for night light or emergency light circuits where indicated on drawings.
  - 2. Plaster frames as required for installation of recessed and semi-recessed fixtures.
  - 3. Safety clips for fixtures installed in grid ceilings.
  - 4. End caps for individually mounted fixtures and end of continuous row fixtures.
  - 5. Finishing collar or combination finishing collar/outlet box for surface mounted fixture used with exposed raceway:
    - a. Finishing Collar: Same finish and peripheral dimensions as the fixture base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.
    - b. Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the fixture base, gauge or thickness of metal as required by National Electrical Code, including provisions for mounting and knockouts or threaded bosses for entrance of raceway.

## 2.3 SOLID STATE LIGHTING (LED) FIXTURES

### A. General

- 1. All fixtures shall conform with standards prepared by CIE, IES, UL, and other standards organizations as they apply to solid state lighting technologies. Including but not limited to:
- 2. TC2-46 CIE/ISO standards on LED intensity measurements.
- 3. TC2-50 Measurements of the optical properties of LED clusters and arrays.
- 4. TC2-58 Measurements of LED radiance and luminance.
- 5. TC2-63 Optical measurement of High-Power LEDs.
- 6. TC2-64 High speed testing methods for LEDs.
- 7. Luminaire performance claims shall be measured in accordance with the requirements of IEC/PAS 62612: Edition 1: 2009-06. The testing quantity for LED package lamps shall be



a minimum of (20) twenty. The drive current and bin reference should be clearly documented. All manufacturer data to include:

- a. Luminaire efficacy should be calculated from the initial lumen output of the luminaire that has reached thermal stability operating in an ambient temperature of 25 degrees Celsius and based on the total power of the LEDs and driver circuit.
- b. Definition of life shall comply with Clause 10 IEC/PAS 62612. Life shall be based on lumen depreciation and failure and shall consist of an endurance test. It shall be clearly noted which part of life and lumen depreciation has been measured and what part has been calculated or extrapolated.
- c. Lumen depreciation shall be clearly document the length of time a complete LED luminaire provided more than a percentage of the rated luminous flux under standard test conditions. For illuminating luminaires the percentage shall be >70%, indicated as L70 (>70%). For direct view luminaires the percentage should be >50%, indicated as L50.
- d. Thermal Losses: The temperature of the p-n junction of the raw LED (die) (Tj) is to be measured at an ambient temperature of 25 degrees Celsius. In a luminaire the die will be operating at a higher temperature. All performance parameters are to measure the junction temperature and board temperature.
- e. Thermal Protection: All fixtures shall be provided with appropriate heat sink to maintain lamp life. Stated lamp life and output shall be measured and identified and documented with heat sink. Any variations from stated life or output without heat sink shall be clearly identified including junction temperature.

8. Drivers

- a. Constant Current Drivers (non-dimming): All constant current drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The driver shall operation on the voltage they are connected to, 120 or 277v input power. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.  
Dimming Drivers: All PWM dimming drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The light output of the LED shall be controlled either by DC voltage applied to the control input (0-10V) with a maximum of 500 microamps per driver. The control equipment must not impose a voltage greater than 11.0V peak maximum on the driver terminals and the short-term transient voltage must not exceed 14 volts. Control equipment intended to control more than one driver must be capable of sinking the current supplied to the control bus by the maximum number of drivers specified for the control device. The control terminals for the driver shall be isolated from the power lines and suitable for use as Class II terminals. Maximum voltage drop not to exceed 0.2 volts. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum.

9. Lamp Module:

- a. LED lamp modules shall be minimum CRI of 70 with tolerances as identified in Clause 7 IEC/PAS 62612.



- b. White LED modules shall be available in 3000K, 3500K, and 4000K as identified in the lighting fixture schedule.

## 2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 26 05 33 "Raceway and Boxes for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Stems:
  - 1. Each stem shall have a brass or steel swivel, hang straight, or other self-aligning device.
  - 2. Wherever a fixture or its hanger canopy is applied to a surface mounted outlet box a finishing ring shall be utilized to conceal the box.
  - 3. Unless otherwise indicated, all stems shall match in color and finish the color of the fixture which they support.
  - 4. Stems shall be free of clamp marks, scratches and all other visual imperfections.
  - 5. Unless otherwise indicated, stems shall be provided in order to adequately mount and level each fixture run with proper structural support per manufacturer's recommendations.
  - 6. Install pendant lighting fixtures plumb and at a height from the floor as specified on the drawings. In cases where conditions make this impractical, refer to the Commissioner for direction. Use ball aligners and canopies on pendant fixtures unless otherwise noted.
  - 7. Space stems equally spaced every fixture run. If field conditions or fixture construction do not allow for this condition, the installing Contractor shall immediately notify the Commissioner prior to commencement of the work.

## 2.5 FINISHES

- A. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light stabilized, baked on at 350 degrees Fahrenheit minimum, catalytically or photo-chemically polymerized after application.
- B. Optical white finishes: minimum 92% reflectance (semi-gloss).
- C. Selection: Unless otherwise indicated, all fixture finishes shall be semi-gloss polyester powder coat enamel (color to be selected by Commissioner).
- D. Undercoat: Except for stainless steel all ferrous metal surfaces shall be given a five stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- E. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.



- F. Unpainted aluminum surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg. per square inch, of a color and surface finish as selected by the Commissioner. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg. per square inch of a color and surface finish as selected by the Commissioner.
- G. Metal finishes: Provide finishes of the color and type indicated and having the following properties:
  - 1. Protection of metal from corrosion: 5-year warranty against perforation or erosion of the finish from weathering.
  - 2. Color retention: 5-year warranty against fading, staining, or chalking from weathering including solar radiation.
  - 3. Uniformity: Provide finish of uniform thickness and color, free from streaks, stains or orange peel texture.

## 2.6 REFLECTORS

- A. Reflectors, cones or baffles shall be absolutely free of spinning lines, stains, ripples or any marks or indentations caused by riveting to other assembly techniques.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
- C. All fixtures with removable reflectors shall be supplied with safety chains/cables. Where stem-mounted pendant fixtures are indicated provide a minimum of (3) three cable supports to minimize sway. Cable supports shall be stainless steel woven wire (or equivalent).
- D. Cone flanges shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except as shown. The flange's major surface shall be perpendicular to the cone axis.
- E. The reflecting surface of the cone or reflector shall be tested for proper sealing. Test per ASTM B136-63T. If any stain is visible, the specimen shall not be considered to have been properly sealed. Reflector cones shall be free of manufactured defects. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than 83% on clear specular finish.
- F. All Alzak parabolic cones shall be guaranteed by the manufacturer against discoloration for a minimum of ten years and in the event of premature discoloration shall be replaced by the manufacturer (including both materials and the expense of labor) at no additional expense to the City of New York.

## 2.7 LENSES, LOUVERS, AND DIFFUSERS

- A. All lenses, diffusers, and shielding media shall be properly and securely mounted within fixture assemblies. All fixtures with removable reflectors, louvers or baffles shall be supplied with safety chains/cables.
- B. All fixtures with removable louvers or other shielding devices shall be supplied with safety chains/cables.
- C. Unless otherwise indicated, all plastic shielding, lenses and diffusers shall be clear 100% UV stabilized virgin acrylic or polycarbonate.
- D. Unless otherwise indicated, all glass shielding, diffusers or lenses shall be clear tempered borosilicate glass. Soda Lime glass is not acceptable. Min. transmittance = 92%.

- E. Optical lenses shall be free from spherical or chromatic aberrations and other imperfections, which may hinder the functional performance of the lenses.
- F. All lenses, louvers or other light diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out. Lay-in type lenses and louvers are not acceptable.

## 2.8 MISCELLANEOUS

- A. Where (or if) indicated all remote step-down transformers and drivers shall be properly wired to fixtures to ensure that voltage drop does not exceed 5%, regardless of transformer's or driver's location.
- B. All remote step-down transformers and drivers shall be mounted in approved NEMA type enclosures and only located in areas previously deemed to be readily accessible by the Commissioner's maintenance staff.
- C. All fixture lengths whether straight or curvilinear shall be fabricated based upon the fixture manufacturer's or contractor's field verified dimensions only.
- D. Fixture manufacturer shall coordinate conduit entry locations with installing contractor.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 INSTALLATION

- A. General: Install fixtures at locations indicated on the drawings. Do not scale electrical drawings for exact location of the lighting fixtures; in general, the architectural reflected ceiling plans indicate the proper locations of lighting fixtures, unless otherwise noted on architectural plans. Set level, plumb and square with ceilings and walls unless otherwise indicated. Align luminaires set in continuous rows.
- B. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- C. All fixture lengths whether straight or curvilinear shall be fabricated based upon the fixture manufacturer's or contractor's field verified dimensions only.
- D. Temporary Lighting: If it is necessary, and approved by Commissioner, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, and reinstall.
- E. Mounting: Mounting heights specified or indicated are to bottom of fixture for suspended and ceiling mounted fixtures and to center of fixture for wall mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation in commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

- F. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by driver manufacturer. Verify with driver manufacturers the maximum distance between driver and luminaire.
- G. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element, where permitted by Code.
  - 1. Install ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- H. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- I. Unless otherwise shown on the Contract Drawings, lighting fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the lighting fixture.
- J. Provide all hangers, rods, mounting brackets, supports, frames, earthquake clips and other equipment normally required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the architectural drawings.
- K. All pendant mounted lighting fixtures within the same room or area shall be installed plumb, and at a uniform height from the finished floor. Adjustment of desired height (if required) shall be made during the installation phase. Unless otherwise shown on the Contract Drawings, stems and canopies shall be matched to the associated lighting fixtures.
- L. Install reflector cones, baffles, aperture plates, light controlling elements for air handling fixtures and decorative elements after completion of ceiling tiles, painting and general cleanup.
- M. Replace blemished, damaged, or unsatisfactory fixtures as directed by the Commissioner.

### 3.3 COMMISSIONING AND DEMONSTRATION

- A. After system checkout and adjustment, operate the system for the review of the Commissioner and Commissioning Agent. Necessary adjustments or modifications shall be made as required by the Commissioner and Commissioning Agent.

### 3.4 ADJUSTING AND CLEANING

- A. Clean lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. Occupancy Adjustments: Within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
  - 1. Adjust aimable luminaires in the presence of Commissioner.
  - 2. As/if required, aiming shall be accomplished at night.



**3.5 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to backup power source and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

**END OF SECTION 26 51 00**

**SECTION 26 56 00**  
**EXTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).

**1.2 SUMMARY**

- A. This Section includes light fixtures, lamps and ballasts requirements for the following:

- 1. Exterior lighting fixtures, with LED modules, components and drivers.
  - a. Light Emitting Diodes (LEDs)
- 2. Fixture mounting shielding & accessories.
- 3. Poles and mounting arms

- B. Refer to other sections for the following:

- 1. Section 04 20 00 "Unit Masonry"
- 2. Section 05 50 00 "Metal Fabrications"
- 3. Section 05 52 13 "Pipe and Tube Railings"
- 4. Section 26 05 53 "Identification for Electrical Systems"
- 5. Section 26 05 00 "Common Requirements for Electrical Work"
- 6. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables"
- 7. Section 26 05 33 "Raceway and Boxes for Electrical Systems"
- 8. Section 26 27 26 "Wiring Devices."
- 9. Section 26 24 16 "Panelboards"
- 10. Section 26 29 13 "Enclosed Controllers"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – Construction Waste Management and Disposal
  - 2. Section 01 81 13 – Sustainable Design Requirements For LEED Buildings
  - 3. Section 01 81 19 – Indoor Air Quality Requirements For LEED Buildings
- C. LEED Building Performance Requirements: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 “Indoor Air Quality Management”, where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED Building Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED Building Submittal requirements.

#### 1.5 DEFINITIONS

- A. Average Rated Lamp Life (LED): The period of time after which 70 percent of its initial output will have declined which is normally targeted at 50,000 hours.
- B. Fixture/Luminaire: A complete lighting unit. Fixtures/luminaires include lamps, ballasts, drivers, and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply.
- C. CCT: Correlated color temperature.
- D. CRI: Color-rendering index.
- E. LER: Luminaire efficacy rating.
- F. LED: Light Emitting Diode
- G. Pole: Luminaire support structure, including tower used for large area illumination.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.7 SUBMITTALS

- A. General:
  1. Reviews of submittals are to establish general conformance to design intent and do not waive contract requirements. Contractor is responsible for all dimensions, quantities, mounting accessories, methods of construction, and compliance with the Contract Documents.
  2. Provide separate submittal product data/shop drawings for each fixture type clearly indicating the fixture type designation per the Contract Documents and all pertinent options and accessories. Do not group similar fixture types together on a single cut sheet. Submittals which do not indicate option data where multiple selections exist will be returned without being reviewed.
  3. The contents of the shop drawings shall be prepared by the Manufacturers. Shop drawings prepared solely by the Contractor will not be acceptable.

- B. **Product Data:** For each luminaire, pole and support component (X series), arranged in order of lighting unit designation. Submit manufacturer's data on features, accessories, finishes, and the following, in reproducible form:
1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters. Submit dimensioned drawings of lighting fixtures.
  2. Details of luminaire attachments and accessories.
  3. Details of installation and construction.
  4. Luminaire materials.
  5. **Photometric Data:** Supply complete photometric data for each fixture. Photometric reports shall be rendered by an independent testing laboratory developed according to methods of the Illuminating Engineering Society (IESNA) of North America as follows:
    - a. Candela distribution data presented graphically and numerically in no more than 5-degree increments (5, 10, 15, etc.). Data developed for up and down quadrants normal, parallel and at 22.5, 45, 167.5 degrees to fixture axis if light output is asymmetric. Photoelectric relays.
    - b. Zonal lumens stated numerically in 10 degree increments (5, 15, etc.) and fixture efficiency.
    - c. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of LED fixtures or fixtures with asymmetric distribution.
    - d. Coefficients of utilization table.
    - e. Driver UL listing, volts, input and output wattage, drive current.
    - f. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
  6. **Lamp Module:** All manufacturer data to include LED module information, including but not limited to:
    - a. Manufacturer of the LED module with part number or other device identifier.
    - b. LED module drive current, voltage, power.
    - c. LED module lumen depreciation curves, life, CCT, CRI at an ambient temperature of 25 degrees Celsius.
    - d. Board temperature of the LED module installed in the luminaire with proper heat sink, when the luminaire is operating at an ambient temperature of 25 degrees Celsius.
    - e. The color bin, CCT, and color shift variation of the LED module at the operating board temperature.
    - f. Color rendering index at the operating board temperature.
  7. Materials, dimensions, and finishes of poles; details of handholes and wire entries, mast or bracket arms and connection to poles, wind load and deflection, corrosion resistance, and finishes.
  8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
  9. Anchor bolts for poles.
  10. Manufactured pole foundations.
  11. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. **Shop Drawings:** Include scalable plans, elevations, sections, details, and attachments to other work.



1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Design calculations (as requested), certified by a qualified professional engineer licensed in the State of New York, indicating strength of mechanical connections.
  3. Wiring Diagrams: For power, signal, and control wiring.
  4. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-6-2013 and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer licensed in the state of New York certifying physical weights and dimensions.
  5. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
  6. Methods of field assembly including mounting.
  7. Components, features and accessories.
  8. Warranty: Provide complete manufacturer's warranty information on all products provided. Sample of special warranty. Sample of special warranty.
- D. Qualification Data: For qualified agencies (laboratories) providing photometric data for lighting fixtures.
- E. Submittals or shop drawings lacking sufficient detail to indicate clear and complete compliance with contract documents shall be rejected. Include plans, elevations, sections, details, and attachments to other work.
- F. Field quality-control reports.
- G. Operation and Maintenance Manuals: For luminaires and poles, to include in emergency, operation, and maintenance manuals. Provide a collection of manufacturer recommended maintenance practices for each lighting fixture type including, but not limited to:
1. Tools required.
  2. Acceptable cleaners and recommended cleaning practices.
  3. Replacement parts list.
  4. Manufacturer service department contact information/Qualified Service Agencies.
  5. Submittal Data.
  6. Operation Data.
  7. Intended Operation Narrative.
- H. Samples: Submit for review one representative sample for each or any lighting fixture required under this Contract.
1. The samples must be actual working unit of fixtures to be supplied and shall be submitted complete with cord and plug, wired for 120 Volt operation.
  2. After sample acceptance, the fixture shall be sent to the project for use as a standard. In the event the submission is rejected, the fixture will be returned to the manufacturer who shall immediately make a new submission which meets the contract requirements.
  3. All substitutions shall be provided as samples for review and approval prior to fabrication.

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
1. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.





- a. Make arrangements with the test facility for the Commissioner to witness test demonstrations. Also obtain the services of the Lighting Manufacturer's Product Manager/Engineer for the proposed product to be present at the test facility. Notify the Commissioner a minimum of 3 weeks prior to the availability of the test facility and provide at least one alternative date for the testing.
2. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.
- B. All lighting fixtures shall be manufactured, furnished, and installed in compliance with "NFPA 70 National Electrical Code" and 2014 New York City Construction Codes. All fixtures shall bear the appropriate UL (or ETL) and IBEW identifications.
- C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Mockups: Provide exterior lighting fixtures for in situ mockups complete with power and control connections; the specific design requirements of several building conditions mandate the necessity of full scale on site mockups prior to final authorization (release) to fabricate.
  1. Obtain Commissioner's approval of fixtures for mockups before starting installations.
  2. Installation of all luminaire types subject to mockup requirements may not proceed until mockup is accepted by Commissioner.
  3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  4. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  5. Mockups of the following fixture types shall be provided by the Contractor in the following configurations:

Type	Location	Magnitude (Extent)
X1	Entry Plaza	1 fixture with pole, temporary power and cabling as a complete assembly
X2/X2a	Parking Lot	2 fixtures with pole, temporary power and cabling as a complete assembly
X3	South Parking Lot	1 fixture with temporary power and cabling as a complete assembly
X8	Roof Top – Parapet	1 fixture with visor, steel support system, temporary power and cabling as a complete assembly
X10	Entry Plaza – Flag Pole	2 fixtures with mounting bracket, temporary power and cabling as a complete assembly
X11	1 Story Wing	1 fixture with visor, steel support system, temporary power and cabling as a complete assembly

- F. Underwriters Laboratories, Inc. (UL): Comply with applicable UL standards pertaining to exterior lighting equipment.
- G. Manufacturer Requirements:
  - 1. Experience: The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material or equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
  - 2. Custom luminaires: Manufacturers shall submit a prototype (pre-fabrication sample) of each fixture for review by the Commissioner. Prototypes shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.

#### 1.9 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction industry standards have the same force and effect as if found in or copied directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference.
  - 1. Referenced standards (standards referenced directly in the contract documents) take precedence over standards that are not referenced but generally recognized in the industry for applicability to the work.
  - 2. Unreferenced standards are not directly applicable to the work, except as a general requirement of whether the work complies with recognized construction industry standards.
- B. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with the latest standard in effect as of date of Contract Documents.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.
- B. Deliver materials in manufacturer's original, unopened, protective packaging.
- C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.
- D. Handle in a manner to prevent damage to finished surfaces.
- E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.
- F. Package steel & aluminum poles for shipping according to ASTM B 660.
- G. Store poles on decay-resistant-treated skids at least 12-inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- H. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.
- I. Light poles and fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.

**1.11 WARRANTY**

- A. **Manufacturer's Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
1. **Warranty Period for LED Entire Luminaires** (fixture components can be field replaceable): Entire fixture shall carry a minimum 1 year warranty from date of substantial completion.
  2. **Warranty Period for LED Entire Luminaires** (fixture components cannot be field replaceable): Entire fixture shall carry a minimum 5 years warranty from date of substantial completion.
  3. **Warranty Period for LED Modules and Drivers:** five (5) years from the date of Substantial Completion.
  4. **Warranty Period for Poles:** Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

**1.12 TECHNICAL & ADMINISTRATIVE REQUIREMENTS**

- A. All information identified in the Contract Documents shall be considered to form a complete and integrated Specification for Lighting Fixtures.
- B. Specifications and drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings nor specified, but that are necessary or normally required for the proper execution, completion, installation and operation of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
- C. The Commissioner shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be normally required in the production of the lighting fixtures. The full and complete responsibility for accurately purchasing, fabricating and installing the lighting fixtures described herein to the fulfillment of those specifications including compliance with all regulatory bodies (i.e.: UL) shall rest solely with the Contractor and the fixture manufacturer.
- D. The Contractor shall be solely responsible for verifying all fixture quantities, lengths and clearances required and shall inform the Commissioner of job conditions at variance with fixtures as specified or detailed which affect installation or location while submission is made.
- E. The Contractor shall be solely responsible for coordinating and expediting the timely procurement and delivery for all lighting equipment, lamps, ballasts and related components for the project.
- F. Ensure that the lighting fixture manufacturer shall keep on file and make available for review by the Commissioner complete Quality Control and Quality Assurance records for all phases of production for all lighting fixtures to be supplied under this project.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Refer to the Lighting Fixture Schedule on the Lighting Drawings.



- B. Subject to compliance with requirements, provide the Basis-of-Design product and manufacturer, or an equivalent product from an approved equal manufacturer, for each lighting fixture type. The Basis-of-Design product and manufacturer for each lighting fixture type, as well as approved equal manufacturers for each lighting fixture type, are provided on the Lighting Fixture Schedule of the Lighting Drawings.

## 2.2 GENERAL

- A. Provide fixtures designed and manufactured specifically for long term outdoor service. Make components, including nuts, bolts, rivets, springs, and similar parts, of corrosion resistant materials or of materials which will assure such resistance.
- B. Provide wet location labeled outdoor fixtures for areas directly exposed to the elements. All upward aiming products shall have a minimum IP rating of 66 (IP66) or otherwise designated in the lighting fixture schedules.
- C. Paint metal parts of fixtures with suitable weather and moisture-resisting paint equal to epoxy-based coatings.
- D. Provide anodized aluminum for aluminum parts of exterior fixtures that are not specified as requiring a painted finish.
- E. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by a NRTL acceptable to 2014 New York City Construction Codes.
- F. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high reflectance enamel with non-yellowing binder and high pigment to binder ratio, with semi-gloss finish. Ferrous parts shall be prepared for finish by industry standard finishing process (see Finishes). Non-ferrous metals (i.e. aluminum) unless otherwise noted be treated with a semi-gloss polyester powder coat enamel finish. Provide each fixture with lamps as indicated in the lighting fixture schedule.
- G. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery.
- H. For steel and aluminum fixtures all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. Whenever possible all fasteners shall be captive type. Where indicated provide tamper resistant fasteners.
- I. Underground wiring:
  - 1. Type THWN installed in rigid PVC conduit.
  - 2. Fixture wiring shall be suitable for the temperature rating of the fixture; wiring through LED channels shall be done with Type SFF2 wire unless otherwise noted on Engineer's drawings.
- J. Metal Parts: Free of burrs and sharp corners and edges. All sheet metal work shall be free from tool marks and dents.
- K. Casting: All aluminum, iron or composite casting shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly furnished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished casting will accurately fit in their designated locations. Unless otherwise noted, for cast aluminum



components use copper-free 319 or 443 aluminum alloy only. For cast iron components use ASTM Spec A48-83 Class 30 gray iron.

- L. Furnish and install yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels or other structure.
- M. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- N. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.
- O. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- P. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- Q. Exposed Fasteners: All fasteners at every product and assembly exposed to view or accessible with the inpatient environment shall be security torx tamper resistant and stainless steel.
- R. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- S. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- T. Provide each fixture with lamps as indicated in the lighting fixture schedule.
- U. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 90 Percent.
  - 2. Specular Surfaces: 87 Percent.
  - 3. Diffusing Specular Surfaces: 75 Percent.
- V. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- W. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service staff, but not seen from normal viewing angles when lamps are in place.
- X. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- Y. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.



- Z. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.
- AA. Brackets: Provide brackets, cantilevered and without underbrace of the sizes, styles and finishes indicated with straight tubular and section to accommodate the luminaire.

## 2.3 SOLID STATE LIGHTING (LED) FIXTURES

- A. General.
  - 1. All fixtures shall conform with standards prepared by CIE, IES, UL, and other standards organizations as they apply to solid state lighting technologies. Including but not limited to:
  - 2. TC2-46 CIE/ISO standards on LED intensity measurements.
  - 3. TC2-50 Measurements of the optical properties of LED clusters and arrays.
  - 4. TC2-58 Measurements of LED radiance and luminance.
  - 5. TC2-63 Optical measurement of High-Power LEDs.
  - 6. TC2-64 High speed testing methods for LEDs.
  - 7. LED Luminaires: Lighting fixtures shall conform to IES LM-79-08 and LM-80-08 standards. All fixtures shall be RoHS compliant.
  - 8. Luminaire performance claims shall be measured in accordance with the requirements of IEC/PAS 62612: Edition 1: 2009-06. The testing quantity for LED package lamps shall be a minimum of (20) twenty. The drive current and bin reference should be clearly documented. All manufacturer data to include:
    - a. Luminaire efficacy should be calculated from the initial lumen output of the luminaire that has reached thermal stability operating in an ambient temperature of 25 degrees Celsius and based on the total power of the LEDs and driver circuit.
    - b. Definition of life shall comply with Clause 10 IEC/PAS 62612. Life shall be based on lumen depreciation and failure and shall consist of an endurance test. It shall be clearly noted which part of life and lumen depreciation has been measured and what part has been calculated or extrapolated.
    - c. Lumen depreciation shall be clearly document the length of time a complete LED luminaire provided more than a percentage of the rated luminous flux under standard test conditions. For illuminating luminaires the percentage shall be >70%, indicated as L70 (>70%). For direct view luminaires the percentage should be >50%, indicated as L50.
    - d. Thermal losses: The temperature of the p-n junction of the raw LED (die) (Tj) is to be measured at an ambient temperature of 25 degrees Celsius. In a luminaire the die will be operating at a higher temperature. All performance parameters are to measure the Junction Temperature and Board Temperature.
    - e. Thermal protection: All fixtures shall be provided with appropriate heat sink to maintain lamp life. Stated lamp life and output shall be measured and identified and documented with heat sink. Any variations from stated life or output without heat sink shall be clearly identified including Junction Temperature.
    - f. Warranty: Entire fixture shall carry a minimum 5 year warranty.
- 9. Drivers
  - a. Constant current Drivers (non-dimming): All constant current drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or



24v input, unless otherwise noted. The driver shall operation on the voltage they are connected to, 120 or 277v input power. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.

- b. Dimming Drivers: All PWM dimming drivers shall be UL 1310 class 2 including short-circuit protection, high-power factor, with either 12v or 24v input, unless otherwise noted. The light output of the LED shall be controlled either by DC voltage applied to the control input (0-10V) with a maximum of 500 microamps per driver. The control equipment must not impose a voltage greater than 11.0V peak maximum on the driver terminals and the short-term transient voltage must not exceed 14 volts. Control equipment intended to control more than one driver must be capable of sinking the current supplied to the control bus by the maximum number of drivers specified for the control device. The control terminals for the driver shall be isolated from the power lines and suitable for use as Class II terminals. Maximum voltage drop not to exceed 0.2 volts. Variability in output shall not exceed 5% in load or 1% line levels. Driver shall be designed for use in -40 degree Celsius environments with a high temperature tolerance of +60 degrees ambient, 80 degrees Celsius case rating. Total harmonic distortions shall not exceed 20% with a current crest factor of 1.5 maximum. All drivers shall be field replaceable.

10. Warranty: Driver shall carry a 5 year warranty.

11. Lamp Module:

- a. LED lamp modules shall be minimum CRI of 70 with tolerances as identified in Clause 7 IEC/PAS 62612.
- b. White LED modules shall be available in 4000°K as identified in the lighting fixture schedule.

## 2.4 LENSES

- A. All lenses, diffusers, and shielding media shall be properly and securely mounted within fixture assemblies. All fixtures with removable reflectors, louvers or baffles shall be supplied with safety chains.
- B. All fixtures with removable shielding devices shall be supplied with safety chains.
- C. Unless otherwise indicated, all plastic shielding, lenses and diffusers shall be clear 100% UV stabilized virgin acrylic or polycarbonate.
- D. Unless otherwise indicated, all glass shielding, diffusers or lenses shall be clear tempered borosilicate glass.
- E. Optical lenses shall be free from spherical or chromatic aberrations and other imperfections, which may hinder the functional performance of the lenses.
- F. All lenses, louvers or other light diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out.

## 2.5 FINISHES

- A. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light stabilized, baked on at 350 degrees Fahrenheit minimum, catalytically or photo chemically polymerized after application.

- B. White finishes minimum 90% reflectance (semi-gloss).
- C. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
- D. Undercoat: Except for stainless steel all ferrous metal surfaces shall be given a five stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- E. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
- F. Unpainted aluminum surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg. per square inch, of a color and surface finish as selected by the Commissioner. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg. per square inch of a color and surface finish as selected by the Commissioner.
- G. Metal finishes: Provide finishes of the color and type indicated and having the following properties:
  - 1. Protection of metal from corrosion: 5-year warranty against perforation or erosion of the finish from weathering.
  - 2. Color retention: 5-year warranty against fading, staining, or chalking from weathering including solar radiation.
  - 3. Uniformity: Provide finish of uniform thickness and color, free from streaks, stains or orange peel texture.
- H. Luminaire finishes: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finishes process and color of pole or support materials.

## 2.6 GENERAL REQUIREMENTS FOR POLE MOUNTED LUMINAIRES

- A. Provide poles of the types and heights indicated. Provide internal raceway for underground power supply, with luminaire support poles base indicated. Provide poles that will carry the indicated supports, luminaires and appurtenances, at the required heights above grade, without excessive deflection or whipping of the luminaire, when subjected to 110-mph winds with a 1.3 gust factor.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mounting, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.
- D. Mast Arms: Provide steel mast arm, fabricated from 2-inch pipe with span and rise as indicated, and continuously welded to pole attachment plat.
- E. Brackets: Provide brackets, cantilevered and without underbrace of the sizes, styles and finishes indicated with straight tubular and section to accommodate the luminaire.
- F. Pole-Top Tenon: Provide corrosion resistant steel tenon securely fastened to the top of the pole shaft fabricated to accept and rigidly support the luminaire to be mounted thereon.



- G. Furnish and install yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels or other structure. All pole-mounted luminaires shall mount via pole-top tenon to reduce vibration.
- H. Structural Characteristics: Comply with AASHTO.
  - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 110 mph, with a gust factor of 1.3.
  - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

## 2.7 POLES: ALUMINUM

- A. Aluminum Poles (Refer to Structural Drawings).
- B. Aluminum 6063-T6 alloy, tapered pole with 0.10" to 0.20" per foot rate of taper, designed for 177 km/h (110 MPH) constant velocity wind load per AASHTO, and 3lbf/sq. ft. ice load.
  - 1. Include base template, 4 galvanized (hot-dip) ASTM A153 steel anchor bolts, stainless steel hardware and pole grounding lug, handhole, cast marine-grade, copper-free aluminum A356-T6 alloy anchor base and bolt covers, vibration pad (as shown in Design Plans) and fabricated galvanized steel ASTM A123 tilt base.
  - 2. Include pole tenon to reduce fixture vibration.
  - 3. All aluminum welding shall be performed in the shop, using the inert metal-arc welding process. Filler metal shall conform to the A.W.S. Specification A5.10. Welders shall be properly trained in accordance with A.S.M.E. Section IX or A.W.S. D1.2.
- C. Pole foundations: As indicated.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 PREPARATION

- A. Before installing any Work, lay out the proposed course for the conduits, location of lighting standards, etc. and have same approved.

### 3.3 DELIVERY, STORAGE, AND HANDLING

- A. Lighting fixtures shall be wrapped for protection during delivery, storage, and handling. Wet or damp wrapping shall be removed, and disposed of, to prevent staining finish.
- B. Deliver materials in manufacturer's original, unopened, protective packaging.
- C. Store materials in original packaging in a manner to prevent soiling and physical damage, prior to installation.
- D. Handle in a manner to prevent damage to finished surfaces.
- E. Where possible, maintain protective covering until installation is complete and remove such coverings as part of final cleanup.

### 3.4 INSTALLATION: LUMINAIRES

- A. General: Install luminaires at locations and heights as indicated, in accordance with the manufacturer's written instructions, applicable requirements of NYPD, ANSI C2 and with recognized industry practices to ensure that lighting installation fulfills requirements.
- B. Furnish and install lighting fixtures as noted on the drawings.
- C. Setting and Securing: Set lighting fixtures plumb, square, and level with structure and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings. Conform to the requirements of NFPA 70. Adjust luminaires that require field adjustment or aiming.
- D. Support: Fasten luminaires securely to indicated structural supports; and check to ensure that the required degree of freedom is provided to allow alignment or aiming of the fixtures for indicated light distribution.
  - 1. Mounting, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
- E. Mounting: Mounting heights specified or indicated are to bottom of fixture for suspended, ceiling mounted and wall mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the existing wall and ceiling condition.
- F. Coordination: Communicate with other trades as appropriate to properly interface, schedule and coordinate installation of lighting fixtures with other work.
- G. Grounding of Equipment: Ground non-current-carrying parts of electrical equipment. Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.
- H. Grounding of Equipment Connections: Provide equipment grounding connections using branch circuit equipment and connected sufficiently tight to assure a permanent and effective ground.
- I. Installation of fixture locations shall be in strict accordance with the intent of the contract drawings and approved shop drawings, specifications and drawings.
- J. Adjust photosensors to prevent false operation of relay by artificial light sources.
- K. Clean lighting fixtures of dirt and debris upon completion of installation.
- L. Protect installed fixtures from damage during remainder of construction period.
- M. Fixture locations: Do not scale electrical drawings for exact location of the lighting fixtures. In general, the architectural site/landscape plans indicate the proper locations of lighting fixtures, unless otherwise noted on architectural plans.
- N. Unless otherwise shown on the Contract Drawings, lighting fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the lighting fixture.
- O. Provide all hangers, rods, mounting brackets, supports, frames, earthquake clips and other equipment normally required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the Contract Drawings.



- P. Instructions: Each lighting fixture shall be packaged with complete illustration and instructions showing how to install. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
- Q. Rigidly align continuous rows of lighting fixtures for true aligned appearance.
- R. Support all lighting fixtures independently of ductwork or piping.
- S. Splices in internal wiring shall be made with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.
- T. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute "through circuit" wiring) shall be suitable for temperature, current, and voltage conditions to which it is subjected.
- U. Install reflector cones, baffles, aperture plates, light controlling elements for air handling fixtures and decorative elements after completion of ceiling tiles, painting and general cleanup.
- V. All pendant mounted lighting fixtures within the same area shall be installed plumb, and at a uniform height from the finished floor. Adjustment of desired height (if required) shall be made during the installation phase. Unless otherwise shown on the Contract Drawings, stems and canopies shall be matched to the associated lighting fixtures.
- W. Use fastening methods and materials approved by manufacturer.
- X. Adjust luminaires that require field adjustment or aiming. Where included, adjust photoelectric device to prevent false operation of relay by artificial light sources.
- Y. Where fixtures are wall-mounted and protrude from the wall surface, provide additional structural support within the wall framing to accommodate the extra moment force created by the fixture.
- Z. Adjust aimable lighting fixtures to provide required light intensities.
- AA. Replace blemished, damaged or unsatisfactory fixtures as directed by the Commissioner.

### 3.5 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Pole installation shall be level and plumb to mounting surface. Follow manufacturers' recommendations and instructions for installations.
- C. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
  - 1. Fire Hydrants and Storm Drainage Piping: 3 feet.
  - 2. Water Gas, Electric, Communication, and Sewer Lines: 3 feet.
  - 3. Existing Trees: 10 feet from tree trunk.
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level recommended by pole manufacturer.
  - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  - 2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.

3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6 inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch (25 mm) below top of concrete slab.

F. Raise and set poles using web fabric slings (not chain or cable).

### 3.6 INSTALLATION OF INDIVIDUAL GROUND MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast luminaire finish into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Sections 03 30 00 "Cast-in-Place Concrete" and 03 33 00 "Architectural Concrete".

### 3.7 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems". In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.8 GROUNDING

A. Ground metal poles and support structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems".

1. Install a minimum of a 3/4" diameter by 8' copper grounding electrode for each pole, unless otherwise indicated, and installed as indicated on Contract Drawings.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems".

1. Install a minimum of a 3/4" diameter by 8' copper grounding electrode for each pole, unless otherwise indicated, and installed as indicated on Contract Drawings.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

### 3.9 RACEWAY AND BOXES

A. Galvanized rigid conduit shall be used under buildings, within five feet of entrances to buildings, in pole foundations, under paved areas and walkways and within 18" horizontal of exterior junction boxes.

B. Provide pull line in empty conduit and duct.

C. Comply with the additional requirements of Section 26 05 33 "Raceways and Boxes for Electrical Systems".

**3.10 IDENTIFICATION**

- A. Provide vinyl tagging with panel source and circuit number on wiring at handhole in each pole and at each exterior box.
- B. Identify each exterior box with one-inch black letters and numbers on white vinyl weatherproof pressure sensitive adhesive labels on the covers.
- C. Identify each pole with three-inch black letters and numbers on white vinyl weatherproof pressure sensitive adhesive labels 6'-6" above grade facing the parking areas or facing the road if the pole is at the road.
- D. Comply with the additional requirements of Section 26 05 53 "Identification of Electrical Systems".

**3.11 CONTRACTOR STARTUP AND REPORTING**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
- C. Replace fixtures that show evidence of corrosion during project warranty period.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- E. Tests: Upon completion of installation of lighting fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- F. Instruct the City of New York's service staff on the proper operation and service of all products in this specification.

**3.12 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations:
  - 1. Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.
  - 2. Comply with the Sanitation Garage Design Guide.
  - 3. Comply with the following IESNA testing guide(s):
    - a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
    - b. IESNA LM-72, "Directional Positioning of Photometric Data."



- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

**3.13 COMMISSIONING AND DEMONSTRATION**

- A. After system checkout and adjustment, operate the system for the review of the Commissioner and Commissioning Agent. Necessary adjustments or modifications shall be made as required by the Commissioner and Commissioning Agent.

**3.14 ADJUSTING AND CLEANING**

- A. Clean: Clean lighting fixtures of dirt and debris upon completion of installation. Do not damage finishes or lens or refractor surfaces.
- B. Clean fixtures internally and externally after completion of installation. Use methods and materials recommended by manufacturer.
- C. Protection: Protect installed fixtures from damage during remainder of construction period.

**END OF SECTION 26 56 00**

**SECTION 27 00 00****TELECOMMUNICATIONS CABLING SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Work of this Section consists of cabling systems and related work described herein, and includes but is not limited to the following:

- 1. Telecommunications Cabling Systems

- B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

- 1. Contract Drawings.

- 2. Telecommunications Distribution Systems.

- C. All cables, connectors, faceplates, patch panels, patch cords, termination blocks, cross-connects, racks, cabinets, wire management devices, ladder racks, documentation, etc. shall be provided by the Contractor as outlined in this specification and the associated drawings unless stated otherwise.

- D. It is the intent of the drawings and specifications to provide a complete, operating telecommunications system. All telecommunications work necessary to provide such a system shall be performed. Any discrepancies shall be brought to the Commissioner's attention.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

- 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 REFERENCES

##### A. Reference Documents

1. ANSI/NFPA-70 (2008 with NYC Amendments) - National Electrical Code.
2. NESC (2012) - National Electrical Safety Code.
3. ANSI/TIA/EIA-568-C.0 (2009+A1:2010+A2:2012) - Generic Telecommunications Cabling for Customer Premises.
4. ANSI/TIA/EIA-568-C.1 (2009+A1:2012), Commercial Building Telecommunications Cabling Standard.
5. ANSI/TIA/EIA-568-C.2 (2009+A1:2010) Balanced Twisted-Pair Telecommunications Cabling Components Standard.
6. ANSI/TIA/EIA-568-C.3 (2008+A1:2011), Optical Fiber Cabling Components Standard.
7. ANSI/TIA/EIA-568-C.4 (2011), Broadband Coaxial Cabling and Components Standard.
8. ANSI/TIA-758-B (2012) Customer-Owned Outside Plant Telecommunications Cabling Standard.
9. ANSI/NFPA 75-2013, Standard for the protection of information technology equipment;
10. ANSI T1.336, Engineering requirements for a universal telecommunications frame;
11. ANSI T1.404, Network and customer installation interfaces - DS3 and metallic interface specification;
12. ASHRAE, Thermal Guidelines for Data Processing Environments;
13. Telcordia GR-63-CORE, NEBS (TM) Requirements: physical protection;



14. Telcordia GR-139-CORE, Generic requirements for central office coaxial cable;
15. TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces.
16. ANSI/TIA-606-B (2012) - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
17. ANSI/TIA-607-B (2013) - Commercial Building Grounding and Bonding Requirements for Telecommunications.
18. BICSI TDMM (2014) - Telecommunications Distribution Methods Manual, 13th Edition.
19. ISO/IEC-11801- Information Technology - Generic Cabling for Customer Premises.
20. NECA/BICSI 568, Installing Commercial Building Telecommunications Cabling.
21. NECA/BICSI 607 (2011) Standard - Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings (ANSI).
22. ANSI/BICSI 002 (2011) - Data Center Design and Implementation Best Practices.
23. TSB-162 Telecommunications Cabling Guidelines for Wireless Access Points.

#### 1.6 CODES, PERMITS AND INSPECTIONS

- A. All telecommunications work shall meet or exceed the latest requirements of all national, state, county, municipal, 2014 New York City Construction Codes, and 2008 National Electrical Code.
- B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the telecommunications work. In the event that no official authority exists which will issue a certificate attesting to the compliance of the telecommunications installation, such a certificate shall be acquired from an independent agency selected by the Commissioner. Inspection and certification fees levied by this agency shall be paid for as part of the telecommunications work.
- C. Any portion of the telecommunications work, which is not subject to the requirements of the 2014 New York City Construction Codes, shall be governed by the National Electrical Code and other applicable sections of the National Fire Code, as published by the National Fire Protection Association.
- D. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).
- E. All installations shall be in conformance with the latest revisions of ANSI/TIA/EIA-568-C, 569-B, 606 and 607, as well as all associated addendums and telecommunications systems bulletins (TSB's).

## 1.7 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall be fully conversant and capable in the cabling of data, voice and CATV facilities and shall at a minimum possess the following qualifications:
1. Installer shall be properly trained by the proposed manufacturer to install the proposed warranted cabling solution.
  2. Installer shall be properly trained in core alignment fiber optic splicing and connectorization techniques/technologies.
  3. Installer shall be properly trained in the use of fiber optic OTDR, OLS and mechanical splicing techniques.
  4. Installer shall be properly trained the installation of riser cable plant and experienced with cable support techniques, products and splicing techniques.
  5. Installer shall be properly trained in the installation of outside plant cable (both copper and fiber optic) including underground and aerial cable installation and splicing and protection techniques.
  6. Experience in the installation of coaxial cabling for the transmission of cable TV broadcast.
  7. Installer
    - a. The firm shall have at least one RCDD installer to oversee the project.

## 1.8 DEFINITIONS AND INTERPRETATION

- A. As used in the drawings and specifications for the telecommunications cabling work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in other documents governing the telecommunications work:
1. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the telecommunications cabling work, shall be understood to have the specific meanings ascribed to them in the following list:
  2. "Accessible Corridor" - A common horizontal pathway that can be approached or entered easily in which telecommunications cables are run until they branch out to individual workstation terminations.
  3. "Administration" - The method for labeling, identification, documentation and usage need to implement moves, additions and changes of the telecommunications infrastructure.
  4. "Assembly" -- A defined set of elements of telecommunications work.
  5. "Backbone" -- Shall refer to the portion of the installation that transmits between



building floors (or between telecommunications rooms). The term "Riser" may also be used interchangeably.

6. "Bonding" - The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
7. "Bundle" -- Shall refer to multiple cables of similar or dissimilar cable types, as specified. The cables shall be neatly placed and tie wrapped together. The bundle size shall be of practical and manageable proportions.
8. "Cabinet (Telecommunications)" - An enclosure with a hinged cover used for terminating telecommunications cables, wiring and connection devices.
9. "Cable" - An assembly of one or more insulated conductors or optical fibers, within an enveloping sheath.
10. "Cabling" - A combination of all cables, jumpers cords, and connecting hardware.
11. "Category 3, 4, 5, 6, 6" -- Conforming to the guidelines issued as part of ANSI/TIA/EIA-568-B and all associated addendums and bulletins.
12. "Centralized Cabling" - A cabling configuration from the work area to a centralized cross-connect using pull through cables, an interconnect, or splice in the telecommunications room.
13. "Channel" - The end-to-end transmission path between two points at which application-specific equipment is connected.
14. "Circuit" -- Any specific run of circuitry.
15. "Circuitry" -- Any telecommunications work which consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.
16. "Common Equipment Room (Telecommunications): An enclosed space used for equipment and backbone interconnections for more than one tenant in a building or campus.
17. "Computer Room" - An architectural space whose primary function is to accommodate data processing equipment.
18. "Concealed" (as applied to circuitry) -- Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.
19. "Connecting Hardware" - A device providing mechanical cable terminations.



20. "Consolidation Point" - A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
21. "Cross-Connect" - A facility enabling the termination of cable elements and their interconnection or cross-connection.
22. "Cross - Connection" - A connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware on each end.
23. "Distribution Frame" -- A system of terminal blocks, patch cords, and backboards that facilitates administration of cross-connect fields for moves and rearrangements.
24. "Data Center" - A building or portion of a building whose primary function is to house a computer room and its support areas.
25. "Demarcation Point" - A point where the operational control or ownership changes.
26. "Earthing" - See grounding.
27. "Electromagnetic Interference" - Radiated or conducted electromagnetic energy that has an undesirable electronic equipment or signal transmission.
28. "Entrance Point" -- Point at which telecommunications cabling enters the building. Where cable enters in conduit that is buried in a concrete floor, the point at which the conduit emerges from the floor is considered the entrance point.
29. "Equipment Cable; Cord" - A cable or cable assembly used to connect telecommunications equipment to horizontal or backbone cabling.
30. "Equipment Distribution Area" - The computer room space occupied by equipment racks or cabinets.
31. "Equipment Room" – An enclosed area or room specifically designated for housing telecommunications terminations and associated electronics.
32. "Equipment Room (Telecommunications)" - An environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect.
33. "Exposed" (as applied to circuitry) -- Not covered in any way by building materials.
34. "Fiber Optic" - See Optical Fiber.
35. "Ground" - A conducting connection, whether intentional or accidental, between an electrical circuit (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.
36. "Grounding" - The act of creating a ground.



- 37. "Grounding Conductor" - A conductor used to connect the grounding electrode to the building's main grounding busbar.
- 38. "Horizontal Cable" - Refers to the portions of the cable installation that are installed between the telecommunications closets and the work area outlets. The terms "Station Cable" or "Workstation Cable" may also be used.
- 39. "Horizontal Cross-Connect" - A cross-connect of horizontal cabling to other cabling, e.g., horizontal, backbone, equipment.
- 40. "IDF" -- Intermediate distribution frame.
- 41. "IDF Closet" - See "Telecommunications Closet".
- 42. "Identifier" - An item of information that links a specific element of the telecommunications infrastructure with its corresponding record.
- 43. "Infrastructure (Telecommunications)" - A collection of those telecommunications components, excluding equipment, that together provide the basis support for the distribution of all information within a building or campus.
- 44. "Interconnection" - A connection scheme that employs connecting hardware for the direct connection of a cable to another cable without a patch cord or jumper.
- 45. "Intermediate Cross-Connect" - A cross-connect between first level and second level backbone cabling.
- 46. "Link" - A transmission path between two points, not including terminal equipment, work area cables, and equipment cables.
- 47. "Low Voltage" -- Less than 50 volts.
- 48. "MDF" -- Main distribution frame.
- 49. "Main Cross-Connect" - A cross-connect for first level backbone cables, entrance cables, and equipment cables.
- 50. "Media (Telecommunications)" - Wire, cable, or conductors used for telecommunications.
- 51. "Modular Jack" - A female telecommunications connector that may be keyed or unkeyed and may have 6 or 8 contact positions, but not all the positions need be equipped with jack contacts.
- 52. "Multimode Optical Fiber" - An optical fiber that carries many paths of light.
- 53. "Multimode Cable" - A cable having more than four pairs.
- 54. "Normal Work Conditions" -- Locations within building confines which are neither damp, wet nor hazardous and which are not used for air handling.

55. "Optical Fiber" - Any filament made of dielectric materials that guides light.
56. "Optical Fiber Cable" - An assembly consisting of one or more optical fibers.
57. "Pathway" - A facility for the placement of telecommunications cable.
58. "Patch Cord" -- A length of cable that is not installed such that it is easily removable. A patch cord is typically connectorized at both ends.
59. "Patch Panel" -- A passive electronic device at which multiple cables are terminated in individual connectors.
60. "Plenum" - A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
61. "PBX" - A private telecommunications switching system.
62. "Pull Box" - A housing located in a pathway run used to facilitate that placing of wire or cables.
63. "Raceway" -- Any pipe, duct, extended enclosure, or conduit (as specified for a particular system) which is used to contain wires, and which is of such nature as to require that the wires be installed by a "pulling in" procedure.
64. "Riser" - See "Backbone".
65. "Screen" - An element of a cable formed by a shield.
66. "Screened Twisted-Pair (ScTP)" - A balanced cable with an overall screen.
67. "Service Provider" - The operator of any service that furnishes telecommunications content (transmissions) delivered over access provider facilitates.
68. "Sheath" - See cable sheath.
69. "Shield" - A metallic layer placed around a conductor or group of conductors.
70. "Single-Mode Optical Fiber" - An optical fiber that carrier only one path of light.
71. "Singlemode Optical Fiber" - See single-mode.
72. "Splice" - A joining of conductors, meant to be permanent.
73. "Star Topology" - A topology in which telecommunications cables are distributed from a central point.
74. "Standard" (as applied to wiring devices) -- Not of a separately designated individual type.
75. "Station Cable" -- See "Horizontal Cable".
76. "Subject to Mechanical Damage" -- Exposed within seven feet of the floor in mechanical



rooms, manufacturing spaces, vehicular spaces, or other spaces where heavy items (over 100 pounds) are moved around or rigged as a common practice or as required for replacement purposes.

77. "Telecommunications" - Any transmission, emission, and reception of sings, signals, writings, images, and sounds, that is, information of any nature by cable, radio, optical, or other electromagnetic systems.
78. "Telecommunications Closet" -- The enclosed area or room specifically designated for the routing, termination and/or cross-connecting of telecommunications cable (i.e., backbone cable) to other telecommunications cable and/or equipment (i.e., workstation cables or concentrators/hubs/switches). This may also be referred to as the telephone or communications closet.
79. "Telecommunications Room" - An enclosed architectural space for housing telecommunications equipment, cable terminations, and cross-connect cabling.
80. "Telecommunications Wiring" -- See "Circuitry".
81. "Telecommunications Work" -- All telecommunications work as defined by the telecommunications drawings and specifications.
82. "UPS" - Uninterruptible Power Supply, an auxiliary power unit for telecommunications systems that provides continuous power in the event of a commercial power failure.
83. "Topology" - The physical or logical arrangement of a telecommunications system.
84. "Wireless" - The use of radiated electromagnetic energy (e.g., radio frequency and microwave signals, light) traveling through free space to convey information.
85. "Work Area Outlet" - See "Workstation".
86. "Workstation" or "Workstation Outlet" -- The point of attachment of voice and/or data end user equipment to the cabling system.
87. "Zone Distribution Area" - A space in a computer room where a zone outlet or a consolidation point is located.
88. Where the word "conduit" is used without specific reference to type, it shall be understood to mean "raceway."
89. No exclusion from or limitation in, the symbolism used on the drawings for telecommunications work or the language used in the specifications for telecommunications work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.
90. The drawings for telecommunications work utilize symbols and schematic diagrams that have no dimensional significance. The telecommunications work shall, therefore,



be installed to fulfill the diagrammatic intent expressed on the telecommunications drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades.

91. Certain details appear on the drawings for telecommunications work that are specific with regard to the dimensioning and positioning of the telecommunications work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated work. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from architectural and structural drawings and specifications only.
92. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred.
93. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

#### 1.9 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.10 SUBMITTALS AND SHOP DRAWINGS

- A. Prior to purchasing any equipment or materials, a list of their manufacturers shall be submitted for review.
- B. Prior to assembling or installing the telecommunications work, the following shall be submitted for review:
  1. Catalog information, factory assembly drawings and field installation drawings as required for a complete explanation and description of all items of equipment.
- C. Submit for approval one sample of each of the following:
  1. Each type of cable.
  2. Each type of cable connector.
  3. Each type of wiring device plate, complete with labeling
  4. Each type of patching/cross connecting device.
  5. Each type of protector.
  6. Each type of identification label.
  7. Other items as requested.
  8. Documents will not be accepted for review unless:





- a. They include complete information pertaining to appurtenances and accessories.
- b. They are submitted as a package where they pertain to related items.
- c. They are properly marked with specific service or function and intended location of use within the project (e.g., "backbone cabling", "telecommunications closet").
- d. They are clearly identified or highlighted to indicate all items that are applicable.
- e. They indicate the project name and address along with the Contractor's name, address and phone number.
- f. They are properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.

**D. Shop Drawing Review**

- 1. Substitutions of equipment, systems, materials, must be coordinated by the Contractor with his own or other trades which may be involved with the item, such as, but not limited to, equipment substitutions which change telecommunications or electrical requirements, or hanging or support weights or dimensions.
  - 2. The following shop drawings shall be submitted to the Commissioner for review, minimum:
    - a. Coordinated wall field elevations for the main equipment room and each telecommunications closet identifying the location dimensions of all termination hardware provided by the Contractor and all devices provided by other trades.
    - b. Coordinated floor plans of the main equipment room and each telecommunications closet identifying the location dimensions of all racks, cabinets and other equipment provided by the Contractor and by other trades.
    - c. Coordinated ceiling plans of the main equipment room and each telecommunications closet identifying the location dimensions of all ladder rack, light fixtures, sprinkler heads, wall openings, sleeves etc.
    - d. Drawings showing conduit and sleeve allocation and fill.
- E. Include in the telecommunications work the issuing of maintenance and operating instructions for the following specialized equipment.**
- a.
  - b. All electronic equipment provided or installed as part of the telecommunications work.



- c. The issuing of operating instructions shall include of supplying of all original operating and maintenance instruction manuals.
  - d. The issuing of operating instructions shall include the supplying of properly trained installers to demonstrate the operation of specialized equipment.
  - e. The issuing of operating instructions shall include the submission of the name, address and telephone number of the manufacturer's representative and service company for each item of equipment so that service and spare parts can be readily obtained.
  - f. After all final tests and adjustments have been completed, fully instruct the City of New York's staff in all details of operation for equipment installed. Supply properly trained installers to operate equipment for sufficient length of time to assure that the City of New York's staff is properly qualified to take over operation and maintenance procedures. Supply properly trained installers to operate equipment for sufficient length of time as required to meet all required operation and performance tests.
- F. Furnish required number of manuals, in bound form containing data covering capacities, maintenance of operation of all equipment and apparatus. Operating instruction shall cover all phases of control and include the following:
- 1. Performance Criteria: For transmission and other equipment as requested.
  - 2. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
  - 3. Instruction Books may be standard booklets but shall be clearly marked to indicate applicable equipment.
  - 4. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
  - 5. Where applicable, one set of operating and maintenance instructions shall be neatly framed behind glass and hung adjacent to the equipment concerned.

#### 1.11 RECORD DRAWINGS AND AS-BUILT DOCUMENTATION

- A. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for record drawing, coordination drawing, and as-built documentation requirements.
- B. Record drawing and as-built documentation for work in this section shall include, but is not limited to, the following:
  - 1. All telecommunications work installed exactly in accordance with the original design.



2. All telecommunications work installed as a modification or addition to the original design.
3. The dimensional information necessary to delineate the exact location of all circuitry and wiring runs that are concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.
4. The numbering information necessary to correlate all telecommunications items (or outlets for same) to the patch panel, end user or head end device to which they are connected.

#### 1.12 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work. In addition, the contractor or subcontractor must be licensed or approved by the manufacturer.
- C. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.
- D. New equipment and materials shall:
  1. Be Underwriters Laboratories, Inc. (U.L.) labeled and/or listed where specifically called for, or where normally subject to such U.L. labeling and/or listing services.
  2. Be clearly labeled identifying the transmission parameters specified (specifically with reference to Category 6 or higher ratings).
  3. Be without blemish or defect.
  4. Be in accordance with the latest applicable.
  5. Be products that meet with the acceptance of the Commissioner.
- E. All items of equipment or material of one generic type shall be the product of one manufacturer throughout.
- F. Manufacturer's Recommendations: Where installation procedures of any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- G. Ensure that the installation of all equipment be performed in accordance with manufacturers' specifications. The necessity of special conditions required by a particular manufacturer shall be brought to the attention of the Commissioner prior to the installation of any equipment in

the area concerned.

- H. Provide a complete fit-out of one (1) of the telecommunications IDF room for review by the Commissioner prior to continuing with the installation of other telecommunications closets. The IDF fit-out shall include all cable terminations, blocks, patch panels, frames, labels, etc. Changes or adjustments required in other telecommunications IDF's as a result of the review of the fit-out room shall be the responsibility of the Contractor. The Commissioner shall be given a minimum of one (1) week notice for the review of the room.
- I. Provide a complete fit-out of a standard wall and furniture mounted workstation for review by the Commissioner. The workstation fit-out shall include all connectors, labeling, cable support, etc. Changes or adjustments required in other wall and furniture mounted workstations as a result of the review of the fit-out shall be the responsibility of the Contractor. The Commissioner shall be given a minimum of one (1) week notice for the review of the fit-out area.

#### 1.13 PROJECT MANAGEMENT

- A. Any questions arising during the installation shall be submitted in writing to the Commissioner.

#### 1.14 WARRANTY AND GUARANTEE

- A. Provide a manufacturer's Warranty for a twenty-five (25) year Static, Dynamic, and Applications Warranty on all telecommunications products installed, starting from the date of Substantial Completion.
- B. All telecommunications work shall be guaranteed by the Contractor to be free from defects. Any defective materials or workmanship, as well as damage to the telecommunications work of all trades resulting from same, shall be replaced or repaired as directed for the duration of stipulated guarantee periods.
- C. The duration of the Contractor's guarantee periods following the date of acceptance of the telecommunications work shall be:
  - 1. One (1) year, starting from the date of Substantial completion.
- D. Non-durable items shall be replaced up to the date of substantial completion, such that they shall have had no more than 100 hours of use prior to this date.
- E. Manufacturer's certification shall be submitted attesting to the fact that specified performance and other criteria are met by all items of telecommunications work for which such certification is required.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Propose a solution based upon the warranted cabling solution from the following manufacturers/manufacturers:
1. Leviton/Berk-Tek
  2. Ortronics/Superior Essex
  3. Panduit/General Cable
  4. Or approved equal.
- B. Horizontal outlet cabling and all associated components (i.e. jacks, faceplates, patch panels, patch cords, etc.): shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
1. Leviton/Berk-Tek
  2. Ortronics/Superior Essex
  3. Panduit/General Cable
  4. Or approved equal.
- C. Twisted-pair copper backbone cabling and all associated components (i.e. Cabling and Terminations blocks, etc.) shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
1. Leviton/Berk-Tek
  2. Ortronics/Superior Essex
  3. Panduit/General Cable
  4. Or approved equal.
- D. Fiber optic backbone cabling and all associated components (i.e. Cabling, connectors, enclosures, connector panels etc.) shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
1. Leviton/Berk-Tek
  2. Ortronics/Superior Essex
  3. Panduit/General Cable
  4. Or approved equal.
- E. Coaxial backbone cabling and all associated components (i.e. Cabling and connectors, etc.) shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
1. Leviton/Berk-Tek
  2. Ortronics/Superior Essex
  3. Panduit/General Cable
  4. Or approved equal.

- F. Coaxial Adaptors: Subject to compliance with requirements, provide products by one of the following:
1. Blonder Tongue
  2. Amphenol RF
  3. Pasternack
  4. Or approved equal.
- G. Cable Trays, Drops, and Retaining Posts: Subject to compliance with requirements, provide products by one of the following:
1. CPI Chatsworth
  2. Panduit
  3. Legrand
  4. Or approved equal.
- H. Post Racks, Shelves, and Cable Managers: Subject to compliance with requirements, provide products by one of the following:
1. CPI Chatsworth
  2. Panduit
  3. Legrand
  4. Or approved equal.
- I. UPS and Power Distribution Units: Subject to compliance with requirements, provide products by one of the following:
1. APC
  2. Eaton
  3. Tripplite
  4. Or approved equal.
- J. Non-Continuous Cable Supports: Subject to compliance with requirements, provide products by one of the following:
1. Caddy
  2. Panduit J-Pro
  3. Legrand Cablofil
  4. Or approved equal.
- K. Public Address System Components: Subject to compliance with requirements, provide products by one of the following:
1. TOA
  2. Atlas
  3. SURE
  4. Or approved equal.

## 2.2 HORIZONTAL DATA WORKSTATION UTP CATEGORY 6A CABLING

- A. Horizontal DATA cabling shall be listed for the in a Communications Plenum (CMP listed)
- B. Horizontal DATA cabling shall be 100 ohm, 23 AWG, 4-pair unshielded twisted pair (UTP) cable and compliant with ANSI/TIA/EIA- 568-C.2 for category 6A, UL444.
- C. Shall pass factory tests with a minimum of 2dB of margin for NEXT & PSNEXT and 4dB of margin for ACRF & PSACRF beyond the CAT 6A standard
- D. Violet jacketed Berk-Tek Lanmark 10G2, or equivalent from approved equal manufacturer listed above, for data horizontal outlet cabling.
- E. The color of all horizontal cabling jackets shall be unique for each application type ( i.e., "VIOLET" cable for DATA)
- F. Splicing of copper cabling shall not be accepted.
- G. Have the name of the manufacturer, UL rating, and incremental footage markings indelibly printed on the outermost jacket by the manufacturer.
- H. All terminated horizontal cable shall be terminated on the same transmission performance jack and patch panel as the transmission rate of the cable, for example all category 6A cable links, that require termination, shall be terminated with a category 6A jack on one side and a category 6A patch panel port.

DESCRIPTION	MANUFACTURER	PART NUMBER
Violet Jacketed Lanmark 10G2, 23 AWG, 4-Pair, Plenum Category 6A Cable	Berk-Tek (Basis-of-Design) or approved equal as per Section 2.1B.	10138182

## 2.3 CATEGORY 6A DATA TERMINATION PATCH PANELS

- A. Be rack mountable, 19-inch.
- B. Be made by an ISO 9001 certified manufacturer.
- C. All terminated horizontal Data cables shall be terminated on the same transmission performance jack and patch panel as the transmission rate of the cable, for example all category 6A cable links, that require termination, shall be terminated with a category 6A jack on one side and a category 6A patch panel port.
- D. All Patch Panels shall be a category 6A (Flat Style) 48-Port, 2- RMU, 110 inline patch panel.
- E. Each telecom room shall have outlet port growth of a minimum of 25% and if required, additional unterminated patch panels shall be installed to achieve this percentage.

DESCRIPTION	MANUFACTURER	PART NUMBER
Cat 6A Flush Patch Panel 48-port	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	6A586-U48

#### 2.4 HORIZONTAL WORKSTATION CATEGORY 6A DATA JACK

- A. All horizontal DATA cabling shall be terminated with a category 6A modular eight-pin, eight conductor (8P8C) "RJ45-type" jack and shall be installed utilizing the T568B termination wiring schedule.
- B. DATA UTP jacks shall exceed ANSI/TIA/EIA 568-C.2 component, permanent link, and channel margins, and the IEEE 10BASE-T (802.3an) requirements, as well as the ISO/IEC 11801 2<sup>nd</sup> Edition, Category 6A Component, Class EA standard.
- C. "Violet" colored DATA jacks shall be installed for data applications at the outlet and shall match and terminate the horizontal data cabling.

DESCRIPTION	MANUFACTURER	PART NUMBER
Violet Category 6A Jack (Data Application)	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	6110G-RP6

#### 2.5 HORIZONTAL WORKSTATION COAXIAL CABLING SYSTEM

- A. The horizontal coaxial outlet cable shall be listed for the in a Communications Plenum (CMP listed).
- B. Shall be suitable for CATV applications.
- C. Shall be RG-6 type, quad shielded, 18 AWG solid bare copper cable.
  - 1. For coaxial cable runs over 200ft, a series 11 (RG-11Type) Belden equivalent cable link will be install as a feeder cable and a 10ft series 6 cable link, at the outlet, as the drop cable with a F-81 (RG- 6/U to RG-11/U) adapter interface.
- D. Shall have both ends of each link terminated with a compression F-type connector
  - 1. The compression F-type connector must be compatible with Belden standard coax cable in fit (No loose or undersized connections).
- E. Shall have both ends of each link shall be installed with a "figure 8 type" service loop installed in the ceiling.  
One foot on the outlet or workstation side and twenty feet within the telecom room.





DESCRIPTION	MANUFACTURER	PART NUMBER
Series 6 compression F-type connector	Belden (Basis-of-Design) or approved equal as per Section 2.1E	FS6U
Plenum Series 6 Coaxial Cable	Belden (Basis-of-Design) or approved equal as per Section 2.1E	6339Q8
Series 11 compression F-type connector	Belden (Basis-of-Design) or approved equal as per Section 2.1E	FS11V
Plenum Series 11 Coaxial Cable	Belden (Basis-of-Design) or approved equal as per Section 2.1E	1153A
F-81 (RG-6/U to RG-11/U) Adapter	Blonder Tongue Adapter (Basis-of-Design) or approved equal as per Section 2.1F	GF-81C

## 2.6 WORKSTATION FACEPLATES

- A. All workstation termination hardware, including mounting boxes, faceplates, surface mount raceway, and outlets, shall match the wall surface color as closely as possible (Color to be coordinated with Commissioner before any installation).
1. Face plates for wall outlets shall be Leviton QuickPort Single- Gang wall plates with ID Windows, or an equivalent product from an approved manufacturer listed above.
  2. Be single or double gang, of the same manufacturer, and supplied in colors and finishes coordinated with the Commissioner and NYPD Facilities Construction Department IT/Facilities.
  3. All faceplate ports “Not Used” or that has no module installed shall have a blank module install so that every port has a module installed.
  4. The exact faceplates for floor, surface, and ceiling shall be coordinated and approve in the field before any installation.

DESCRIPTION	MANUFACTURER	PART NUMBER
1-Port Wall phone plate	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	4108W-*SP
2-Port Wall plate	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	42080-2*S



4-Port Wall plate	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	42080-4*S
2-Port surface mount box	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	41089-2*P
Modular Furniture Faceplate	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	49910-***
75 Ohm F-type coax bulkhead modules	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	40831-0B*
Blank module Insert	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	41084B*B

## 2.7 CATEGORY 6A PATCH CORDS

- A. Patching, equipment, and station cords shall be factory manufactured and ETL verified for compliance with Category 6A for channel performance.
- B. Field-manufactured cordage is not permitted, factory terminated to industry standard 8P8C modular plugs at both ends.
- C. Patch cords shall meet ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class E standards for supporting 1000BASE-T transmission over twisted-pair cabling systems up to 100 meters.
- D. The wiring schedule shall match that of patch panels and outlets.
- E. Cordage shall be supplied by the same manufacturer as the modular jacks, patch panels, and connecting/termination.
- F. Furnish and install two (2) Category 6A RJ-45/RJ-45 patch cords for each category 6A DATA port on every outlet type.
  - 1. Half of the DATA patch cords shall BLUE jacketed and shall be installed in the telecommunication room side of the horizontal link. These patch cords shall be provided in varying lengths as indicated to ensure a neat and organized installation. The maximum lengths for patch cord combined lengths on a single circuit shall conform to EIA/TIA-568B. Based on the patch cord allowance indicated above, the Commissioner reserves the right to modify the patch cord lengths provided to ensure a neat and orderly installation. Make recommendations as to the required patch cord lengths to meet these objectives.
  - 2. The second half of DATA patch cords shall BLUE jacketed and shall be located at the telecom outlet/workstation. Furnish and install a 7 foot, Category 6A RJ-45/RJ-45 patch cord at each workstation port. (Must conform to EIA/TIA-T568B).

- G. Patching shall be as directed by the Commissioner after equipment vendor selection.
- H. Each patch cord shall be provided with a unique identifier indicated at each end, minimum.
- I. Prior to purchasing patch cords, it shall be understood that the quantities presented represent an allocation which can be reconfirmed by the Commissioner prior to purchase.
- J. Patching connection records shall be provided by the contractor as specified elsewhere.
- K. All Patch cords shall be neatly dressed and tied using Velcro type cable ties. Patching shall be performed so as to ensure the ability to easily read and access patch panel port identification.
- L. All patch cords shall be manufactured by the same manufacturer as the horizontal structured cabling system.
- M. All patch cords shall be the same data transmission performance rate (i.e. Cat-6A) as the horizontal structured cabling system.

DESCRIPTION	MANUFACTURER	PART NUMBER
Category 6A UTP Patch cord	Leviton (Basis-of-Design) or approved equal as per Section 2.1B	6210G-XXL (Replace XX with length needed in 03, 05, 07, & 10-foot lengths)

## 2.8 FIBER OPTIC INTRA-BUILDING BACKBONE CABLING SYSTEM

- A. The fiber optic intra-building backbone cabling system:
  - 1. Intra-building fiber optic backbone cabling shall be the following type:
    - a. Interlocking armored 12-Strand, TIA OM4 –tight buffered 50/125 nm, 1300nm and 850 nm multimode fiber optic cable.
    - b. Interlocking armored 24-Strand, TIA OM4 –tight buffered 50/125 nm, 1300nm and 850 nm multimode fiber optic cable.
  - 2. Fiber optic backbone cabling shall comply with NEC section 770 and shall be OFNP rated, minimum, unless otherwise noted.
- B. All backbone cabling shall be installed as indicated on the drawings. All work shall be in accordance with the standards identified in this specification and with industry standards.
  - 1. Fiber optic backbone cabling shall be standards compliant with ANSI/ICEA S-104-696; ANSI/TIA- 568-C.3; Telcordia GR-409
- C. All raceways containing fiber optic cable shall be provided with a label "Caution - Fiber Optic Cable" located on the raceway every 20 feet, minimum.



- D. All fiber optic cables shall be provided with strain relief where they enter patch panel housings.
- E. Fiber strands shall terminate with LC pre-polished OM4 connectors.
- F. Terminated fiber strands shall be inserted onto a precision molded 12 LC connector version, with fiber-optic platform adapter plate and installed in a rack-mount enclosure on both sides.
  - 1. Subject to compliance with requirements, provide Leviton Opt-X 1000i Rack-Mount Enclosure or an equivalent product from one of the following:
    - a. Belden
    - b. Ortronics
    - c. Or approved equal.
- G. Furnish (12) twelve 1 meter, duplex (TX/RX) LC to LC, OM3 fiber optic patch cords for each and every backbone cable. Leviton or approved equal part #.

DESCRIPTION	MANUFACTURER	PART NUMBER
Plenum Interlocking armored 12- Strand, TIA OM4 –tight buffered 50/125 nm,	Berk-Tek (Basis-of-Design) or approved equal as per Section 2.1D	PDPK012FB3010/25
Plenum Interlocking armored 24- Strand, TIA OM4 –tight buffered 50/125 nm,	Berk-Tek (Basis-of-Design) or approved equal as per Section 2.1D	PDPK024FB3010/25
LC pre-polished OM4 connectors L.O. Multimode, 50/125 micron, Aqua	Leviton (Basis-of-Design) or approved equal as per Section 2.1D	49991-LLC.
Optical Patch Panel	Leviton (Basis-of-Design) or approved equal as per Section 2.1D	5R2UM-S06
12 Strand multimode LC adapter plate	Leviton (Basis-of-Design) or approved equal as per Section 2.1D	5F100-2QL
1 meter, Duplex LC to LC, OM4 patch cord, 50/125 micron, Aqua Reverse Polarity	Leviton (Basis-of-Design) or approved equal as per Section 2.1D	54DLC-M01

## 2.9 OVERHEAD CABLE TRAY SYSTEM

- A. The runway width shall be 18 inches and gray in color.
- B. Made of 3/8" x 1-1/2" x .065" (9.53 mm x 38 mm x 1.65 mm) wall rectangular steel tubing

- C. Cross members welded at 12" (300 mm) intervals
- D. Underwriters Laboratory Classified for suitability as an equipment grounding conductor only (must remove paint or use ground strap)
- E. Cable runways and accessories shall meet the specifications defined in the NEC and shall be marked for the intended location, application, and grounding.
- F. Cable runways shall be properly bonded/earthed/grounded per manufacturer's instruction and ANSI/NECA/BICSI-607 (2011).
- G. Provide and install all straight sections, vertical and horizontal, 90° bends, T's, and cross sections, supports, and all accessories as shown on the Contract Documents.
- H. Provide and install cable tray runway cable radius drops above all telecom racks or cabinets and every location where cabling is routed through the cable tray rungs.
- I. Provide and install 6-inch high cable retaining post at 2-foot intervals for all cable tray pathways. Installed as per the manufacturer's instructions.
- J. All system components shall be bonded to ground per the J-STD 607 Standard.

DESCRIPTION	MANUFACTURER	PART NUMBER
24" W Cable Tray Section	CPI Chatsworth (Basis-of-Design) or approved equal as per Section 2.1G	10250-124
18" W Cable Tray Section	CPI Chatsworth (Basis-of-Design) or approved equal as per Section 2.1G	10250-118
12" W Cable Tray Section	CPI Chatsworth (Basis-of-Design) or approved equal as per Section 2.1G	10250-112
Runway cable radius drops.	CPI Chatsworth (Basis-of-Design) or approved equal as per Section 2.1G	12100-118
6-inch high Cable Retaining Post	CPI Chatsworth (Basis-of-Design) or approved equal as per Section 2.1G	10596-106

#### 2.10 4 – POST 30" DEEP RACK FOR TELECOMMUNICATIONS ROOMS

- A. 30" Deep Rack Channel with a UL listed 2,000 lbs. loading rating.
- B. Shall have rack-mount unit marks to simplify equipment installation.
- C. Shall be properly bonded/earth/grounded per manufacturer's instruction and ANSI/NECA/BICSI-607 (2011).

- D. Shall be installed with 6" Vertical Cable Managers installed on the sides of the rack as shown on the TC-300 series drawings.
- E. Each Relay rack shall be installed with 2RU Horizontal Cable Mangers as illustrate on the TC-300 series drawings.
- F. Rack #2 in each IT room shall be equipped with a UPS, PDU, and associated equipment as shown on the TC-300 series drawings.

DESCRIPTION	MANUFACTURER	PART NUMBER
Ortronics 30" deep 4 Post MM20 Rack	Ortronics (Basis-of-Design) or approved equal as per Section 2.1H	OR-MM20730ADJ12-B
Ortronics 6" Vertical Cable Manager	Ortronics (Basis-of-Design) or approved equal as per Section 2.1H	OR-MM20VMS706-B
Ortronics Ladder support brackets (used to support 24" Ladder tray above racks)	Ortronics (Basis-of-Design) or approved equal as per Section 2.1H	OR-MM20CRB6H24-B
Ortronics 2RU Horizontal Cable Manger	Ortronics (Basis-of-Design) or approved equal as per Section 2.1H	OR-MM6HMF2RU
Ortronics Vertical Lacing Bars	Ortronics (Basis-of-Design) or approved equal as per Section 2.1H	LBV-45-2
Eaton 12 kw, 6 RU BladeUPS	Eaton (Basis-of-Design) or approved equal as per Section 2.1H	ZC1212608100000
Eaton 3 RU Battery Drawer	Eaton (Basis-of-Design) or approved equal as per Section 2.1H	103005747-6591
Eaton RPM (Rack Power Module)	Eaton (Basis-of-Design) or approved equal as per Section 2.1H	Y03114055100000
Raritan 60-amp PDU	Raritan (Basis-of-Design) or approved equal as per Section 2.1H	PX PX3-5325R-V2
Tripp-Lite PDU	Tripp-Lite (Basis-of-Design) or approved equal as per Section 2.1H	PDUNV

#### 2.11 NON-CONTINUOUS CABLE SUPPORTS (J-HOOKS)

- A. J-Hooks shall be located 5-Feet apart at maximum to adequately support and distribute the cable's weight. The manufacturers for cable loading should be followed.

- B. J-Hooks shall not be overfilled with cabling. Contractor to follow manufacturer's recommendation for fill capacity.
- C. Non-continuous cable supports shall be constructed of a durable material with the ability to manage and support a large number of cables. They shall be suitable for use in air handling spaces and have complete horizontal and vertical 1" bend radius control to help prevent degradation of cable performance. For use above a drop ceiling grid only, all cables that are through an area without a grid shall be run through conduit.
- D. Supports shall meet the specifications defined in the National Electric Code (NEC), and shall be marked for the intended location, application, and grounding as appropriate.

DESCRIPTION	MANUFACTURER	PART NUMBER
J-Hook	Caddy (Basis-of-Design) or approved equal as per Section 2.1J	CATXXHP (XX=as needed sizing)
CAT HP J-Hook Tree	Caddy (Basis-of-Design) or approved equal as per Section 2.1J	Application (Ceiling, Flange, or Wall)
Adjustable Cable Supports	Caddy (Basis-of-Design) or approved equal as per Section 2.1J	CAT 425 (Application)

## 2.12 BONDING, EARTHING, & GROUNDING

- A. The Telecommunications Grounding Busbar (TGB) shall be a tinned solid copper bar, 2 inches high, 10 inches long, and 1/4-inch thick, manufactured with holes evenly spaced horizontally and vertically throughout in accordance with the pattern specified by the current version of TIA-607.
- B. The TGB shall be equipped with isolated mountings that provide a 2-inch standoff from the wall.
- C. The Equipment Bonding Conductors (EBC) shall be at least a #6 AWG stranded conductor with a green insulating jacket.
- D. All bonding lugs shall be permanent two-bolt type. All taps shall be permanent compression type "H" taps.
- E. A vertical copper bus bar shall be provided with each enclosure and rack to serve as an extension of the TGB for equipment within the cabinet. This bus bar shall be:
  - 1. Manufactured from copper alloy.
  - 2. 79 inches by 0.67 inches by 0.05 inches.



3. Pre-punched with mountings for equipment bonding connections that match those on the vertical rail as specified by EIA-310.
  4. Coated with anti-oxidant compound.
  5. Include a hardware kit with rack-installation hardware and screws for bonding equipment to the busbar A brushed or sanded finish A hardware kit for bonding the rack or cabinet to the TGB.
- F. Non-corrosive, non-insulating compound shall be provided for all connections.

DESCRIPTION	MANUFACTURER	PART NUMBER
Copper Compression Tap & Clear Cover	LEVITON (Basis-of-Design) or approved equal as per Section 2.1H	HTAP & HTWC
Copper Compression 2-Hole Long Barrel Lug	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	LCC-W
Telecommunications Main- Grounding Busbar (To be installed in the 1 <sup>st</sup> floor Server room)	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	GB4B1028TPI-1
Telecommunications Grounding Busbar (To be installed in all IDF rooms)	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	GB2B0514TPI-1
Auxiliary Cable Bracket	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	GACB
Telecommunications Equipment Bonding Conductor Kit	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	GJ6xxxUH (xxx denotes length)
Universal Beam Clamp	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	GUBC500-6
Electrostatic Discharge Port Kit	PANDUIT (Basis-of-Design) or approved equal as per Section 2.1H	RGESD

## 2.13 TELECOMMUNICATION OUTLET CABLING

- A. All telecommunication outlet cabling shall be home run from designated telecommunications room to each designated telecommunications outlet location.



- B. Each telecommunications outlet location is indicated on the drawings by a telecommunications outlet identification tag. Provide cabling, jacks, faceplates, labels, testing, etc. as described in this section for each and every location identified by a telecommunications outlet identification tag.
- C. Telecommunication outlet cabling shall be one of the following types:
  - 1. Standard 2-Port Data Outlet
  - 2. Standard 2-Port Data Outlet with TV Outlet
  - 3. Wall Phone Outlet
- D. Outlet Type Cable Configurations
  - 1. A Standard 2-Port Data Outlet consist of:
    - a. Two (2) individual 4 pair category 6A cables.
      - (1) Each category 6A data cable shall be terminated on individual category 6A jacks following the T568 wiring standard at the outlet.
        - (a) Exact faceplate to be coordinated in the field.
      - (2) Each category 6A data cable shall be terminated on individual category 6A patch panel port following the T568 wiring standard at the telecommunication room.
  - 2. A Standard 2-Port Data Outlet with TV Outlet consist of:
    - a. Two (2) individual 4 pair category 6A cables.
      - (1) Each category 6A data cable shall be terminated on individual category 6A jacks following the T568 wiring standard at the outlet.
        - (a) Exact faceplate to be coordinated in the field.
      - (2) Each category 6A data cable shall be terminated on individual category 6A patch panel port following the T568 wiring standard at the telecommunication room.
    - b. One (1) individual quad shielded CATV series 6 coaxial cable (RG-6 type)
      - (a) Exact faceplate to be coordinated in the field.
      - (1) For coaxial cable runs over 180ft, a series 11 cable link will be installed as a feeder cable and a 10ft series 6 cable link, at the outlet, as the drop cable with a F-81 (RG- 6/U to RG-11/U) adapter interface.
      - (2) Both ends of each series 6 coaxial link shall be terminated with a

compression F-type connector. The compression F-type connector must be compatible with the CATV Cable in fit (No loose or undersized connections).

3. Wall Phone Outlet consist of:
  - a. One (1) individual 4 pair category 6 voice cable.
    - (1) Each category 6A cable shall be terminated on individual category 6A jack following the T568 wiring standard at the outlet.
      - (a) Exact Faceplate/surface mount box to be coordinated in the field.
    - (2) Each category 6A cable shall be terminated on individual category 6A patch panel port following the T568 wiring standard at the telecommunication room.
- E. Cabling to furniture mounted workstation outlets shall terminate in faceplates mounted on the furniture system raceway where available. Knockouts in the furniture system raceway shall be provided by the cabling contractor where not included as part of the furniture system. All cabling shall be routed via the furniture system raceway. Coordinate all telecommunications work with the furniture system vendor. All cabling feeds from an outlet box, into the furniture system raceway or surface raceway shall be protected using Leviton, or approved equal listed above, corrugated loom tubing. Where no opening is provided in the furniture raceway by the furniture vendor for entrance of the communications cable into the raceway, it shall be provided for by the cabling contractor. All necessary protection for the cable shall also be provided. Provide the necessary connectors and faceplates (as described elsewhere). The type of faceplate to be used shall be coordinated with the Commissioner for color, finish, etc. Where the furniture system does not contain an integral raceway, and no apparent wire management method is provided, the cabling shall be neatly dressed and concealed installation acceptance shall be based upon review and approval by the Commissioner. Workstation outlets shall be surface mounted using screws or other permanent fastening. Velcro, double sided tape or other adhesive materials are not considered acceptable.
- F. Cabling to wall mounted workstation outlets shall terminate in a single- or double-gang box provided by other trades. Provide the necessary connectors (as described elsewhere) under a single-gang faceplate. The type of faceplate to be used shall be coordinated with the Commissioner for color, finish, etc.
- G. Cabling to floor mounted workstation outlets shall be terminated in a flush or surface mounted poke-thru or service fitting provided by others. All cabling and connectors shall remain within the poke-thru or service fitting housing. Provide the necessary connectors (as described elsewhere) under a faceplate which is coordinated with the poke-thru or service fitting provided. If necessary, modify the blank plates provided with the poke-thru or service fitting in order to accommodate the connectors. All connectors, jacks, ports, etc. shall be provided with blanking or protective covers for protection.
- H. For twisted pair cabling, maintain the minimum number of twists per foot as prescribed for the

particular cable. The twists shall be maintained to within 0.5" of the cable termination.

- I. All twisted pair cables shall terminate in vapor tight, insulating displacement type connectors (IDC).
- J. All terminations for horizontal twisted pair cabling shall conform to the T568B wiring standard. This wiring scheme shall be maintained throughout the installation (i.e. for all workstation outlets, patch panels, etc.), unless otherwise noted.
- K. Horizontal cabling shall be neatly bundled and tie wrapped at 4' intervals, minimum, using nylon tie wraps. Tie wraps shall be rated for use in plenum spaces as required.
- L. If plastic jack icons are available for the specified faceplate, provide an icon for each and every port. The icon type and color shall be as indicated on the drawings or as directed by the Commissioner.
- M. Test each and every telecommunications outlet and provide test documentation according to the testing procedures described elsewhere in this specification.

#### 2.14 PUBLIC ADDRESS SYSTEM

- A. PA Speaker cabling shall be listed for the uses in a Communications Plenum (CMP listed).
- B. PA speaker cabling shall be, 18 AWG, 1-pair stranded bare copper conductors and shall be compliant with NEC and 2014 New York City Electrical Code.
- C. Shall pass all factory tests.
- D. Have the name of the manufacturer, UL rating, and incremental footage markings indelibly printed on the outermost jacket by the manufacturer.
- E. Splicing of copper cabling shall not be accepted.
  - 1. All speaker cable daisy chains from one speaker to the next in the line of speakers, then goes to the IT closet on the floor. The ends of all cables shall terminate in the first Floor Server room. All speaker cable on the second floor go down to the first floor IT / Server Room. All speaker cables on the cellar level go up to the first floor IT / Server room.
  - 2. All Public Address hardware shall be installed in the first floor IT / Server Room in the lockable wall cabinet.

DESCRIPTION	MANUFACTURER	PART NUMBER
1-pair-18 AWG stranded bare copper Plenum-CMP, Speaker Cable	Belden (Basis-of-Design) or approved equal as per Section 2.1B	6300UE

Amplifier	TOA (Basis-of-Design) or approved equal as per Section 2.1K	Model # A-912mk2, P92MK2 or equal, With wattage rating capable of supplying sound to the entire building
Mixer	TOA (Basis-of-Design) or approved equal as per Section 2.1K	To be determined by Amp Selection or equal
Microphones	SURE (Basis-of-Design) or approved equal as per Section 2.1K	450 Series II or equal
Telephone Interface	TOA (Basis-of-Design) or approved equal as per Section 2.1K	L01-S or equal
Microphone Interface	TOA (Basis-of-Design) or approved equal as per Section 2.1K	M-01 or equal
Signal Generator Interface	TOA (Basis-of-Design) or approved equal as per Section 2.1K	S-01S, S-02S or equal
Loud Horn speakers	Atlas (Basis-of-Design) or approved equal as per Section 2.1K	APC-30T or equal
Wall Mounted Baffle Speaker	Atlas (Basis-of-Design) or approved equal as per Section 2.1K	410-8 Baffle with SD-72 Speaker
Recessed Ceiling mounted Speakers	Atlas (Basis-of-Design) or approved equal as per Section 2.1K	SD-72W or equal
Recessed Ceiling mounted Speakers Volume Control	Atlas (Basis-of-Design) or approved equal as per Section 2.1K	SD-72WV or equal
Back Boxes	Atlas (Basis-of-Design) or approved equal as per Section 2.1K	199-8, QS95-8NS or equal
Lockable steel wall Cabinet	Atlas (Basis-of-Design) or approved equal as per Section 2.1K	600-12 or equal

## 2.15 LABELING

- A. Manufacturers: Subject to compliance with requirements, provide Panduit Easy-Mark self-illuminating or Turn-Tell labels, or equivalent products by one of the following:
1. Belden
  2. Ortronics
  3. Or approved equal.
- B. All label printing will be machine generated by labeling software and desktop and hand-held



printers using indelible thermal transfer ribbons or cartridges. Self-laminating labels or turnable vinyl band labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

1. Data cables shall be identified with self-laminated cable markers that can be rotated for visibility from any angle, and allow repositioning on the cable to align legends for improved aesthetics. (Turnable vinyl band labels )
2. Cabinets, Racks, and equipment shall be identified with thermal transfer printed, die-cut, microcellular foam with a polyester printable surface and high-tack adhesive. (Raised Panel Labels)

## 2.16 MATERIAL

- A. Where the drawings and/or specifications indicate materials to be provided by the Contractor, they shall be provided without deviation. Any conflict with this requirement shall be brought to the Commissioner's attention.
- B. The parts referred to in this document and/or drawings are recommended types. The vendor supplying these parts must supply the same or equivalent parts. The Commissioner reserves the right to examine and approve any and all parts acquired to satisfy the installation requirements, and to reject these parts without penalty if they do not meet with the specifications.

## PART 3 – EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 IDENTIFICATION AND TAGGING FOR TELECOMMUNICATIONS DEVICES

- A. Label individually:
  1. Each and every wire and cable.
  2. Each fiber optic cable and fiber strand.
  3. Each outlet faceplate/termination box (and each jack/port).
  4. Each termination block and patch panel (and each termination).
  5. Each equipment and termination frame, rack and cabinet.
  6. Each wall termination field.
  7. Each junction box used for telecommunications wiring.
  8. Each system (i.e., voice, LAN, etc.) as identified by the Commissioner.



9. Other items as directed.
- B. Develop and submit for approval a labeling system for the cable installation in coordination with the Commissioner. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. Missing or unclear nomenclature criteria for the items specified above shall not be construed as a reason not to identify the items and shall be brought to the Commissioner's attention.
- C. Prior to installing any identifying tags, labels or nameplates, submit the following for review and approval. Conform to all revisions by the Commissioner:
  1. Samples of the nomenclature being used for each type of label.
  2. Samples of each type of identifying tag, label or faceplate.
- D. All materials required for labeling shall be provided by the Contractor. All labels shall be permanently adhered, easily visible. Printing on all labels shall be permanent and smudge-proof. All text shall be typed or otherwise machine printed. Handwritten labels will not be accepted.
- E. Wires and cables shall be identified at both ends minimum.
- F. Labels for risers, cables, wires, faceplates, cover plates, etc., shall be provided with textual descriptions provided.
- G. Labels for risers, cables, wires, faceplates, cover plates, etc., shall be provided with bar coding in addition to any textual descriptions provided. The bar coding shall contain the textual information in bar code format. It shall be the contractor's responsibility to ensure that both the text and bar codes are visible, even if two labels are required.
- H. Identification of all equipment frames, racks, cabinets and wall termination fields shall be by means of nameplates showing 1" high white lettering on a black background. Coordinate the exact location of the nameplate with the Commissioner.
- I. Identification of all rack or wall mounted equipment, patch panels, etc. shall be by means of nameplates showing 1/4" high white lettering on a black background fastened in the upper left hand corner of all equipment. An attempt shall be made to place the label in the same location on similar equipment.
- J. For patch panels each port shall be identified on both the front and rear of the patch panel.
- K. Device plates for patch panels and miscellaneous termination hardware whose function is not readily apparent shall be with 1/8" high letters suitably describing the equipment controlled or system served (i.e., Appletalk, Ethernet, etc.).
- L. Identify each outlet box, junction box, and cabinet used in conjunction with empty raceway for wires of a future system by means of indelible markings on the inside denoting the system.
- M. Junction boxes used for telecommunications wiring and located in unfinished spaces (i.e., hung

ceilings, equipment rooms, etc.) shall be clearly identified on the outside as "COMM."

### 3.3 FIRE-STOPPING

- A. Firestopping shall be provided for all penetrations of conduit, wireways, bus ducts, cable trays, etc., through fire-rated walls and floors and other fire-rated separations as follows:
1. Excess space in framed openings through structural floors between conduits and concrete shall be grouted in with concrete to a depth of at least the thickness of the slab plus 2" minimum above the slab.
  2. Conduit penetration through poured concrete or masonry walls shall be grouted in with concrete and provided with tight fitting escutcheon plates on both sides.
  3. Conduit penetrations through fire-rated dry walls shall be with sleeves through the wall fitted with escutcheon plates on both sides with excess openings filled with fire stop material specifically manufactured for the purpose.
  4. Excess space within conduit sleeves or stubs through floor slabs or walls where low voltage/telecommunications cables pass through shall be filled with firestopping material specifically manufactured for the purpose.
  5. Where cable trays pass through fire rated partitions or floors utilize fittings specifically manufactured for this purpose that includes multi-cable framed opening sleeves through the wall or floor and insert modules of firestop material through which the cable passes-all installed in accordance with manufacturer's recommendations. Include all additional components necessary for a complete firestop installation. The total cross sectional area of the firestop frame shall be equal to four (4) times the cross sectional area of the cable tray. The cable tray shall stop on each side of the wall or floor.
  6. Utilize fire-rated fittings, as specified elsewhere for penetrations through floor slabs for supplying floor outlets.
  7. Refer to Section 07 84 10 – "Firestopping" for firestopping system requirements.
- B. All conduits/sleeves used for vertical cable passage shall be sealed utilizing suitable material after the installation of cables as follows:
1. The material shall be non-corrosive to the cable jacket or insulation that it applies to.
  2. The material shall provide for a minimum of three (3) hour fire rating.
  3. The material shall be non-shrinking, waterproof and smoke tight.
  4. The material shall remain flexible and non-hardening.
  5. The material shall be of the type that when installed will not slip through the openings, will stick to the surfaces of the openings and the cable and will not require any pressure to be applied to the cable in order to keep it in place.



6. The material shall be installed in a neat and workmanlike manner and the final installation shall be smooth finished to the top of the sleeve or conduit.
  7. The material shall be easily removable without damaging the cables after being set or cured for at least one week.
- C. All horizontal cable penetrations through rated walls shall be sealed in a manner that will provide a fire rating equal to the wall construction.
- D. Upon completion of the telecommunications work, the Contractor will certify that all openings for the cables satisfactorily sealed and fire stopped.
- E. All materials used for firestopping shall be approved for the purpose and the rating of the wall or floor and all methods employed shall meet with the approval of NYC DOB and FDNY.
- F. Refer to architectural drawings and specifications for all locations of fire rated walls and floors.

### 3.4 MOUNTING HEIGHTS

- A. Heights of all wall mounted outlets shall be in accordance with the following list. (Dimensions are above finished floor unless noted.)
1. Telecommunications outlet in field constructed wall, partition or column unless otherwise specified below -- 18" to centerline. (Refer to architectural drawings for all outlet heights unless otherwise noted on drawings).
  2. Telecommunications outlet in factory fabricated wall or partition, unless otherwise specified below -- Dimension determined by wall or partition construction. (Refer to architectural drawings for all outlet heights unless otherwise noted on drawings).
  3. Telecommunications outlet in telecommunications rooms, mechanical spaces, electric switchboard rooms electric closets -- 5'-0" to centerline. (Refer to architectural drawings for all outlet heights unless otherwise noted on drawings).
  4. Termination blocks in MDF and IDF locations -- 6'-0" to the top of the highest termination block. The clearance between adjacent 110 type termination blocks shall be 3" minimum. (Refer to architectural drawings for all outlet heights unless otherwise noted on drawings).
- B. Heights of all wall mounted outlets shall be in accordance with the architectural drawings and details. Equipment mounting heights shall be in accordance with telecommunications details. Any discrepancies shall be brought to the Commissioner's attention.
- C. Architectural drawings and field instructions issued by the Commissioner take precedence over the above list and shall be adhered to.

### 3.5 SUPPORTS



- A. Support work in accordance with best industry practice and the following.
- B. Include supporting cabinets to floor in IT Closets / IT Server Room.
- C. Supporting cables with strut channel, cable hangers and threaded rod are the responsibility of the Contractor.
- D. Nothing (including outlet, pull and junction boxes and fittings) shall depend on conduits, raceways or cables for support.
- E. Nothing shall rest on, or depend for support on, suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Vertical members that suspend the ceiling (together with their horizontal bracing that occurs above the ceiling), however, may be used for support.
- F. As a minimum procedure, in suspended ceilings support small runs of circuitry from ceiling suspension members as defined above. Support larger runs of circuitry directly from structural slabs, decks or framing members.
- G. Where support members must of necessity penetrate air ducts, include, in accordance with instructions issued in the field, airtight sealing provisions that allow for a relative movement between the support members and the duct walls.
- H. Include in the telecommunications work channel sills or skids for leveling and support of all floor mounted telecommunications equipment.
- I. Where permitted loading is exceeded by direct application of telecommunications equipment to a slab or deck, include in the telecommunications work proper dunnage as required to distribute the weight in a safe manner.
- J. Fire-resistant, UL Rated, Velcro straps shall be used for securing riser cables. The cable ties shall be laced through the strands of the messenger and secured to the cable to be supported.
- K. All Velcro Wraps / Straps used to support telecommunications cabling shall be of the fire-resistant type. The support rating of the wraps / straps to be used shall be a minimum of twice that of the weight per unit of the cable(s) to be supported.
- L. Riser cabling shall be supported via wall mounted slotted strut channel framing or vertical ladder rack. The framing shall be extended the entire length of the riser shaft (whether or not used entirely by the communications contractor). Vertical members for cable support shall be extended and secured from slab to slab at distances no more than 4' on center. No less than three (3) horizontal cross members shall be fastened to the vertical members using approved system accessories. All framing components shall be 1-1/2" by 1-1/2" minimum perforated >C' channel.

### 3.6 FASTENINGS

- A. Fasten telecommunications work to the building structure in accordance with the best industry practice and the following.



- B. As a minimum procedure, where weight applied to the attachment points is 100 pounds or less, fasten to building elements of:
  - 1. Wood -- with wood screws.
  - 2. Concrete except precast and solid masonry -- with bolts and expansion shields.
  - 3. Hollow construction -- with toggle bolts.
  - 4. Solid metal -- with machine screws in tapped holes or with welded studs.
  - 5. Precast concrete and steel decking or subfloor --with fastenings as specified below for applied weights in excess of 100 pounds.
- C. No more than three (3) riser cables in excess of 0.5" in diameter shall be fastened using one Velcro wrap / strap.
- D. Velcro warps shall be deployed every four (4) feet minimum when fastening telecommunications cables in horizontal cable tray.
- E. Velcro wraps / straps shall be deployed every two (2) feet minimum when fastening telecommunications cables run vertically on a wall or rack.
- F. Velcro wraps / straps fastening multiple small cables shall form a grouping no larger than three (3) inches in diameter.
- G. Fire-resistant, UL Rated Wraps / Straps shall be used for fastening riser cables to vertical cable tray.
- H. All cables shall be grouped and bundled utilizing approved Fire-resistant, UL Rated Wraps / Straps, the best industry practice and the following:
  - 1. Where multiple cables serve a single workstation, the cables shall be tied as a single bundle every four (4) feet, minimum.
  - 2. Horizontal cabling routed in cable tray shall be tied every ten (10) feet, minimum.
  - 3. Cables routed in surface mounted raceways shall be tied and fastened to the raceway using tie anchor mounts secured with screws every two (2) feet, minimum.
  - 4. Cables routed in furniture systems shall be tied at every pedestal location and at least once in between each pair of pedestals, minimum.
  - 5. Cables shall be tied on racks, frame, cabinets, etc., every two (2) feet, minimum.

### 3.7 LOCATING AND ROUTING CIRCUITRY

- A. All circuitry shall be run concealed except that it shall be run exposed:
  - 1. Horizontally at the ceiling and vertically on the walls of telecommunications and



telephone closets and of permanently unfinished spaces which are not assigned to mechanical or electrical equipment.

- B. Concealed circuitry shall be so located that building construction materials can be applied over its thickest elements without being subject to spalling or cracking.
- C. Circuitry run exposed shall be routed parallel to building walls and column lines.
- D. Exposed circuitry located overhead shall be run in a completely accessible manner on the underside of all piping and ductwork.
- E. Circuitry run in suspended ceilings shall be routed parallel to building walls, column lines, etc.
- F. Circuitry shall be routed so as to prevent telecommunications conductors from being subject to high ambient temperature. Minimum clearances from heated lines or surfaces shall be maintained as follows:
  - 1. Crossing where uninsulated-----6"
  - 2. Crossing where insulated-----3"
  - 3. Running parallel where uninsulated--3'-0"
  - 4. Running parallel where insulated --- 6
- G. Circuitry shall not be routed over or under a boiler except where special provisions for wiring through these specific high ambient temperature areas have been indicated.
- H. Circuitry shall not be run in elevator or dumbwaiter shafts, hoistways, and the like.
- I. Circuitry for miscellaneous systems indicated without notation as to location and routing shall be run as per the requirements and notations governing the adjacent telecommunications circuitry.
- J. Under no circumstances shall voice/data wiring pass through electric closets, switchgear rooms, gas meter rooms, mechanical spaces, janitors closets(unless noted), etc.
- K. The distance limitations for the following cable types/systems shall be as follows:
  - 1. 24 AWG maximum distance: 90m.
  - 2. Twisted Pair (4 pr) maximum distance: 90m.
- L. Provide a minimum of 6" clearance between telecommunications cables and fluorescent, neon, incandescent or high intensity discharge fixtures such as mercury vapor lamps.
- M. Provide a minimum of 36" clearance between telecommunications cables and all motors, transformers or other devices with a potentially high electromagnetic interference.

- N. Utilize existing empty conduit, provided by others, for the routing of the telecommunications wiring.
- O. Utilize existing cable tray provided by others for routing of telecommunications wiring.
- P. Utilize the raised floor system provided in special rooms (i.e., computer rooms, etc.) for the routing of the telecommunications wiring. The routing under the raised floor shall be via "accessible corridors."

### 3.8 INSTALLING CIRCUITRY

- A. In runs of conduit or raceway including flexible limit the number of bends between cable access points to a total which does not exceed the maximum specified for the particular system. Where no such maximum is specified, limit the number to two right angle bends or the equivalent thereof.
- B. Each conduit or raceway assigned for telecommunications work shall be provided with a bushed opening.
- C. All conduits entering telecommunications closets and/or equipment rooms shall be provided with bushed openings.
- D. It is the Contractor's responsibility to ensure that the telecommunications cabling is protected from all sharp edges, burrs, etc., in all raceway systems intended for telecommunications cabling.
- E. An attempt shall be made to locate the wall space for terminations on one continuous wall.
- F. At each workstation, the Contractor will cable and install cable connectors for connection to final equipment. The Contractor will cable, connectorize and/or punch down cables on connector blocks furnished and installed in the telecommunications closets serving the various station areas. Riser prebundled or bulk cables will be labeled, connectorized, punched down and cross-connected through a separate set of terminal strips and then routed through inter-floor slots or sleeves. Other outlet locations will be cabled as specified and indicated elsewhere.
- G. The Contractor is responsible for all pulls through conduit, sleeves, etc. of all bundled or individual cables including all labelling and connectorizing at all junctions and terminations. All required connecting blocks will be furnished and installed by the Contractor. Other outlet locations will be cabled and specified as indicated on the drawings.
- H. Each type of cabling media (i.e. fiber, twisted pair, etc.) shall be bundled separately for all horizontal runs unless otherwise specified.
- I. Maintain the manufacturer's recommended minimum bend radius on all cables throughout the installation.
- J. All cables terminated on blocks, patch panels, equipment assemblies, etc., shall be installed in increasing consecutive alphabetical or numerical order, starting from the upper left hand corner of the terminating device, unless otherwise noted.

- K. All cables shall be provided with strain relief such that pulling on the cable jacket will not affect the terminated conductors.

### 3.9 PULLING WIRES INTO CONDUITS AND RACEWAYS

- A. Delay pulling in until the project has progressed to a point when general construction procedures are not liable to injure wires and cables, and when moisture is excluded from raceways.
- B. Utilize nylon snakes or metallic fish tapes with ball type heads to set up for pulling.
- C. In raceways 2" trade size and larger, utilize a pulling assembly ahead of wires consisting of a suitable brush followed by an 85% diameter ball mandrel. Submit certifications that mandrelling has been performed as specified.
- D. Prior to installation, submit evidence that wires are new (in accordance with the definition of "new" as hereinbefore specified).
- E. Leave sufficient slack on all runs of wire and cable to permit the secure connection of devices and equipment.
- F. Include circular wedge-type cable supports for wires and cables at the top of any vertical raceway longer than 20 feet. Also include additional supports spaced at intervals which are no greater than those set forth as industry minimum standard. Supports shall be located in accessible pull boxes. Supports shall be of a non-deteriorating insulating material manufactured specifically for the purpose.
- G. Pulling lubricants shall be products manufactured specifically for the purpose.
- H. Slack on wires and cables located in cabinets and pull boxes shall be formed and set in place in groupings corresponding to their occupancy of raceways. They shall also be arranged, with insulators and supports provided where necessary, such that cable shims or other such temporary expedients do not have to be left permanently in place to prevent the wires and cable from shifting when covers or trims are removed.

### 3.10 SERVICE ENTRANCE TERMINATION AND PROTECTION

- A. A service entrance room (SER) has been provided for the termination and protection of outside services (i.e. local exchange carriers (LEC), CATV, etc.).
- B. It is the responsibility of the contractor to coordinate with the individual vendors and the base building team terminating within the service entrance room and extending service to elsewhere within the building for cable routing and termination locations where it may affect work outlined in the specifications.
- C. Outside cabling shall extend into the building entrance facility not more than 50 feet without termination, protection and/or grounding, unless specifically stated otherwise.
- D. Building entrance telecommunications circuits shall be protected in accordance with Article

800 of the National Electrical Code and best industry practice as outlined in this specification.

- E. A distance of six (6) feet, minimum shall be maintained between any communication circuits and any lightning conductors.
- F. All conductive building entrance cables shall be spliced to the building entrance protector unit fusible links using an approved splice chamber.
- G. Under no circumstances shall a building be served from a protector located in a different building if the cable between the buildings is run exposed.
- H. The building entrance protector units shall be located so as to minimize the length of the drop conductors or the line side of the protectors.

### 3.11 INSTALLING CABLES IN UNDERGROUND CONDUIT BANKS

- A. The telecommunications work required in conjunction with underground conduit banks shall include:
  - 1. Wire and cable as indicated.
- B. Cables shall be installed in accordance with the following:
  - 1. Their splices shall be insulated and waterproofed by use of an encapsulating kit manufactured specifically for the purpose or by plastic tape method specified for splicing under normal telecommunications work conditions. When using the plastic tape method, apply an electric insulating putty under the tape to assure a smooth contour and two coats of glyptol paint over the tape.

### 3.12 INSTALLING CABLES IN CONDUIT BANKS RUN BELOW GRADE SLAB

- A. The telecommunications work required in conjunction with conduit banks run below grade slab shall include:
  - 1. Wires and cables as indicated.
- B. Cables shall be installed in accordance with the following:
  - 1. Their splices shall be insulated and waterproofed by use of an encapsulating kit manufactured specifically for the purpose or by plastic tape method specified for splicing under normal telecommunications work conditions. When using the plastic tape method, apply an electric insulating putty under the tape to assure a smooth contour and two coats of glyptol paint over the tape.

### 3.13 INSTALLING WIRING DEVICES

- A. Install wiring devices in accordance with the following:
  - 1. Telecommunications outlets shall be mounted horizontally or vertically as directed.
  - 2. Provide plates for all wall mounted telecommunications devices.

3. Utilize stanchions flush floor outlet fittings as standard mounting for all floor mounted outlets.
4. Obtain final field instructions from the Commissioner prior to locating devices whose plates flush floor outlet fittings stanchions or visible parts have been specified in materials, colors or finishes which differ.

### 3.14 GROUNDING AND BONDING

- A. Ground all systems and equipment in accordance with best industry practice and the following:
  1. All ground connectors in the main telecommunications equipment rooms and telecommunications closets shall be made to the ground bars provided for that purpose as part of the electrical work.
  2. All metal panels, enclosures, boxes, racks, raceways, etc. in equipment rooms, telecommunications equipment rooms and closets shall be grounded.
  3. Conductors utilized for grounding and bonding shall not be less than #6 AWG and shall have type "TW" or better insulation. Cables used for grounding and bonding shall have green jacket color.
  4. National Fire Protection Agency (NFPA) 70, the National Electrical Code NEC, NFPA 780, the Standard for Installation of Lightning Protection Systems, Telecommunication Industry Association. 2011. ANSI J/STD-607-B, Commercial Building and Bonding Requirements for Telecommunication, and the New York City Fire Department.

### 3.15 TESTING

- A. Before an application for final acceptance of the telecommunications work will be considered, all tests deemed necessary by the Commissioner to show proper execution of the telecommunications work shall have been performed and completed in the presence of the Commissioner. Scheduling of all testing procedures shall be arranged with the Commissioner.
- B. Tests specified to be performed in this document are intended to verify the quality of all cabling. This document also establishes a uniform method of reporting the test results for evaluation by the Commissioner.
- C. All tests are to be performed upon completion of the initial installation.
- D. Performing the indicated tests does not constitute equipment or circuit acceptance.

### 3.16 TEST EQUIPMENT

- A. The equipment indicated below represents test equipment utilized to develop this test specification. Substitute test equipment may be used, upon approval by the Commissioner, provided the same level and quality of testing is performed.
  1. Twisted pair riser cable:
    - a. Testing Product: Independent Technologies Multi pair tester.
    - b. Sperry Instruments



- c. Fluke
      - d. Or approved equal.
  - 2. Twisted pair/coax cables:
    - a. Testing Product: Level IV Fluke DTX Cable Analyzer with all accessories, or an equivalent product from an approved equal listed below:
    - b. JM Test Systems
    - c. Bird
    - d. Or approved equal.
  - 3. Utilize the following accessories as required (refer to manufacturers handbook):
    - a. RJ-45 test module
    - b. 110 Punch Down block adapter kit
- B. Prior to any testing being performed, the Commissioner shall be supplied with a list of test equipment to be used, for his review and approval, if not the equipment identified in this specification. The submittal shall include documentation indicating that the proposed equipment is capable of performing all of the tests as required by this specification.

### 3.17 TESTS TO BE PERFORMED

- A. Tests are to be performed on the following aspects of the telecommunications cabling system:
- 1. From each telecommunications closet (IDF) termination to each and every workstation termination.
- B. All cable runs for which equipment will not initially be attached must be tested to the same level of compliance as all other cabling.
- C. Prior to any acceptance testing being performed, a sample test shall be performed for each series of tests (i.e., copper, fiber, etc.). The sample test shall consist of a regular acceptance test on a few sample cables as selected by the Contractor. The Commissioner shall be given a minimum of one week notice so he may observe the test.
- D. Voice grade cable
- 1. Test equipment: Cable Analyzer with applicable accessories – see TEST EQUIPMENT paragraph of this section.
  - 2. Tests to be performed.
    - a. The following items must be demonstrated:
      - (1) Conductors are electrically continuous between terminations.
      - (2) Conductors are electrically isolated from all other conductors.
      - (3) Conductors contain no shorts to ground.
      - (4) Cables have a properly grounded shield (where applicable) as specified and in accordance with the best industry practice.



- (5) Polarity.
- E. Data grade cable - The tests on this cable shall be the same as for Item D above. In addition, the following test shall be performed on all pairs of a twisted pair cable or pair #1 of a cable greater than 4 pairs.
1. Test equipment: Cable Analyzer with applicable accessories – see TEST EQUIPMENT paragraph of this section.
  2. Tests to be performed:
    - a. The test equipment shall be configured to test the maximum transmission performance for which the cable is rated (i.e., Cat 3 = 10 Mbps, Cat 6 = 100 Mbps).
    - b. The following minimum information shall be provided for each cable and pair to be tested:
      - (1) Length - find the total cable length.
      - (2) Resistance - measured for each cable pair.
      - (3) Noise - measured for each pair at the following frequencies:  
10Hz - 150KHz, 150KHz - 16MHz, 16MHz - 100MHz.
      - (4) Insertion Loss (Attenuation) - measured for each pair at 10MHz.
      - (5) Near End Cross Talk (NEXT) - measure NEXT in dB and the associated frequency.
      - (6) Delay - measured for each pair.
      - (7) Delay Skew - find the delay skew between the fastest and slowest pairs.
      - (8) Attenuation to Crosstalk Ratio (ACR).
      - (9) Power Sum Near End Crosstalk (PSNEXT)
      - (10) Wire map - indicate that the wiring at the near end and far end are as specified.
    - c. For all cables required to meet Category 6 and Category 6 requirements detailed elsewhere in this specification, the following additional information shall be provided for each cable and pair:
      - (1) Equal Level Far End Crosstalk (ELFEXT)
      - (2) Power Sum Equal Level Far End Crosstalk (PSELFEXT)
      - (3) Power Sum Attenuation to Crosstalk Ratio (PSACR)



- (4) Structural Return Loss (SRL)
  - d. During testing (link test), if any failures or marginal pass results occur (a marginal pass is indicated as "\*pass" on the test equipment), the following procedures are to be taken:
  - e. For marginal pass (\*pass) results, the circuit will be retested. If the re-test result is a failure, troubleshoot and correct the problem. If the result is again a marginal pass for any reason other than excess length, troubleshoot and correct the problem as if the result were a failure. If the marginal pass is due to excess length, make every effort to remove slack in the run and re-test.
    - (1) For failure results, re-test and/or troubleshoot to correct the problem. Provide documentation to support the good circuit by providing the test results of that circuit that indicate "pass" (a non-marginal pass).
    - (2) Provide an explanation for each failure for each marginal pass result that has not been resolved, including a description of the steps taken to troubleshoot the circuit and the reason why further corrective action has not been undertaken.
- 3. Fiber optic cable
  - a. Test equipment -- Optical time domain reflectometer (OTDR) with chart recorder.
- 4. Tests to be performed
  - a. A prequalified one hundred (100) foot minimum fiber optic cable containing the same performance parameters of the cable to be tested, shall be connected at the OTDR end of the test setup.
  - b. The OTDR shall be used on each fiber optic strand to identify the following parameters. The below measurements shall be taken at both 850nm and 1300nm using a short pulse width:
    - (1) Length of cable.
    - (2) Discontinuities with the cable/connectors.
    - (3) Areas of localized attenuation.
    - (4) Total loss (dB) from end to end including terminations.
  - c. Cursor and marker distances shall be standardized for fiber optic cables with the same origin and destination for all tests (i.e., main equipment room to telecommunications closet).
  - d. No area of localized attenuation shall be greater than 0.2 dB.
  - e. The OTDR trace should be expanded to fill at least two-thirds to three quarters of the OTDR screen. The input pulse and the end "spike" of the

cable shall both be displayed.

- f. The input pulse and the end "spike" shall be elevated off the bottom of the screen by approximately one division.
- g. Each OTDR trace shall be annotated with information regarding fiber identification and the settings selected on the OTDR.
- h. The OTDR traces shall be maintained as a permanent record for the purposes of maintenance and restoration.

**F. Coaxial cable**

- 1. Test equipment: Cable Analyzer with applicable accessories – see TEST EQUIPMENT paragraph of this section.
- 2. Tests to be performed:
  - a. The following items must be demonstrated:
    - (1) Conductors are electrically continuous between terminations.
    - (2) Conductors are electrically isolated from all other conductors.
    - (3) Conductors contain no shorts to ground.
    - (4) Cables have a properly grounded shield (where applicable) as specified and in accordance with the best industry practice.
- 3. Perform continuity testing upon installation and termination or all infrastructure cabling and provide a cable run sheet indicating the results. Further test may be requested by Commissioner if continuity results are deemed unsatisfactory. Any cable which is determined to not meet performance specifications following continuity testing shall be replaced at no further expense to The City of New York before the system shall be accepted as complete. Continuity test results may not be used to qualify cabling performance specifications or acceptance.
- 4. Testing and Certification of installed and terminated vertical and horizontal cables for Structural Return Loss are based on FCC standard methods of determining SRL. The installed cable infrastructure shall meet or exceed the cable manufacturer's specifications for SRL.

**3.18 CORRECTIVE ACTION**

- A. Any defects or deficiencies discovered in any of the telecommunications work shall be indicated on the test report and be corrected.
- B. Upon completion of testing and problem resolution, all connections tested are to be 100% error free.
- C. Any connections determined to be not correctable shall be indicated at each end of the

termination as "bad" (in red).

### 3.19 EQUIPMENT INSTALLATION AND TESTING

- A. The Contractor shall be available during equipment installation and testing to help isolate faults that may exist in the cabling system installation.
- B. Coordinate with other vendors where necessary to resolve any discrepancies between the cabling system and the vendors' cabling or equipment.

### 3.20 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 27 00 00**

**SECTION 27 41 00****AUDIO-VIDEO COMMUNICATIONS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
  - 1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

**1.3 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.4 AV PROJECT REVIEW**

- A. Provide engineering services, fabrication, AV-related low voltage cabling and terminations, installation, instruction, documentation, and one year of warranty coverage for hardware, software, and workmanship in the spaces and subsystems in scope. Provide fully operational systems based on the Contract Documents, whether or not every required interface and component is specifically detailed therein. All engineering services shall be performed by Contractor's professional engineer licensed in the State of New York, and all products of engineering services shall be submitted for review and approval by Commissioner.



**1.5 CONTRACTOR SCOPE OF WORK**

- A. Include in the audiovisual work all necessary supervision and the issuing of all coordination information to any other trades who are supplying work to accommodate the audiovisual installations.
- B. For items of equipment, if any, which are to be installed but not purchased as part of the audiovisual work (i.e., City of New York Supplied Equipment), the audiovisual work shall include:
  - 1. The coordination of their delivery.
  - 2. Their unloading from delivery trucks driven in to any point on the property line at grade level.
  - 3. Their safe handling and field storage up to the time of permanent placement in the project.
  - 4. The correction of any damage, defacement or corrosion to which they may have been subjected.
  - 5. Their field make-up as may be necessary for their proper operation.
  - 6. Included shall be the purchase and installation of any adapters or other wiring terminations as may be necessary to adapt their terminals to the wiring as called for and to the connection methods set forth in these specifications.
  - 7. Provide all power strips required in racks, under tables, in credenzas, and in all other locations where AV equipment is to be plugged in and where the available power wall plate does not have sufficient outlet quantity. Determine the size of the required power strips for each specific location and condition.

**1.6 CODES, PERMITS AND INSPECTIONS:**

- A. All audiovisual work shall meet or exceed 2014 New York City Construction Codes, National Electrical Code, and other applicable sections of the National Fire Code, as published by the National Fire Protection Association.
- B. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA) and the Americans with Disabilities Act (ADA).

**1.7 GUARANTEES AND CERTIFICATIONS:**

- A. All audiovisual work shall be guaranteed to be free from defects. Any defective materials or workmanship, as well as damage to the audiovisual work resulting from the work of all trades, shall be replaced or restored as directed for the duration of stipulated guarantee periods.
- B. The duration of Contractor's guarantee periods following the date of substantial completion of the audiovisual work shall be:
  - 1. One year following the date of substantial completion. This includes one-year warranty coverage by the Contractor if specific furnished products carry less



than one-year warranty by the manufacturer.

- C. When available, all components shall be coordinated and installed as part of a manufacturer's certification program. Where components selected are from different manufacturers and are not covered as part of a single (or multiple) program(s), guarantee all aspects of the audiovisual installation as outlined in this specification and associated drawings for the above stipulated minimum period.
- D. Non-durable items shall be replaced up to the date of substantial completion, such that they shall have had no more than 10 hours use prior to this date.
- E. Prior to substantial completion, certification shall be submitted attesting to the fact that specified performance and other criteria are met by all items of audiovisual work where a particular level of performance is indicated.
- F. All Manufacturers' equipment warranties shall be activated by the Contractor in the City of New York's name and shall commence on the date of substantial completion. In the case of Contractor-modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the Commissioner with a written warranty equivalent to that of the original manufacturer.

#### 1.8 REFERENCES

- A. Reference to "U.L. (Materials Construction) Standards" shall mean the "Standards for Safety," published by Underwriters Laboratories, Inc. (Main Office: 333 Pfingsten Road, Northbrook, Illinois 60062).
- B. Reference to "NEMA Standards" shall mean the "Approved Standards" published by the National Electrical Manufacturers Association (Main Office: 2101 "L" Street, N.W., Washington, D.C. 20037).
- C. Reference to "ANSI Standards" shall mean the standards published by the American National Standards Institute (Main Office: Twenty East Fortieth Street, New York, New York 10016).
- D. Reference to "EIA/TIA Standards" shall mean the standards published by the Electronic Industries Association and Audiovisual Industry Association, 201 Pennsylvania Avenue, N.W., Washington, D.C. 20006.
- E. Reference to "IEEE Standards" shall mean the standards published by the Institute of Electrical and Electronics Engineers.
- F. Reference to "SMPTE Standards" shall mean standards published by the Society of Motion Picture and Television Engineers, 595 West Hartsdale Ave, White Plains, NY 10607.
- G. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any audiovisual item in the drawings and specifications for audiovisual work carries with it the instruction to furnish, install and connect the item as part of the audiovisual work regardless of whether or not this instruction is explicitly stated.
- H. No exclusion from or limitation in, the symbolism used on the drawings for audiovisual work or the language used in the specifications for audiovisual work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.



- I. The drawings for audiovisual work utilize some symbols and schematic diagrams which have no dimensional significance. The audiovisual work shall, therefore, be installed to fulfill the diagrammatic intent expressed on the audiovisual drawings, but in conformity with the dimensions indicated on the Drawings.
- J. Certain details appear on the drawings for audiovisual work which are specific with regard to the dimensioning and positioning of the audiovisual work. These are intended only for general information purposes. They do not release the Contractor from the requirement for field coordination for individual items of the indicated work with associated trades and field conditions and actual field dimensions.
- K. Information as to general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications. Exact locations for all Audiovisual Jack plates and built-in devices shall be derived from the Drawings.
- L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.
- M. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.
- N. It is the intent of the drawings and specifications to provide a complete operating audiovisual system. All audiovisual work necessary to provide such a system shall be performed. Any discrepancies shall be brought to the Commissioner's attention.

**1.9 QUALITY ASSURANCE:**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new. Supply the latest model (in the specified series) available, of each piece of equipment.
- C. New equipment and materials shall:
  - 1. Be Underwriters Laboratories, Inc. (U.L.) labeled and/or listed where specifically called for, or where normally subject to such U.L. labeling and/or listing services.
  - 2. Be clearly labeled identifying the power parameters specified.
  - 3. Be without blemish or defect.
- D. All items of equipment or material of one generic type shall be the product of one manufacturer throughout.
- E. Substitutions of Audiovisual Equipment for that shown on the schedules or designated by model number in the specifications may not be considered if the item is not a regular cataloged item shown in the current catalog of the manufacturer.
- F. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior





to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

**1.10 SUBMITTALS and RESPONSIBILITIES OF THE CONTRACTOR:**

**A. Furnish the following unless otherwise noted in drawings or equipment list:**

1. Flat Panel Displays
2. Video Projectors
3. Control System Processors
4. Touch panels
5. Transmitters and Receivers
6. Misc. AV components necessary for fully functional AV system

**B. Prior to assembling or installing the audiovisual work, the following shall be submitted for review:**

1. Catalog information, factory assembly drawings and field installation drawings as required for a complete explanation and description of all items of equipment.
2. Submit for approval one sample of each of the following:
  - a. Each type of cable if other than that specified.
  - b. Each type of cable connector if other than that specified.
  - c. Each type of jack plate or floor box assembly, complete with labeling, or a full-scale rendering thereof, complete with font-styles and color schemes.
  - d. Each type of patching/cross connecting device, if other than that specified.
  - e. Each type of identification label.
  - f. Other items as requested.
  - g. Pin-to-pin wiring drawings including all field wire pulls and wiring internal to the equipment rack.
  - h. Rack elevation drawings, front and back
  - i. Equipment cabinet shelf arrangements
  - j. Mounting details
  - k. Connector plate layouts



- I. Shop drawings for rack system integration
    - m. Exact locations for all permanently installed devices
- C. Style and color of ceiling speakers or grille cloth, connector plate style and finish, wood grain, stain and finish and any other interior furnishings must have prior approval of the Commissioner.
- D. Documents will not be accepted for review unless:
  - 1. They include complete information pertaining to appurtenances and accessories.
  - 2. They are submitted as a package where they pertain to related items.
  - 3. They are properly marked with the specific system for which they are intended, function, and intended location of use within the project.
  - 4. They are clearly identified or highlighted to indicate all items which are applicable.
- E. Shop Drawing Review by Commissioner
  - 1. The purpose of the review of shop drawings is to maintain the integrity of the design. Unless the Contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor's letterhead, approval by the Commissioner does not constitute acceptance. Except for the products specified herein, it is not to be assumed that the Commissioner has read the text nor reviewed the technical data of a manufactured item proposed by the Contractor, except where the Contractor has pointed out differences between his product and the specified model.
  - 2. Shop drawings should consist of the following:
    - a. Pin to pin system flow diagrams
    - b. Rack elevations – front and rear
    - c. Cable management methods for rack cabling
    - d. Cable pull schedules
    - e. Cable labeling methodology
    - f. Mounting details for any equipment mounted on walls/ceilings including but not limited to projectors, speakers, flat panels, and projection screens. Mounting details are to include specific drawings and model numbers of all parts and pieces involved to attach the equipment to the building structure.
    - g. Faceplate drawings including custom faceplates within floor boxes or wall boxes
  - 3. It is the responsibility of the Contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades. Approval of shop drawings containing errors does not relieve the Contractor from making corrections at his expense.



4. Substitutions of equipment, systems, materials, must be coordinated by the Contractor with his own or other trades which may be involved with the item, such as, but not limited to, equipment substitutions which change audiovisual or electrical requirements, hanging or support weights or dimensions.
- F. Include in the audiovisual work the issuing of operating instructions for the following specialized equipment:
  1. All electronic equipment provided or installed as part of the audiovisual work.
  2. All database software and/or programs.
- G. The issuing of operating instructions shall consist of supplying properly trained installers to demonstrate the operation of specialized equipment. This demonstration shall be performed after the system is installed in the environment, and with external building systems, such as HVAC, on and operating at normal levels. The issuing of operating instructions shall also consist of supplying of all original operating and maintenance instruction manuals.
- H. The issuing of operating instructions shall include the submission of the name, address and telephone number of the manufacturer's representative and service company for each item of equipment so that service and separate parts can be readily obtained, at the Commissioner's option.
- I. After all final tests and adjustments have been completed, fully instruct the City of New York's service operators in all details of operation for the systems installed. Supply properly instructed installers to support system operation for a sufficient length of time to assure that the City of New York's service operators are properly instructed to take over operation and service procedures. Supply qualified installers to oversee the installation for sufficient length of time as required to assist all systems equipment vendors in the operation and performance of systems tests.
- J. Furnish complete documentation, in bound form containing data covering capacities, maintenance and operation of the installed systems and apparatuses. Operating instructions shall cover all phases of control and include the following:
  1. Performance Criteria: For transmission and other criteria as requested.
  2. List of Spares: Recommended for normal service requirements.
  3. Parts List: Identifying the various parts of the installation for service and replacement purposes.
  4. Instruction Books may be standard booklets but shall be clearly marked to indicate applicable equipment.
  5. Wiring Diagrams: Generalized diagrams are not acceptable; submittal shall be specifically prepared for this Project.
- K. Where applicable, one set of riser diagrams and/or floor plans, and system flow diagrams shall be neatly framed behind plexiglass and hung adjacent to the racks concerned.
- L. Schedule of Implementation



1. Any site condition which impedes the timely performance of the Contractor shall be brought to the attention of the Commissioner.
2. Schedule milestones are to include but not be limited to the following:
  - a. Purchase order received.
  - b. Agreed upon equipment ordering date.
  - c. Cutsheet submittals, substitution samples.
  - d. Drawing submittals.
  - e. In-shop fabrication.
  - f. Job site equipment delivery.
  - g. Installation, testing and burn-in.
  - h. Instruction and final punch list completion.
  - i. Turnover and occupancy.

**1.11 DESCRIPTION OF STANDARD AUDIOVISUAL ASSEMBLIES:**

- A. Ensure that the installation of all equipment be performed in accordance with standard manufacturers specifications and installation methods. The necessity of special conditions required by a particular manufacturer shall be brought to the attention of the Commissioner prior to the installation of any equipment in the area concerned.

**1.12 WORK INCLUDED:**

- A. Audiovisual materials and services as described in this AV Specification Section 27 41 00 and on the accompanying Contract Documents.

**1.13 RELATED WORK:**

- A. General Construction Work.
- B. Telecommunications Systems. Contractor must coordinate with the Telecom drawings.
- C. Electrical Specifications. Contractor must coordinate with the Electrical drawings.
- D. Lighting Specifications. Contractor must coordinate with the Lighting drawings.

**1.14 REFERENCES:**

- A. 2014 New York City Construction Codes
- B. National Electrical Code / NFPA 70
- C. Sound System Engineering. Fourth Edition, Don and Carolyn Davis, Howard Sams & Co. The Chapter on "System Installation" is the Contractor's reference for acceptable installation and wiring methods for AV.



- D. Utilize the manufacturer's published recommended installation and termination instructions, methods, and tools for crimp connections and all other termination devices. Submit such instructions to the Electrical trade performing the terminations of any and all low voltage AV signal cables, connectors, Jack plates, etc.
- E. Instrumentation Fundamentals and Applications, Morrison, Wiley Interscience, NY. Reference for grounding and shielding techniques.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT SCHEDULE

- A. See Audiovisual Systems Equipment Schedule following PART 3 of this Section and prior to the end of this Section, for all basis-of-design products. Subject to compliance with requirements, provide basis-of-design product, or approved equal, for each product type.
- B. Provide shop drawings with a complete list of materials to be used at each location as indicated herein. Shop drawings and materials list must be approved before contractor is allowed to begin any installation work.
- C. Propose a Smart LED 4K UHD TV solution based upon the warranted solution from the following manufacturers:
  - 1. LG
  - 2. Sony
  - 3. Samsung
  - 4. Or approved equal.
- D. Horizontal outlet cabling and all associated components (i.e. jacks, faceplates, HDMI Couplers, HDMI right angle adapters, HDMI patch cords and cables, etc.): shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
  - 1. Leviton/Berk-Tek
  - 2. Ortronics/Superior Essex
  - 3. Panduit/General Cable
  - 4. Comprehensive Connectivity
  - 5. Or approved equal.
- E. Wall Mount for Smart LED 4K UHD TV (Wall mount shall be properly sized for the specific TV size) shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
  - 1. Chief Manufacturing
  - 2. Peerless
  - 3. Church Field
  - 4. Or approved equal.
- E. Audio Visual Equipment Racks (Rack used for the storage of Audio Visual equipment) and all associated components shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the



following:

1. Chief Manufacturing
  2. Ortronics/Legrand
  3. Peerless
  4. Mid Atlantic
  5. Or approved equal.
- F. Audio Visual Equipment and all associated components (i.e. Audio Amplifiers, Matrix switches, Touch Panels, Gateways, IR Extenders and connectors, etc.) shall be products included in one of the following manufacturer's warranted solutions. Subject to compliance with requirements, provide products by one of the following:
1. Crestron
  2. Extron
  3. BiAMP
  4. Xantech
  5. Or approved equal.
- G. Audio Visual Ceiling mounted speakers and all associated components: Subject to compliance with requirements, provide products by one of the following:
1. JBL
  2. Bose
  3. Polk Audio
  4. Yamaha
  5. Or approved equal.
- H. Microphones and wireless microphones: Subject to compliance with requirements, provide products by one of the following:
1. Sennheiser
  2. Sure
  3. AKG
  4. Or approved equal.
- I. Hearing Induction Loop Amplifier and all associated components including Induction Loop Cable and connectors: Subject to compliance with requirements, provide products by one of the following:
1. InLoop
  2. Williams AV
  3. Audioropa
  4. Or approved equal.

### PART 3 – EXECUTION



3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 WORKMANSHIP AND INSTALLATION PRACTICES

- A. Use professional quality workmanship in all aspects of the installation, including neat and orderly dressing, strain relief and labeling of all cables.
- B. Set up and adjust each variable component of the system using calibrated signal generators and signal analyzers, as may be required, to optimize the gain-structure and overall performance of the system, as per manufacturer's specifications and good system engineering practices. Wherever applicable use the setup and convergence procedures specified by the manufacturer to assure proper adjustment of said components. This includes but is not limited to a complete setup of all video and audio components, monitors, projectors, cameras, recording and playback devices, scan converters, modems, fiber optic components, codecs. In addition all serial and/or parallel device control protocols i.e., RS-232C, RS-485, RS-422 and related data control signals must be tested and conform to industry standards and practices unless specified by the manufacturer of said equipment. Signal Transport i.e. fiber optics, ISDN, wireless, webcasting, satellite transmission reception and all forms not mentioned in this document which appear in the project design must be tested. These setup parameters and results shall be submitted to the Commissioner for review prior to system Acceptance Tests.
- C. The images and sound at any and all selected AV jacks and systems in the facility shall be judged by the Commissioner, to be free of visible ghosting, snow, hum, noise or distortion beyond that which is evident at the source. Professional quality broadcast monitors shall be used as the reference hardware for subjective image tests, using SMPTE and/or AES reference video and audio program material. If signal degradation, as judged by the Commissioner, is evident anywhere in the system, make such adjustments as required to eliminate such signal degradation, at no further expense to the City of New York, if the signal degradation is outside of the expected performance of the installed components, and due to a deficiency in the workmanship, installation, or setup practices of the Contractor.
- D. Test each and every component and jack plate location of the system once installed, in the presence of the Commissioner, if so requested, to provide visual and measured proof of performance at any one or more selected locations in the facility. Demonstrate all functions of the system.
- E. All equipment, except portable equipment, shall be fixed firmly in place. Equipment cabinets and mounts shall be square and plumb, and fastenings and supports shall be adequate to support their loads with a safety factor of at least three, and as specified elsewhere in this document.
- F. Take whatever steps are necessary to prevent hum or interference from electromagnetic and electrostatic fields, to supply adequate ventilation in equipment cabinets, to prevent equipment vibration and to install equipment so as to provide maximum safety to the operator. In the case of interference determined to be caused by building systems or building ground, document the problem to the Commissioner for resolution with the project team.
- G. All wiring and termination shall be in strict conformity with 2014 New York City Construction Codes. Low voltage audio, video, and control wiring and connections shall be in conformance with those rules and practices as stipulated in "Sound System Engineering,



Second Edition” by Don and Carolyn Davis (Howard Sams and Co.), and in accordance with good industry standard practices.

- H. Isolated Terminal blocks and connector panels should be provided in all equipment cabinets and wiring boxes for incoming and outgoing cables. Terminal blocks shall be labeled with engraved laminated plastic legends fixed in place with a suitable permanent adhesive. “Dymo-Labels” and similar semi-permanent labeling will not be acceptable anywhere in the facility. All conductors shall either be marked with approved pressure sensitive tags or identified by color code. When color coding is employed in lieu of tagging, a cable schedule shall be prepared on 8 ½" x 11" acid-free paper or vellum, inserted into a suitable transparent holder and the schedule shall be hung inside the cabinet or box. Copies of the schedule shall be included in the As-built file.
- I. Perform all work in a neat and workmanlike manner. He/she shall assign workmen to the job in numbers sufficient to meet the schedule commitments and insofar as it is reasonable, the same person shall remain in charge of the work from its inception until completion.
- J. Connector panels shall be inset at least 3" from the rear plane of the rack to allow cable management and strain relief without extending beyond the rear plane of the rack. Cable organizers should be used on the rear of the rack to distribute in a neat and orderly fashion all cables to the appropriate connector panel or AV Component. Rear rack rails should be inset to accommodate the connector panels. All cables shall be strain- relieved. All cable bundles within or on the racks shall be use Velcro wire loops at least every 6", or as appropriate. No wire ties shall be used, so as to prevent crimping or damage of internal conductors.
- K. Cables should always be home runned from one connection to another connection with no barrels or terminal blocks unless specified in the design or unless approved by the Commissioner.
- L. Any rooms or spaces which have movable/portable furniture shall have all AV cables terminated in the floor box/wall box. No cables shall be run through grommet holes in floor boxes or wall boxes if the associated furniture is movable and/or reconfigurable. All cables must have disconnects if furniture is not permanent.
- M. Submit shop drawings showing full-scale connector panels and their labels, prior to fabrication, for approval.
- N. Provide all rack hardware and accessories as needed for completely finished racks. This includes, but is not limited to, shelves, blank panels, vent panels, side panels, power distribution hardware (approved by 2014 New York City Electrical Code), and all other accessories. There shall be no open spaces visible on the front plane of the racks. All rack mounted monitors will be provided with rack mounts providing custom fit equipment-surrounds without visible gaps. Where required due to equipment heat dissipation, intake and exhaust fans shall be provided for each rack.
- O. Submit, for approval, front-view elevations and rear-view elevations of racks showing hardware location and wiring scheme, prior to assembly.
- P. Provide all AV Jack plates with connectors as indicated by function on the drawings. Submit for approval, prior to fabrication, full-scale drawings of each type of jack panel. Each connector shall have engraved labels which are keyed to the As-built set of drawings.





- Q. Where applicable, manufacture connector panels for the inside of the floor boxes, with an electrically isolated connector for each cable entering or leaving the box. The connectors shall be permanently labeled as to function and/or wire number, keyed to the As-Built Drawings.
- R. Adjust each variable parameter of each computer interface in each room to optimize signal quality when viewed on displays in the facility. These adjustments include, but are not limited to, “peaking” controls, horizontal and vertical centering, gain controls, dip-switch settings, etc., as to optimize performance of the interfaces, and to name and program pre-sets for each anticipated type of user-provided computer.
- S. During the course of the project and installation, develop a completion list of non-completed tasks required to execute final sign off of the Systems.
- T. Submit, for approval, an Acceptance Test Approval Form to be used during System Acceptance Tests
- U. Warehouse all equipment included in the Bid Specification, as required, until such time as appropriate to install such equipment at the job site.
- V. Schedule an Acceptance Test with the Commissioner. During that process, take the Commissioner to each and every part of the system and prove to the satisfaction of the Commissioner that all systems are installed in accordance with the AV Specifications, and that all systems are operating normally. If there are non-acceptable elements of the installation, as determined by the Commissioner, immediately schedule restoration and modification as will be needed to bring the Systems into accord with the Specification, at no further expense to the City of New York.

**3.3 INSTRUCTION:**

- A. At its discretion the Commissioner may assign one or more service operators to participate with the Contractor during installation of the AV System. In this case, without delay of the work, familiarize the Commissioner and the City of New York’s service operators with the system's components and installation.
- B. During initial tests and adjustments, permit the City of New York’s service operators to observe and shall explain, when feasible, the significance of each test.
- C. Instruction shall not be deemed completed until the Commissioner has determined that the City of New York’s service operators are adequately instructed to operate the system and to perform routine service.

**3.4 COORDINATION:**

- A. Refer to the DDC General Conditions and Section 01 32 34 “Computer Aided Design Coordination” for coordination and record drawing Requirements.
- B. The audio-visual communications trade shall coordinate and cooperate with other trades to ensure satisfactory work progress. If minor moves or changes are necessary to accommodate other equipment, with or at the Commissioner’s request, such changes shall be made without claim for additional payment.
- C. When an AV system interfaces with other equipment, such as floor boxes, provide equipment cabinets and boxes readily identifiable terminal strips or connector plates to which interfacing



cables may be connected. Coordinate with other suppliers to ensure the appropriateness of the interface.

**3.5 IDENTIFICATION AND TAGGING FOR AUDIOVISUAL DEVICES:**

- A. Incorporate all electrical trade field cable numbers and all in-rack numbers as part of the as-built documents. Identify discrete identification numbers for all AV devices which includes, but is not limited to:
  - 1. Each and every audiovisual cable.
  - 2. Each fiber optic cable and fiber strand associated with AV.
  - 3. Each AV junction box.
  - 4. Each termination block and patch panel (and each termination -- front and rear as applicable).
  - 5. Each equipment termination frame and cabinet.
  - 6. Each raceway and junction box used for audiovisual wiring.
  - 7. Other items as directed by Commissioner.
- B. The nomenclature used to identify cables, blocks, equipment, etc. shall be as approved by the Commissioner. Missing or unclear nomenclature criteria for the items specified above shall not be construed as a reason not to identify the items and shall be brought to the Commissioner's attention.
- C. Provide all materials required for labeling. All labels shall be permanently adhered, easily visible and shall be smudge-proof. All text shall be typed (not handwritten). All cables shall be labeled at both ends minimum.
- D. Identification of all equipment, racks, bulkheads, patch panels, systems, etc. shall be by means of engraved lamacoid (or approved equivalent) nameplates showing 1/4" high white lettering on a black background fastened in the upper left hand corner of all equipment, where feasible. An attempt shall be made to place the label in the same location on similar equipment. Submit for approval by the Commissioner any nameplates intended for application to AV equipment prior to attaching any nameplates.
- E. Identification for the wires and cables shall be by means of wrap around "brady" type labels, or approved equivalent.
- F. Device plates for patch panels, miscellaneous termination hardware, electronic equipment (i.e., controllers, multiplexers, etc.) whose function is not readily apparent shall be engraved with 1/8" high letters suitably describing the equipment controlled or system served.
- G. Identify each outlet box, junction box, and cabinet used in conjunction with empty raceway for wires of a future system by means of indelible markings on the inside denoting the system.
- H. Prior to installing identifying tags and nameplates, submit their nomenclature for approval. Conform to all re-visions issued by the Commissioner.



- I. Junction boxes used for audiovisual wiring and located in unfinished spaces (i.e., hung ceilings, equipment rooms, etc.) shall be clearly identified on the outside as per EIA/TIA-606 Standards unless specified otherwise.
- J. All labeling and identification information shall be provided as part of the As-built drawings as specified elsewhere.
- K. All AV devices with serial numbers shall be labeled. All phones installed in meeting rooms shall be labeled with the phone number, based on label types and locations (to be provided).

### 3.6 CABINETS AND ENCLOSURES:

- A. When fed from above, a smooth grommited hole (sized as required and no less than 2" inside diameter) shall be provided in the top back corner of the equipment cabinet opposite the electrical plug strip in the cabinet (if any). The opening shall be provided with a non-conducting grommet so as to protect the cable from any sharp edges.
- B. All rack mounted equipment which can be serviced from the front side of the rack shall include rack rails or similar and provide cable service loops to extend equipment outward for service without disconnection or removal.
- C. Cabling run in equipment cabinets shall be routed vertically and horizontally in a squared-off manner. The cables shall be secured to the cabinet framing members with color coded Velcro cable ties or approved equal. All cables connected to an item of equipment or patch panel shall approach the device from the door hinge side of the cabinet (i.e., right or left). The cables shall be neatly bound and dressed, with strain relief on each and every cable. All rack mounted equipment which can be serviced from the front side of the rack shall include rack rails or similar and provide cable service loops to extend equipment outward for service without disconnection or removal. Provide black cable "Snakeskin" mesh braided cable sleeve to encase any cable bundles that are exposed to view at tabletop locations and at other locations where neat dressing of cables is appropriate. There shall be no visible multi-cable runs or umbilicals without the use of braided cable sleeve. Take measures to prevent fraying or damage to both ends of the cable mesh using a method to be approved by the Commissioner prior to deployment.
- D. Where the rack is movable, provide a cable loop of sufficient length as to provide access to the rear of the rack for maintenance, by moving the rack perpendicular to its normal position, for full access to the rear of the rack. There shall be strain relief for any and all cables which are part of a movable rack cable loop.
- E. Where possible, for cabinets placed on raised floor tiles, coordinate with the raised floor contractor to ensure that tile openings are properly sized, located and are edge cut to facilitate the removal of the tile after cable is installed. Verify the ability to remove tiles in the front and rear of cabinets to ensure access under the cabinet.
- F. Forced air ventilation shall be provided for each rack by the Contractor, unless otherwise noted, of sufficient CFM rating as to adequately cool the AV equipment mounted in the rack.
- G. Two 20 amp plug strips with outlets mounted 6" on center shall be provided as part of the cabinet. The plug strips shall be mounted in the rear of the cabinet opposite the rear door hinge. The plug strips shall be suitable for hard wiring to electrical junction boxes. Final connection will be by others.



- H. Equipment/patch panel mounting rails within cabinets shall be adjustable from front to back within the cabinet.
  - I. Cabinets located on a raised floor shall be positioned so as to cover a single tile (where possible).
  - J. Cabling which runs between cabinets shall be via the raised floor (where available unless specified otherwise). Coordinate AV trade with the raised access flooring trade. Generally, the front plane of the rack(s) shall be within 2" of the floor's T-bar support structure. Cables run between cabinets with no raised floor shall be run at the top or bottom along the back of the cabinet.
  - K. A minimum of 2-6" clear shall be maintained in front and behind cabinets. Cabinet doors shall open toward the nearest wall when the cabinet is located within 5'-0" of the wall.
  - L. Where multiple runs of small diameter cabling are installed vertically within cabinet enclosures (i.e., between patch panels and/or equipment), they shall be run in panduct L or C type raceway fastened to cabinet framing members. Raceways shall be sized as required.
  - M. For racks located on raised floors, coordinate with the raised floor vendor to ensure proper sized openings are provided and located in the raised floor tile for unobstructed routing of the cabling.
  - N. Cabling for connection to rack mounted patch panels and equipment shall be dressed such that the labeling of the patch panels and/or equipment is readily visible and access to said items is not obstructed.
  - O. Each rack shall be provided with an equipment ground assembly.
  - P. For items of equipment which are indicated as being rack mounted and for which no rack mounting hardware is available, a fitted rack mounted equipment shelf shall be provided, providing for no visible gaps adjacent to the mounted hardware. Custom fitted rack mounts shall be by Middle-Atlantic Products, CPI Chatsworth, Panduit, or approved equal.
  - Q. Horizontal wire management panels shall be provided as necessary to ensure a neatly dressed installation.
- 3.7 MOUNTING HEIGHTS:
- A. Heights of all wall mounted outlets and other AV devices shall be in accordance with the Drawings.
- 3.8 SUPPORTS:
- A. Support work shall be in accordance with best industry practice and shall be plumb and true.
- 3.9 FASTENINGS:
- A. Fasten audiovisual work to the building structure, where applicable, in accordance with the best industry practice and with a safety factor of at least three.
- 3.10 TESTING:
- A. Where applicable the following test devices shall be used:



- B. Audio Tests
  - 1. Distortion Analyzer
  - 2. Audio/Video Oscilloscope
  - 3. Volt Meter
  - 4. Audio Signal Generator
  - 5. Sound Pressure Level Meter
  - 6. Audio analyzer by TEF, MLSSA, QuantAsylum, or approved equal.
- C. Video Tests
  - 1. Dual-input Waveform Monitor
  - 2. Vectorscope
  - 3. Video Pattern Generator and SMPTE bars
  - 4. SMPTE Test Tapes
  - 5. Computer test-signal generator
  - 6. Broadband video sweep generator
  - 7. Broadband video spectrum analyzer
  - 8. QuantumData 780, or an equivalent product by Murideo, Sequoia Technology, or approved equal.
- D. Data and Digital Signals
  - 1. Data capture.
  - 2. BER testing.
  - 3. Timing-reclocking ttr
  - 4. Bit rate verification.
  - 5. Fluke Linkrunner, or an equivalent product by JM Test Systems, Bird, or approved equal.
- E. Deliver the rack portion of the AV System pre-wired and pre-tested.
- F. Provide all setup and performance tests.
- G. Prior to system acceptance completely set up and test the systems as a whole to confirm that overall performance meets the expected performance based on equipment specifications and proper interfacing and gain structuring techniques.



- H. If subjective performance is deficient as far as signal-to-noise, Total Harmonic Distortion, and gain-before-feedback, for the audio subsystems, the Commissioner will require objective tests. For video subsystems, image sharpness, contrast, focus, and convergence will be considered. Objective tests will be required if image quality is deficient from expected product specifications and the system as a whole, as determined by the Commissioner.
- I. Time and skilled installers must be allocated as part of the Contractor's scope to perform off-line setup configurations and level adjustments for each system, and on-line tests with installers at far end sites and the near end site (for audio and videoconferencing) for final adjustments.
- J. After setup, all levels of each pot, as well as nominal meter ranges shall be clearly documented in the technical manual for that room. In addition, where feasible, and only after on-line successful tests, pots and levels that can be marked on the hardware itself shall be so marked.

**3.11 TEST EQUIPMENT:**

- A. Prior to any testing being performed, the Commissioner shall be supplied with a list of test equipment to be used, for his review and approval. The submittal shall include documentation indicating that the proposed equipment is capable of performing all of the tests required to execute the successful installation and certification of the AV systems.

**3.12 TESTS TO BE PERFORMED:**

- A. Tests are to be performed on the following aspects of the audiovisual system for large venues with speech reinforcement systems:
  - 1. Raw unequalized house curve through program speakers using pink noise
  - 2. Ambient noise measurements placed on NC template
  - 3. RT60 reverberation time
  - 4. Gain structure chart showing measured levels at each and every variable gain point through the system. This will be submitted as the reference setup for the system upon system completion.
  - 5. Available headroom before clipping for each input stage. This information may be placed on the gain structure chart.
  - 6. Feedback Stability Margin for speech reinforcement system, which should be at least 6 dB.
- B. Video Format Types - Which may be part of the design include but are not limited to; Composite and Component Analog Video, Serial and Parallel Digital Video, HDBaseT, Standard Definition all various formats of High Definition Video. Computer generated RGB or DVI or Displayport formats and resolutions.
- C. New Formats and Emerging Signal Types - It shall be the responsibility of the Contractor to be fully experienced in new and emerging forms of video delivery protocols as it relates to video systems used in the design. This includes but is not limited to MPEG and similar streaming video as well as media transfertypes, i.e. IEEE 1394, USB, SCSI or any



additional types of media transfer protocols not described herein. The Contractor should have a full understanding of the process of encoding and decoding various formats.

**D. Video/Audio and Data Testing**

1. All Video/Audio and Data Testing shall be done using the prescribed test equipment outlined in section 3.10 and may include additional test components offered by the Contractor. It is the responsibility of the Contractor to provide all test equipment electronics, harnesses and adapters to perform tests. All Contractor Test equipment must bear the latest calibration sticker issued by that device's manufacturer or manufacturer approved calibration service.

**E. Video Signal Distribution and Timing - (All Formats)**

1. All video systems shall conform to the required proper testing of all aspects of the video signal and the related format. Testing parameters shall where applicable conform to the specified videoformat standard(s) for analog and digital Formats.
2. Signal distribution adjustments shall include unity gain where applicable to achieve a proper signal amplitude for video, pulse and audio signals. Signal distribution adjustments shall also include Gain and Equalization adjustments for cable length compensation where required. This includes proper cable lengths and equipment adjustments to ensure correct horizontal and sub-carrier timing and reclocking for digital formats. No equipment shall use input video auto-timing unless approved by the Commissioner. No devices shall use AGC for gain control unless approved by the Commissioner. All devices which are deemed as part of the clause include but are not limited to;
  - a. Cameras, Video Recording Devices, Distribution Amplifiers, A to D and D to A converters, Signal generators, Frame Synchronizers, Time Base Correctors, Routers, Standards Converters, Transcoders, Fiber Optics, and Video Processors.
3. All Video testing must conform to the guidelines set forth by SMPTE, NTSC, AES, EIA, IEEE, FCC, and ASTC where applicable.
4. All signal testing and optimization shall be made on short haul systems and long haul systems end to end when applicable.

**F. Color Video Monitors and Projectors:** Where appropriate as reference or for system testing, the color video monitors shall be of broadcast grade and capable of displaying the signal format and/or additional formats being used. . This includes but is not limited to all analog and digital, composite and component video formats. Standard and high definition resolutions. All additional resolutions. Monitors where appropriate shall provide cross pulse and under-scan features for testing purposes. Monitors should have blue only feature for color phase (hue) calibration.

1. Calibration: All Color Video Monitors/Projectors shall be calibrated with test generated signals including SMPTE Color Bars to adjust setup, brightness and colorimetry.
2. Computer monitors shall be calibrated using appropriate computer test signals or using the display or video graphics adapter manufacturers LUT (lookup table) or calibration application.



3. Convergence, linearity and geometry should be observed for defect and corrected during installation unless mechanical defect warrants manufacturer servicing.
4. Other Display Devices:
  - a. Computer LCD displays: All LCD displays shall be sized according to the ergonomic integration into the end users work environment. LCD displays shall be calibrated using appropriate computer test signals or using the display or video graphics adapter manufacturers LUT (lookup table) or calibration application.
  - b. All panels should be observed for defect such as excessive "dead pixels" and returned to the manufacturer for servicing or replacement.

**3.13 RECORD OF TEST RESULTS:**

- A. A record of all required tests shall be provided to the Commissioner. The information shall be maintained as permanent record for the purposes of maintenance and restoration.
- B. A brief description outlining the test equipment used and a single line diagram indicating the test setup shall be provided to the Commissioner for his review. The level of description should be sufficient enough to allow an individual who is not familiar with the specific test equipment to recreate any portion of the test.
- C. Test results to be provided shall contain the following minimum information:
  1. For all similar tests include:
    - a. Project name
    - b. Description of test
    - c. Source origin
    - d. Source destination
    - e. Cabling Scheme to be determined by Commissioner.
    - f. Cable pair/strand
    - g. Test date
    - h. Tester (individual responsible for conduct of the test)
    - i. Page of.
    - j. Levels of signal, and reference of dB ratio
    - k. Settings of all pots on equipment
    - l. Graphs and observations
- D. All test results shall be provided in the following formats:





1. Printed (3 bound copies)
  2. Permanent digital format as dictated by client.
  3. The test equipment shall have the ability to record test results to a printer or memory for printing later. Submitting of these printed test forms is preferred in lieu of handwritten forms.
  4. The test results are required to be submitted electronically per instruction from the Commissioner to associate the information with a cable database.
- E. A copy of the test results in both electronic and printed formats shall be provided to the Commissioner for review and record.
- 3.14 CORRECTIVE ACTION:
- A. Any defects or deficiencies discovered in any of the audiovisual work shall be indicated on the test report and be corrected, at no further expense to the City of New York.
  - B. Upon completion of testing and problem resolution, all connections tested are to be 100% error free.
  - C. Any connections determined to be not correctable shall be indicated at each end of the termination as "bad" (in red).
  - D. For those systems requiring specialized setup and or skills, coordinate prior to delivery a certified onsite engineer licensed in the state of New York to certify the proper installation, programming and testing of the said equipment or system at no additional expense to The City of New York. If the equipment is delivered, installed and requires the attention of additional installers to configure, program and or test it, then the City of New York is not responsible for any additional charges unless approved by the Commissioner.
1. Systems which may require such specialized assistance include but are not limited to:
    - a. Cameras, Automated switching, Computer based Video/Audio Systems, Video/Audio/Data Routers, Router Control Systems, Fiber Optic Systems, Machine Control, Graphics/Digital Audio/NLE Workstations, Intercom, Telecommunications systems and Computer Networked Systems, Projectors, automatic microphone systems, KVM systems, etc.
- 3.15 EQUIPMENT INSTALLATION AND TESTING:
- A. Be available during equipment installation and testing to help isolate faults which may exist in the cabling system installation.
  - B. Coordinate with other vendors where necessary to resolve any discrepancies between the cabling system and the vendors cabling or equipment.
- 3.16 AUDIO PERFORMANCE CRITERIA:
- A. Definition of terms: The "Audio System Performance Criteria" set forth in this section will define the parameters of acceptable performance of the Audio System.



- B. The attributes of system performance are divided into two sets of criteria: Subjective and Objective Criteria.
- C. Subjective Audio Performance Criteria: The Contractor is required to use subjective listening tests to determine if the system will meet the expected performance criteria, as well as the objective requirements of high quality audio installations. The Contractor must subjectively evaluate the system in terms of frequency response, intelligibility, loudness, and noise transmission. Listening test should be performed while the system is transmitting typical audio material (including speech) and operating at nominal level.
- D. All audio systems should fall within the specified ranges stated in this specification.
- E. Any signal level adjustment is to be made such that it does not alter the signal integrity of any other system.
- F. Objective Audio Performance Criteria:
  - 1. It is the Contractor's responsibility to assure the audio system operates within standard audio system performance criteria, whether or not the criteria are explicitly delineated herein.

G. Electro-acoustic Signal to Noise:

The following are expected Electro-acoustic signal to noise ratios for various systems: Program Systems 20-26 dB

Amplified Speech System (NOM=1)	20-26 dB
Amplified Speech System (NOM=2)	17-23 dB
Amplified Speech System (NOM=4)	15-21 dB
Mix Minus System (NOM=3)	1-13 dB
Conference System	15-20 dB

Video Conference System	15-20 dB
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Studio Systems	40-45 dB
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- H. It is expected that Electro-acoustic Signal to noise test will be conducted in the following manner:
  - 1. Electro-Acoustic System Signal to Noise Test:
    - a. Reading A: Measure the ambient sound pressure level with a sound Level meter (wide band A weighted). Note readings at various points in the room. Also note any points in the room that result in measured changes greater than + or - 3 dB S.P.L.
      - (1) Room Ambient Noise Level: The maximum acceptable ambient noise level for audio rooms under this specification is NC 35 (Noise Criteria) This translates to a wide band A weighted noise floor of 46 dB SPL.
    - b. Introduce nominal sound into the room using the specified system components.



(1) (Audio conference system, mic system, program system).

- c. Reading B: Measure sound in the room using the sound level meter (A weighted). Note the level readings at the same points as the ambient test.
- d. Subtract reading A from reading B. This is the Electro-Acoustic Signal to Noise Ratio for that system.

I. Audio Bandwidth:

The audio systems to be installed in this project are to have the following minimum bandwidth(s): The bandwidth of a system is measured as + or - 3dB of the Audio frequency bandpass.

Program Systems (no subwoofer)	40-20kHz
Program systems (subwoofer)	20-20kHz
Amplified Speech System	150-15kHz
Mix Minus System	300-15kHz
Audio Conference System	300-7kHz
Video Conference System	300-7kHz
Studio Systems	20-20 kHz

J. Signal to noise:

- 1. It is the Contractors responsibility to provide electronic systems that have a minimum electronic signal to noise ratio of -55 dB, unless otherwise specified herein. For studio systems the overall minimum signal to noise ratio is 65 dB.

K. Total Harmonic Distortion:

- 1. The Audio systems are to have the following maximum distortion levels:
- 2. Program Systems (no subwoofer) 0.5%
- 3. Amplified Speech System 0.5%
- 4. Mix Minus System 0.5%
- 5. Audio Conference System 1.0%
- 6. Video Conference System 1.0%
- 7. Studio Systems 0.2%

L. Overall System Headroom:

- 1. It is the responsibility of the Contractor to set up the system to meet the following minimum headroom requirements:



Program Systems	10 dB
Amplified Speech System	15-20dB
Mix Minus System	6-12dB
Audio Conference System	3dB
Video Conference System	3dB
Studio Systems	24dB

**M. Level Matching:**

It is the responsibility of Contractor to verify the proper level matching of system components. The components are to operate within the sensitivity specification provided by the manufacturer.

**N. Mismatching of levels:**

1. Any level mismatching between system components defined in this design is the responsibility of the Contractor to recognize and correct in the submission drawings at no expense to the City of New York.
2. Any level mismatch caused by the substitution of equipment is the responsibility of the Contractor to recognize and correct.
3. Any level mismatch caused by the addition or substitution of City of New York furnished equipment is to be presented to the Commissioner within one week of the identification of the manufacturer and model number of City of New York supplied equipment. The Contractor will present the proper interface solution, purchasing expense of, and availability of the device(s).

**O. Field verifications:**

1. It is the Contractor's responsibility to notify and recommend solutions to the Commissioner if for any reason the Audio System Performance Criteria cannot be met due to changes in field conditions, equipment, or additional requirements of the system or if these changes render the performance criteria to be insufficient. The Commissioner reserves the right to alter the performance criteria to meet changing field or system conditions.

**P. See Audiovisual Systems Equipment Schedule below, as referred to by Part 2 of this section. All products from specific manufacturers listed in schedule are the Basis-of-Design product. For each product, subject to compliance with requirements, provide either the Basis-of-Design product or an equivalent product from an approved manufacturer listed above – see Paragraphs 2.1 D through 2.1 I.**

Audiovisual Systems Equipment Schedule May 21 <sup>st</sup> , 2019					
ROOM NUMBER	LOCATION NAME	DESCRIPTION	MANUFACTURER	PART NUMBER	COUNT
Cellar Level					
003	Stress Reduction Room	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
1 <sup>ST</sup> Floor					
100-D	Main Desk - Lobby	32" Class LED, 1080P, Smart HDTV	SAMSUNG, or approved equal	N5300	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
100L	Lobby – Reception Desk	Hearing Induction Loop Amplifier	InLoop, or approved equal	Commercial InLoop 3000	1
		Direct Burial Induction Loop Cable		TBD Based on contractor site survey	1
		Microphone (Counter wired)	SENNHEISER, or approved equal	TBD	1
102-C	Operations Supervisor / Admin Lieutenant	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1



		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 50' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-50PROBLK	1
103	Community Room	LG-75" Class LED, Smart 4K UHD	LG, or approved equal	UK6570PUB	1
		X-Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	XCB1U	1
		S1 Rack, 20U, 23" Deep	Chief Manufacturing, or approved equal	NS1F2023	1
		3-Series 4K Digital Media - Presentation System 350	CRESTRON, or approved equal	DMPS3-4K-350-C	1
		AVIA 8-Channel Power Amplifier	CRESTRON, or approved equal	AMP-8150	1
		Wireless Microphone Receiver	SENNHEISER, or approved equal	SL Rack Receiver DW	1
		Podium Microphone	SENNHEISER, or approved equal	SL Tablestand 133-s DW	1
		Hand Held Microphone	SENNHEISER, or approved equal	SL Handheld DW	1
		JBL Control Ceiling Speakers	JBL, or approved equal	Control 26CT	6
		Hearing Induction Loop Amplifier	InLoop, or approved equal	Commercial InLoop 9000	1
		InfiNET EX & ER wireless Gateway	CRESTRON, or approved equal	CEN-GWEXER	1
		8.7" Wireless Touch Screen	CRESTRON, or approved equal	TST-902	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	2



		PRO AV/IT Series High speed 50' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-50PROBLK	3
		4-Port Wall plate	Leviton or approved equal	42080-4*S	2
		HDMI Feedthrough QuickPort Connector, White Housing	Leviton or approved equal	40834-W	2
		HDMI Female to Right Angle Male - Upward Position	Comprehensive Connectivity, or approved equal	HDF-RAMU	2
		Direct Burial Induction Loop Cable		TBD Based on contractor site survey	1
		Dinky Link Surface Mount Standard IR Receiver	Xantech, or approved equal	DL25K	1
109	Platoon Commander	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1
110	Patrol Supervisor Admin	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1



111	Executive Officer	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1
113	Commanding Officer	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1
115	Muster / Community Training Room	LG-75" Class LED, Smart 4kUHD	LG, or approved equal	UK6570PUB	2
		X-Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	XCB1U	2
		S1 Rack, 20U, 23" Deep	Chief Manufacturing, or approved equal	NS1F2023	1
		3-Series 4K Digital Media - Presentation System 350	CRESTRON, or approved equal	DMPS3-4K-350-C	1
		AVIA 8-Channel Power Amplifier	CRESTRON, or approved equal	AMP-8150	1
		Wireless Microphone Receiver	SENNHEISER, or approved equal	SL Rack Receiver DW	1





		Podium Microphone	SENNHEISER, or approved equal	SL Tablestand 133-s DW	1
		Hand Held Microphone	SENNHEISER, or approved equal	SL Handheld DW	1
		JBL Control Ceiling Speakers	JBL, or approved equal	Control 26CT	8
		Hearing Induction Loop Amplifier	InLoop, or approved equal	Commercial InLoop 9000	1
		InfiNET EX & ER wireless Gateway	CRESTRON, or approved equal	CEN-GWEXER	1
		8.7" Wireless Touch Screen	CRESTRON, or approved equal	TST-902	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	2
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-345PROBLK	3
		4-Port Wall plate	Leviton or approved equal, or approved equal	42080-4*S	2
		HDMI Feedthrough QuickPort Connector, White Housing	Leviton or approved equal, or approved equal	40834-W	2
		HDMI Female to Right Angle Male - Upward Position	Comprehensive Connectivity or approved equal	HDF-RAMU	2
		Direct Burial Induction Loop Cable		TBD Based on contractor site survey	1
		Dinky Link Surface Mount Standard IR Receiver	Xantech, or approved equal	DL25K	1
118	Precinct Integrity Officer	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1



		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1
<b>2<sup>ND</sup> Floor</b>					
204A	Precinct Planning Supervision	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1
206	Staff Lounge	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	2
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	2
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	2
207	Special Operations	LG-49" Class LED, Smart 4kUHD	LG, or approved equal	UJ6200	1
		Large Fusion Micro- Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	LTM1U	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 35' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-35PROBLK	1



212A	Conference Room	LG-60" Class LED, Smart 4kUHD	LG, or approved equal	UK6090PUA	1
		X-Large Fusion Micro-Adjustable Fixed Wall Display Mount	Chief Manufacturing, or approved equal	XCB1U	1
		S1 Rack, 20U, 23" Deep	Chief Manufacturing, or approved equal	NS1F2023	1
		3-Series 4K Digital Media - Presentation System 350	CRESTRON, or approved equal	DMPS3-4K-350-C	1
		AVIA 8-Channel Power Amplifier	CRESTRON, or approved equal	AMP-8150	1
		Microphone (Table Top)	SENNHEISER, or approved equal	MEB-114B	3
		JBL Control Ceiling Speakers	JBL, or approved equal	Control 26CT	4
		Hearing Induction Loop Amplifier	InLoop, or approved equal	Commercial InLoop 9000	1
		InfiNET EX & ER wireless Gateway	CRESTRON, or approved equal	CEN-GWEXER	1
		8.7" Wireless Touch Screen	CRESTRON, or approved equal	TST-902	1
		PRO AV/IT Series High speed 6' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-6PROBLK	1
		PRO AV/IT Series High speed 50' HDMI	Comprehensive Connectivity, or approved equal	HD-HD-50PROBLK	2
		Dinky Link Surface Mount Standard IR Receiver	Xantech, or approved equal	DL25K	1

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**SECTION 28 00 00****SECURITY SYSTEMS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. For telecommunication and cabling systems – Section 27 00 00 “Telecommunication and Cabling Systems”

**1.2 SUMMARY****A. Section includes:****1. Security System (SS).**

- B. The intent of this document is to provide the design specification for furnishing Intercom System (IC), Closed Circuit TV (CCTV) System, Prisoner Cell Alarm system and Door Alarm System. The security system (SS) described in this specification shall be functionally operational for monitoring and control of the premises. The entire security system shall include, but not be limited to the following:

**1. Prisoner Cell Alarm System**

- a. Control Panel
- b. Keypad
- c. Pull Cords
- d. Pull Switches
- e. Pull Cords Wall Rings
- f. Pull Cord Connectors
- g. Siren/Strobe
- h. Power Supply

**2. Door Alarm System**

- a. Control Panel
- b. Door Contacts
- c. Power Supply



3. Emergency Door Control System
  - a. Electromagnetic Locks
  - b. Power Supplies
  - c. Push Button
4. CCTV System (Color)
  - a. CCD cameras with lenses: PoE IP cameras, indoor, outdoor.
  - b. Connection to the central NYPD Video Management and Recording System (Genetec)
5. Power Injectors
  - a. Housings.
  - b. Mounts.
  - c. Surge Suppressors (for exterior cameras)
6. Network Switches
7. Intercom System
  - a. Wall Mount Master Unit
  - b. Wall Mount Security Grade slave units
  - c. Power Supply
8. Cables and Wires
9. Card Access System

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 19 "INDOOR AIR QUALITY MANAGEMENT", where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 SUBMITTALS

- A. Submittals, approvals and documentation deliverables.
  1. Prior to the start of installation, submit the following for approval:
    - a. General description of operation.
    - b. Technical specification data sheets for all items included in this specification.
    - c. Samples of all exposed equipment and mounting hardware.
    - d. Shop drawings showing wiring diagrams, installation and mounting methods and details, point-to-point termination schedules. All drawings shall be fully dimensioned.
  2. Prior to start of testing, submit for approval the methodology for factory and site testing to be used including sample data sheets.
  3. Prior to start of instruction, submit syllabus and course outline for approval. Coordinate with security department for scheduling.
- B. Computer system documentation (3 copies). Include configuration diagrams, as-built capacities, field expansion capabilities, operating system and software configuration. Include fully documented application software manual(s).
- C. Evidence that the design, manufacture and testing of the components of the systems and sub-systems that are not manufactured by the supplier shall be in accordance with the specifications.

#### 1.7 WARRANTY

- A. Warrant the installed system to be free of defects of materials and workmanship for a period of one (1) year following substantial completion.

#### 1.8 INSTRUCTION

- A. Instruct a minimum of 6 operators for system operation. Each operator shall be instructed for a



total of 24 hrs. each. The instruction shall be provided by a professional engineer licensed in the State of New York on behalf of the contractor. In addition to Operator instruction, provide instruction to Security Management and Facilities operators employed by the City of New York. Each Security and Facilities Management operator shall be instructed for a total of 16 hours each.

1. Provide each operator with complete, printed operating instructions and brief sub-system description in manual or handbook form.
2. Provide Video Recording of the instruction session and associated documentation (Alternate).
  - a. Provide three (3) copies.
3. Provide two distinct instruction sessions, Operator and Management, with minimum instruction time of 40 hrs. Sessions shall be scheduled to suit the requirements of the City of New York's service operators and may be scheduled at any time from the award of the contract to the end of the guarantee period at the Commissioner's request. Also at the Commissioner's request, one or both instructing sessions may be scheduled at the contractor's office.
4. The City of New York's service operators shall be instructed in preventive services for all Video Intercom, Card Access and CCTV Equipment.

#### 1.9 DELIVERY, STORAGE AND HANDLING

- A. Expenses of all shipping to the site, and of all unusual storage requirements, shall be borne by the Contractor. It shall be the responsibility of the Contractor to make appropriate arrangements and to coordinate for the proper acceptance, handling, protection, and storage of equipment so delivered.
- B. Movement of material, either at the time of delivery or subsequently, shall be the sole responsibility of the contractor. All expenses associated with this movement shall also be the responsibility of the contractor.
- C. Safely store all equipment. In the event of equipment disappearance from the site, bear full responsibility for all expenses associated with equipment replacement at no additional expense to the City of New York.

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work. In addition, the contractor or subcontractor must be licensed or approved by the manufacturer.
- C. All equipment provided shall be new and shall meet or exceed the latest published specifications of the manufacturer in all respects.
- D. Contractor to provide the latest model/revision of a specified piece of equipment.
- E. Obtain detailed instructions for installation from manufacturer of each product.



## 1.11 SEQUENCING AND SCHEDULING

- A. Prior to installation of any equipment, advise and coordinate with the Commissioner.
- B. Provide a schedule listing of activities including employee allocation and material procurement that demonstrates the plan to meet the construction schedule. This schedule shall include the number of employees to be assigned and duration required for each phase. After award of the contract, the schedule shall be updated to show any operational conflicts which shall be coordinated and approved by the Commissioner before implementation.

## PART 2 - PRODUCTS

### 2.1 GENERAL

#### A. Material

- 1. Wire (see riser diagram drawings)
  - a. Provide wire in accordance with security drawings
  - b. Emergency power shall be provided by others to a Junction Box at each location shown on security drawings.
- 2. Identification and Tagging
  - a. All cables, wires, terminal blocks and terminals shall be identified by labels, tags or other permanent markings.
  - b. All markings shall clearly indicate the function, source and destination, polyolefin of each wire. Use wire markers for each wire.
  - c. All terminal points shall be appropriately labeled.

#### B. Security Software

- 1. Security applications software shall be a standard off-the-shelf product of the SS system manufacturer and shall be supplied complete with necessary user license(s) and manufacturer's documentation.
- 2. Perform all necessary modifications and programming of the security software, including any interface with existing database(s).
- 3. All data retrieval and transfers with existing databases shall be on line in real time.

#### C. Security Hardware

- 1. System and system equipment shall be listed, labeled or approved by applicable standards of Underwriters Laboratories, Inc.
- 2. Equipment Enclosures
  - a. All enclosures for equipment supplied under this specification shall be lockable and protected against tampering by being equipped with tamper switches or triggering mechanisms electrically compatible with the alarm system.



- b. All controls, which affect the sensitivity of the units, shall be located inside the tamper resistant enclosure.
- c. Keylocks or key operated switches used to protect enclosures shall have Underwriter's Laboratories listed locking cylinders.

**D. Security Systems Power Requirements**

- 1. Refer to security drawings for locations of the electrical junction boxes and receptacles, number and size of the electrical circuits.

**E. Uninterruptible Power Supply (UPS)**

- 1. The unit shall be uninterruptible power supply designed for rack mounting in a standard 19" EIA rack mount assembly and tower, where required. It is also possible that a central system will provide UPS capability throughout the facility.
- 2. The run time shall be 34.3 minutes at half load and 9.7 minutes at full load.
- 3. The unit shall include RS232 Interface port.
- 4. The unit shall support following features: Automatic Self Test, Automatic Voltage Regulation (AVR), Hot Swap Batteries, Intelligent Battery Manager, Network Grade line conditioner, Overload Indicator, Replace Batt Indicator, Scalable Run Time, User Replaceable batteries.
- 5. Output: (8) 120 VAC outputs, (6) outputs for field UPS connection type shall be NEMA 5-15R
- 6. The unit shall include surge protection and filtering.
- 7. Operating environment: 32-104°F,
- 8. The unit shall comply with CSA, FCC A, UL 1778.
- 9. See security drawings for UPS size and model for Equipment Cabinet.
- 10. Manufacturer: Subject to compliance with requirements, provide APC No.: SUA2200 (for reception desk and security desk) or an equivalent product by one of the following:
  - a. Eaton
  - b. Triplite
  - c. Or approved equal.

**F. Network Equipment**

- 1. General
  - a. All network equipment shall support the following standards:
    - (1) Safety certification: UL1950, IEC 60950, CSA-C22.2 No. 950, AS/NZA



3260, 21CFR 1040, EN60825-1, IEC 60825-1, TS-001.

- (2) EMC Compliance: China EMC certification, EN55022, FCC (CFR 47, Part 15) Class A, CISPR22; EN 55024; CISPR22; AS/NNZS 3548; VCCI, CE Marking, NEBS Level 3; ETSI ETS-300386-2
- (3) IEEE Compliance: 802.1d - Bridging, 802.1p.q - VLAN tagging, 802.1s - Per VLAN Group Spanning Tree Protocol, 802.1w - Rapid Spanning Tree Protocol, 802.1x - Identity-Based Networking Services (IBNS); 802.3 - 10BASE-T, 10BASE-FL; 802.3ab - 1000BASE-T; 802.3ad - Link aggregation; 802.3ae - 10 Gigabit Ethernet; 802.3af - Power over Ethernet (PoE); 802.3u - 100BASE-TX, 100BASE-LX
- (4) Environmental: Reduction of Hazardous Substances (ROHS) 5
- (5) Telco: Common Language Equipment Identifier (CLEI) code
- (6) Warranty: Limited lifetime warranty

2. PoE Switch (located in IDF rooms)

- a. The unit shall be a 48 port fixed-configuration model that provides wire-speed Fast Ethernet and Gigabit Ethernet connectivity.
- b. The unit shall include built-in (2) Gigabit Ethernet port that accommodates GBIC/SFP transceivers, (2) 10/100/1000 ports and (48) 10/100 ports.
- c. The unit shall include 802.3af Class 3 Power over Ethernet (PoE) for each port.
- d. The unit shall support wide range of authentication methods, data encryption technologies, and NAC based on users, ports and MAC addresses.
- e. The unit shall support 802.1S/W that enables standard based fault tolerance, load balancing and rapid recovery.
- f. The unit shall support Per VLAN Spanning Tree Plus (PVST+) that increases available bandwidth by allowing traffic on redundant links.
- g. The unit shall support QoS (Quality of Services). Shall allow network control list (ACLs) and multicast services.
- h. The power shall not exceed 470W.
- i. Sole sourcing: PoE switches shall be sourced from the same manufacturer as that of Layer 2, 3 switches.
- j. System integration: PoE switches shall be fully compatible and integrated with full functionality to NYPD's existing Cisco centralized network infrastructure. Coordinate compatibility requirements with Commissioner.
- k. Manufacturer: Subject to compliance with requirements, provide Cisco. Model No.IE4000, or Catalyst 9400 (48 port PoE).

3. Layer 2, 3 Switch



- a. The unit shall be an intelligent, multilayer, modular switch and router.
- b. The unit shall have stackable chassis with rear access power supply.
- c. The chassis shall include redundant Supervisor Engine 32.
- d. The unit shall support the following ports and modules:
  - (1) Gigabit Ethernet SFP (Small Factor Pluggable) – 4 ports
  - (2) 10/100/1000 Ethernet – 24 PoE ports
- e. The unit shall meet or exceed the following performance specifications:
  - (1) Onboard Memory (DRAM) - 4GB
  - (2) Flash memory – 2 Gb
  - (3) Total Bandwidth – up to 176 Gbps
  - (4) Total routed ports – up to 208
  - (5) MAC addresses supported –32,000 effective
  - (6) IP v4 Routes supported – 24,000
  - (7) VLAN – 4000 maximum
- f. Power consumption shall be – 750 Watt 120 VAC.
- g. Sole sourcing: Layer 2, 3 switches shall be sourced from the same manufacturer as that of PoE switches.
- h. System integration: Layer 2, 3 switches shall be fully compatible and integrated with full functionality to NYPD's existing Cisco centralized network infrastructure. Coordinate compatibility requirements with Commissioner.
- i. Manufacturer: See security drawings for switch basis-of-design models for each location. Subject to compliance with requirements, provide Cisco Catalyst Model C9404R (48 port PoE).

**G. Surge Protector and/or Power injector**

- 1. The unit shall be Power Over Ethernet Power/Video/Data surge protection device.
- 2. The unit shall be able to protect power, video and data on fixed or PTZ cameras
- 3. The unit shall include RJ45 connector with external grounding screw.
- 4. The unit shall be able to maintain Ethernet data speed without signal degradation.
- 5. The unit shall comply with IEEE Std. 802.3af and 802.3at for PoE.
- 6. The protector shall be available as a single device or 12-Port, 2U rack mount.



7. The unit shall meet the following specifications:
  - a. Connection - RJ-45 In/Out
  - b. Pinout - all 8 pins shall be protected
  - c. Data Rate: 100 mbps (100Base-T)
  - d. Maximum continuous current: 1.5 amp
  - e. Dissipation: 3000 W/pair
  - f. Protection mode: Line-Ground (All)
  - g. Operating temperature: -40°F - 158°F (-40°C - 70°C)
  - h. Maximum Humidity: 95% non-condensing
  - i. Dimensions: 1.7" x 3" 1.2" (43mm x 76mm x 30mm)
  - j. Housing shall be ABS
  - k. Warranty: 10 years Limited
8. Manufacturer: Subject to compliance with requirements, provide Ditek Model No. DTK-MRJPOE, or an equivalent product by one of the following approved manufacturers:
  - a. AXIS,
  - b. Littelfuse,
  - c. Or approved equal.

## 2.2 PRISONER CELL ALARM

### A. Control Panel

1. The unit shall be a digital alarm control communicator designed to transmit a digital signal through telephone line.
2. The unit shall be listed by UL for NFPA 72 applications, Central Station, Local, Police Connect, Bank Safe and Vault, Mercantile Safe and vault and Grade A Household.
3. The unit shall support initiating and indicating modules and command centers.
4. The unit shall meet the following requirements:
  - a. 8 Hybrid zones on-board (hardwire or wireless), including 2 2-wire fire zones
  - b. Up to 16 EOL zones with multiplexing (zones from RP1CAe2 alpha keypads or multiplex expansion modules)
  - c. Uses 4-or 8-zone expansion modules



- d. Up to 16 users
  - e. Supports choice of up to 7 Gemini keypads,
  - f. 256 event logging
  - g. 3 outputs
  - h. Interior bypass group
  - i. Event log with open/close suppression
  - j. Phone-In Interface Module
  - k. Includes transformer
5. The control panel shall meet the following specifications requirements
- a. Input Power 16.5VAC via Class 2 Plug-in 20 VA transformer
  - b. Aux & remote power 12Vdc regulated
  - c. 500 mA standby current rating with 20VA transformer, supplied
  - d. 650 mA standby current rating with optional 40VA trans.
  - e. Alarm current 2A
  - f. Loop Resist. 300 ohm max.; 50 ohm max for 2-wire fire
  - g. Burg. Voltage Output -1; programmable negative outputs -2
  - h. Operating temp. 0-49 degrees C.
  - i. Communication formats: Ademco Point ID, Silent Knight Fast/Slow, Radionics Fast/Slow, Universal High Speed, SIA and Pager.
  - j. Manufacturer: Subject to compliance with requirements, provide Napco/Gemini Model GEM-P1632 (Basis-of-Design), or an equivalent product by one of the following:
    - (1) Interlogix
    - (2) Honeywell
    - (3) Or approved equal.

**B. Keypad**

- 1. The unit shall be a Deluxe 32-character keypad
- 2. The keypad shall include:
  - a. Backlit, menu-driven, dual-line display



- b. Custom alphanumeric zone directory
  - c. Built-in 4 Zone expansion module
  - d. Display of wireless transmitter signal strength 1-10
  - e. EZ Keypad Programming2 with actual Q&A's to step through configuration
  - f. New intuitive, stay & away ease-of-use buttons, for easy one button arm and easy "instant" (hold-down) with the GEMK1CA.
  - g. Large soft touch backlit keys with tone
  - h. Backlit displays for easy reading
  - i. Wireless transmitter signal strength indication
  - j. Decor friendly soft white design
  - k. Fire, police and auxiliary programmable panic keys
  - l. Fingertip reference chart
3. Manufacturer: Subject to compliance with requirements, provide Napco/Gemini. Model GEMK1CA (Basis-of-Design), or an equivalent product by one of the following:
- a. Interlogix
  - b. Honeywell
  - c. Or approved equal.

**C. Pull Cord**

- 1. The unit shall be a high quality vinyl coated wire center cable.
- 2. The wire center shall be performed galvanized 3/32" aircraft cable.
- 3. The overall diameter shall be 3/16", size #6D, color shall be available in red, green, yellow and blue.
- 4. Manufacturer: Subject to compliance with requirements, provide Trans-Lite (Basis-of-Design) Model XE-99009 (pull cord), AE-18858 (pull cord connectors), DE-99043 (wall rings), or equivalent products from one of the following:
  - a. Mircom
  - b. Cornell
  - c. Or approved equal.

**D. Pull-cord Switch**

- 1. The unit shall be a high quality wall mounted, slow action, of small design



switch with pull wire function.

2. The switch shall meet the following specification requirements:
  - a. Enclosure: aluminum die-cast powder coated
  - b. Cover: steel, powder-coated
  - c. Degree of protection IP 65 to IEC/EN 60529
  - d. Contact material silver
  - e. Switching elements change-over contact with double break, galvanically separated contact bridges
  - f. Switching system - slow action
  - g. Connection screw connection terminals
  - h. Cable cross-section - max. 2.5 mm<sup>2</sup> (incl. conductor ferrules)
  - i. Cable entry 1 x M16 x 1.5
  - j. U imp - 4 kV
  - k. U I - 400 V
  - l. Current - 4 A
  - m. Utilization category AC-15
  - n. I e /U e - 4 A/400 VAC
  - o. Max. fuse rating - 4 A gG/gN fuse
  - p. Ambient temperature –20 °C ... +80 °C
  - q. Mechanical life - > 1 million operations
  - r. Operation cycles - 3600/h
  - s. Actuating force - max. 40 N
  - t. Features - pull-wire function
3. Manufacturer: Subject to compliance with requirements, provide Steute. Model ES 51Z (Basis-of-Design), or an equivalent product from one of the following:
  - a. Trans-lite
  - b. Mircom
  - c. Or approved equal.





**E. Siren/Strobe**

1. The unit shall be an indoor/outdoor 25 watt dual tone armored siren with amber strobe.
2. The unit shall be enclosed in rust-free aluminum die-cast housing.
3. The unit shall be mounted directly to the wall or 4" x 4" square back box.
4. The unit shall meet the following specifications:
  - a. Input voltage: 12 VDC
  - b. Current draw: 1.31 Amps
  - c. Operating voltage range: 9.6-14.4 VDC
  - d. Strobe
    - (1) Flash rate: 20-100 times/minute
    - (2) Candle power - 60,000 candles
  - e. Siren
    - (1) Sound Output – 127 bDA
    - (2) Tamper Contact capacity – 0.3A @ 12V DC
  - f. Operating Temperature: -4°F - 140°F (-20°C - 60°C)
5. Manufacturer: Subject to compliance with requirements, provide Amseco Model SSX-81SA (Basis-of-Design), or an equivalent product from one of the following:
  - a. Gentex
  - b. Amseco
  - c. Or approved equal.

**F. Power Supply**

1. 12 VDC Power Supply
  - a. The unit shall be a multi-output power supply/charger that converts a 115VAC/60Hz input into four (4) Class 2 Rated 12VDC or 24VDC power- limited outputs.
  - b. The unit shall meet the following specifications:
    - (1) Input: 115VAC, 60Hz, 3.5 amp, Input fuse rated @ 3.5 amp/250V.
    - (2) Output:
      - (a) 12VDC or 24VDC selectable output.



- (b) 12VDC @ 4 amp or 24VDC @ 3 amp supply current.
- (c) Four (4) Class 2 Rated fuse protected power- limited outputs.
- (d) Outputs are rated @ 3.5 amp.
- (e) Filtered and electronically regulated outputs.
- (f) Short circuit and thermal overload protection.
- c. Battery Backup:
  - (1) Built-in charger for sealed lead acid or gel type batteries.
  - (2) Automatic switch over to stand-by battery when AC fails.
  - (3) Maximum charge current 0.7 amp.
- d. Supervision:
  - (1) AC fail supervision (form "C" contacts).
  - (2) Notification trigger is selectable for 30 seconds (factory set) or 6 hours.
  - (3) Low battery supervision (form "C" contacts).
  - (4) Battery presence supervision (form "C" contacts).
- e. Visual Indicators:
  - (1) AC input and DC output LED indicators.
- f. Electrical:
  - (1) Operating temperature: 0° C to 49° C ambient. (2) 24.57 or 36.85 BTU/Hr.
  - (3) System AC input VA requirement: 402.5VA.
- g. Mechanical:
  - (1) Enclosure Dimensions (H x W x D approx.): 13.5" x 13" x 3.25"  
(342.9mm x 330.2mm x 82.55mm)
  - (2) Accommodates up to two (2) 12VDC/7AH batteries.
  - (3) Product weight (approx.): 7.3 lbs. (3.31 kg).
  - (4) Shipping weight (approx.): 8.4 lbs. (3.81 kg).



- h. Agency Approvals
  - (1) UL 294 UL Listed for Access Control System Units.
  - (2) UL 603 UL Listed Standard for Power Supplies for Use with Burglar Alarm Systems.
  - (3) UL 1069 UL Listed Hospital Signaling and Nurse Call Equipment.
  - (4) UL 1481 UL Listed Standard for Safety for Fire Protective Signaling Systems.
- i. Manufacturer: Altronix. Model AL600ULACMCB8 – no substitutions allowed.

## 2.3 EMERGENCY DOOR CONTROL SYSTEM

### A. Electromagnetic Lock

- 1. The unit shall be electromagnetic lock with 1,200 pounds of pull-apart holding force.
- 2. The unit shall have a Lifetime replacement warranty
- 3. The unit shall meet the following specifications:
  - a. Power consumption of 400mA @ 12VDC & 200mA @ 24VDC
  - b. Dual voltage, 12 VDC or 24 VDC, field switch selectable.
  - c. Bondstat standard
  - d. Instant release circuit, no residual magnetism
  - e. Surface mounts using only a drill and allen wrench
  - f. Fully sealed electronics, tamper proof & weather proof
  - g. Mounted using steel machine screws into blind finishing nuts
  - h. Architectural brushed stainless steel finish
  - i. Polished brass, clear anodized, & polished stainless finish dress covers available
  - j. Hardware accessories shall include brackets, housings, and dress covers as needed for every opening type
  - k. Shall include ten feet of jacketed stranded conductor
  - l. Lock and strikes plated to provide corrosion resistance
  - m. The lock shall be Fail Safe
  - n. The lock shall be UL listed



4. Manufacturer: Securitron. Model V2M1200 DB – no substitutions.

**B. Push Button**

1. The Push Button shall be 30.5 mm, Heavy-Duty, Assembled Push-Pull Unit.
2. The unit shall meet the following specifications:
  - a. Lamp Voltage - 120 VAC
  - b. Actuator - Standard
  - c. Actuator Color - Red
  - d. Light Unit Type - LED, full voltage
  - e. Light Unit Voltage - 120 VAC
  - f. Bus Material - Plastic
  - g. Number Of Positions - Two-position
  - h. Type - 30.5 mm, Heavy-Duty
  - i. Operating Mode - Maintained push and pull
  - j. Contact Configuration - 1NO-1NC
  - k. Size - 40 mm
  - l. Rating - NEMA 3, 3R, 4, 4X, 12, 13
  - m. Series - 10250T
  - n. Illumination - Illuminated
  - o. Certifications: CSA Certified, UL Listed
3. Manufacturer: Eaton/Cutter Hummer. Model 10250T597LRD2A-1X. No substitutions allowed.

**C. Power Supply**

1. The unit shall be a power supply with a constant output rating at both 12v and 24v settings, universal 120 VAC to 240 VAC input, and polarized option board connectors.
2. The unit shall include fire alarm interface board mounting that allows outputs to be configured as switched (power cut) or unswitched (power continues) when signal is provided.
3. The power supply shall meet the following specifications:
  - a. Input voltage 120/240 VAC, 50/60 Hz, universal input



- b. Output voltage 4A @ 12 or 24 VDC
- c. Field selectable with jumper Switching supply, 5% regulation, 240mVpp max ripple
- d. Enclosure Grey/baked enamel 14" x 12" x 4" (H x W x D), Eight 1/2 " x 3/4 " knockouts,  
  
NEMA Grade 1, Hinged cover with lock down screws.
- e. Operating temperature 32° - 120°F (0° - 49°C)
- f. Certifications ANSI/UL 294
  - (1) ULC-S318
  - (2) RoHS
  - (3) FCC Part 15
  - (4) Class 2
- g. Boards included:
  - (1) 900-BBK: Battery backup kit (backup board plus battery pack)
  - (2) 900-FA: Plug-in fire alarm (must be installed on option boards)
  - (3) 900-4R \* : 4 Relay output board or 900-8F \* : Fused, 8 zone option board
- h. AC primary fuse size 4A, 250v, 5 x 20mm SLOW-BLOW
- i. Battery fuse size 7.5A 32v ATO blade style
- j. DC output protection Overload protection - current limited foldback circuit
- k. Indicators LED indicators:
  - (1) AC input (visible on outside of enclosure)
  - (2) DC output
  - (3) Isolated SPDT contacts to monitor AC power status
- l. Weight (power supply) Approx. 9.0 lbs
- m. Weight (each battery) 4.0 lbs
- n. AC input termination 3 position terminal block with protective cover.  
Wire capacity: 10 AWG max.
- o. DC output termination 2 position terminal block with wire capacity: 12 AWG max.



- p. Option board connectors 2
  - q. Fire alarm board connector Yes (requires connection on option board)
  - r. Keylock – yes
  - s. Shall include 900-BAT: Backup battery pack
4. Manufacturer: Schlage. Model PS904 – no substitutions allowed.

## 2.4 DOOR ALARM SYSTEM

### A. Alarm Control panel

- 1. The unit shall be a Multi-Zone Annunciators that can be used as "stand alone" annunciators or interface with any other control panel via communication bus. Slave configurations are also available for all models.
- 2. Each zone shall have a green LED for status, a red LED for alarm memory, a yellow LED for shunt and a zone control button for acknowledge, reset and bypass functions.
- 3. Zone and common input and output type, timers and other features shall be programmable with easy to use free software.
- 4. The panel shall meet the following specifications:
  - a. Mounting - recessed
  - b. Size - 4 1/2" x 4 1/2" x 2"
  - c. Color - stainless steel faceplate
  - d. Power - requires 12 VDC power supply
  - e. Inputs
    - (1) Normally closed, normally open
    - (2) High Security multi-state end-of-line resistor Loop (color coded)
  - f. Outputs
    - (1) One open collector output per zone rated at 24 VDC, 100 mA (color coded)
  - g. Other: Four Auxiliary Control Inputs and 2 Common Zone Outputs may be programmed for a variety of functions
- 5. Manufacturer: Flair Electronics. Model 531 BC or approved equal.

### B. Door Contacts

- 1. Housing of ABS fire retardant plastic (coordinate color with Commissioner)



durable material. Provide reasonable protection against moisture and dust.

2. Operating gap between faces of switch housing and the magnet housing to be sized to accommodate installation variances and field conditions.
3. Contact shall contain a hermetically sealed magnetic reed switch rated for 10,000,000 cycles.
4. Wire shall be 22 gauge 4 conductor up to a maximum run of 5,000 ft. Home run each window and door to control panel, as specified on the security riser diagram.
5. Contact and magnet shall be drill mounted on metal and sealed with suitable adhesive.
6. Devices shall have End of line Resistor (EOLR) at the last device of each zone to provide zone supervision.
7. Manufacturer: Interlogix/UTC Model # Door Contact Recessed 1076D-N (1078C), Magnet for Hollow Core Door 1840-N, Door Contact Surface Mount 1045T, Door Contact Armored Cable 2507AD-L, Overhead Door Contact Potter ODC-59 - no substitutions allowed.

- C. Power Supply. Provide Altronix model AL600ULACMCB8 – no substitutions allowed. See power supply specifications for Prisoner Alarm System.

## 2.5 INTERCOM SYSTEM

### A. Master station

1. The intercom system shall be of an open voice, selective calling type with selector switches for each station.
2. System shall be fully intermixable with other masters or sub stations of the same series. Master station shall be simplex operation, with hands free reply from the responding station.
3. Master station shall be equipped with station selector switches, OFF button for standby mode, TALK button for simplex operation, and PRIV (privacy) button to block unauthorized monitoring.
4. An All Call button shall be provided for initiation of an announcement throughout the system when the All Call Adaptor or Chime & Music Center is included in the system.
5. Voice volume control shall adjust transmit and receive volume at the calling master station, and a call tone volume control shall be located beneath the operation plate.
6. A call from a sub or door shall be annunciated by a momentary electronic call tone, and the corresponding station LED shall light for approximately 20 seconds. The LED shall not light if a master station calls another master station. LEDs above selector buttons shall illuminate when the station button is pressed at the calling master. The Occupied LED shall light to indicate that the system is in use, and the Off LED shall light on the unit that has a station selected.
7. Master station shall flush mount into a wall. An optional backbox (BBX-1E) shall



be available for ease of installation. Sub stations shall be available in the following configurations:

- a. (1) surface or flush mount styles, with or without privacy;
  - b. (2) surface mount with three call buttons, with or without privacy;
  - c. (3) weather resistant door stations in surface or flush mount styles, mounted on or in standard 1-gang or 2-gang boxes; and (4) vandal proof style, indoor or outdoor models.
8. Optional equipment shall be available to provide chime from up to three door stations, All Call from a master station, and background music distribution to all or selected sub or master stations in the system.
  9. Wiring shall be multiple conductors with an overall shield inside a single jacket, including eight (8) common wires, plus one (1) individual wire per station in the system between masters. Maximum 12 conductors. Wiring to sub stations shall be two (2) conductors in a 1-master system, or three (3) conductors in a system with two or more masters, or when All Call is included.
  10. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    - a. Aiphone. Model LEF-3 (master station) (Basis-of-Design) or equivalent product from one of the following:
    - b. Siedle
    - c. Comelit
    - d. Or approved equal.
  11. Provide manufacturer's power supply for all products as required.

**B. Wall Mount Slave Station**

1. The unit shall be a vandal and weather resistant sub stations constructed of 12 gauge stainless steel.
2. The station shall be flush mounted into a standard 2-gang box, or surface mounted into the SBX-2G.
3. Each unit shall include tamper proof screws and a tool for installation.
4. The station shall have a stainless steel mechanical call button or red mushroom type button.
5. Communication at the master is push-to-talk or handset, and communication at the sub is hands free.
6. The slave station shall meet the following specifications:
  - a. Power Source: Supplied by master





- b. Speaker: 20 ohms, 2 -1/2" diameter, water and puncture resistant, 2.5 oz. ceramic magnet
  - c. Call Button: Mechanical SPST switch, stainless steel or Red mushroom SPST switch
  - d. Faceplate: 12 gauge stainless steel
  - e. Calling: Mono-electronic tone at master while call button is pressed, plus LED for 20 seconds (LED available on multiple-call masters only)
  - f. Communication: Hands free at sub. Master is push-to-talk, release-to-listen.
  - g. Mounting: Flush mount into a 2-gang box or surface mount
  - h. Mounting Hardware: 6x32 T-10 TORX tamper proof screws (tool supplied)
  - i. Terminations: Color-coded prewired pigtails
  - j. Wiring: Shielded cable is recommended. 3 Conductor shall be used for homerun wiring.
  - k. Wiring Distance: 650' w/ 22AWG; 1600' w/18AWG
  - l. Dimensions: 4-11/16"H x 4-11/16"W x 2"D
7. Wall Mount Slave Station Basis-of-Design: Subject to compliance with requirements, provide wall mount slave station by Aiphone, Model LE-SS (Basis-of-Design) or equivalent product from one of the following:
- a. Siedle
  - b. Comelit
  - c. Or approved equal.
8. Manufacturer of slave stations shall be same as that of Master station listed above under 2.5 A.

## 2.6 CLOSED CIRCUIT TELEVISION SYSTEM (CCTV)

### A. Scope

- 1. It is the intention of these specifications to set forth the minimum requirements for the performance of an integrated CCTV System which can provide adequate and reliable surveillance. In all details not specifically stated herein, it is understood that the equipment shall meet or exceed those requirements of the Electronic Industries Association (EIA) and the Underwriter Laboratories (UL) which are current at the time of the award or installation.
- 2. The CCTV System shall be designed and constructed as an IP based integrated highly reliable Surveillance and Alarm Assessment System. NYPD is using a centralized Genetec VMS for storing video recording off-site as well as for administering and controlling each individual camera. The contractor's responsibility shall be to furnish



and install the specified cameras, procure the necessary licenses (from Genetec or from NYPD inventory, as directed by NYPD), and coordinate with NYPD for the initial configuration and aiming of the cameras. The system shall consist of:

- a. IP Cameras
- b. Lenses.
- c. Camera enclosures.
- d. Camera mounts.
- e. Power supplies.
- f. Video Monitoring Workstations.

**B. Cables**

1. Protect the cables from kinks and do not subject it to bends of less than eight (8) inches radius.
2. Where required by code, plenum cable shall be provided.
3. CAT 6 cables shall be provided for IP cameras.
4. All data cables serving CCTV cameras shall be black in color.

**C. Identification and Tagging**

1. All cables, wires, terminal blocks and terminals shall be identified by labels, tags or other permanent markings.
2. Markings shall clearly indicate the function, source and destination of all cabling, wiring and terminals.

**D. Network Video Recorder (NVR) – Integrate CCTV system with NYPD's existing centralized network video recorder system located off-site. The existing network video recorder system is Genetec VMS. Coordinate system requirements with Commissioner to provide a CCTV system that is fully integrated and connected with the existing video recorder system.**

**E. CCTV Camera**

1. Standards, Regulations & Recognitions
  - a. The camera shall be backed by a minimum of three years manufacturer warranty.
  - b. The manufacturer shall provide the option of extended warranty for the camera. The optional extended warranty shall be available in two-year extension blocks for a total warranty period of maximum five years.
  - c. The camera shall meet product safety standards as defined in IEC/EN/UL 60950-1



- d. The camera shall meet product safety standards as defined in IEC/EN/UL 60950-22
- e. The camera shall meet ISO/IEC 14496-10 MPEG-4 Part 10, Advanced Video Coding (H.264)
- f. The camera shall meet ISO/IEC 14496-2 (Profiles ASP and SP) (MPEG-4 Part 2)
- g. The camera shall meet SMPTE 296M (HDTV 720p)
- h. The camera shall meet SMPTE 274M (HDTV 1080p)
- i. The camera shall meet ONVIF Profile S or ONVIF Version 1.01 or higher as defined by the ONVIF organization.
- j. The camera shall carry the following EMC approvals:
  - (1) EN55022 Class B
  - (2) EN55024
  - (3) FCC Part 15 - Subpart B Class A + B
  - (4) VCCI Class B
  - (5) C-tick AS/NZS CISPR22 Class B
  - (6) ICES-003 Class B
  - (7) KN22 Class B
  - (8) KN24
- k. The camera shall meet the following standards:
  - (1) IEEE 802.3af/802.3at (Power over Ethernet)
  - (2) IEEE 802.1X (Authentication)
  - (3) IPv4 (RFC 791)
  - (4) IPv6 (RFC 2460)
  - (5) QoS – DiffServ (RFC 2475)
- l. The camera shall meet the following mechanical environmental standards:
  - (1) IEC 60529 IP66/67
  - (2) NEMA 250 Type 4X
  - (3) IEC/EN 62262 IK10+ (50 J)



- (4) ISO 20653 IP6K9K
    - (5) IEC 60068-2-1
    - (6) IEC 60068-2-2
    - (7) IEC 60068-2-6
    - (8) IEC 60068-2-14
    - (9) IEC 60068-2-27
    - (10) IEC 60068-2-60
    - (11) IEC 60068-2-78
  - m. The camera shall meet the following Railway environmental standards (1) EN 50121-4
  - (2) IEC 62236-4
2. Mechanics & environmental
- a. The camera enclosure shall include the following:
    - (1) Vandal resistant aluminum and polycarbonate body providing encapsulated electronics
    - (2) clear transparent cover
    - (3) Fitted with a dehumidifying membrane
    - (4) The camera enclosure shall provide the ability to adjust the camera modules angle with -5 to 90° tilt, 360° pan and 95° rotation while maintaining an image that is not interfered by the camera housing.
  - b. The camera shall operate in a temperature range of -40°C to +60°C (-40°F to +140°F).
  - c. The camera shall operate in a humidity range of 10-100% RH (condensing).
3. Sensors & optics
- a. The camera shall be equipped with an IR-sensitive progressive scan sensor.
  - b. The camera shall be fitted with a megapixel lens providing automated iris functionality with P-Iris control and provide remote zoom and focus functionality.
  - c. The camera shall provide images down to:
    - (1) Lens 9 mm - HDTV 1080p 25/30 fps with WDR-Forensic Capture: Color 0.18 lux,



B/W 0.04 lux

- (2) Lens 9 mm - HDTV 1080p 50/60 fps: Color 0.36 lux, B/W 0.08 lux
- (3) Lens 22 mm - HDTV 1080p 25/30 fps with WDR-Forensic Capture: Color 0.28 lux,

B/W 0.06 lux

- (4) Lens 22 mm - HDTV 1080p 50/60 fps: Color: 0.56 lux, B/W:0.11 lux

4. Image Control

- a. The camera shall incorporate Automatic and Manual White Balance.
- b. The camera shall incorporate automatic and manually defined exposure zones.
- c. The camera shall support a configurable shutter in the range from 1/142850 s to 2 s in HDTV 1080p 25/30 50/60 fps mode.
- d. The camera shall support a configurable shutter in the range from 1/142850 s to 2 s in WUXGA (1920x1200) 25/30 fps mode.
- e. The camera shall incorporate capture mode with the following settings:
  - (1) HDTV1080p (1920 x 1080) with WDR: 25/30 fps with power line frequency 50/60 Hz
  - (2) HDTV1080p (1920 x 1080) without WDR: 50/60 fps with power line frequency 50/60 Hz
  - (3) WUXGA(1920 x 1200) without WDR: 25/30 fps with power line frequency 50/60 Hz
- f. The camera shall provide backlight compensation.
- g. The camera shall allow for rotation of the image in steps of 90°
- h. The camera shall incorporate a function for optimization of low light behavior.
- i. The camera shall incorporate a function for Electronic Image Stabilization (EIS) for real-time image stabilization.

5. Video

- a. The camera shall provide simultaneous Motion JPEG and H.264 video streams.
- b. The camera shall be designed to provide at least two video streams in HDTV 1080p (1920x1080) at up to 60 frames per second (60Hz mode) or 50 frames per second (50Hz mode).
- c. The camera shall support Baseline Profile H.264 encoding with motion estimation in up to 60 fps (60Hz), 50 fps (50Hz) in HDTV 1080p resolution.



- d. The camera shall support Main Profile H.264 encoding with motion estimation and context- adaptive binary arithmetic coding (CABAC) in up to 60 fps (60Hz), 50 fps (50Hz) in HDTV 1080p resolution.
  - e. The camera shall support High Profile H.264 encoding with motion estimation up to 50/60 fps in up to 60 fps (60Hz), 50 fps (50Hz) in HDTV 1080p resolution.
  - f. The camera shall provide video in landscape format 4:3 and 16:9 as well as corridor format 3:4 and 9:16.
  - g. The H.264 implementation shall include both unicast and multicast functionality and support Maximum Bit Rate (MBR) as well as Variable Bit Rate (VBR).
6. Audio
- a. The camera shall support two-way full duplex audio.
7. Input sources:
- a. External microphone (balanced/unbalanced)
  - b. External line device
8. Output sources:
- a. External line device
9. Encoding
- a. The camera shall support:
    - (1) AAC LC at 8/16 kHz
    - (2) G.711 PCM at 8 kHz
    - (3) G.726 ADPCM at 8 kHz
10. Connectors
- a. The camera shall be equipped with a RJ45 10BASE-T/100/BASE-TX PoE Ethernet port or higher.
  - b. The camera shall be equipped with two configurable inputs/outputs, configurable for in- or output functionality.
  - c. The camera shall be equipped with a 3.5mm connector for Line out.
  - d. The camera shall be equipped with a 3.5mm connector for Line/Mic In.
11. PTZ functionality
- a. The camera shall incorporate guard tour functionality.



- b. The camera shall incorporate preset positions functionality.
  - c. The camera shall provide 3x optical and 2x digital zoom with 9 mm lens.
  - d. The camera shall provide 2.4x optical and 2x digital zoom with 22 mm lens.
  - e. The camera shall provide control queue functionality.
  - f. The camera shall provide On-Screen Directional Indicator (OSDI) functionality.
12. Event functionality
- a. The camera shall be equipped with an integrated event functionality, which can be triggered by:
    - (1) Live Stream Accessed
    - (2) Tampering
    - (3) Video Motion Detection
    - (4) Audio Detection
    - (5) Day/Night Mode
    - (6) External Input
    - (7) Temperature
    - (8) Schedule
    - (9) Manual Trigger/Virtual Inputs
    - (10) PTZ functionality
    - (11) Embedded third party applications
    - (12) Edge storage disruption detection
  - b. The cameras response to a triggered event shall include:
    - (1) Send notification, using HTTP, HTTPS, TCP or email
    - (2) Send images, using FTP, HTTP, HTTPS, network share or email
    - (3) Send video clip, using FTP, HTTP, HTTPS, network share or email
    - (4) Day/Night Vision Mode
    - (5) Play Audio Clip
    - (6) Activate External Output
    - (7) Send SNMP trap message



- (8) PTZ control functionality
  - (9) WDR Mode
  - (10) Recording to local storage and/or network attached storage
- 13. Storage
  - a. The camera shall be equipped with a video buffer for saving pre- and post-alarm images and shall have a microSD-card slot to support local storage of video.
  - b. The camera shall support SD/SDHC/SDXC UHS-I, memory up to 64 GB, speed class 10.
  - c. The camera shall support recording to network attached storage.
- 14. Other functionality
  - a. The camera shall include a customizable pixel counter functionality, identifying the size of objects in number of pixels.
  - b. The camera shall provide text overlay ability, including date and time.
  - c. The camera shall have the ability to apply a graphical image as an overlay image in the video stream.
  - d. The camera shall have the ability to apply privacy masks in the video stream
- 15. Network functionality
  - a. The camera shall support both static IP addresses and addresses from a DHCP-server.
  - b. The camera shall support both IPv4 and IPv6.
  - c. The camera shall incorporate support for Quality of Service (QoS).
  - d. The camera shall incorporate support for Bonjour.
  - e. To secure access to the unit as well as provided content, the camera shall support HTTPS, SSL/TLS.
  - f. The camera shall support IEEE 802.1X authentication.
  - g. The camera shall provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.
  - h. The camera shall support IP address filtering and include at least three different levels of password security.
  - i. The camera shall support time synchronization via NTP server.





16. Power
  - a. The camera shall accept Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3.
17. Maintenance & service
  - a. The camera shall provide a log file, containing information about all users connecting to the unit since last restart. The file shall include information about connecting IP address and the time of connecting.
  - b. The camera shall be monitored by a Watchdog functionality, which shall automatically re- initiate processes or restart the unit if a malfunction is detected.
  - c. The camera shall send a notification when the unit has re-booted and all services are initialized.
18. API & applications
  - a. The unit shall contain a built-in web server making video, audio and configuration available in a standard browser environment using HTTP.
  - b. The camera shall be fully supported by open and published API (Application Programmers Interface) providing necessary information for integration of functionality into third party applications.
  - c. The camera shall allow for applications developed by third parties to be uploaded into the camera, and the camera vendor shall provide compatibility tools to verify the stability and performance of the applications.
  - d. The camera shall conform to ONVIF Profile S or ONVIF Version 1.01 or higher as defined by the ONVIF organization and be upgradable at any time.
19. Manufacturer: Axis Communications. Models Q3515-LV 9mm, Q3515-LVE 9mm, Q8414-LVS, Q6155-E 60Hz, Q6000-E MK II, and P3225-LV MK II (See drawing TAC-405 for details). No substitutions allowed.

**F. CCTV PC**

1. The VMS Display workstation:
  - a. Intel Core i7-4790 Processor (Quad Core, 8MB, 3.60GHz w/HD4600 Graphics)
  - b. Operating System: Microsoft Windows 10 Professional.
  - c. RAM:8 GB DDR2 533 MHZ Memory
  - d. Hard Disk:120 MB for software installation; minimum 30 GB for data storage
  - e. Ethernet card TCP/IP 10/100 Base-T or higher



- f. Miscellaneous: AGP 8X (0.8) or AGP 4X (0.8V/1.5V) support
  - g. Video Card: High performance PCI Express x16 graphics card supporting DirectX 9.0 and dual independent monitors. At least 512 MB of high speed graphics memory.
  - h. DVD: DVD playback requires DVD drive
  - i. The workstation needs NYPD Finest 2.0 image & Genetec VMS installed.
- 2. Monitor:
  - a. UltraSharp 21.5-inch VGA 1600 X 1200 or higher resolution flat panel LCD monitor with 24 bit color support.
  - b. Dot pitch/Pixel Pitch shall 0.255mm
  - c. The Video Bandwidth shall be 162 MHZ
  - d. Image aspect ratio shall be 4:3
  - e. Image contrast ration shall be 800:1
  - f. Power consumption - 75 Watt (7) The size shall be 17.5"W x 7.6"D x 14.4"H
  - g. Manufacturer: Dell, HP, Viewsonic, or approved equal.
- 3. All-In-One PC (For Exterior Cameras)
  - a. The unit shall be a desktop All-in-One PC.
  - b. The unit shall meet the following specifications:
    - (1) Processor: Intel Core i5-6500 Processor (Quad Core, 6MB, 4T, 3.2GHz, 65W)
    - (2) Operating System: Windows 10 Professional English, French, Spanish 64bit.
    - (3) Display: XX IN WLED Full-HD AIO Non-Touch Display
    - (4) Memory1: 4GB (1x4G) 1600MHz DDR3L Memory
    - (5) Hard Drive: 2.5 inch 500GB 7200rpm Hard Disk Drive
    - (6) Graphics Card: Intel Integrated Graphics
    - (7) Optical Drive: 8x DVD+/-RW 9.5mm Optical Disk Drive.
    - (8) Keyboard: Dell KB216 Wired Keyboard English Black
    - (9) Mouse: Dell MS116 Wired Mouse Black
    - (10) Wireless: Intel Dual Band Wireless 8260 (802.11ac) + Bluetooth



- (11) Warranty: 3 Years Hardware Service with Onsite Service After Remote Diagnosis
- (12) Dimensions: Height: 52.78 cm (20.78") x Width: 36.3 cm (14.29") x Depth: 6.35 cm (2.5")
- (13) Weight: 6.341kg (13.98lbs)
- (14) Slots: Supports optional optical disc drive and standard media card reader 1 M.2 connector (Wi-Fi Card)
- (15) Ports:
  - (a) 4 – USB 3.0 (2 side, 2 rear)
  - (b) 2 – USB 2.0 (rear)
  - (c) HDMI 1.4
  - (d) Display Port 1.2
  - (e) RJ-45
  - (f) 1 Universal Headset (Side)
  - (g) Line-out 1 Rear
- (16) Chassis: 1 internal 2.5"
- (17) Regulatory:
  - (a) Product Safety, EMC and Environmental Datasheets

c. Manufacturer: Dell, HP, Lenovo, or approved equal.

## 2.7 Card Access System (ACS)

### A. Scope

- 1. It is the intention of NYPD to use Lenel OnGuard as the Card Access Control system for those doors/gates that will be controlled by a card access system. Initially, the scope addresses only the IT rooms and a specific gate. In all details not specifically stated herein, it is understood that the equipment shall meet or exceed those requirements of the Electronic Industries Association (EIA) and the Underwriter Laboratories (UL) which are current at the time of the award or installation.
- 2. The Card Access System (ACS) shall be designed and constructed and integrated into the NYPD Lenel Enterprise System consisting of:
  - a. CARD ACCESS SYSTEM – No substitutions.

Network Intelligent Controller	Lenel LNL-3300
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Dual Reader Interface Module	Lenel LNL-1320
Input control module (if necessary)	LNL-1100
Ethlan Micro board 10/100MBPS	Lenel LNL-ETHLAN-MICR On Board 10/100Mbps Ethernet
HID RP 40 Card Reader	HID RP 40 # 920NWNNEKE054W (#ICE0458)
Request-to-Exit Motion Detector	Bosch DS 150i
Request-to-Exit Release Button	Alarm Controls TS2-2
Cabinet w/Power Supply	Lenel LNL-600ULX-4CB6
Cabinet w/Relay Power Supply	Alronix AL600ULACMCB8
Door Contact recessed	Interlogix United Technologies Model # 1076D-N (1078C)
Magnet for Hollow Core Door	Interlogix United Technologies Model # 1840-N
Door Contact surface mount	Interlogix United Technologies Model # 1045T
Door Contact Armored Cable Surface Mount	Interlogix United Technologies Model # 2507AD-L
Overhead Door Contact	Potter ODC-59 Series
Battery	Yuasa Battery # N5P-12
Access control Flexible cable (Plenum)	West Penn AC251822BYE1000

b. MAGNETIC DOOR LOCKS - No substitutions.

Magnetic Lock	Securitron V2M1200DB
Three Piece "Z" Bracket	Securitron Z-V2M1200
Power Supply	Schlage PS904
Push Button	Cutter Hammer 10250T597LRD2A-1X 30.5 mm, Heavy-Duty, Assembled Push-Pull Unit, Red Standard Operator, 2 Position, Operating Mode: Maintained Push, Maintained Pull, 40 mm, LED Illuminated, 120 VAC, 1NO, 1NC

c. DOOR CONTACTS – No substitutions.



Door Contact recessed	Interlogix United Technologies Model # 1076D-N (1078C)
Magnet for Hollow Core Door	Interlogix United Technologies Model # 1840-N
Door Contact surface mount	Interlogix United Technologies Model # 1045T
Door Contact Armored Cable Surface Mount	Interlogix United Technologies Model # 2507AD-L
Overhead Door Contact	Potter ODC-59 – no substitutions allowed.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

A. Description

1. Prepare data in the form of an instructional manual.
2. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:
  - a. Part 1: Directory; listing names, addresses, and telephone numbers of Commissioner, Contractor, and major equipment suppliers.
  - b. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of suppliers.
  - c. Identify the following: Significant design criteria.
    - (1) Equipment Tests
    - (2) Parts list for each component.
    - (3) Operating instructions.
    - (4) Maintenance instructions for equipment and systems.
  - d. Part 3: Project documents and certificates, including the following:
    - (1) Shop drawings and product data.
    - (2) Card reader and door contacts open and close reports.
    - (3) List of all active devices (card reader, contacts, motion detectors, glass break detectors).



- (4) Certificates.
- (5) Photocopies of warranties.
- (6) Photocopies of bonds.

**B. Contents, Each Volume**

- 1. Table of Contents: Provide title of project; names, addresses, and telephone numbers of Commissioner, Sub-consultants and contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- 2. For each Product or System: List names, addresses and telephone numbers of suppliers, including local source of supplies and replacement parts.
- 3. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- 4. Drawings: Supplement product data to illustrate relations of components parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- 5. Narrative Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- 6. Warranties.
- 7. Bonds.

**C. Manual for Equipment and Systems**

- 1. Each item of Equipment and Each system: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and test, and complete nomenclature and model number of replaceable parts.
- 2. Include color coded wiring diagrams as installed.
- 3. Operating Procedures: Includes start-up, break-in and routine normal operating instructions and sequences. Include regulation, control stopping, shut-down and emergency instructions. Include summer, winter, and any special operating instructions.
- 4. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting, disassembly restoration, and reassembly instructions, and alignment, adjusting, balancing, and checking instructions.
- 5. Provide servicing schedule for all recording equipment.
- 6. Include manufacturers printed operation and maintenance instructions.
- 7. Include sequence of operation by controls manufacturer.
- 8. Provide original manufacturer's parts list, illustrations, assembly drawings, and



diagrams required.

9. Provide control diagrams by controls manufacturer as installed.
10. Provide list of original manufacturers; spare parts, current prices, and recommended quantities to be maintained in storage.
11. Include test reports as specified in Section 3.7.
12. List additional requirements specified in individual Product specification sections.
13. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

**D. Instruction**

1. Before final inspection, instruct The City of New York's designated service operators in operation, adjustment and maintenance of products, equipment, and systems, at agreed upon times.
2. For equipment requiring seasonal operation, perform instruction for other seasons within six months.
3. Use operation and maintenance manuals as basis for instruction. Review contents of manual with service operators in detail to explain all aspects of operation and service.
4. Prepare and insert additional data in Operation and Maintenance manual when needed as the need for such data becomes apparent during instruction.

E. After all final tests and adjustments have been completed, fully instruct the proper City of New York's service operators in all details of operation for equipment installed. Supply properly trained installers to operate equipment for sufficient length of time to assure that The City of New York's service operators are properly instructed to take over operation and service procedures. Supply properly trained installers to operate equipment for sufficient length of time as required to meet all required performance tests.

F. Furnish required number of manuals, in bound form containing data covering capacities, maintenance of operation of all equipment and apparatus. Operating instruction shall also include the following:

1. Parts List: Identifying the various parts of the equipment for restoration and replacement purposes.
2. Instruction Books may be standard booklets but shall be clearly marked to indicate applicable equipment.
3. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.

G. Where applicable, one set of operating and maintenance instructions shall be neatly framed behind glass and hung adjacent to the equipment concerned.

**3.3 GENERAL REQUIREMENTS**



- A. Installation shall include the delivery, storage, setting in place, fastening to the building structure, interconnection of the system components, alignment, adjustment and all other work, whether or not expressly specified which is necessary to result in a tested and operational system.
- B. All installation practices shall be in accordance with, but not limited to, the specifications and drawings. Installation shall be performed in accordance with requirements and recommendations of the National Electrical Code and 2014 New York City Electrical Code.
- C. During the installation and up to the date of substantial completion, the protect finished and unfinished work against damage or loss. In the event of such damage or loss, replace or restore such work at no expense to the City of New York.
- D. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three.
- E. All boxes, equipment, etc., shall be plumb and square. The Contractor must take such precautions that are necessary to prevent and guard against electromagnetic and electrostatic hum, to supply adequate ventilation and to install the equipment to provide reasonable safety for the operator.
- F. In the installation of equipment and cables, considerations shall be given not only to operational efficiency, but also to overall aesthetic factors.
- G. Electrical work should be installed to specifications. All security wiring shall be concealed or in conduit as noted.
- H. Supply and install all fittings and accessories, required for proper, safe and reliable operation of the system whether or not they are specified.
- I. No exposed equipment shall be installed without the Commissioner's approval of design, finish and mounting details.

#### 3.4 CABLE INSTALLATION

- A. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.
- B. All cabling run in ceiling cavities shall be neatly strapped, dressed and adequately supported every 8-10 feet. Cable installation shall conform to good engineering practices and to the standards of the most current National Electrical Code.
- C. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables which interface with racks, cabinets, consoles or equipment modules. Wire shall be interfaced with screw terminal blocks through the use of spade lugs installed on the cable with an installation tool specifically recommended by the manufacturer of the lug. Evidence of the installation of cables and wires without the appropriate connectors, spade lugs and tools shall be sufficient cause for rejection of the work and reinstallation of the cables or wires.
- D. Where cables or wires require soldering, the soldering shall be done using rosin core solder and controlled temperature soldering equipment. Evidence of solder joints not made with rosin



core solder or with non- temperature controlled tools shall be sufficient cause for rejection of the work and resoldering of all connections.

- E. Every cable or wire shall be labeled or coded at each end. Each terminal of each field terminal strip shall be permanently labeled or coded to show the zone, instrument or item served. Terminal blocks shall be numbered by circuit pairs, such as 1 to 25, 26 to 50, etc.
- F. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination. Separate groups should be formed for the following:
  - 1. Power cables.
  - 2. Video cables and audio cables carrying signals less than 2.0 volts, peak-to-peak.
  - 3. Audio cables carrying signals between 2.0 volts and 24 volts, peak-to-peak, security monitoring cables carrying signal under 5 volts, peak-to-peak.
  - 4. Audio cables carrying signals above 24 volts, peak-to-peak, and local control system cables carrying signals under 24 volts, current limited to under 5 amperes.
- G. All security cables shall be in conduit if routed through an exposed ceiling. Under no circumstances shall cables be exposed in the finished area.
- H. Coaxial cables shall be run in continuous lengths except for terminations. No splices shall be permitted in any conduit run.
  - 1. All coaxial cables shall be terminated with "BNC" twist-on type. Connector crimp type connector are not acceptable.
  - 2. Provide connectors by Cambridge, Belden (PPC), TE Connectivity, or approved equal.
  - 3. Install all wiring in such a fashion to avoid interference from electrically induced interference.
- I. All conduit support shall be as required.
- J. Shielded conductors shall be installed in separate steel conduits and shall not occupy the same enclosure with unshielded conductors. Shielded conductors may be grouped together.
- K. Where shielded conductors enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors. Install sleeve on shield grounds in panels. Conduit connections shall be made to assure no interaction between power and signal circuits.
- L. Electrical self-stripping tap and pigtail connectors shall be tin plated brass "U" element contact. Connectors shall be 3M Brand Scotchlok 567 to 577., or an equivalent product by Grote, Hillman, or approved equal.

### 3.5 GROUNDING

- A. A single system ground point shall be established for the system. This shall consist of a single grounding point to which all grounds shall be connected.
- B. The system ground shall be located in the base of the security equipment racks. It shall consist

of copper bar sufficient in size to accommodate the required grounds.

- C. The system ground is to be connected to the local ground bus by conductors which have not more than 0.1-ohm total resistance. Under no conditions shall AC neutral either in a power panel or in receptacle outlets be used for a reference ground.
- D. Provide R.F. shielding and R.F. filtering for all systems and components to ensure no interaction with potential R.F. systems in proximity to the site.

### 3.6 FINISHES

- A. Equipment finishes shall be manufacturer's standard unless otherwise noted in the specification. All finishes, whether standard or custom, shall be submitted to the Commissioner for approval prior to fabrication.

### 3.7 TESTING

- A. When the Contractor has completed his own system tests and when the system record documents, including drawings, operation and maintenance manuals, are complete, the Commissioner is to be notified that the system fulfills the specifications and is ready for acceptance testing.
  - 1. Provide written documentation describing the total system test methodology for review and approval prior to commencement of system test including:
    - a. Remote devices including door contacts, card readers, door hardware, multiplex panels and all related remote security devices.
    - b. Communications system including intercom and video intercom components.
    - c. Power supplies.
    - d. Panic alarm system including glass break sensors, sirens, panic buttons and all related security devices.
  - 2. Provide a minimum of (3) qualified installers during the test period.
  - 3. Provide the required test equipment to perform a complete systems test.
- B. Approved English software packages shall be entered into the security computer systems and be debugged. Document and enter the initial database into the system. Provide the necessary blank forms with instruction to the Commissioner to fill-in all the required data information that will make up the database. The database shall then be reviewed by the contractor and entered into the system. A copy of the document and a copy of the recorded database on a diskette shall be made available for review on a later date. Prior to full operation, a complete demonstration of the computer real-time functions shall be performed in the presence of the Commissioner. A printed validation log shall be provided as proof of operation for each software application package. In addition, a point utilization report shall be furnished listing each point, the associated programs utilizing that point as an input or output and the programs which that point initiates.
- C. Upon satisfactory on-line operation of the system software, the entire installation including all subsystems shall be inspected. Perform all tests, furnish all test equipment and consumable supplies necessary and perform any work as required to establish performance levels for the



system in accordance with the specifications. Each device shall be tested as a working component of the completed system. All system controls shall be inspected for proper operation and response. The scope of the inspection work shall include, but not be limited to, the following:

1. Document all measured values and control settings for the system. These values and settings shall be recorded in the operation and maintenance manuals and shall be made available at the time of acceptance testing, following the indicated testing procedures.
  2. Check each system including all inputs and outputs for compliance with the performance standards.
    - a. Test shall demonstrate the specified response time of card readers during simulation of specified maximum access control request load on system.
    - b. Function all remote sensors for proper operations and testing of all wiring. The test shall include operating each device as it should operate in normal usage. No operations are to be simulated for this test.
  3. Check each control and monitoring function from all origination points to all controlled locations for proper operation.
  4. Adjust each piece of equipment as required for optimum quality and to meet the manufacturer's published specifications.
  5. Check to ensure that all systems are free from spurious oscillation and radio frequency pickup both in the absence of any input signal and also when the system is driven to full output.
  6. Establish tentative normal settings for all systems controls. All setup controls shall be adjusted for optimum system performance and shall be marked for reference.
  7. Demonstrate the power-up and power-down procedure for each system. These procedures shall be documented and then incorporated into the systems operation manual.
- D. All tests shall be documented by the Contractor and shall be witnessed by the Commissioner. Following the system test and inspection, the Commissioner shall prepare a list of any outstanding work, which must be completed by the Contractor prior to issuance of the certificate of substantial completion.
- E. Upon receipt of the Contractor's notice that all punch list items from previous inspections are complete, the Commissioner shall reinspect the work for final acceptance. Provide all test equipment, materials and installers as required to assist in final acceptance. The final acceptance test shall consist of the following:
1. Verify that all record documentation is complete.
  2. The operation of all system and equipment shall be demonstrated by the Contractor to comply with the contract documents. Both subjective and objective tests may be required of the Contractor by the Commissioner to determine compliance with the specifications.
- F. Upon completion of the reinspection, the Commissioner shall either accept the system as being

substantially complete or advise the Contractor of work not completed or obligations not fulfilled as required for final acceptance. If necessary, the entire procedure shall be repeated.

- G. The inspections and tests may be suspended at the option of the Commissioner if it is his opinion that major components of the system are defective. Be available at the job site to make adjustments and restorations and take corrective action during the tests.
- H. The system shall be accepted as complete when all base contract work has been completed and all remedial work is performed and all documentation is complete, accurate and accepted, and the City of New York's service operators have received the specified instructions.
- I. Complete logs of tests shall be retained by the Contractor for inspection and review at any time after the testing has started. Upon final completion of system tests the log records shall be submitted.
- J. Submit detailed test check list and descriptive methodology for approval at least 4 weeks prior to start of test.
- K. Field Tests:
  - 1. Complete field tests shall be performed on all sub-systems. Each individual function shall be tested and proven correct in function and response a minimum of two times with not less than two-month time between individual tests.
  - 2. Provide the services of fully qualified technicians. Tests shall be performed after the system is adjusted and operating in accordance with specification requirements.

### 3.8 EQUIPMENT IDENTIFICATION

- A. Each major piece of equipment shall be provided with a permanently engraved or embossed metal identification tag. The tag shall include the following information:
  - 1. Name of manufacturer.
  - 2. Manufacturer's equipment description.
  - 3. Serial number and model number.
  - 4. Voltage and current rating.

**END OF SECTION 28 00 00**

**SECTION 28 08 00****COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]

**1.2 SUMMARY**

- A. This section includes commissioning process requirements for Electronic systems, assemblies, and equipment.
- B. Related Sections:
  - 1. DDC General Conditions Section "General Commissioning Requirements" for general commissioning process requirements.

**1.3 DESCRIPTION**

- A. Commissioning is a systematic process of confirming that all building systems perform interactively according to the Commissioner's Project Requirements and the Basis of Design and continuing through construction, acceptance and the warranty period with actual verification of performance.
- B. The Commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.
- C. The CxA directs and coordinates the commissioning activities and reports to the Commissioner. All members in the construction process work together to fulfill their contracted responsibilities and meet the objectives of the Commissioner's Project Requirement's as detailed in the Contract Documents.

**1.4 DEFINITIONS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for definitions.

**1.5 SUBMITTALS**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for CxA's role.



- B. Refer to DDC General Conditions Section “Submittals” for specific requirements. In addition, provide the following:
- C. Certificates of readiness
- D. Certificates of completion of installation, prestart, and startup activities.
- E. O&M manuals
- F. Test reports

## **1.6 QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer’s calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

## **1.7 COORDINATION**

- A. Commissioning Kick-Off Meeting – Construction Team: Contractors will attend a meeting of the Commissioning Team, chaired by the CxA, to review the scope of commissioning process activities and the Commissioning Plan with discussions on milestones, activities, and assignments of responsibilities. The flow and type of documents and the amount of submittal data given to the CxA will be determined. Meeting minutes will then be distributed to all parties by the CxA.
- B. Commissioning Meetings: Contractors will attend coordination meetings with the Commissioning Team, chaired by the CxA, to review progress on the Commissioning Plan, construction deficiencies, scheduling conflicts, and to discuss strategies and processes for upcoming commissioning process activities.
- C. Miscellaneous Construction Meetings: The CxA attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in the commissioning process.
- D. Pre-testing Meetings: Contractors will attend pretest meetings with the Commissioning Team, chaired by the CxA, to review startup reports, pre-test inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers’ authorized service representative services for each system, subsystem, equipment, and component to be tested.
- E. Testing: Contractors will coordinate with testing personnel and agencies for timing and access for CxA to witness test.
- F. Manufacturers’ Inspection and Startup Services: Contractors will coordinate services of manufacturers’ inspection and startup services.
- G. Testing, Adjusting and Balancing: Contractors will coordinate with plan and schedule for testing, adjusting and balancing for timing and access for CxA to witness process.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the contractor shall ultimately be responsible for all standard testing equipment for the electronic systems in Division 28. A sufficient quantity of two-way radios shall be provided by each contractor.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the The City of New York and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the The City of New York upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the The City of New York.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems
- B. Red-lined Drawings: The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data: Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems. The CxA will review the O&M literature once for conformance to project requirements. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.



- D. Demonstration and Instruction: Contractor will provide demonstration and instruction as required by the specifications. A complete instruction plan and schedule must be submitted by the Contractor to the CxA four weeks (4) prior to any instruction. An instruction agenda for each instruction session must be submitted to the CxA one (1) week prior the instruction session

### **3.2 CONTRACTOR'S RESPONSIBILITIES**

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meetings.
- C. Participate in Electronic systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CA.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and instruction in each purchase order or sub-contract written.
- F. Prepare preliminary schedule for Electronic system orientations and inspections, operation and maintenance manual submissions, instruction sessions, equipment start-up and task completion for The City of New York. Distribute preliminary schedule to commissioning team members.
- G. Update schedule as required throughout the construction period.
- H. Assist the CxA in all verification and functional performance tests.
- I. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- J. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- K. Coordinate with the CxA to provide 48-hour advanced notice so that the witnessing of equipment and system start-up and testing can begin.
- L. Notify the CxA a minimum of two weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- M. Participate in, and schedule vendors and contractors to participate in the instruction sessions.
- N. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required:
  - 1. Fire Alarm System
- O. The equipment supplier shall document the performance of his equipment.
- P. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.





- Q. Equipment Suppliers
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the The City of New York, to keep warranties in force.
  2. Assist in equipment testing per agreements with contractors.
  3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- R. Refer to DDC General Conditions Section “General Commissioning Requirements” for additional Contractor responsibilities.

### **3.3 CxA'S RESPONSIBILITIES**

- A. Refer to DDC General Conditions Section “General Commissioning Requirements” for CxA’s Responsibilities.

### **3.4 TESTING PREPARATION**

- A. Certify in writing to the CxA that Electronic systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Electronic instrumentation and controls have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with building automation, smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### **3.5 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of Electronic testing shall include the entire Electronic system installation, from the incoming power equipment throughout to each peripheral and end device. Testing shall include measuring, but not limited to resistance, voltage, and amperage of system(s) and devices.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

- D. The CxA along with the contractor and other contracted subcontractors, including the fire alarm Subcontractor shall prepare detailed testing plans, procedures, and checklists for Electronic systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Electronic system, document the deficiency and report it to The City of New York. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.6 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 28 sections. Provide submittals, test data, inspector record, infrared camera or special equipment and certifications to the CA.
- B. Electronic Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 28 Sections "Instrumentation and Control" and "Sequence of Operations"; Assist the CxA with preparation of testing plans.
- C. Fire Detection and Alarm System Testing: Provide technicians, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- D. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:
  - 1. Fire Detection and Alarm System

### **3.7 DEFICIENCIES/NON-CONFORMANCE, RETESTING, FAILURE DUE TO MANUFACTURER DEFECT**

- A. Refer to DDC General Conditions Section "General Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, retesting, or failure due to manufacturer defect.



### **3.8 APPROVAL**

#### **A. Deficiencies/Non-Conformance**

1. The CxA will record the results of the functional test on the test form. All deficiencies or non-conformance items shall be noted and reported to the Commissioner and Contractors on a standardized form.
2. The Contractor shall respond to new deficiencies within five (5) business days. The response shall either indicate the issue will be corrected with anticipated date of completion indicated or the response should clearly indicate why the Contractor disputes the claim while referencing the contract document in dispute or request further information to clarify the concern.
3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA.
4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
5. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing Contractor.
6. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it, the CxA documents the deficiency and the Contractor's response and intentions or corrections. The CxA and Contractor then proceed to another test or sequence. Once the Contractor corrects the deficiency, the test is rescheduled and repeated in the anticipation of correct operation or function.
7. When there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the CxA documents the deficiency and the Contractor's response. The deficiency is then forwarded to parties assumed to be responsible for the deficiency. Resolutions are made at the lowest management level possible. Other parties are brought into the discussion as needed. Final interpretive authority is with the Commissioner. Final acceptance authority is with the Commissioner and CxA. The CxA will then document the resolution process. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency. The CxA then reschedules the test as stated in the section above.

#### **B. Failure due to Manufacturer Defect**

1. If 10% or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable only by the Commissioner. In such case, the Contractor shall provide the Commissioner with the following.
  - i. Within one week of notification from the Contractor the manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Commissioner within two weeks of the original notice.
  - ii. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
  - iii. The Commissioner will determine whether a replacement of all identical units or a repair is acceptable.
  - iv. Two examples of the proposed solution will be installed by the Contractor and the Contractor will be allowed to test the installations for up to one week, upon which the Commissioner will decide whether to accept the solution.
  - v. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.



### **3.9 DEFERRED TESTING**

- A. Unforeseen Deferred Testing – If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Commissioner. These tests will be conducted in the same manner as the seasonal tests, as soon as possible. Services of necessary parties will be negotiated.

### **3.10 MANUFACTURER’S MANUALS**

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in DDC General Conditions.
- B. Refer to DDC General Conditions Section “General Commissioning Requirements” for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

### **3.11 INSTRUCTION OF NEW YORK CITY PERSONNEL**

- A. The Contractor shall be responsible for instruction coordination, scheduling, and ultimately for ensuring that instruction is completed.
- B. The CxA shall oversee the instruction of the City of New York for commissioned equipment and systems.
  - 1. The CxA shall interview the City of New York to determine the special needs and areas where instruction will be most valuable. The Commissioner and CxA shall decide how rigorous the instruction should be for each piece of commissioned equipment. The CxA shall communicate the results to the Contractor, who will in turn communicate to the subcontractors and vendors who also have instruction responsibilities.
  - 2. In addition to these general requirements, the specific instruction requirements of the City of New York by Contractors, subcontractors and vendors are specified in the individual sections listed in Section 1.2 – SUMMARY.
  - 3. Each Sub and vendor responsible for instruction will submit a written instruction plan to the Contractor for review and approval prior to instruction. The Contractor will submit one comprehensive instruction plan to the CxA and the Commissioner.
  - 4. The plan will be reviewed by the CxA and the Commissioner. Comments pertaining to its deficiencies will be forwarded to the Contractor. The instruction plan will be rewritten until approved by the CxA and the Commissioner. The final approved instruction plan will cover the following elements:
    - a. Equipment (included in instruction)
    - b. Intended audience
    - c. Location of instruction
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of instruction on each subject
    - g. Qualified instructor for each subject
    - h. Instructor qualifications
    - i. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)



5. For the primary equipment, the Controls Subcontractor shall provide a discussion of the control of the equipment during the instruction conducted by each subcontractor or vendor.
6. Instruction documentation shall include the following items:
  - a. Copy of the instruction plan, including schedule, syllabus, and agenda.
  - b. Copy of the Commissioner's Project Requirements.
  - c. Copy of the Basis of Design.
  - d. Compiled operations manuals.
  - e. Compiled maintenance manuals.
  - f. Completed manufacturer instruction manuals.
  - g. Red-lined drawings.
  - h. Other pertinent documents.
7. The CxA develops criteria for determining that the instruction was satisfactorily completed, including attending some of the instruction, etc. The CxA recommends approval of the instruction to the Commissioner using a standard form. The Commissioner signs the approval form/letter template.
8. At one of the instruction sessions, the CxA presents a presentation discussing the use of the blank functional test forms for re-commissioning equipment
9. Videotaping of the instruction sessions in DVD format will be provided by the CxA

### **3.12 FUNCTIONAL BUILDING SYSTEMS DEMONSTRATION TEST (72 HOURS)**

- A. Refer to Addendum to the General Conditions Section "General Commissioning Requirements" for requirements pertaining to 72-Hour Functional Building Systems Demonstration Testing.

**END OF SECTION 28 08 00**



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**SECTION 28 31 11****FIRE ALARM INTEGRATED AUDIO/VISUAL EVACUATION SYSTEM****PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Related Sections:
  - 1. Section 07 84 10 "Firestopping"
  - 2. Section 08 70 00 "Finish Hardware"
  - 3. Division 21 Fire Suppression
  - 4. Division 23 Heating Ventilating and Air Conditioning Monitoring & Control (HVAC).
  - 5. Division 26 Electrical, Section 260500 Common Work Results for Electrical

**1.02 SUMMARY**

- A. Section Includes:
  - 1. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques. The features and capacities described in this specification are required as a minimum for this project.
  - 2. The system shall be in full compliance with 2014 New York City Construction Codes and the New York City Fire Department's standards and regulations.
  - 3. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
  - 4. The system as specified shall be supplied, installed, tested and approved by the New York City Fire Department, and turned over to the Commissioner in an operational condition.
  - 5. In the interest of job coordination and responsibilities, the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, inspection and tests, and shall be capable of providing a "UL Listing Certificate" for the complete system.

**1.03 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

1. Adhesives, sealants, paints and coatings used for the work of this section shall meet the Volatile Organic Compound (VOC) limits specified in Section 01 81 13.13 – "Volatile Organic Compound (VOC) Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings" where applicable. Certification of VOC content shall be in accordance with the LEED Building Submittals requirements of this section.

#### 1.04 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.05 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.06 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

#### 1.07 DEFINITIONS

- A. Broadcast Media: The speakers, radio, cell phone, and other media that will carry the selected message to the selected audience.
- B. FACP: Fire alarm control panel.
- C. NAC: Notification Appliance Circuit. A circuit used to monitor and activate notification appliances or devices.
- D. FM: FM Global (Factory Mutual).
- E. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- F. NICET: National Institute for Certification in Engineering Technologies.
- G. UL: Underwriters Laboratories.
- H. VESDA: Very Early Smoke-Detection Apparatus.
- I. NYFD: New York City Fire Department

#### 1.08 SYSTEM DESCRIPTION

- A. The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor based operating system having the following capabilities, features, and capacities:





1. The local system shall provide status indicators and control switches for all of the following functions:
  - a. Audible and visual notification alarm circuit zone control.
  - b. Status indicators for sprinkler system water-flow and valve supervisory devices.
  - c. Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

#### 1.09 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
- B. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
- C. System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
- D. The system shall have Class A circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.
- E. The system shall be capable of the following configurations. Both configurations are permitted on the same network.
  1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, or two, isolated Class A circuits.
- F. The system shall have an optional digital alarm communication transmitter.
- G. The system shall provide an off-normal warning prior to reset for all active devices.
- H. The system shall be capable of remote monitoring via a software system that provides a graphical representation of the fire alarm control panel at a remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control.
- I. The system shall be capable of being configured via a PC Tool.
- J. The system shall provide the following functions and operating features:
  1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
  2. Provide Class A initiating device circuits.
  3. Provide two Class A notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
  4. Audibles shall be synchronized throughout the entire building.
  5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.



- K. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.
- L. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- M. Fire alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual pull station
  - 2. Heat detector
  - 3. Addressable area smoke detectors
  - 4. Addressable Multi-criteria, dual optical smoke detectors
  - 5. Addressable Multi-criteria smoke detectors with built-in Carbon Monoxide (CO) sensor
  - 6. Standard Addressable Duct smoke detector
  - 7. Specialized Duct Smoke detector
  - 8. Projected beam detector
  - 9. Automatic sprinkler system water flow switch.
- N. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using an LCD display with multiple detail screens.
  - 1. Fire Alarm Condition:
    - a. Sound an audible alarm and display a custom message defining the building in alarm and the specific alarm point initiating the alarm on an LCD display.
    - b. Log into the system history archives all activity pertaining to the alarm condition.
    - c. Sound the ANSI 117-1 signal with synchronized audible notification appliances and synchronized strobes throughout the facility.
    - d. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
    - e. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
    - f. Activation of any smoke detector in the elevator lobby or the elevator equipment room shall, in addition to the actions described, cause the recall of the elevator to the 1<sup>st</sup> floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the NYFD.
    - g. Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
    - h. System operated duct detectors as per local requirements shall accomplish HVAC shut down.
    - i. Door closure devices shall operate by floor or by local requirements.
  - 2. Supervisory Condition:
    - a. Display the origin of the supervisory condition report at the local fire alarm control panel LCD display.
    - b. Activate supervisory audible and dedicated visual signal.
    - c. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.



- d. Record within system history the initiating device and time of occurrence of the event.
- 3. Trouble Condition
  - a. Display at the local fire alarm control panel LCD display, the origin of the trouble condition report.
  - b. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
  - c. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
  - d. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
  - e. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
  - f. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
- O. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

#### 1.10 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
  - 1. Supervisory power requirements for all equipment.
  - 2. Alarm power requirements for all equipment.
  - 3. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
  - 4. Voltage drop calculations for wiring runs demonstrating worst-case condition.
  - 5. NAC circuit design shall incorporate a 15% spare capacity for future expansion.
- C. Submit manufacturer's requirements for testing Signaling Line Circuits and device addresses prior to connecting to control panel. At a minimum the following tests shall be required; device address, the usage (Alarm, Supervisory etc.), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Complete drawings covering the following shall be submitted by the contractor for the proposed system:



- a. Floor plans showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable 2014 New York City Electric Code fill used.
  - b. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings.
- E. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
- 1. Light fixtures.
  - 2. HVAC registers
  - 3. Fire protection equipment interfaces
  - 4. Special suppression system interfaces
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- I. Software and Firmware Operational Documentation:
- 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
- J. Warranty: Sample of special warranty.

#### 1.11 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide.
- 1. FM Global (Factory Mutual (FM)):FM Approval Guide
  - 2. National Fire Protection Association (NFPA)
    - a. NYC National Electrical Code 2014
    - b. NYC National Fire Alarm Code 2014
    - c. NYC Standard For The Installation of Air Conditioning and Ventilating Systems
    - d. NYC Life Safety Code 2014
    - e. NYC Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment
  - 3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition
    - a. UL Fire Protection Equipment Directory
    - b. UL Electrical Construction Materials Directory
    - c. UL 38 – Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
    - d. UL 228 – Door Holding Devices
    - e. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
    - f. UL 268A - Smoke Detectors for Duct Application



- g. UL 464 - Audible Signal Appliances
  - h. UL 497A – Secondary Protectors for Communications Circuits
  - i. UL 521 - Heat Detectors for Fire Protective Signaling Systems
  - j. UL 864 - Control Units for Fire Protective Signaling Systems
  - k. UL 1283 – Electromagnetic Interference Filters
  - l. UL 1449 - Transient Voltage Surge Suppressors
  - m. UL 1971 - Signaling Devices for the Hearing Impaired
  - n. UL 2075 – Gas and Vapor Detectors and Sensors
  - o. UL 2572 – Mass Notification Systems
  - 4. Building Code
    - a. NYC Building Code 2014
    - b. NYC Fire Code 2014
  - 5. New York City Building Codes as adopted and/or amended by NYPD, ADA, and/or NY State equivalency standards as adopted by NYFD.
  - 6. New York Fire Department.
  - 7. NYC-MEA
  - 8. The manufacturer shall have a minimum of 15 years production experience in the manufacture and design of high sensitivity aspiration-type smoke detection systems.
  - 9. ISO 9002
- B. Supplier Qualifications
- 1. The manufacturer of the supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid. The manufacturer must have factory branches as well as independent distributors to allow the end user with the ability to utilize factory educated and authorized competitive service providers after system installation and commissioning.
  - 2. Provide the services of a factory educated and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be a professional engineer licensed in the State of New York.
  - 3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to The City of New York's personnel in the system operation and maintenance.
  - 4. The suppliers shall furnish evidence they have an experienced service organization, which carries a stock of spare and parts for the system being furnished.
  - 5. The equipment supplier shall be authorized and educated by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.
- C. Installer Qualifications:
- 1. The Contractor's installer shall enlist the services of a professional engineer licensed in the State of New York to assist in provision of the systems specified by this section. All work products of the Contractor's Engineer shall be submitted to Commissioner for review and acceptance.
  - 2. The Contractor's installer shall be properly instructed in accordance with UL for certifying fire alarm systems.
- D. Testing Agency Qualifications: Qualified for testing indicated.
- E. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.
- F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.



1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.
3. Combustion Characteristics: ASTM E 136.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Pre-installation Conference: Conduct conference at Project site.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

#### 1.13 PROJECT CONDITIONS

- A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.
- B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.14 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire alarm equipment that fail(s) in materials or workmanship within specified warranty period.
  1. Warranty Period: 1 year from date of Substantial Completion.

#### 1.15 SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for 1 year.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  1. Provide 30 days' notice to the Commissioner to allow scheduling and access to system and to allow the Commissioner to upgrade computer equipment if necessary.

#### 1.16 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

### PART 2 - PRODUCTS



## 2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Siemens Building Technologies (Basis-of-Design).
  - 2. Edwards, A Division of UTC Fire and Security.
  - 3. Notifier: a Honeywell company (onyx).
  - 4. Cerberus Pyrotronics (Fire Findor XLSV).
  - 5. Or approved equal.
- B. All products provided in this section shall be sole sourced from any single approved manufacturer listed above. Throughout this section, product requirements are given with reference to the Basis-of-Design manufacturer. If using product from a non-Basis-of-Design manufacturer, provide an equivalent product from an approved equal manufacturer for each product listed.

## 2.02 CONTROL PANEL

- A. Model: Provide Siemens Desigo Fire Safety FC and FV 2025, or equivalents from approved equal manufacturer listed above.
- B. The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detector and other initiation device information to control system output functions.
- C. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal and reset the panel.
- D. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks.
- E. The fire control panel system shall be capable of the following configurations.
  - 1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  - 2. The system shall support 252 addressable devices, each of which may be divided in any ratio on one, or two separate, isolated Class A circuits.
- F. The fire control panel system shall be capable of the following configurations. Both configurations are permitted on the same network.
  - 1. The system shall support up to 504 addressable devices, which includes a second SLC configuration and each may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
  - 2. The system shall support 504 addressable devices, each of which includes a second SLC configuration and each may be divided in any ratio on one, or two separate, isolated Class A circuits.
- G. The system shall be capable of supporting unshielded wiring applications.
- H. The system shall be compliant with the requirements of NFPA 720 as a Carbon Monoxide Detection Control Unit and shall meet the UL 2075 listing requirements. All inputs from CO sensors shall be indicated visually and audibly at the control panel. CO sensor inputs shall be distinct and descriptively annunciated from other signals.



- I. System Components:
  1. The System Periphery board shall be capable of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The onboard microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following; Power, Gnd. Fault, Alarm, Trouble. This board is integral to the system. The board shall be model number FCI2016-U1, or equivalent from approved equal manufacturer listed above.
  2. The system periphery board shall be capable of supporting two system drivers of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits, for a total panel capacity of 504 addressable devices. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The onboard microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LED's on the board shall provide annunciation for the following: Power, Gnd. Fault, Alarm, and Trouble. This board is integral to the system. The board shall be model number FCI2017-U1, or equivalent from approved equal manufacturer listed above.
  3. The Signal Line Circuits (SLC) shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.
  4. The standard Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Fire Safety control panels, when configured as a global PMI. The standard operator interface can acknowledge, silence, and reset panels via Global PMI.
  5. The LED Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Fire Safety control panels, when configured as a global PMI. Additionally, the operator interface provides twelve multicolored configurable LEDs for annunciating system status
  6. The System Periphery Board shall contain 2 Class B NAC circuits rated at 3 amps each with power-limited outputs. The zones shall be isolated and independently supervised. There shall be at least 6 unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady (Such as "Recall"), Temporal Code 3 (for CO alarms), March Time 120ppm, March Time 60ppm, and March Time 30ppm. The card shall have the following LED's to provide trouble shooting and annunciation; Power, Gnd. Fault, Zone Activation or Trouble. This functionality shall be integral to the system. The card shall be model number FCI2016-U1/FCI2017-U1, or equivalent from approved equal manufacturer listed above.
  7. The control panel shall be equipped with four Form C relays for alarm, trouble, supervisory, and programmable output. The system shall provide the mounting of all system cards, field wiring, and panel's inter-card wiring. All power limited field wiring shall be separated from all non-power limited internal wiring. The card shall be model number FCI2016-U1/FCI2017-U1, or equivalent from approved equal manufacturer listed above.
- J. System response time from alarm to output shall be an average of three (3) seconds.





- K. All system cards and modules shall have Flash memory for downloading the latest module firmware.
- L. Passwords:
  - 1. Technician Level Password - There shall be a 4-character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:
    - a. Arming and disarming devices.
    - b. Activating, deactivating or modifying detector ASD and sensitivity settings.
    - c. Activating and deactivating the History Log function and deleting obsolete entries.
    - d. Changing the system time and date.
  - 2. Maintenance Level Password - There shall be a 4-character password that a user must enter into the control panel in order to access the panel's reporting functions and walktest functions.
  - 3. Acknowledge Silenceable Reset Access - There shall be a key required to open a locked cabinet that a system user must use in order to acknowledge events, turn silenceable audibles and visuals on and off, and perform panel resets.
- M. Degrade Mode Alarm Activation:
- N. Software Modifications: The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made. Systems that require the use of external programmers or change of EPROMs are not acceptable.
- O. Logic: The fire alarm system shall support generic functions that deal with binary states (True/False, high/low), and produce desired outputs from one or more binary inputs (for example, alarm outputs from detector or manual station inputs). AND, OR, NOT, Any N, Latches, Start Timer, Delay Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function. The system shall support 500 logic functions.
- P. History: The system shall store 2000 events in history. Trouble warnings will occur when the History buffer is full.
- Q. Reports:
  - 1. The system shall have the ability to provide configuration, status, queue and history reports.
  - 2. Configuration reports shall provide the following information:
    - a. Custom Messages
    - b. Database Information
    - c. Entity Type
    - d. Zone usage
    - e. Device Category
    - f. Firmware revision
  - 3. Status reports shall provide the following information:
    - a. Disarmed cards and devices
    - b. ASD settings
    - c. Sensitivity in %/foot
    - d. Alarm threshold in %/foot
    - e. Temperature in degrees F.
    - f. Walktest
  - 4. Queue reports shall provide the following information:
    - a. Alarm events with custom message and event time



- b. Gas alarm events with custom message and event time
  - c. Supervisory events with custom message and event time
  - d. Trouble events with custom message and event time
  - e. Status events with custom message and event time
  - f. Information events
5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:
- a. Alarm events
  - b. Gas alarm events
  - c. Supervisory events
  - d. Status changes
  - e. Alarm verification
  - f. Output activation from logic
  - g. System Reset
  - h. Event Acknowledgements
  - i. Block Acknowledgements
  - j. Audible Silence System Flag Changes
  - k. Sensitivity Changes
  - l. Arm / Disarm Commands
  - m. Arm / Disarm By Logic
  - n. Manual Output Overrides
  - o. Output Overrides By Logic
  - p. Time Changes
  - q. Menu Logins
  - r. ASD Changes
  - s. Walktest
  - t. Device Input to Logic Activations/Deactivations

## 2.03 POWER SUPPLY

- A. The system Power Supply FP2011-U1, or equivalent from approved equal manufacturer listed above shall be a 170 Watt, 6-amp that provides 24VDC power for system operation. The power supply shall be filtered and regulated. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz.
- B. The system Power Supply FP2012-U1, or equivalent from approved equal manufacturer listed above, shall be a 300 Watt, 9-amp that provides 24 VDC power for system operation. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated for 120/240 VAC 50/60 Hz.
- C. The battery charger shall be able to charge the system batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed to select battery sizes.
- D. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.

## 2.04 SYSTEM ENCLOSURE

- A. Provide the enclosure as specified. Provide the color as to the 2014 New York City Construction Codes and FDNY requirements.



- B. Provide three-height-unit backbox as part of the manufacturer's system hardware for use with system enclosures. Each backbox is used to fasten the device with an outer door.

## 2.05 GRAPHIC ANNUNCIATOR

- A. Provide the Siemens model FT2007-U1 LED driver, or equivalent from approved equal manufacturer listed above, for use with custom graphic annunciators. Provide outputs for 32 zones including Alarm, Supervisory, and Trouble per zone. Also included shall be outputs for seven (7) system status indicators. 16 input points shall be provided. These inputs points shall be programmable as generic zone inputs, or as system inputs (reset, silence/unsilence, acknowledge, or lamp test) which allows specified functionality from a remote graphic annunciator. Programming the LED driver shall be integral to the manufacturer's Fire Safety programming tool.

## 2.06 REMOTE ANNUNCIATOR

- A. LCD Annunciator Panel: Provide FT2014/FT2015 LCD remote annunciator(s), or equivalent from approved equal manufacturer listed above, as indicated on the drawings. The remote annunciator shall provide visual indication of all system status changes including alarm, supervisory, trouble, and system status. Display shall include text descriptions as programmed at the main panel for all device status and system status. The remote annunciator shall provide key-lock switch protected functionality including reset, signal silence/un-silence, and acknowledge. The annunciator panel shall be available in both red and black housings.

## 2.07 INTELLIGENT INITIATING DEVICES

- A. General
  - 1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections.
- B. Smoke Detectors – Standard:
  - 1. Model: Siemens Standard Addressable H-Series, or equivalent from approved equal manufacturer listed above.
  - 2. The detector shall be guaranteed in writing not to false alarm when configured by the factory educated certified technician. The detector must provide up to 11 different environmental algorithms that allow the detector to provide superior false alarm immunity without the need for additional alarm verification delays.
  - 3. The detector shall have a multicolor LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
  - 4. The multi-criteria smoke detector shall be an intelligent digital photoelectric detector with a programmable heat sensor. Detectors shall be listed for use as open area protective coverage, in duct installation, and sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. So as to minimize the effort required by the installing and maintenance technician to appropriately configure the detector to ensure optimal system design, the detectors shall be programmable as application specific. Application settings shall be selected in software for a minimum of eleven environmental fire profiles unique to the devices installed location.
  - 5. The detector shall be designed to eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes, and air movement while factoring in conditions



- of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.
6. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The outputs shall be from an input of smoke obscuration, a thermal condition or a combination of obscuration and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
  7. The detector shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
  8. For the detector where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
  9. The smoke detector shall be model number HFP-11.
  10. Where required, there shall be available a programmable remote lamp configurable to remotely duplicate the on-board LED status of another system device. It shall be model ILED-H.
- C. Smoke Detectors:
1. Model: Siemens S-Line Addressable FDOO-Series, or equivalent from approved equal manufacturer listed above.
  2. The detectors shall be guaranteed in writing not to false alarm when configured by the factory educated certified technician. The detectors must provide at least 19 different environmental algorithms that allow the detector to provide superior false alarm immunity without the need for additional alarm verification delays.
  3. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
  4. Detectors shall utilize state of the art forward/backward light scattering technology, with improved detection for smoldering and flaming fire signatures. The detectors shall replace the need for ionization detectors due to improved response characteristics to flaming fires.
  5. When required, the detectors shall incorporate an addressable Carbon Monoxide (CO) sensor. The CO sensor shall be selectable as an input to the multi-criteria fire detector algorithm and as an independent life-safety CO gas detector (in compliance with NFPA 720).
  6. Detectors shall provide pre-alarm signal at 0.2% obscuration/ft. and a full alarm at 1.0% obscuration/ft. to meet the performance requirements of National Fire Protection Association Standard 76, Fire Protection of Telecommunications Facilities as a Very Early Warning Fire Detector (VEWFD).
  7. The forward/backward light scattering technology shall provide improved immunity to spurious activation (deceptive phenomena). The detectors shall have a "No False Alarm Guarantee".
  8. The detectors shall be RoHS-compliant: it shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.
  9. The multi-criteria detector with CO input shall be UL 2075 compliant as a gas and vapor detector.
  10. The multi-criteria fire detectors shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in-duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detectors' communications shall allow the detectors to provide alarm input to the system and alarm output from the system within four (4) seconds. So as to minimize the effort required by the installing and maintenance technician to appropriately configure the detector to ensure optimal system design, the detectors shall be programmable as application specific. Application settings shall be



selected in software for a minimum of 19 environmental fire profiles unique to the devices installed location.

11. The detectors shall be designed to eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.
12. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
13. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
14. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
15. The detectors shall support the use of an ambient temperature warning signal at the panel. This temperature shall be user-configurable for the set temperature of the warning and the event type generated by the warning. This event can be used to trigger system logic.
16. The multi-criteria detector with CO sensor shall support the use of an ambient Carbon Monoxide (CO) warning signal at the panel. This ambient CO level shall be user-configurable in parts per million (PPM) for the set threshold of the warning and event type generated by the warning. This event can be used to trigger system logic.
17. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
18. UL Listed as "direct in-duct" mounting.
19. Available models:
  - a. FDOOT441. Multi-Criteria incorporating 2 Optical sensors and 2 Thermal sensors with an operating temperature range of 32°F to 120°F. Nineteen selectable profiles. Polarity insensitive installation wiring. Three color LED.
  - b. FDOOTC441. Multi-Criteria incorporating 2 Optical sensors, 2 Thermal sensors, and Carbon Monoxide sensing technologies with an operating temperature range of 32°F to 120°F. Twenty-Five selectable profiles. Polarity insensitive installation wiring. Three color LED. CO sensor may be programmed as part of the multi-criteria or may be an independent CO detector.

**D. Smoke Detectors:**

1. Model: Siemens C-Line Addressable FD-Series, or equivalent from approved equal manufacturer listed above.
2. The smoke detectors must provide at least 3 environmental parameter sets to assist in device sensitivity configuration.
3. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
4. The detector shall be RoHS-compliant: it shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.
5. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
6. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
7. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
8. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.



9. Available models:
  - a. FDOT421. Multi-Criteria incorporating 1 Optical sensor and 1 Thermal sensor with an operating temperature range of 32°F to 100°F. Available in four parameter sets. Polarity insensitive installation wiring. Three color LED.
  - b. FDO421. Photoelectric Smoke detector with an operating temperature range of 32°F to 120°F. Available in three parameter sets. Polarity insensitive installation wiring. Three color LED.
- E. Heat Detectors – Addressable
  1. Thermal Detectors shall be rated at 135 degrees fixed temperature and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135 degrees Fahrenheit. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
  2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage. The thermal detector shall be model number HFPT-11 or equivalent from approved equal manufacturer listed above.
  3. Model FDT421 heat detector, or equivalent from approved equal manufacturer listed above, shall have the following temperature settings:
    - a. Fixed temperature at 135°F, 145°F, 155°F, 165°F, 174°F
    - b. Rate of Rise at 15°F/ min (8.3°C) at 135°F (57°C)
    - c. Rate of Rise at 15°F/ min (8.3°C) at 174°F (79°C)
    - d. Low temperature warning at 40°F (4.4°C)
- F. Duct Smoke Detectors – Addressable
  1. For duct detector applications, the smoke detector shall be an intelligent digital photoelectric detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
  2. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation.
  3. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available. A NEMA-3R and NEMA-4X option shall be available. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.
  4. The intelligent duct detector shall have a model number from the FDBZ-Series or equivalent from approved equal listed above. Where required there shall be available a duct housing with an on-board relay. Also where required, there shall be a standalone housing available with its own power supply and test/reset switch that does not require connection to a fire alarm control panel. It shall be model FBZ492-PR.
  5. Duct smoke detector housing shall allow use in duct systems with air velocity ranging from 100 to 4,000 feet per minute, within temperature ranges of 32°F to 120°F per minute, and with relative humidity ranging from 0 to 95%.
  6. Duct Housings and Accessories:
    - a. FDBZ492 Global Air Duct Housing for Conventional and Addressable Detectors or equivalent from approved equal manufacturer listed above.
    - b. FDBZ492-R Global Air Duct Housing for Addressable P2 Detectors with Relay Application or equivalent from approved equal manufacturer listed above.



- c. FDBZ492-R Global Air Duct Housing for Conventional Detectors with Relay Application or equivalent from approved equal manufacturer listed above.
  - d. FDBZ492-PR Global Air Duct Housing for Conventional Detectors with Relay Application and Built-in Power Source or equivalent from approved equal manufacturer listed above.
  - e. FDBZ-WP Weather-Proof housing to accommodate all versions of Global Air Duct Housings or equivalent from approved equal manufacturer listed above.
  - f. FDBZ-RTL Remote Test Lamp for Conventional Detectors or equivalent from approved equal manufacturer listed above.
- G. Detector Bases – Addressable
- 1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.
  - 2. Multi-Criteria Fire Detector Model FDOOTC441 or equivalent from approved equal listed above shall be listed as providing CO detection in duct application.
  - 3. The model number for the standard base shall be DB-11 - 6" Version or equivalent from approved equal manufacturer listed above.
  - 4. The model number for the standard base shall be DB-11E - 4" Version or equivalent from approved equal manufacturer listed above.
  - 5. Device capable of generating a 3,000 Hz tone that provides a signal up to 85dBA at 10 feet (3.1m) for localized annunciation. With the exception of the 520Hz low frequency square wave, the device shall meet the requirements of UL464. When used with a Fire Safety intelligent detector, Device shall have option of being powered directly from a signal line circuit (SLC) in a two-wire configuration. All device bases shall be capable of sounding simultaneously, individually or in any combination depending upon the system configuration.
  - 6. The model ABHW-4S or equivalent from approved equal listed above is a UL / ULC Listed supplementary smoke-detection device that meets or exceeds the 85dB at 10 ft. (3.1m) audibility requirement, including the low-frequency requirement of 520 Hz for 'Sleeping Areas'. The ABHW-4S shall meet the requirements of UL464. All model ABHW-4S bases are capable of sounding simultaneously, individually or in any combination: it is based upon the detector type, and when it used and configured with a compatible FACP.
- H. Manual Pull Stations – Addressable
- 1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.
  - 2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.
  - 3. The double action pull station shall be model number HMS-D, or equivalent from approved equal manufacturer listed above.
  - 4. Where required, there shall also be available pull stations with break glass, capable of explosion proof installation, capable of weatherproof installation, reset key operation, and metal housings.
- I. Addressable Interface Devices
- 1. Addressable Interface Devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be



- provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be model number HTRI or FDCIO Series, or equivalents from approved equal manufacturer listed above.
2. Where needed, a Conventional Zone Module shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 conventional smoke detectors and an unlimited number of contact devices. This module shall also be capable of monitoring Linear Beam detectors and conventional Flame detectors. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations (model DI-3IS with ISI-1, or equivalents from approved equal manufacturer listed above) compatible with the conventional zone module. The module shall be model HZM, or equivalent from approved equal manufacturer listed above.
  3. Single Device Damper Monitoring and Control: A single HTRI switch input, or equivalent from approved equal manufacturer listed above, shall be able to monitor all 3 states of a damper – open, closed, and in transit. A single device shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.
  4. Model FCIO422 addressable input/output module, or equivalent from approved equal manufacturer listed above, shall be insensitive to polarity and shall have capability for up to 4 separate inputs (Class B) or 2 separate Class A inputs and 4 separate outputs (Class B).
  5. Model HCP addressable control point shall provide remote, independent control of any of the following:
    - a. A notification appliance circuit (NAC)
    - b. A telephone zone
    - c. A speaker zone.
    - d. Door hold open devices: The fire door holder shall be a Fire Safety Model SDH-X-D or equivalent from approved equal manufacturer listed above. The unit shall operate in conjunction with the Fire Safety Fire Detection System to provide automatic release of the door when fire or smoke is detected by the system. The unit shall be listed by Underwriters' Laboratories, Inc. The door holder shall be wired to the Fire Safety Fire Alarm Equipment in an accordance with 2014 New York City Electrical Code wiring practice.

## 2.08 DEVICE PROGRAMMING UNIT

- A. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall be model DPU with carrying case.

## 2.09 NOTIFICATION APPLIANCES

- A. Series LFS – Low Frequency Sounders
  1. Notification appliances shall be Siemens Series LFS sounders, or equivalent from approved equal manufacturer listed above.
  2. Sounders shall be UL Listed under Standard 464 to meet the NFPA 72 (Fire) and NFPA 720 (CO Life Safety) requirements for sleeping rooms.
  3. Low profile sounder-only design.
  4. Selectable Tones (Temporal 3, Temporal 4, or Continuous)
  5. Sounders capable of synchronized coded output from fire alarm control panel (FACP) notification appliance circuit when set to "Continuous"
- B. Strobes





1. Visual-notification appliances shall be Series ST Strobe Appliances, or equivalent from approved equal manufacturer listed above.
2. The Series ST shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service
3. Strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 Class B
4. Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens.
5. All inputs shall be compatible with standard, reverse polarity supervision of circuit wiring by a Fire-Alarm Control Panel (FACP).
6. Strobe Plates, when installed, shall be the ST-MC-RETRO Strobe Plate, or equivalent from approved equal manufacturer listed above, and shall have the same electronic circuitry as the device strobe.
7. The Strobe shall be of low-current design.
8. The strobe intensity shall have field-selectable settings and shall be rated per UL Standard 1971 for 15/30/75/95cd or 115/177cd for ceiling mount where Multi-Candela appliances are specified.
9. The selector switch for selecting the candela shall be tamper resistant.
10. The appliance shall be compatible with the DSC sync modules, FireFinder XLS panel, FC2005, FC2025-2050, FV2025-2050, or PAD-3/4 power supply, or equivalents from approved equal manufacturer listed above, with built-in sync protocol when synchronization is required.
11. The strobes shall not drift out of synchronization at any time during operation.
12. If the sync module or Power Supply fails to operate, (i.e. - contacts remain closed), the strobe shall revert to a non-synchronized flash rate.
13. The strobes shall be designed for indoor surface of flush mounting.
14. The Strobe Appliances shall incorporate a Patented, Integral Strobe Mounting Plate that shall allow mounting to single-gang, double-gang, 4-inch square, 100mm European type back boxes, or a Surface Back box.
15. The Multi-Candela or Single-Candela Strobe Plate shall mount to either a standard, 4-inch square back box for flush mounting, or shall mount to the SBL2S back box for surface mounting.
16. All notification appliances shall be backward compatible.

**C. Horn/Strobes**

1. Audible / visual notification appliance shall be Series HS Horn Strobe and standalone Horn Appliances or equivalents from approved equal manufacturer listed above.
2. Horn Strobe and standalone Horn Appliances shall meet and be listed for:
3. UL Standard 1971 (Emergency Devices for the Hearing-Impaired for Indoor Fire Protection Service)
4. Standard 464 (Fire Protective Signaling)
5. Horn strobe shall be listed for indoor use and shall meet the requirement of FCC Part 15 - Class B
6. All inputs shall be compatible with standard reverse polarity supervision of circuit wiring by the Fire Alarm Control Panel (FACP)
7. Horn Strobe and standalone Horn Appliances shall have a minimum of three (3) field selectable setting for dBA levels, and shall have a choice of continuous or temporal (Code 3) audible outputs
8. Horn Strobe shall be of low-current design
9. Strobe portion of the appliance shall produce a flash rate of one (1) flash per second over the Regulated Input Voltage Range, and shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens.
10. Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:



- a. 15/30/75/110cd
- b. 135/185cd
- 11. The selector switch for selecting the candela setting shall be tamper resistant
- 12. Synchronization is possible when using the DSC sync modules, FireFinder XLS panel, FC2005, FC2025-2050, FV2025-2050, or PAD-3/4 power supply, or equivalent from approved equal manufacturer listed above, with built-in sync protocol
- 13. The strobes shall not drift out of synchronization at any time during operation.
- 14. The strobes shall revert to a non-synchronized flash-rate, if the sync module or Power Supply should fail to operate (i.e. – contacts remain closed)
- 15. All notification appliances shall listed for Special Applications:
  - a. Strobes are designed to flash at 1-flash-per-second minimum over their “Regulated Input Voltage Range”
- 16. All candela ratings represent minimum-effective Strobe intensity, based on UL Standard 1971

**D. Input Voltage Range**

**2.10 DIGITAL COMMUNICATOR**

- A. The Multi-Point Digital Alarm Communicator FCA2015-U1, or equivalent from approved equal manufacturer listed above, shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remote Receiving Station. The DACT shall support the following:
  - 1. Ademco Contact ID or SIA protocol
  - 2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones
  - 3. SIA selection shall provide the ability to transmit events for up to 10000 individual points
  - 4. Programming of accounts and phone numbers
  - 5. Dual phone line interface
  - 6. Line fault monitoring.
  - 7. Automatic 24-hour test
  - 8. The DACT supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral and reset events.
  - 9. The DACT supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm, and manual alarm events.
  - 10. Optionally, the DACT can be programmed to report events by event queue only.

**PART 3 - EXECUTION**

**3.01 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.02 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.03 INSTALLATION**

- A. Perform work in accordance with the requirements of NFPA 70, NFPA 72 and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.



- B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- C. In the event that limited energy cable installation is allowed, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 3 feet and where installed in environmental air plenums, be rated for such use and tied/supported by components listed for environmental air plenums installation.
- D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- E. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- G. Provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

#### 3.04 BOXES, ENCLOSURES AND WIRING DEVICES

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.

#### 3.05 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the 2014 New York City Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits minimum 18 AWG twisted.
- D. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.



- E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
- F. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- G. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and service.

### 3.06 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

### 3.07 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- C. A consistent color code for fire alarm system conductors throughout the installation.

### 3.08 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Testing General:
  - 1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
  - 2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
  - 3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
  - 4. Test reports shall be delivered to the acceptance inspector as completed.
  - 5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:
    - a. Ladders and scaffolds as required to access all installed equipment.
    - b. Multi-meter for reading voltage, current and resistance.
    - c. Two-way radios and flashlights.



- d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
- e. Decibel meter.
- f. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

### 3.09 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the Contractor's professional engineer licensed in the State of New York in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Commissioner and test results recorded for use at the final acceptance test.
- E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- F. Final Acceptance Test: Notify the Commissioner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until megger test results, the loop resistance test results, and the submittals required in Part 1 are provided to the Commissioner. Test the system in accordance with the procedures outlined in NFPA 72.
  - 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
  - 2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
  - 3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
  - 4. Visually inspect all wiring.
  - 5. Verify that all software control and data files have been entered or programmed into the FACP.
  - 6. Verify that Shop Drawings reflecting as-built conditions are accurate.
  - 7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
  - 8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
  - 9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.



- G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
    - a. Open, shorted and grounded signal line circuits.
    - b. Open, shorted and grounded notification circuits.
    - c. Primary power or battery disconnected.
  2. System notification appliances shall be demonstrated as follows:
    - a. All alarm notification appliances actuate as programmed
    - b. Audibility and visibility at required levels.
  3. System indications shall be demonstrated as follows:
    - a. Correct message display for each alarm input at the control display.
    - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
    - c. Correct history logging for all system activity.
  4. System off-site reporting functions shall be demonstrated as follows:
    - a. Correct zone transmitted for each alarm input
    - b. Trouble signals received for disconnect
  5. Secondary power capabilities shall be demonstrated as follows:
    - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
    - b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
    - c. System battery voltages and charging currents shall be checked at the fire alarm control panel.
- H. VESDA System Tests
1. The contractor shall allow for the manufacturer's representative to attend commissioning of the entire installation in the presence of the Commissioner.
  2. All necessary instrumentation, equipment, materials and labor shall be provided by the Contractor.
  3. The Contractor shall record all tests and system calibrations and a copy of these results shall be retained on site in the System Log Book.
  4. System Checks
    - a. Visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc., comply with the Specification.
      - a. Check the system to ensure the following features are operational and programmed in accordance with the specification.
      - b. Alarm threshold levels
      - c. Detector address
      - d. Time and date
      - e. Time delays
      - f. Air flow fault thresholds
      - g. External button operable (Reset/ Isolate)
      - h. Referencing
    - b. Units set to U.S. /S.I.
    - c. Check to ensure that all ancillary warning devices operate as specified.
    - d. Check interconnection with Fire Alarm Control Panel to ensure correct operation.
  5. Tests
    - a. Introduce Smoke into the Detector Assembly to provide a basic functional test.



- b. Introduce smoke to the least favorable Sampling Point in each Sampling Pipe. Transport time is not to exceed two minutes.
- c. Activate the appropriate Fire Alarm zones and advise all concerned that the system is fully operational. Fill out the log book and commissioning report accordingly.
- d. If more than two bar graph divisions illuminate under normal conditions (no smoke), review event log for two (2) weeks from date of commissioning and make appropriate adjustments to the alarm and delay thresholds.

### 3.10 DOCUMENTATION

- A. System documentation shall be furnished to the Commissioner and shall include but not be limited to the following:
  - 1. Refer to the DDC General Conditions and Section 01 32 34 "Computer Aided Design Coordination" for coordination and record drawing Requirements.
  - 2. System operation, installation and maintenance manuals.
  - 3. System matrix showing interaction of all input signals with output commands.
  - 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
  - 5. System program showing system functions, controls and labeling of equipment and devices.

### 3.11 PROTECTION

- A. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

### 3.12 DEMONSTRATION

- A. Instructor: Include in the project the services of an instructor, who shall have received specific education from the manufacturer for the instruction of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall instruct the employees designated by the Commissioner, in the care, adjustment, maintenance, and operation of the fire alarm system.
- B. Instruction sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the Commissioner.
- C. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Commissioner. The instruction may be divided into two or more periods at the discretion of the Commissioner. One instruction session shall be videotaped by the contractor. Videotapes shall be delivered to the Commissioner.
- D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the Commissioner.



- E. Comprehensive system troubleshooting instructions shall be provided for a single individual designated by the Commissioner. This session shall be separate and distinct from the above described sessions.
- F. All instruction sessions shall be conducted following final system certification and acceptance. Three additional instruction sessions shall be provided for all security personnel on all shifts six months after final system certification.
- G. All instruction sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific instruction from the manufacturer for the instruction of other persons regarding the inspection, testing, and maintenance of the system provided.

**END OF SECTION 28 31 11**



**SECTION 31 00 00****EARTHWORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 03 30 00 – Cast In Place Concrete
- C. Section 07 10 00 – Foundation Waterproofing
- D. Section 31 50 00 – Excavation Support and Protection
- E. Section 31 61 00 – Footings
- F. Section 31 68 00 – Foundation Soil Anchor

**1.2 SUMMARY**

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the excavation, foundation construction, filling and grading as shown on the Drawings and specified herein including, but not limited to the following:
  - 1. Removal of existing pavements, curbs, utilities, and former foundation walls, pile caps, grade beams etc., designated for removal; relocation of fence and fence posts when necessary and other structures encountered or left by wreckers, old walls, rubble, etc.
  - 2. All excavation of earth, concrete, construction debris, uncontrolled fill, remnants of foundations, and other materials to the bottom of foundation subgrades, pile caps, foundation, walls, pits and slabs as required and indicated on drawings.
  - 3. Excavation, filling and rough grading of site area at adjacent structures and roadways as required and within the Contract Limit Line.
  - 4. Excavation, filling, grading and compacting to required elevations for all floors and slabs on grade.
  - 5. Excavation, filling, grading and compacting to required elevations for appurtenances and site work.
  - 6. Pumping and dewatering as required for work of this section and foundation work (elevator pits, etc.).
  - 7. Excavation and trenching for mechanical trades, including but not limited to all plumbing, heating, water, gas and electric within the buildings as shown or required by the drawings; backfilling same with clean fill as described hereinafter, and thoroughly compacting to "Rough Grading" elevations.
  - 8. Providing additional approved suitable material for filling and rough grading.
  - 9. Legal disposing, off the site of surplus excavated materials unsuitable for filling or backfilling. Refer to environmental specifications.
  - 10. Other labor and materials as may be reasonably inferred to be required to make the work under this Section complete.

**1.3 REFERENCES**

- A. All work and materials under this section shall conform to the latest revision of the following standard specifications, where not otherwise required by the Contract Documents.

- B. All work shall comply with the requirements of the the 2014 Construction Codes of the City of New York, requirements of the New York State Department of Labor, requirements of Occupational Safety and Health Administration (OSHA), requirements of New York State Department of Health (NYSDOH), requirements of the New York State Department of Environmental Conservation (NYSDEC), requirements of the New York City Department of Environmental Protection (NYCDEP), requirements of the New York State Department of Transportation (NYSDOT), requirements of New York City Department of Transportation (NYCDOT), and requirements and drawings approved by the Long Island Rail Road (LIRR).
- C. The following publications form a part of this Specification to the extent indicated by the specific citations in other paragraphs of this Specification. In case of conflict, the particular requirements of this Specification shall govern, unless indicated otherwise.
  - 1. American Society for Testing and Materials (ASTM) and American Association of State and Highway Transportation Officials (AASHTO) Publications:
  - 2. 2014 New York City Building Code.
  - 3. Geotechnical Engineering Report for 116th Precinct Station House, Queens, New York, prepared by Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C., dated 15 December 2017.
  - 4. Remedial Action Plan for NYPD 116th Precinct State House, Queens, New York, CEQR No. 18NYPD02Q, prepared by Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C., dated 22 April 2019.

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Test Reports: Submit the following information for each source of each material submitted for review and comment by the Commissioner:
  - 1. Test reports on borrow material as follows:
    - a. Particle size analysis in accordance with ASTM D 422 (sieve only).
    - b. Soil classification in accordance with ASTM D 2487
    - c. Moisture content in accordance with ASTM D 2216
    - d. Modified Compaction Curve in accordance with ASTM D 1557.

2. Include data for all samples indicating the exact location and methods of transportation and placement of all materials.
3. Submit a 5-lb (minimum) sample of each borrow material proposed for use as general fill, drainage fill and controlled fill.

- B. Catalog Cuts: Submit catalog cuts and manufacturer's literature for compaction equipment, and waterproofing.
- C. Certification For Examination of Site and Records: Before proceeding with the Work, submit certification in an acceptable form, signed by the Contractor, stating that careful examination has been made of the site, existing structures, existing adjacent structures, records of utility lines, boring records, soil samples, geotechnical report, the Drawings, and all other Contract Documents.

#### 1.8 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. Refer to Section 01 40 00 "Quality Requirements", Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Field Testing of Fill Areas: Prepared fill lifts will be tested and approved by the Commissioner before construction of any further work thereon. Inspection and test of subgrades and fill layers will be taken as follows:
  1. Below building slabs and pit areas: For each compacted fill layer, make 1 field density test for every overlaying 2,500 sq-ft of building slab-on-grade or paved area-on-grade, but not less than three tests per lift. Perform field density tests in accordance with ASTM D 2922.
  2. Foundation wall backfill: Take at least three field density tests in accordance with ASTM D 2922 at locations and elevations as directed by the Commissioner.
- C. Codes and Permits:
  1. Procure and pay for all permits and licenses required to complete the work of this Section.
- D. Special Inspection:
  1. Before commencing work of this Section, meet with the Commissioner, and other concerned entities. Review the excavation and earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

#### 1.10 PROJECT CONDITIONS

- A. The Contractor, by careful examination, shall inform himself as to the nature and location of the work; the confirmation of the ground, the nature of the subsurface conditions; the locations of the groundwater table; the character, quality and quantity of the materials to be encountered; the character of the equipment and facilities needed preliminary to and during the execution of the work; and all other matters which can be in any way affect the work.



- B. Borings are available for the Contractor's review. Neither The City of New York nor the Commissioner make predictions or representations regarding the character or extent of soil, rock, or other subsurface conditions to be encountered during the work. The Contractor shall make his own deductions of the subsurface conditions which may affect the methods or expenses of construction of the work hereunder. Additional borings and other exploratory operations may be performed by the Contractor, at the Contractor's option, and following the Commissioner's approval. No change in the Contract Sum will be authorized for such additional exploration undertaken by the Contractor.
- C. Soil samples taken from the borings are available for the Contractor's inspection.
- D. Existing Utilities: Locate existing underground utilities in and beyond the areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during the work.
  - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with the Commissioner and utility companies in keeping respective services and facilities in operation. Restore damaged utilities to the satisfaction of utility owner.
  - 2. Do not interrupt existing utilities serving facilities occupied by The City of New York or the adjacent properties, during occupied hours, except when permitted in writing by the Commissioner and then only after acceptable temporary utility services have been provided. Provide a minimum of 48-hour notice to the Commissioner, and receive written notice to proceed before interrupting any utility.
  - 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.
- E. Examine drawings to determine the sequence of operations and relation to work of other trades. Start of work will signify acceptance of field conditions and will acknowledge coordination with other trades.
- F. Comply with the safety regulations of NYCDEP and the 2014 New York City Construction Codes, as well as those of Occupational Safety and Health Administration (OSHA).

#### 1.11 PROTECTION

- A. The project site is an urban area. The work shall be executed so that no damage or injury will occur to the existing public and adjoining or adjacent structures, Long Island Railroad structure, streets, paving, sewers, gas, water, electric or any other pipes. Should any damage or injury caused by the Contractor, or anyone in Contractor's employ, or by the work under this Contract occur, the Contractor shall, at their own expense, restore such damage.
- B. The above shall also include the protection of all existing utilities (including sewers, water lines, electrical lines, and telecommunication lines) to remain in use within and adjacent to the area affected by the work of this project.
- C. Monuments, benchmarks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, have them replaced at no additional expense to The City of New York.

#### 1.12 SUBSURFACE STRUCTURES AND UTILITIES

- A. The Contractor shall become acquainted with the existence and location of all surface and subsurface structures and utilities within the project area and beneath the surrounding streets. Contractor shall not damage any of those that are to remain and shall leave them accessible and make the necessary provision by sheeting, hanging, supporting or other means necessary to

obtain this result, subject to the approval of the New York City Department of Buildings and Department of Transportation, and the utility companies involved.

#### 1.13 ERRORS IN DEPTH

- A. In the event that any part of the excavation is carried, through error, beyond the depth and the dimensions indicated on the drawings or called for in the specifications, then the Contractor, at his own expense, shall furnish and install gravel, stone, or concrete fill with which to fill to the required level at all locations, subject to approval of the Commissioner.

#### 1.14 DESIGN AND MAINTENANCE OF TEMPORARY WORK

- A. Temporary work (other than Support of Excavation) shall be planned and installed so that the permanent work can be conveniently and adequately erected. Contractor shall be responsible for the adequacy of temporary work.
- B. Temporary work shall be maintained in good condition.
- C. Temporary work shall be changed, shifted, rebuilt, etc., as needed to suit the conditions of the permanent work.

#### 1.15 DEFINITIONS

- A. Wherever the word “excavating”, “excavate”, “excavation”, “carried down”, “remove”, etc., are used, they shall be taken to include the removal of all existing work, including brickwork, rubble work, former foundation remnants rubbish, earth, as well as rock, boulders, steel grillages and concrete and all other materials and obstructions encountered; they shall also be taken to include all sheet piling, bracing, pumping, and all operations and items needed for the proper execution of the work. Excavation is considered unclassified.
- B. Where the words “finished grades,” “finished grade lines,” or “future finished grades,” appear in these specifications, they shall be taken to mean the finished elevations as indicated on the drawings.
- C. Rough grading consists of cutting or filling to the elevation established on the Contract Drawings.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. All fill and backfill shall be material classified as controlled fill by the 2014 New York City Construction Codes. Composition shall consist of angular sands and gravels. Flat structured material such as mica (the main component of “mole” rock) falling into the acceptable gradation or other material affecting the permeability and structural characteristics of sand material shall not be permitted.
- B. Controlled Fill: Controlled fill material shall consist of well-graded sand, gravel, crushed rock, or a mixture of these, or equivalent materials with a maximum of 10 percent passing the #200 sieve, as determined from the percent passing the #4 sieve.
- C. Drainage Fill: Clean natural ¾-inch crushed stone (recycled concrete shall not be used as drainage fill) having the following gradations:

Sieve Size	%Passing by Weight
2 inch	100

¼ inch	25 to 60
No. 40	5 to 40
No. 200	0 to 5

- D. General Fill: Shall have no more than 20% by weight of stones or masonry debris, containing no stones or other materials greater than 4 inches in any dimension and contain less than 50% by weight materials finer than No. 200 mesh sieve.
- E. Fill for utility trenches shall meet the criteria given for structural fill and shall not contain sharp, angular pieces and pieces larger than 2 inches in any dimension.
- F. Before bringing any fill to the site, submit the source for approval by the Commissioner, in accordance with Section 1.7 of this specification.
- G. All fill materials (structural, granular, and general fill) required shall be free from wood, debris, combustible materials, vegetable matter or any material subject to decay or disintegration. Fill material shall not be contaminated.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.
- B. Refer to the Remedial Action Plan for provisions regarding the management and disposal of impacted on-site soils.

#### 3.2 PREPARATION OF PROJECT SITE

- A. Notify the Commissioner and the Long Island Railroad before the start of work.
- B. Install all necessary protective equipment, structures such as fences, signs, scaffolding, etc. before the start of work.
- C. Remove all existing structures, utilities, pavement in accordance with the Contract Documents.
- D. Protect all utility lines, which are not to be abandoned. Contractor shall be responsible for any damage to utilities that may occur.
- E. Perform test pits alongside each of the adjacent buildings to determine the extent and depth of the below-grade space and the foundation type.

#### 3.3 SITE DRAINAGE, PUMPING, AND DEWATERING

- A. The Contractor shall assume the responsibility for site drainage and shall maintain such drainage during the life of this contract in a manner so as not to adversely affect adjacent areas and structures.
- B. Provide adequate pumps, or other equipment, appurtenances, power, drains, materials and labor necessary to excavation continuously dry during excavation, foundation construction, and backfilling and at such other times as the progress of the work may demand or as necessary to ensure safety to the structure shall be provided.

- C. All pumping both inside and outside the areas of the building shall be performed, continued and maintained as required for the completion of all work, including the work of the mechanical trades, throughout the contract.
- D. Manage runoff to limit the impact on construction.
- E. The dewatering system or systems shall be installed and operated in such a manner as to avoid the movement of fines or loss of ground from below the bearing level and shall not influence the stability of surrounding areas. The facilities needed to eliminate loss of ground shall be included.
- F. Do not use any portion of the building foundation units or any part thereof as a sump for drainage resulting from pumping in any other area. Do not conduct water to other adjacent or nearby public or private properties.

### 3.4 GENERAL EXCAVATION

- A. The excavation shall be unclassified and shall comprise and include the satisfactory removal and legal disposal of all materials encountered regardless of the nature of the materials and shall be understood to include, boulders, earth, hardpan, miscellaneous fill, foundations, demolition debris from on-site buildings, structures, slabs, walls, utilities, pavements, curbs, piping, and debris.
- B. All excavation shall extend to the depths of the form and size required for the installation of the work as indicated on the drawings.
- C. Excavation shall be to required elevations for the bottom of pile caps, floors pits, slabs, walls, etc. Excavation shall be made to a depth that will allow installation of the full depth of concrete slabs, sub-base, and waterproofing as shown on drawings with a 1-inch tolerance. Excavation lines shall provide sufficient clearance for the proper execution of all concrete work including allowances for formwork, shoring, and inspection.
- D. A 3-inch-thick concrete mud-slab shall be required on all surfaces that will require horizontal waterproofing. All vertical surfaces to receive "blind-side" waterproofing shall require a flat/rigid substrate.
- E. The bottom of excavations shall be leveled off and graded to receive foundations, slabs, pits, trenches, and grade beams.
- F. Any impacted soils encountered shall be stockpiled on-site and disposed off-site in accordance with the Remedial Action Plan.

### 3.5 EXCAVATION FOR BUILDING SLABS AND STRUCTURAL MEMBERS

- A. Subgrades of building slabs and structural members including framed slabs and grade beams shall be approved by the Commissioner before proceeding with their construction. Subgrades resulting from excavation shall be free of unsuitable material (fill, loose rock pieces, organics, debris, etc.) as judged by the Commissioner.
- B. Unauthorized Excavation: Excavations performed below the elevations shown or specified, shall be filled and compacted as hereinafter specified, at no additional expense.
- C. Authorized Additional Excavation: Where the Commissioner determines that the bearing material encountered is unsuitable, remove the unsuitable bearing material. The removed material shall be replaced with controlled fill or concrete as directed by the Commissioner.

### 3.6 PROOFROLLING

- A. Before backfilling, all excavations should be proofrolled using a minimum 3-ton roller. Any loose areas identified by proofrolling should be removed and replaced with controlled fill in accordance with Section 3.07.

### 3.7 FILLING, GRADING, AND COMPACTING

- A. Filling and backfilling shall not be performed until work has been accepted by the Commissioner. All wood, paper, and other deleterious materials shall be cleaned out from excavations before backfilling.
- B. The filling or backfilling within the area of the building shall be done so that there will be no void spaces below floors and bottoms of pits and trenches, unless otherwise noted
- C. General: Material for fill and backfill shall be Controlled Fill as herein specified under Part 2 of these specifications. The material may be obtained from borrow sources and shall be free of any contamination.
- D. Placing: Place fill in horizontal 12-inch-thick maximum loose layers to produce a uniform thickness of the material. Start placement in the deepest area and progress approximately parallel to the finished grade. Do not place fill where free water is standing, on frozen subsoil or on surfaces that have not been approved.
- E. Compacting: Compact each layer of fill with the appropriate equipment listed below in this Article to achieve as a minimum the following percentages of maximum density at optimum moisture when tested in accordance with ASTM D1557:

LOCATION	% MAX. DENSITY
Under Building Slab-on-Grade	95
Under Paved Areas	95
Under Structural Members and Structural Slabs	92
Behind Foundation Walls	95

- F. Building Slabs with Foundation Anchors and Utilities - Compact each 12-inch-thick lift of the general fill with a minimum six overlapping passes with a 3-ton vibratory roller compactor in open areas. Use a 1-ton walk behind roller compactor to the extent possible in areas that preclude access by a 3-ton compactor. Use a plate tamper in and around penetrations, small restrictive areas, or any other areas not accessible to the 1-ton roller compactor.
- G. Compaction Equipment: Granular fills (sand, gravel, friable earth) shall be compacted with a vibratory plate compactor not less than 0.5 ton in static weight to the extent possible. A jumping jack shall be used in and around penetrations, small restrictive areas, or any other areas not accessible to the roller or heavy plate compactor.
- H. Backfilling against Foundation Walls: After completion of foundation walls and removal of forms, clean the excavation of all trash and debris before application of waterproofing and/or vapor barrier and placement of backfill.
- I. Do not backfill against foundation or basement walls until completion of supporting floor construction to top of backfill or first level above the top of backfill, unless adequate temporary shoring is provided.





- J. If Contractor elects to backfill against foundation or basement walls prior to completion of supporting floor slabs, these walls shall be shored. Temporary shoring shall be designed by a professional engineer licensed in the State of New York retained by the Contractor. Shoring engineering services and calculations shall be submitted to the Commissioner for review and approval.
- K. In placing backfill, take special care to prevent wedge action, eccentric loading or overloading of the structure by equipment used for compacting backfill material, and to prevent damage to waterproofing on walls. Where subsoil drainage systems are installed, place backfill to prevent any damage to the systems. Any damage to waterproofing or drainage systems caused by backfilling or excavation operations shall be corrected or replaced by the Contractor at his own expense.
- L. Additional backfilling required to bring fill to the finished subgrades shown shall be done by the Contractor only after the concrete walls or piers, against which the backfilling is done, have attained their full design strength, have been braced and the written permission to backfill is obtained from the Commissioner. If fill is required on both sides of a wall, it shall be brought up simultaneously and evenly on both sides.
- M. Do all filling necessary to bring the ground surfaces to the required levels for floors, pits, and areaways as shown on the drawings.
- N. Any surplus materials shall be removed from the site and legally disposed in accordance with the Remedial Action Plan. Should additional material be required for the placing of backfill, other than material obtained from the site, obtain and deliver and place accepted backfill material as required.

### 3.8 FIELD QUALITY CONTROL

- A. The Commissioner shall review all laboratory test results and submitted reports specified in this Section.
- B. The Commissioner will interpret the tests, state in each report whether or not the test specimens and results comply with all requirements of the Contract Documents and note any deviations.
- C. The Commissioner will identify when and where samples are to be obtained for testing.
- D. Collect samples and forward them to the Testing Agency. Testing Agency will submit the following laboratory test reports to the Commissioner.
  - 1. Laboratory results conducted on each type of borrow and fill material:
    - a. Gradation Analysis – ASTM D 422.
    - b. Atterberg Limits – ASTM D 4318.
    - c. Modified Moisture Density Curve Determination – ASTM D 1557.
  - 2. The Commissioner will review for conformance of materials to be used for fills, based on the gradations given in these specifications.
- E. Engineering Inspection:
  - 1. All engineering inspections shall comply with the requirements of the 2014 New York City Building Code.
  - 2. Building Slab Subgrades: the Testing Agency shall inspect subgrades for all building slabs and footing elements. No pavement, slab, or footing shall be constructed unless the subgrade is approved by the Testing Agency.



3. Proofrolling: Proofrolling operations shall be inspected by the Testing Agency.
4. Backfilling and Compaction: The Testing Agency shall verify the densities of the fill placed. The Testing Agency shall take field density tests of the fill placed and shall report to the Commissioner. No fill shall be placed without inspection and approval of the Commissioner. The testing agency will take field tests (in accordance with ASTM D 2922) of the subgrade for every 2,500 sq-ft, but not less than three tests per lift in each area, and a minimum of three tests for every compacted soil lift behind foundation walls.

### 3.9 CLEAN-UP AND DISPOSAL

- A. All excess material including, earth, rock, fill, shall be removed from the site and legally disposed of in accordance with the DDC General Conditions and the Remedial Action Plan.
- B. All lumber, forms and metal work shall be removed immediately after completion of local areas. The Contractor shall be responsible for removal of all debris produced by work to this section from the site.
- C. Sidewalk and streets adjoining the property shall be broom cleaned and free of debris, rubbish, trash and obstructions of any kind caused by the work of this Section.

### 3.10 MONITORING EXISTING STRUCTURES

- A. Monitoring Requirements – The adjacent buildings shall be monitored as follows:
  1. Vertical and Lateral Displacements –
    - a. Before starting work, the Contractor's Professional Engineer licensed in the state of New York and Land Surveyor license in the state of New York shall check and verify governing dimensions and elevations, survey conditions of adjoining properties, and record any prior settlement or cracking of structures, pavements, and other improvements. Video all adjacent structures prior to the beginning of any construction activities.
    - b. Install a minimum of 5 lateral and vertical reference points (on the upper third and the lower third of each building face) on each building abutting the site. In addition, provide reference points at the ground surface, all-around the excavation perimeter, at 25 feet on-center. All monitoring locations shall be subject to review by the Commissioner.
    - c. The monitoring points shall be established by the Contractor's Professional Land Surveyor licensed in the State of New York, and referenced to a fixed off-site benchmark. Video all monitoring points prior to the beginning of any construction activities.
  2. Ground Vibrations –
    - a. The vibration monitoring locations shall be selected by the Commissioner.
    - b. The seismographs will be provided by, and the monitoring performed by the Testing Agency.
    - c. Monitoring shall be performed before the start of work to obtain ambient levels, and daily during excavation and foundation construction work. Written reports summarizing the monitoring results shall be submitted to the Commissioner for review.
- B. Frequency and Reporting
  1. Vertical and Lateral Displacements - Monitoring shall be performed twice on a weekly basis during any excavation support or foundation work. Readings shall be taken to nearest



0.005 ft. Written reports summarizing the monitoring results shall be submitted by the Contractor's Professional engineer licensed in the State of New York to the Commissioner for review on a weekly basis. The reports shall be submitted in both electronic copies and hard copies. The reports shall include the raw data points as well as graphs and tables summarizing the monitoring data.

2. Ground Vibrations – The ground vibrations caused by the foundation work, bracing and foundation installation operations shall be monitored continuously with threshold-type seismographs capable of measuring ground movements to 0.02 in/sec. Written reports summarizing the monitoring results shall be submitted by the Contractor's Professional engineer licensed in the State of New York to the Commissioner for review on a weekly basis.

**C. Threshold**

1. Vertical and Lateral Displacements –
  - a. The maximum allowable movements of the adjacent buildings and structures shall be 1/4 inches for horizontal movement and 1/4 inches for vertical movements. The action thresholds shall be three consecutive readings of 1/16 inch of movement, or one confirmed reading of 1/8 inch.
  - b. The maximum allowable movements of the adjacent pavement or ground shall be 1 inch for horizontal movement and 1/2 inches for vertical movements. The action thresholds shall be one half of the maximum allowed movement.
2. Ground Vibrations – The maximum allowable ground vibration immediately adjacent to any of the adjacent structures is 0.5 in/sec.

**D. Action Items**

1. Any movement exceeding the above criteria will be reported immediately to the Commissioner. Work in the immediate area will cease.
2. On exceeding any of the established thresholds, all work will be stopped until the adjacent structure/building in question is inspected and evaluated by the Contractor's Professional Engineer and the Commissioner, to confirm its structural integrity. Modify procedures as required to maintain vibrations and movements within established thresholds. If required, submit a corrective plan of action prior to continuing work. The Contractor shall restore any damage to the structures at his own expense and to the satisfaction of the Commissioner.
3. The Contractor may establish additional monitoring points on the existing adjacent structures, subject to the building owner's approval, to adequately monitor and otherwise keep himself informed of the structures' conditions during the work.
4. Restore, to the satisfaction of the Commissioner, by restoration, replacement, or otherwise, the portions of buildings, or their contents, altered by the Contractor in furtherance of his excavation support work. Restoration shall be completed to the conditions which existed prior to the start of work.

**END OF SECTION 31 00 00**

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**SECTION 31 10 00****SITE CLEARING, REMOVALS AND PREPARATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).
- B. Section 31 00 00 – Earthwork
- C. Section 31 25 00 - Soil Erosion and Sediment Control
- D. Section 33 02 00 - Protection of Existing Utilities

**1.2 SECTION INCLUDES**

- A. Miscellaneous site clearing including removal of trees, asphalt, concrete, curbs, rails, fences, storage containers, storage tanks, and mobile trailers in preparation for site improvements.
- B. Protection of existing utilities.
- C. Disconnection and capping or removal of identified utilities and in-service unidentified utilities encountered.
- D. Backfilling voids in subgrade created as a result of removals.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS.
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

**1.5 ENVIRONMENTAL REQUIREMENTS**

- A. Construct erosion control systems as shown on the plans or as directed by the Commissioner to protect adjacent properties and water resources from erosion and sedimentation.

**1.6 JOB CONDITIONS**

- A. Variations or discrepancies in actual site conditions at the commencement of work under this contract shall be brought to the attention of the Commissioner prior to the commencement of any site work.

**PART 2 - PRODUCTS****2.1 Not applicable****PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 PREPARATION**

- A. Verify that construction phasing and clearing limits are clearly tagged, identified and marked.

**3.3 PROTECTION**

- A. Locate and identify existing utilities that are to remain and protect them from damage as indicated on the Contract Drawings.
- B. Conduct operations with minimum interference to public or private access ways and facilities. Maintain access and egress at all times and clean or sweep any roadways daily or as required by the 2014 New York City Construction Codes and the New York City Department of Transportation. At such times as deemed necessary by The City of New York, dust control shall be provided in accordance with specification Section 31 25 00 – Soil Erosion and Sediment Control.
- C. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a Land Surveyor registered in the State of New York and replaced, as necessary, by the same at no additional expense to The City of New York.
- D. Provide traffic control as required, in accordance with the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and New York City Department of Transportation requirements.

**3.4 CLEARING AND REMOVAL**

- A. Clear areas required for access to site and execution of work.



- B. Unless otherwise indicated on the Contract Drawings, improvements or obstructions interfering with installation of new construction shall be removed completely. Backfill shall be conducted with suitable on-site fill material or suitable imported material placed and compacted as per Section 31 00 00 - Earthwork.
- C. Existing utilities to be removed/abandoned shall be properly disconnected in accordance with the applicable utility. Provide the utility and The City of New York two weeks of prior notice, in writing, before the work is to commence to schedule and coordinate disconnect of utility with other surrounding functions.
  - 1. Utilities indicated to be removed shall be removed completely including all pipe and structures foundations. Trenches shall be backfilled and compacted in accordance with the specifications or as directed by the Commissioner.
  - 2. Utilities indicated to be abandoned shall be left in place unless directed otherwise by the Commissioner.

### 3.5 DISPOSAL OF MATERIALS

- A. No burning of any material, debris or trash on site or off site will be allowed.
- B. Transport site debris, rubbish and other materials with appropriate vehicles, and legally dispose of off-site to areas approved by the Commissioner.

**END OF SECTION 31 10 00**



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**SECTION 31 25 00****SOIL EROSION AND SEDIMENT CONTROL****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).
- B. Section 31 10 00 – Site Clearing, Removals and Preparation
- C. Section 31 00 00 – Earthwork
- D. Storm Water Pollution Prevention Plan (SWPPP) prepared by Langan Engineering, Surveying, Landscape Architecture, and Geology, D.P.C.

**1.2 SUMMARY**

- A. Provide all labor, materials, equipment and services to implement all erosion and sediment control practices and procedures as indicated in the Contract Documents.
- B. Inspect and maintain all erosion and sediment control practices weekly, prior to anticipated rainfall events, and after rainfall events. Needed restorations shall be made immediately.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCES:**

- A. New York State Department of Environmental Conservation (NYSDEC) Standards and Specifications for Erosion and Sediment Control, latest revision.
- B. United States Department of Environmental Protection Agency (EPA) Document No. EPA 832/R-92-005, "Storm Water Management for Construction Activities", Chapter 3, latest revision.
- C. New York City Building Code, 2014 edition.

**1.6 ENVIRONMENTAL REQUIREMENTS**

- A. Protect adjacent properties and water resources from erosion and sediment damage throughout construction in accordance with the Soil Erosion and Sediment Control Plan and NYSDEC standards. The Contractor shall be responsible for administering the Plan.
- B. Discharge from dewatering operations shall not be directed to surface waters. Discharge from dewatering operations shall be per DDC General Conditions.

**1.7 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.8 SUBMITTALS**

- A. The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:
  - 1. Product Warranty
  - 2. Product Data
- B. All calculations and shop drawings shall be signed and sealed by a Professional Engineer registered in the State of New York and submitted to the Commissioner for review.

**1.9 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.10 DELIVERY, STORAGE AND HANDLING**

- A. Store materials in designated areas and as recommended by the manufacturer to protect against the elements, direct exposures, and damage.
- B. Furnish erosion control blankets, jute mesh and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement.

**1.11 WARRANTY**

- A. Erosion control material shall have a warranty for use and durable condition for project specific installations.
- B. Temporary erosion control materials shall carry a minimum eighteen (18) month Manufacturer's warranty from date of substantial completion.

- C. Permanent erosion control materials shall carry a minimum three (3) year Manufacturer's warranty from date of substantial completion.

## PART 2 - PRODUCTS

### 2.1 SILT FENCE

- A. Silt fence posts: wood, steel, or an approved synthetic material, with a minimum length of three (3) feet. Hardwood posts shall have a minimum cross sectional area of 3.5 square inches. Steel posts shall be standard T and U sections weighing not less than 1.00 pounds per linear foot.
- B. Silt fence fabric: Fabric shall meet or exceed the following specifications:

PROPERTY	UNIT	TEST METHOD	MIN. ACCEPTABLE VALUES
Grab Tensile Strength	lbs.	ASTM D4632	110
Elongation at Failure	%	ASTM D4632	20
Puncture Strength	lbs.	ASTM D4833	60
Mullen Burst Strength	PSI	ASTM D 3786	300
Flow Through rate	(gal./min.sf)	ASTM D 4491	25
Equivalent Opening Size		US Std. Sieve ASTM D 4751	40-80
Ultraviolet Radiation Stability	%	ASTM D 4355	70

- C. Wire Fence: Minimum 14 gage with a maximum six-inch mesh opening.

### 2.2 STRAW BALE DIKE

- A. Hay or straw bales: New straw that shall be either wire bound or nylon string tied.
- B. Bale stakes: Rebar, steel pickets, or 2-inch x 2-inch hardwood stakes.

### 2.3 STABILIZED CONSTRUCTION ENTRANCE

- A. Stone aggregate: 1-inch to 4-inch clean stone or reclaimed or recycled concrete.
- B. Geotextile: woven or non-woven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydro-carbons, mildew, rot resistant, and conform to the fabric properties shown:

PROPERTY	UNIT	TEST METHOD	Light duty* Roads Grade Subgrade	Heavy duty** Haul Roads Rough Graded
Grab Tensile Strength	lbs.	ASTM D1682	200	220
Elongation at Failure	%	ASTM D1682	50	60
Puncture Strength	lbs.	ASTM D751	40	125
Mullen Burst Strength	PSI	ASTM D3786	190	430
Equivalent Opening Size		US Std. Sieve CW-02215	40-80	40-80
Aggregate Depth	(inches)	-	6	10

1. \*light duty roads: Area sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. Trivera Spunbound 1115
  - b. Mirafi 100X
  - c. Typar 3401
  - d. Or approved equal.
2. \*\*heavy duty roads: Area sites with only rough grading, and where most travel would be multi-axle vehicles. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. Trevira Spunbound 1135
  - b. Mirafi 600X
  - c. Typar 3801
  - d. Or approved equal.

#### 2.4 FILTER FABRIC INLET PROTECTION:

- A. Filter Fabric: Fabric shall be a woven polypropylene geotextile and sewn by a double needle machine using a high strength nylon thread. Fabric shall be manufactured to fit the drainage inlet.

PROPERTY	UNIT	TEST METHOD	MIN. ACCEPTABLE VALUES
Grab Tensile Strength	lbs.	ASTM D4632	110
Grab Elongation	%	ASTM D4632	10-15
Puncture Strength	lbs.	ASTM D4533	900
Trapezoidal Tear	lbs.	ASTM D4533	65-90
Flow Through rate	(gal./min.sf)	ASTM D 4491	66
Equivalent Opening Size	US Sieve	ASTM D 4751	30
Ultraviolet Radiation Stability	%	ASTM D 4355	96
Permittivity	sec-1	ASTM D-4491	0.862

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PREPARATION

- A. Review site conditions and Contract Drawings prior to the commencement of demolition, earth moving activities or excavation.
- B. Notify the Commissioner prior to the commencement of work. Any proposed deviation from the Contract Drawings must be submitted to the Commissioner in writing 72 hours prior to commencing work.

- C. Install erosion and sediment controls for each work area prior to commencement of work within that work area. Comply with NYSDEC standards and specifications.
- D. Perform all erosion and sediment controls in accordance with the Contract Drawings.

### 3.3 SILT FENCE

- A. Silt Fence shall be placed as close to disturbed area as possible, but at least 10 feet from the toe of a slope steeper than 3H:1V. The area beyond the fence must be undisturbed or stabilized. The type of silt fence specified for each location on the plan shall not exceed the maximum slope length and maximum fence length requirements shown in the following table:

Slope	Steepness	Slope Length/Fence Length (ft.)		
		Standard	Reinforced	Super
<2%	< 50:1	300/1500	N/A	N/A
2-10%	50:1 to 10:1	125/1000	250/2000	300/2500
10-20%	10:1 to 5:1	100/750	150/1000	200/1000
20-33%	5:1 to 3:1	60/500	80/750	100/1000
33-50%	3:1 to 2:1	40/250	70/350	100/500
>50%	> 2:1	20/125	30/175	50/250

- B. Maximum allowable slope length and fence length will not exceed the limits shown in the Design Criteria for the specific type of silt fence used; Maximum allowable ponding depth of 1.5 feet behind the fence. Given that erosion would occur in the form of sheet erosion and there is no concentration of water flowing to the barrier; Soil conditions allow for proper keying of fabric, or other anchorage, to prevent blowouts.
- C. Locate silt fence at the toe of slopes and at ground level throughout its length. Drive posts securely at least 16-inches into the ground on the down slope side of the trench. Set post spacing a maximum of ten (10) feet apart. Adjust spacing to place posts at low points along fence line.
- D. Fasten support wire fence to upslope side of posts, extending six inches below grade. Attach continuous length of fabric to upslope side of fence posts. Avoid joints, particularly at low points in the fence line. Fasten fabric securely to support posts where joints are necessary and overlap to the next post. Place the fabric in the trench so the bottom folds across the bottom of the trench.
- E. Inspect silt fences weekly and after each rainfall event. Remove any sediment deposits found promptly to provide adequate storage volume for the next rain and reduce pressure on the fence. Do not undermine the silt fence during clean out. Replace fabric that is torn, decomposed, or in any way becomes ineffective, immediately without additional expense to The City of New York.
- F. In addition to procedure summarized above, refer to installation and service requirements outlined in the Contract Drawings.

### 3.4 STRAW BALE DIKE

- A. Use straw bale dikes subject to the following conditions:

Slope Steepness	Maximum Length (ft.)
2H:1V	25

3H:1V	50
4H:1V	75
5H:1V or flatter	100

- B. Do not exceed ¼ acre drainage area for overland flow per 100-feet of straw bale dike with silt fence, with maximum ponding depth of 1.5 feet behind the fence. Given that erosion would occur in the form of sheet erosion and that there is no concentration of water flowing to the barrier.
- C. Excavate the area to accommodate placement of straw bales which are to be embedded in the soil a minimum of four inches, and placed so the string or wire is horizontal. Place bales in a row with ends tightly abutting the adjacent bale. Anchor the bales securely by driving two stakes or rebar through each bale to a minimum depth of 1.5 to 2 feet into the ground. Drive the first stake in each bale toward the previously laid bale to force the bales together. Drive stakes flush with the top of the bale.
- D. Inspect straw bales weekly and after each rainfall event, restore or replace promptly as needed. Remove accumulations of sediment trapped by straw bale filters regularly. Remove temporary straw bales from the site at the conclusion of construction. Restore the areas where the straw bales were installed to match the surrounding area. Restoration may include, but is not limited to, seeding and establishing the lawn area.
- E. In addition to procedure summarized above, refer to installation and maintenance requirements outlined in the SWPPP and on the Contract Drawings.

### 3.5 STABILIZED CONSTRUCTION ENTRANCE

- A. Install stabilized construction entrances at any point where traffic will be entering or leaving a construction site to or from a public-right-of-way, street, alley, sidewalk, or parking area.
- B. Install and maintain a minimum stone thickness of 6-inches.
- C. The stabilized construction entrance width shall be twelve feet minimum but not less than the full width of points of where ingress or egress occurs. The stabilized construction entrance shall be a minimum width of 24-feet if there is only one entrance to the site.
- D. The length of the stabilized construction entrance shall be 50-feet minimum.
- E. Place geotextile over the entire area to be covered with aggregate.
- F. Provide piping of surface water under entrance as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.
- G. Maintain the entrance in a condition which will prevent tracking of sediment onto public-right-of-way or streets. This may require periodic top dressing with additional aggregate. Remove all sediment spilled, dropped, or washed onto public right-of-way immediately.
- H. Clean wheels, when required, to remove sediment prior to entrance onto public right-of-way. Perform washing, when required, on an area stabilized with aggregate, which drains into an approved sediment trapping device. Prevent all sediment from entering storm drains, ditches and watercourses.
- I. In addition to procedure summarized above, refer to installation and maintenance requirements outlined in the SWPPP and on the Contract Drawings.

### 3.6 FILTER FABRIC DROP INLET PROTECTION

- A. Install inlet protection at all existing, temporary, and new catch basins located within the disturbed work area.
- B. Space support stakes evenly around the inlet a maximum of three (3) feet apart. Drive support stakes a minimum of 18-inches below grade. Bridge spans greater than three (3) feet with the use of wire mesh behind the filter fabric for support.
- C. Drive support stakes close to the inlet so any overflow drops into the inlet and not on the unprotected soil.
- D. Cut filter fabric from a continuous roll to eliminate joints. Overlap joints, if needed, to the next stake. Extend filter fabric a minimum of one (1) foot below grade and backfill. Securely fasten fabric to the support stakes and frame.
- E. Do not extend filter fabric more than 1.5 feet above the inlet crest unless reinforced.
- F. Install wooden frame completely around the crest of the fabric for overflow stability.
- G. Inspect the fabric barrier after each rain event and restore as needed. Remove sediment from the pool area as necessary with care not to undercut or damage the filter fabric.
- H. In addition to procedure summarized above, refer to installation and maintenance requirements outlined in the SWPPP and on the Contract Drawings.

### 3.7 EROSION CONTROL BLANKET

- A. Place erosion control blankets on any disturbed slopes with grades from 1H:1V to 3H:1V.
- B. Excavate and grade the areas to receive the erosion control blanket. Install seed per the manufacturer's recommendation.
- C. Roll blankets down or horizontally across the slope. Unroll blanket with the appropriate side against the soil surface.
- D. Secure all blankets to the soil surface by placing staples in appropriate locations as shown in the staple pattern guide provided by the manufacturer.
- E. Staple the edge of parallel blankets with a four (4) inch overlap.
- F. Splice consecutive blankets, if necessary, across the slope and place over end (shingle style) with a three (3) inch overlap.
- G. Anchor the blankets as follows:
  - 1. Anchor the blanket at the top of the slope in a 6-inch deep x 6-inch wide trench with approximately twelve (12) inches of blanket extended beyond the upslope portion of the trench.
  - 2. Backfill and compact the trench after stapling.
  - 3. Apply seed to compacted soil and fold the remaining twelve (12) inch portion of the blanket back over seeded and compacted soil.
- H. Maintain and inspect the erosion control blankets per the manufacturer's recommendations.

- I. In addition to procedure summarized above, refer to installation and maintenance requirements outlined in the SWPPP and on the Contract Drawings.

### 3.8 TEMPORARY STOCKPILE

- A. Secure PVC sheeting in place with tie downs and/or weights such as sand bags at the end of each workday and during adverse weather conditions.
- B. Construct stockpiles so that the height does not exceed fifteen (15) feet. Side slopes shall not be steeper than 2H:1V.
- C. Contain all stockpiles with hay bales and silt fence placed continuously around the perimeter.
- D. Apply temporary seeding to all stockpiles which will be inactive for twenty (20) days or longer.
- E. Maintain stockpiles in accordance with DDC General Conditions and NYCDEP regulations.
- F. In addition to procedure summarized above, refer to installation and maintenance requirements outlined in the SWPPP and on the Contract Drawings.

### 3.9 EROSION CONTROL IMPLEMENTATION

- A. Place erosion control systems in accordance with the staging and features outlined in the Contract Drawings.
- B. Follow construction phasing in the sediment control plans to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations.
- C. Incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls.
- D. Properly construct, stabilize, and maintain all temporary and permanent erosion and sedimentation control measures and related items.
  1. Perform general inspection of sediment and erosion controls at end of each work day, and assure that controls are in good condition before leaving.
  2. Perform detailed inspection of all sediment and erosion controls at least once every seven days and within 24 hours after each rainfall of more than one half (0.5) inch.
  3. Perform any needed maintenance and restorations, and add measures as needed to control erosion and sediments.
  4. Remove accumulated sediments from sediment traps and behind silt fences before they reach 50% of capacity. Dispose of sediments in upland area, stabilized to prevent further erosion or sedimentation.
  5. Maintain written records of all inspections, maintenance and restorations, and submit copies of the written reports to the Commissioner at the end of each month of work.
- E. Replace at own expense any control measure that is not functioning properly as directed by the Commissioner.
- F. Install inlet protection on all new catch basins immediately upon construction of catch basins.
- G. Implement dust control measures during construction. Minimize dust clouds by watering down construction area or other approved methods as required.



- H. Secure a tarp over materials in all construction vehicles hauling materials either into or out of the construction area to prevent sediment pollution of public roadways.
- I. Design erosion and sediment controls specific to the site in accordance with the NYSDEC Standards, which are more stringent than the EPA Standards.

### 3.10 NON-STORMWATER DISCHARGE CONTROLS

- A. Groundwater encountered within excavations shall be disposed per DDC General Conditions.
- B. Cleaning water for construction vehicles and equipment shall be diverted to the temporary and approved erosion and sediment control measures. Chemicals and detergents shall not to be used.
- C. Coordinate with the Commissioner to identify areas on-site for construction vehicle transit (i.e. – haul roads, contractor trailers and parking areas, etc.) or equipment staging which shall be monitored and where runoff can be controlled.
- D. Water used for dust control measures shall be applied using appropriate quantities and equipment. No chemical additives shall be used.
- E. Water main flushings, hydrostatic test water, fire test water, and chlorination test water shall be directed to the control measures on the site. Turbid water is to be detained to allow sufficient sedimentation time (minimum of 24 hours). Chlorinated water is to be detained until the water is de-chlorinated (minimum of 24 hours).
- F. Concrete trucks shall be washed out in an area approved of by the Commissioner. Designate wash-out areas with proper signage. Locate a concrete wash-out box near the concrete trucks to prevent concrete residue from being washed off-site. Wash-out containers can be pre-fabricated or constructed on-site out of plywood and plastic sheeting. All runoff from wash-out activities shall be directed to the on-site control measures. Discarded cementitious materials shall be removed and disposed off-site.
- G. Building washing or parking lot cleaning water (where no spills or leaks of toxic or hazardous materials have occurred) that may enter the storm drainage system shall not contain chemicals or detergents.

### 3.11 REMOVALS

- A. Maintain erosion and sediment control devices within each work area until final stabilization of that work area.
- B. “Final stabilization” shall mean that all soil disturbance activities have ceased and a uniform, perennial vegetative cover with a density of eighty (80) percent over the entire pervious surface has been established; or other equivalent stabilization measures, such as permanent landscape mulches, rock rip-rap or washed/crushed stone have been applied on all disturbed areas that are not covered by permanent structures, concrete or pavement.
- C. Remove erosion and sediment control devices in accordance with the DDC General Conditions.

**END OF SECTION 31 25 00**



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**SECTION 31 50 00****EXCAVATION SUPPORT AND PROTECTION****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 03 30 00 – Cast-in-Place Concrete
- C. Section 07 10 00 – Foundation Waterproofing
- D. Section 31 68 00 – Foundation Soil Anchor
- E. Section 31 00 00 – Earthwork

**1.2 SUMMARY**

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the design and installation of excavation support, protection and monitoring of adjacent structures as shown on the contract documents and specified herein including, but not limited to the following:
  - 1. Design and installation of soldier pile and lagging to prevent any damage to existing structures, buildings, walls, street paving, utilities adjacent to new construction and in the vicinity of the new construction.
  - 2. Performing exploratory test pits to determine conditions of existing adjacent foundations and utilities.
  - 3. Review drawings of existing adjacent buildings.
  - 4. Protection and monitoring of adjacent buildings, streets, and utilities.
  - 5. Other labor and materials as may be reasonably inferred to be required to make the work under this Section complete.
  - 6. Removal of piling and bracing, as required.
  - 7. Monitoring of adjacent structures and berms, in accordance with this specification and the 2014 New York City Building Code.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 REFERENCES

- A. The latest revision of the following standard specifications, where not otherwise required by the Contract Documents:
  - 1. ASTM A36 Standard Specification for Carbon Structural Steel.
  - 2. ASTM A252 Standard Specification for Welded and Seamless Steel Pile Piles.
  - 3. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens).
  - 4. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- B. Field Reference Manual: Specifications for Structural Concrete, ACI 301, with Selected ACI and ASTM References, SP 15. Contractor shall keep at least one full copy in the field office at all times.
- C. 2014 New York City Building Code Requirements for Structural Concrete, ACI 318 and Commentary, ACI 318R (referred to hereafter as ACI Code).
- D. Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, ACI 211.1.
- E. Guide for Measuring, Mixing, Transporting and Placing Concrete, ACI 304.
- F. Recommended Practice for Evaluation of Strength Test Results of Concrete, ACI 214.
- G. All work shall comply with the requirements of the 2014 New York City Construction Codes and and the New York City Department of Environmental Protection.
- H. Geotechnical Engineering Report – 116th Precinct Station House, Queens, New York, prepared by Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C., dated 15 November 2018.

## 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

## 1.7 SUBMITTALS

- A. Unless otherwise indicated, transmit all submittals to the Commissioner for review and acceptance before proceeding with ordering, fabricating, or any other work of this Section. Submittal review will be of the concept only and shall not in any way diminish or limit the Contractor’s responsibility for the performance and quality of the work of this Section and the protection of existing structures.
- B. The Contractor’s Professional Engineer licensed in the State of New York shall prepare an outline of the Contractor’s construction methods and step-by-step procedures together with plans and details of the excavation support system to satisfy the 2014 New York City Building Code requirements and approved drawings. This shall be coordinated with the relevant submittals identified in Section 31 00 00 “Earthwork” and shall be submitted and reviewed by the Commissioner for the concept before submittal of the shop drawings.



- C. The Contractor shall supersede the Commissioner as the applicant for the support of excavation work.
- D. Plans and Shop Drawings: Support of Excavation (SOE) Drawings in the Contract Documents are for the purpose of filing and have been provided for reference only. The Contractor must prepare and submit plans and shop drawings for all items in this Section and shall supersede the Commissioner for the Support of Excavation. The design plans and shop drawings shall be submitted signed and sealed by the Contractor's Professional Engineer licensed in the State of New York. Contractor shall obtain DOB approval of these plans.
  - 1. Excavation Support – Provide calculations, plans, and shop drawings that show the limits and layout of the excavation support system. Provide representative sections for each side of the excavation that include calculations, structural details of the SOE wall, and embedment depth. Provide elevations that give the location and identification of all lateral bracing elements.
    - a. Excavation side stabilization plan, details and calculations including but not limited to sheeting and bracing.
    - b. Adjacent footing bearing strata stabilization plan.
    - c. Adjacent property and structures protection and monitoring plan. Show in a detailed and scaled plan locations of survey control point locations.
    - d. The grout mix design and procedures the Contractor intends to use for grouting of the bolts and anchors.
    - e. Submit original manufacturer's certificates for all materials as specified herein.
- E. Monitoring of Existing Structures: Submit the monitoring plan specified herein at least two weeks before proceeding with the work. Submit monitoring results as specified herein within two days after completing the monitoring work.
- F. Certification For Examination of Site and Records: Before proceeding with the Work, submit certification in an acceptable form, signed by the Contractor, stating that careful examination has been made of the site, existing structures, existing adjacent structures, records of utility lines, test boring records, soil samples, geotechnical report, the Drawings, and all other Contract Documents.
- G. Procedures and methods shall be used to ensure safety and stability of all adjacent structures, as well as identification of the entity that will sign the DOB TR-forms as the responsible party for the Structural Stability of the adjacent buildings.

#### 1.8 PROJECT CONDITIONS

- A. The Contractor, by careful examination, shall inform themselves as to the nature and location of the work; the conformation of the ground, the nature of the subsurface conditions; the locations of the groundwater table; the character, quality and quantity of the materials to be encountered; the character of the equipment and facilities needed preliminary to and during the execution of the work; and all other matters which can be in any way effect the work.
- B. Borings are available for the Contractor's review. The City of New York makes no predictions or representations regarding the character or extent of soil, rock, or other subsurface conditions to be encountered during the work. The Contractor shall make their own deductions of the subsurface conditions which may affect the methods or expense of construction of the work hereunder, and agrees that he will make no claims for additional compensation should he find conditions during the progress of the work different from those as the Contractor calculated and/or anticipated. Additional borings and other exploratory operations may be performed by Contractor, at the Contractor's option and following the Commissioner's approval. No change in the Contract Sum will be authorized for such additional exploration undertaken by the Contractor.

- C. Soil samples taken from the borings are available for the Contractor's inspection.
- D. Existing Utilities: Locate existing underground utilities in and beyond the areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during the work.
  - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Commissioner and utility companies in keeping respective services and facilities in operation. Restore damaged utilities to satisfaction of utility owner.
  - 2. Do not interrupt existing utilities serving facilities occupied by The City of New York or adjacent properties, during occupied hours, except when permitted in writing by the Commissioner and then only after acceptable temporary utility services have been provided. Provide minimum of 48-hour notice to the Commissioner, and receive written notice to proceed before interrupting any utility.
  - 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.
- E. Examine drawings to determine sequence of operations, and relation to work of other trades. Start of work will signify acceptance of field conditions and will acknowledge coordination with other trades.
- F. Compliance with all federal, state and local environmental and health and safety regulators, including but not limited to Occupational Safety and Health Administration (OSHA).

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Contractor Qualifications: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- C. Design Supervision: For support of excavation, retain the services of a Professional Licensed Engineer licensed in the State of New York who shall design and supervise installation of all work of this Section. The Contractor's Professional Engineer shall sign, seal and submit all relevant New York City Building Department Technical Report forms.
- D. Surveying and Monitoring: The City of New York shall engage and assign survey and monitoring work of this Section to a Professional Land Surveyor licensed in the State of New York. The results of all monitoring work of this Section shall be made immediately available to the Commissioner. Adjacent buildings shall be monitored by the Contractor at least twice per week for vertical and horizontal movements during all work.
- E. Special Inspection:
  - 1. The Special Inspection Agency, hired by the City of New York, shall be solely responsible for providing special inspection for all sheeting, shoring, and bracing work.
  - 2. Before commencing work of this Section, meet with the Commissioner, and other concerned entities. Review the sheeting and bracing procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days before convening conference. Record discussions and agreements and furnish a copy to each participant.



- F. Monitoring of Excavation Support System: Engage and assign survey and monitoring work of this Section to a Professional Land Surveyor licensed in the State of New York. The results of all monitoring work of this Section shall be made immediately available to the Contractor's Professional Engineer responsible for the engineering supervision of the work specified herein and to the Commissioner.
- G. Codes and Permits:
  - 1. Comply with the 2014 New York City Building Code, and requirements of the New York City Department of Environmental Protection.
  - 2. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided without additional expense to the City of New York.
  - 3. Procure and pay for all permits and licenses required to complete the work of this Section.

#### 1.10 PROTECTION

- A. There are sensitive buildings adjacent to, and within the vicinity, of the site. The work shall be executed so that no damage or injury will occur to the existing public and adjoining or adjacent structures, streets, paving, sewers, gas, water, electric or any other pipes. Should any damage or injury caused by the Contractor, or anyone in Contractor's employ, or by the work under this Contract occur, the Contractor shall, at own expense, restore such damage and shall assume all responsibility for such injury.
- B. The above shall also include the protection of all existing utilities (including sewers, water lines, electrical lines and telecommunication lines) to remain in use within and adjacent to the area affected by the work of this project.
- C. Monuments, benchmarks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, replace them at no additional expense to the City of New York.

#### 1.11 PRE-CONSTRUCTION CONDITIONS DOCUMENTATION

- A. A pre-construction conditions documentation of the adjacent structures (including the LIRR station and track south of the site) shall be performed before the start of the excavation.
- B. The Contractor may perform, if he wishes, his own conditions verification survey and shall submit any findings that differ from the City of New York's as specified herein.

### PART 2 – PRODUCTS

#### 2.1 MATERIAL

- A. Provide suitable sheeting, bracing, and soil support materials which will withstand loads imposed without movement. Materials shall be kept in serviceable condition at all times. The Contractor should refer to the support of excavation drawings for the sizes of the elements.
- B. Steel soldier piles shall conform to ASTM A-992 Grade 50.
- C. Miscellaneous Steel shall conform to ASTM A-572 Grade 50.

### PART 3 – EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 GENERAL

- A. Excavation support shall be constructed in accordance with the 2014 New York City Building Code requirements.
- B. Install soldier piles to permit excavation to the required foundation subgrade as required to install the slabs and pits.
- C. Excavation support shall be adequate to resist earth and hydrostatic pressures and lateral pressures due to surcharge loads, to prevent displacement of the adjacent ground; and to prevent loss of support or damage to buildings, utilities, sidewalks, and streets. Lateral loads created from adjacent buildings, cranes and/or street loads shall be included in the design.
- D. During the excavation work specified in Section 31 00 00 - Earthwork, if additional locations may require sheeting and bracing based on the Contractor's construction methods and procedures, then provide such additional supports at no additional expense to the City of New York. Such additional supports shall be designed and constructed in accordance with the requirements of this Section, as per the Contract Documents.
- E. Excavation support and bracing may be removed, left in place, or cut as approved by the Commissioner. Any material that affects finished construction shall be removed. Carefully remove materials such that no loss of support occurs beneath areas adjacent to the sheeting. Any material left in place must be removed not less than four-ft below finish grade. Sheeting and bracing material removed from the excavation shall be immediately removed from the site and lawfully disposed of.

### 3.3 SOIL EXCAVATION SUPPORT

- A. Temporary excavation walls shall be provided along the sides of excavations in soil where the overburden exceeds 4 feet, and any other material not self-supporting as defined by the plans or a plan by the Contractor's Professional Engineer licensed in the State of New York.
- B. Excavation adjacent to the temporary wall shall not exceed a depth of 2 feet below the point of lateral support to be installed. Lateral support shall be installed and preloaded before continuing excavation.
- C. Provide all support system components needed to ensure the proper installation of work and to protect adjacent structures, streets, paving, utilities, etc.
- D. Subgrade preparation for heel blocks shall be by subgrade preparation procedures outlined in Specification Section 31 00 00 – Earthwork. Subgrades to be maintained in a firm and dry state during construction.
- E. Sides of the site shall be protected against cave-in and movement of soil at all times.
- F. Install all corner bracing and rakers at the same elevation level before jacking them one by one to the specified prestressing force.
- G. The above work shall be carried out in such a manner as not to interfere with the progress of the work under this Contract. If it is found necessary to change the position of the shoring, bracing, spurs, walers, rakers, or other items to permit the construction work to proceed, do this work at no additional expense to the City of New York.
- H. At the completion of the work, remove all shoring, bracing, spurs, rakers and other items and remove same from the project premises when directed by the Commissioner.



- I. Where temporary bracing is required to withstand earth pressures, the backfill shall not be placed until after temporary bracing has been installed. If portions of the ground floor must be placed and have reached sufficient strength for the design of any portion of the foundation to withstand their required lateral load, backfilling shall not be placed until this work has been performed and the concrete reaches its necessary strength.

### 3.4 PROTECTION OF ADJACENT STRUCTURES, STREETS AND UTILITIES

- A. The work shall be executed so that no damage or injury will occur to the existing public and adjoining or adjacent structures, streets, paving, sewers, or utilities. Should any damage or injury caused by the Contractor, or anyone in Contractor's employ, or by the work under this Contract occur, the Contractor shall, at own expense, restore such damage and shall assume all responsibility for such injury.
- B. Monuments, benchmarks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, have them replaced.
- C. The adjacent and surrounding structures, streets, utilities shall be protected and monitored during the work described herein. Excavation work shall be restricted to hours indicated by the Commissioner.

### 3.5 MONITORING

- A. Monitoring of Excavation Support System: Install reference points at a maximum spacing of 25-ft on-center around the entire perimeter of the excavation to properly monitor the ground movements behind the excavation support system. As the excavation proceeds, install points on the soldier pile to measure potential lateral deflection. These locations shall be subject to review by the Commissioner. Reference points shall also be installed on all adjacent buildings.
  1. The monitoring points shall be established by the Contractor employing a Professional Land Surveyor licensed in the State of New York, and referenced to a fixed off-site benchmark. The Contractor's vibration monitoring plan shall be submitted to the Commissioner for review and acceptance.
  2. Monitoring of the excavation support system and buildings shall be performed twice a week during any sheeting, bracing, and excavation work. Readings shall be taken to nearest 0.005 ft. Written reports summarizing the monitoring results shall be submitted by the Contractor's Professional Engineer licensed in the State of New York for review and acceptance by the Commissioner.
- B. Monitoring of Adjacent Buildings: Conduct crack monitoring of all adjacent buildings. Implement vibration monitoring and façade survey monitoring (lateral displacement and settlement) at all adjacent buildings within a 90-ft radius of the site. The Contractor will receive monitoring reports on a weekly basis and will be notified when threshold are exceeded. Monitor all adjacent buildings for movement as per this specification section.
- C. Alert levels: should any of the following magnitudes of movement be detected, immediately take remedial action and advise the Commissioner.
  1. The maximum allowable movements of the adjacent buildings and structures shall be 1/4 inch for horizontal movement and 1/4 inch for vertical movements. The action thresholds shall be three consecutive readings of 1/16 inch of movement, or one confirmed reading of 1/8 inch.
  2. The maximum allowable movements of the adjacent pavement or ground shall be 1 inch for horizontal movement and 1/2 inch for vertical movements. The action thresholds shall be one half of the maximum allowed movement.



3. Ground vibrations - The limit for ground vibration peak particle velocity is 2.0 ips for frequencies from 40 Hz to 100 Hz. For frequencies below 40 Hz, vibration limits are 0.75 ips and 0.5 ips, with graphical transition lines equivalent to constant displacements.
4. Water level - The limit for fluctuation in water level is a 2-foot increase or decrease in any measurement after pumping has stabilized at any temporary subgrade during excavation.

**D. Exceedance Action Plan**

1. If any monitoring measurement exceeds allowable limits, the Commissioner shall be notified and the following actions shall be taken.
  - a. The Contractor will immediately stop work in the vicinity of the exceedance.
  - b. Inspect the building (or portions thereof) for potential damage. Inspections shall be made by the City of New York's special inspection engineer for structural stability, the Contractor's engineer, and the Commissioner.
  - c. Immediate notification to DOB and the Commissioner in case of damage or unsafe condition.
  - d. Excavation and foundation construction procedures shall be re-assessed as necessary to maintain vibration levels and movements within acceptable limits.
  - e. Work stoppage to assess excavation methods and to inspect the buildings identified herein for damage is at the Commissioner's discretion.
  - f. Develop alternate methods and procedures, subject to the review and approval of the Commissioner.
  - g. Resume work using the agreed upon alternative method.
  - h. DOB will be notified of events that exceed allowable limits and of corrective measures implemented to maintain acceptable limits.

- E. Restore, to the satisfaction of the Commissioner, the portions of buildings, or their contents, altered by the Contractor in furtherance of his sheeting, and bracing work. Restoration shall be completed to the conditions which existed before the start of work.

**3.6 FIELD QUALITY CONTROL**

- A. Concrete: Retain a certified testing agency to take samples of the concrete. A minimum six grout cylinders per batch shall be taken to determine the compressive strength of the concrete.
- B. Excavation Support: The Special Inspection Agencies, retained by the City of New York, shall be responsible for the inspections of all excavation supports.
- C. Adjacent Building Monitoring: The Contractor shall be responsible for establishment and monitoring of all of the survey control points. Survey results shall be reported to the Commissioner 24 hours following the survey.

**3.7 CLEAN-UP**

- A. All excess material shall be removed from the site and legally disposed.
- B. All lumber, forms and metal work shall be removed immediately after completion of local areas. Remove all debris produced by work to this section from the site.
- C. Sidewalk and streets adjoining the property shall be broom cleaned and free of debris, rubbish, trash and obstructions of any kind caused by the work of this Section.

**END OF SECTION 31 50 00**

## **SECTION 31 61 00**

### **FOOTINGS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract City of New York Standard Construction Contract.

##### **1.2 SUMMARY**

- A. The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of footings and related work, complete, in accordance with the Drawings and as specified herein.

##### **1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS**

- A. Concrete Submittals Section 03 30 00
- B. Concrete Quality Control Section 03 30 00
- C. Cast-in-Place Concrete Section 03 30 00
- D. Concrete Reinforcement and Embedded Assemblies Section 03 20 00
- E. Structural Steel Section 05 12 00
- F. Thermal and Moisture Protection Division 7
- G. See Drawings for locations, sizes, top elevations, and details. See Geotechnical Report for general soil conditions.

##### **1.4 CODES AND STANDARDS**

- A. 2014 New York City Building Code: Footing work shall conform to the requirements of the 2014 New York City Building Code identified on the structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
- B. Standards:
  - 1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. ACI 301 – Standard Specifications for Structural Concrete.
  - 3. ACI 315 – Details and Detailing of Concrete Reinforcement.
  - 4. ACI 318 – Building Code Requirements for Reinforced Concrete.
  - 5. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.



6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
7. AWS D1.4 – Structural Welding Code-Reinforcing Steel.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 SUBMITTALS

- A. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

1. Submittal Schedule
2. Footing Construction Methods
3. Installer Qualifications
4. Shop drawings
5. Construction Log
6. Contractor's Survey Report
7. Submittals required by Related Documents
8. Mill Certificates
9. Concrete Testing Agency Reports
10. Product Data

- B. Detailed submittal requirements: See below for specific requirements for each required submittal.

1. Submittal Schedule: See Section 03 30 00 "Cast-in-Place Concrete"
2. Footing Construction Methods: Submit for record, footing construction procedures developed by the Footing Contractor.
3. Installer Qualifications: Submit proof of qualifications as stated in the CONTRACTOR QUALIFICATIONS section of this Specification.
4. Shop drawings in accordance with 03 20 00 and 03 30 00, and as noted.
  - a. Concrete mix designs in accordance with Section 03 30 00 "Cast-in-Place Concrete".
  - b. Footing reinforcement in accordance with Section 032000 "Concrete Reinforcement and Embedded Assemblies".
  - c. Footing layout drawing showing the location of each footing (with respect to building gridlines), size and depth of footing, and top of footing elevation.
5. Construction Log: Testing Agency shall document, sign, and submit for record, a record of each footing construction, including:
  - a. Footing designation, top and where possible bottom elevation, and size of footing.
  - b. Size, length, and location of installed reinforcement.
  - c. Deviation of centerline plan location.
  - d. Actual allowable soil bearing capacity
  - e. Inspection and testing
  - f. Method of concrete placement, time of beginning and ending concrete discharge for each truck, (including any delays in concreting and location of construction joints in shafts) and any deviation from planned construction methods.
  - g. Volume of concrete supplied to footing and ratio of actual volume to theoretical volume.

6. Contractor's Survey Report: Submit for record plans sealed and signed by a Professional Surveyor licensed in the state of New York, indicating as built plan locations of footing centerlines (with respect to building gridlines), top and where possible bottom elevations, and identifying deviations of footing centerlines from design plan locations. Footings that are outside of specified tolerances shall be specifically identified on the plan.
7. Submittals required by Related Documents.
8. Mill Certificates: Per Specification section 03 20 00 "Concrete Reinforcement and Embedded Assemblies", submit for record certified reports for physical and chemical properties of following materials:
  - a. Reinforcement bars.
9. Concrete Testing Agency Reports: Submit for record
  - a. Reports of field observations.
  - b. Reports of field quality control tests, as related to concrete and reinforcement.
  - c. Immediately notify the Commissioner of any deviations from the Drawings.
10. Product Data: Submit for record for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and ICC reports, where applicable, for products of each manufacturer specified in this section.
  - a. Refer to DDC General Conditions for submittal process and requirements
  - b. Refer to Section 03 30 00 – "Cast-in-Place Concrete" for additional submittal requirements related to concrete trades.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. In accordance with Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies" and 03 30 00 "Cast-in-Place Concrete".

#### 1.8 PROJECT SITE CONDITIONS

- A. Geotechnical Information: Contractor to examine site, records of test borings, soil samples, and Geotechnical Reports that are available in the Contract Documents. Soil boring test results are provided by The City of New York for information, and are not guaranteed to represent conditions that are present at footing locations. Soil boring test results are not intended as representations or warranties of the continuity of the reported conditions. It is expressly understood that The City of New York will not be responsible for interpretation or conclusions drawn by Contractor from the Geotechnical Report. At no additional expense to The City of New York, evaluate the available data and provide additional test borings and other investigations as necessary for installing footings.
- B. Site Survey: Survey of site, existing utilities, and existing construction available from The City of New York represent conditions known to The City of New York.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. See Section 03 30 00 "Cast-in-Place Concrete".

- C. The Contractor's Geotechnical Engineer shall be properly trained to perform the type of work required by the Project. The Contractor's Geotechnical Engineer shall be a Licensed Geotechnical Engineer in the state of New York. The engineer shall develop a site dewatering plan and advise on footing construction techniques, including assistance in the development of construction procedures and the development of solutions to construction problems.

#### 1.10 TESTING AGENCY

- A. Testing Agency: The City of New York will engage a qualified testing agency to perform Special Inspections.
- B. The Contractor shall be responsible for, and bear all expenses associated with the filing and securing of approvals, if any, for Form TR3: Technical Report Concrete Design Mix, including, but not limited to, engaging the services of a New York City licensed Concrete Testing Lab for the review and approval of concrete design mix, testing, signatures and professional seals, etc., compliant with NYC Department of Buildings requirements, for each concrete design mix.
- C. Refer to Section 01 40 00 "Quality Requirements", Article 1.9, of the DDC General Conditions, for additional information regarding Special Inspections.

#### 1.11 QUALITY ASSURANCE BY TESTING AGENCY

- A. Source Quality Control
  - 1. See Section 03 30 00 "Cast-in-Place Concrete".
- B. Field Quality Assurance
  - 1. See 03 30 00 "Cast-in-Place Concrete" for general requirements.
  - 2. Contractor's Responsibilities
    - a. Examine the areas and conditions under which footings are to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.
    - b. Furnish complete sets of approved shop drawings and other submittals to the Commissioner and Testing Agency.
    - c. Furnish notifications to the Commissioner and Testing Agency, with at least 24 hour advance notice of start of pouring each footing.
    - d. Provide access for the Commissioner, Contractor's Testing Agencies, and Testing Agency. Provide concrete materials for sampling and testing.
    - e. Furnish storage facilities for material samples, in accordance with ACI Standard Practice.
    - f. Coordinate with the Testing Agency and Commissioner.
    - g. Provide additional inspection and testing resulting as a consequence of following:
      - 1) Lack of adequate evidence that work is in compliance with this Specification
      - 2) Work performed with improper supervision
      - 3) Work performed without prior notice
      - 4) Work performed contrary to Drawings and Specifications.
  - 3. The Testing Agency shall perform the following tests and inspections, evaluate test results, and review compliance of the Contractor's work with Contract Documents and prepare and submit reports:



- a. Review Contractor's proposed footing installation methods, sequences, and procedures.
  - b. Verify bearing stratum and bearing capacity of each footing; verify levelness of footing end bearing surface.
  - c. Determine final bearing elevation at each footing location.
  - d. Observe, record, and report footing as-built plan location, footing size and final elevations of bottom (where possible) and top of completed footings.
  - e. Coordinate with the Commissioner.
4. Testing Agency shall conduct the following tests and inspections of the Contractor's work during construction and prepare and submit reports:
  - a. Inspection of Batch Plant: As required to ensure that concrete delivered to job complies with Specifications and design mix. Batch plant inspection shall be required once at start of job and thereafter if concrete falls below Specifications.
  - b. Inspection of Reinforcement: Provide continuous visual inspection of site fabrication. Record the steel reinforcement bar sizes, grade, length, and number of bars.
  - c. Inspection of Concrete and Reinforcement Placement: Provide continuous visual inspection of installation of reinforcement and concrete placement including verification of laitance removal at top of footings.
  - d. Check ready mix delivery tickets for correct concrete mix design number. Record batch to placement time. Check slump, temperature, and batch to placement time for each set
  - e. Slump Tests: ASTM C143. Make 1 test from each truck.
  - f. Concrete Compressive Strength Tests: Testing Agency will take a minimum of one sample set of concrete cylinders per 20 cubic yards of concrete. See Section 03 30 00 "Cast-in-Place Concrete" for requirements. Cure cylinders to simulate same curing conditions as concrete in footings. Reports of cylinder tests shall state footing location(s), laboratory or site curing, compression strength, type of fracture, age at testing, concrete supplier, mix specification strength, any other pertinent information, test results, and conclusions.
  - g. Additional Tests: Perform additional testing if, in the opinion of the Commissioner, concrete of poor quality has been placed based on cylinder strengths below Specification requirements or visual defects. Tests may be compression tests on cored cylinders, ASTM C42, and load tests as outlined in ACI 318, or as directed by the Commissioner. Complete continuous coring of footings will be required, at Contractor's expense, where verification of quality of concrete is not otherwise attainable.

#### 1.12 QUALITY CONTROL BY CONTRACTOR

- A. See Section 03 30 00 "Cast-in-Place Concrete".

#### 1.13 OBSERVATIONS BY COMMISSIONER

- A. See Section 03 30 00 "Cast-in-Place Concrete".

#### 1.14 PERMITS AND WARRANTY

- A. Permits: See Section 03 30 00 "Cast-in-Place Concrete".

1. Drawings and calculations prepared by the Contractor's Licensed Professional Engineer in the state of New York for temporary shoring and/or earth retention shall be submitted to the Commissioner and the New York City Department of Buildings for review.

- B. Warranty: See Section 03 30 00 "Cast-in-Place Concrete".

#### 1.15 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Flyash: Concrete shall incorporate flyash as a replacement for at least 20% (by weight) of the Portland cement. All design mixes are subject to review and approval by the Commissioner.
  2. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.

#### 1.16 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### PART 2 - PRODUCTS

#### 2.1 CONCRETE

- A. See Section 03 30 00 "Cast-in-Place Concrete"

#### 2.2 REINFORCEMENT

- A. Section 03 20 00 "Concrete Reinforcement and Embedded Assemblies"

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.



### 3.2 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

- A. Before installing footings adjacent to known existing utilities, notify Commissioner and utility company to ensure that protective work will be coordinated and performed by Contractor in accordance with requirements of the Commissioner and the utility company. If any existing service lines, utilities, and utility structures to remain in service are uncovered or encountered during work, protect the uncovered element from damage and provide support where necessary.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during footing excavation, immediately notify the Commissioner and utility company. Cooperate with the Commissioner and utility company in keeping their respective services, utilities and facilities in operation. Restore damaged utilities to entire satisfaction of the Commissioner and utility company concerned.
- C. Do not interrupt existing utility service facilities occupied and used by The City of New York, or owners of other properties adjacent or near to the project site, including properties directly to the east, west, south, and to the north on the opposite side of North Conduit avenue, except when permitted in writing by the Commissioner and then only after acceptable temporary utility services have been provided.
- D. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by footing operations.

### 3.3 SITE DEWATERING

- A. Before installing footings, provide site dewatering based on the Contractor's site dewatering plan.
- B. Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult the Contractor's Geotechnical Engineer and the Commissioner before using alternative methods of construction.
- C. If excessive seepage is coming in from below the bottom of the footing excavation, removal by pumping within the excavation is inappropriate, as this may loosen the bearing soils and reduce the bearing soil capacity; therefore, an alternate means of dewatering will be required.

### 3.4 GENERAL FOOTING EXCAVATION

- A. Tolerances: Plan location tolerance is 2% of footing dimension but no greater than 2 inches (50 mm), whichever is greater, If indicated tolerances are exceeded, see "Footing Corrective Measures" in Part 3.
- B. Forming Sides of Footings:
  - 1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
  - 2. When trench forms are used, provide an additional 1" (25 mm) of concrete on each side of the minimum design profiles and dimensions indicated.
- C. Cleanup of Footing Bottom: Excavate bottom to a level plane. Remove loose materials or free water as determined by Testing Agency.
- D. Bottom of adjacent footings that are at different elevations should never result in an excavation slope between footings greater than 1.0 vertical to 1.5 horizontal unless otherwise noted in the

drawings or geotechnical report. If steeper slopes occur, the EOR should be notified before any concrete is placed.

### 3.5 ADDITIONAL EXCAVATION AND FOOTING DEPTH

- A. Do not excavate below elevations noted by contract documents without prior review by the Commissioner.
- B. Where the Testing Agency determines that soil encountered at design bearing elevation is not capable of providing minimum design bearing capacity, perform additional excavation as recommended by the Testing Agency.
- C. If obstructions are encountered that interfere with new construction, remove such existing elements or develop corrective methods. Propose corrective actions and their recommendations in writing and submit them for review by the Commissioner. Efforts shall be made to address obstructions at no additional expense to The City of New York.

### 3.6 DISPOSAL OF EXCAVATED MATERIALS

- A. Dispose excavated materials off site in a manner that will not interfere with other construction activities. Keep construction site at all times clean and free of soil and other debris that could affect progress of other construction activities.

### 3.7 FOOTING REINFORCEMENT

- A. Fabrication in accordance with 03 20 00 "Concrete Reinforcement and Embedded Assemblies" from approved shop drawings.

### 3.8 FOOTING BEARING STRATA

- A. Footing Bearing Stratum Criteria and Verification
  - 1. Footings shall be founded on soil strata with bearing capacity indicated on Drawings. Footings shall not be excavated until test results by Testing Agency confirm allowable bearing values indicated on Drawings, but shall be excavated immediately thereafter.
  - 2. Each footing bearing strata must be inspected and be acceptable to Testing Agency before placing concrete
  - 3. Footing excavations to acceptable bearing strata shall not be left exposed to weather for more than 48 hours before footing concrete is placed.
  - 4. At no time before or after footing concrete is placed shall the soil below the footing be allowed to freeze. Adequate freeze protection must be sufficient depth to provide adequate frost protection per the geotechnical report.

### 3.9 CORRECTIVE MEASURES

- A. If unforeseen field conditions require corrective installation methods, immediately notify the Commissioner.
  - 1. Where a change to the construction installation method result in an as-built footing in compliance with the Contract Documents, submit installation method for record.
  - 2. Where the as-built footing does not meet the design intent of the Contract Documents. Propose corrective actions and their recommendations in writing and submit them for review by the Commissioner.



If footings are installed outside allowable tolerances, develop and provide corrective methods including calculations based on actual locations of footings, taking into account eccentricity between final centerline of footing and design location of column centerline. Propose corrective actions and their recommendations in writing and submit them for review by the Commissioner. Relevant calculations shall be included with the submitted proposal of corrective actions and shall be sealed and signed by Contractor's Engineer licensed in the state of New York.

**END OF SECTION 31 61 00**



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## SECTION 31 68 00

### FOUNDATION SOIL ANCHOR

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 03 30 00 – Cast in Place Concrete
- C. Section 07 10 00 – Foundation Waterproofing
- D. Section 31 00 00 – Earthwork
- E. Section 31 50 00 – Excavation Support and Protection

##### 1.2 SUMMARY

###### A. Section includes:

- 1. Excavation and drilling associated with pile foundations and installation of drilled piles at the locations shown in the drawings, and having design axial compressive capacities (service load) as indicated and as located on the latest drawings. Respective design capacities are as indicated below.
- 2. Double-corrosion protected permanent soil anchors at the locations and of the capacities indicated in the drawings. Respective design capacities are as indicated below.

Type	Tensile Capacity (kips)	Drill hole (inches)	Threaded Bar Diameter	Free Length (feet)	Bond Length (feet)	Grout Strength (psi)
RA-1	50	6	1"	10	25	4,000
RA-2	100	6	1-3/8"	10	35	4,000

- 3. Soil anchors shall consist of vertical drilled, grouted and post-tensioned elements utilized to provide uplift resistance against dynamic loads, wind loads, and hydrostatic pressures.
- 4. Actual bond and free-stressing lengths shall be determined by the Contractor's Professional Engineer Licensed in the State of New York based upon the anchor design capacity with calculations submitted to the Commissioner for review.
- 5. Soil anchor location survey and identification plan.
- 6. As-built drawings.

### 1.3 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

### 1.4 LEED BUILDING SUBMITTALS

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

### 1.6 SUBMITTALS

- A. Submit permanent anchor shop drawings, calculations, and data signed and sealed by a Professional Engineer licensed in the State of New York, a minimum of 14 days before fabrication or commencement of installation work. The shop drawings shall include as a minimum:
  - 1. Provide the means and methods statement for the stabilization of subgrade before the soil anchor installation.
  - 2. The Contractor's detailed permanent anchor layout and identification plan.
  - 3. The proposed jacking forces at lock-off required to achieve the specified design loads. Provide supporting calculations that show the estimated seating losses and long-term creep losses after lock-off.
  - 4. The numbering system of the anchors and the locations of the anchors the Contractor intends to Performance Test.
  - 5. The grout mix design and procedures the Contractor intends to use for grouting of the anchor.
  - 6. The complete section detail of the double-corrosion protected anchor assembly from head to tip with all appurtenant dimensions and details, including but not limited to, lower anchorage corrugated sheathing and smooth upper sheathing, centering devices, anchor head details, etc.
  - 7. Plan and procedures for anchor placement, grouting.
  - 8. Procedure for tensioning anchor bar including tensioning sequence. Include method of measuring loads and elongation of anchor bar during jacking and certified calibration chart for the pump/pressure gauge/jack assembly.

- B. Submit results of all tests including applied load charts no later than 24 hours after each test. The submittal shall be signed and sealed by a Professional Engineer licensed in the State of New York.
- C. Submit original manufacturer's certificates for all materials as specified herein.

#### 1.7 REFERENCES

- A. All work and materials under this section shall conform to the latest revision of the following standard specifications, where not otherwise required by the Contract Documents.
  - 1. "Recommendations for Prestressed Rock and Soil Anchors," Post-Tensioning Institute, latest edition.
  - 2. ASTM A 722 Specifications for Uncoated High-Strength Steel Bars for Pre-Stressing Concrete.
  - 3. ASTM A 572 Specifications for Structural Steel.
  - 4. ACI-318 latest edition-Building Code Requirements for Structural Concrete.
  - 5. Geotechnical Engineering Report for 116th Precinct Station House, Queens, New York, prepared by Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C., dated 15 November 2018.

#### 1.8 PROJECT CONDITIONS

- A. Soil samples taken from the borings are available for the Contractor's inspection.
- B. The Contractor, by careful examination, shall inform himself as to the nature and location of the work; the confirmation of the ground, the nature of the subsurface conditions; the locations of the groundwater table; the character, quality and quantity of the materials to be encountered; the character of the equipment and facilities needed preliminary to and during the execution of the work; and all other matters which can be in any way affect the work.
- C. Investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions, and other limitations affecting transportation to, ingress and egress of the site of the work. Secure in advance any transportation permits as may be required.
- D. Existing Utilities: Locate existing underground utilities in and beyond the areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during the work.
  - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Commissioner and utility companies in keeping respective services and facilities in operation. Restore damaged utilities to the satisfaction of utility owner.
  - 2. Do not interrupt existing utilities serving facilities occupied by The City of New York or the adjacent properties, during occupied hours, except when permitted in writing by the Commissioner and then only after acceptable temporary utility services have been provided. Provide a minimum of 48-hour notice to the Commissioner, and receive written notice to proceed before interrupting any utility.
  - 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

- E. Examine drawings to determine the sequence of operations, and relation to work of other trades. The start of work will signify acceptance of field conditions and will acknowledge coordination with other trades.

## 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Contractor Qualifications: The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
- C. Retain a registered Professional Engineer Licensed in the State of New York to engineer all soil tie-down anchor work. The Contractor's engineer shall sign and seal all submittals related to soil tie-down anchors and shall be present at all meetings associated with this work. All work products of the Contractor's engineer shall be submitted to the Commissioner for review and acceptance prior to incorporation into the work.
- D. Quality Control Inspection:
  - 1. The Contractor's permanent anchor installation and tensioning work shall be subject to all required special inspections.
  - 2. The Contractor shall have the sole responsibility for coordinating his work with the Commissioner to assure that all tests and inspection procedures required by the Contract Documents are properly provided. Cooperate fully with the Commissioner and the inspector in the performance of their work.
    - a. The Commissioner will keep records, including items completed each day, job and weather conditions, a log of each permanent soil tie-down anchor, depth and size of the drill hole, grouting of the hole, and any other pertinent construction details. Cooperate and assist the Commissioner in the making of these records.
    - b. The Contractor will notify the Commissioner promptly of any part of the work of this section not in compliance with these specifications.
  - 3. Testing Service: Employ a testing laboratory to perform material testing on the grout for the permanent anchors with the results of all tests submitted to the Commissioner for review. The City of New York will employ an independent testing laboratory to perform any special inspections, as required.
  - 4. Materials and installed work may require testing at any time as work progresses. Allow free access to material stockpiles and facilities. Re-testing of rejected materials and installed work shall be Contractor's responsibility and shall be done at their expense.

## PART 2 - PRODUCTS

### 2.1 PERMANENT ANCHORS

- A. Soil-anchor hole-diameter shall be 6 inches minimum.
- B. Soil anchor reinforcement shall be permanent double-corrosion protected Dywidag-threadbars manufactured by Dywidag Systems International, Inc., or approved equivalent product from one of the following:
  - 1. Contech Systems



2. Williams Form Engineering Corp
  3. Or approved equal.
  4. Anchor reinforcement shall made of steel conforming to ANSI/ASTM A722 Grade 150.
  5. Anchor design capacities shall be 50 kips for 1-inch-diameter thread bars, and 100 kips for 1-3/8-inch-diameter threaded bars, or as shown on the Drawings.
  6. The coupler is to be per the manufacturer's recommendations. Splicing is not permitted. Anchors shall be unkinked and free of nicks or injurious defects that interrupt the continuity of the corrosion protection materials and the steel bar encased within it.
- C. The anchors shall be furnished complete with all components and accessories, including but not limited to double corrosion protected threaded bars, bearing plates, washers, gaskets, nuts, steel tubes, grout sleeves, grout pipes, smooth and corrugated sheaths, and mastic corrosion inhibitor.
- D. Anchorage lengths shall be as follows:
1. Bond Length – The bond length of the anchors shall be a minimum of 25 feet (for 50-kip anchors) and 35 feet (for 100-kip anchors) into the Building Code Class 3b or better granular material.
  2. Free Stressing Length – The free-stressing length of the anchors shall be a minimum of 10 feet below the excavation subgrade.  
Actual bond and free-stressing lengths shall be determined by the Contractor's Professional Engineer based upon the anchor design capacity with calculations submitted to the Commissioner for review.
- E. Bearing plates, washers, and nuts shall conform to ANSI/ASTM F-432 and shall be galvanized.
- F. Nuts shall be the hexagonal head, heavy-duty type conforming to ASTM A-325 and shall be galvanized.
- G. Furnish certified copies of mill reports for each test and copies of certificates for each lot showing the nominal size, area, weight per linear foot, Guaranteed Ultimate Tensile Strength (GUTS), yield strength, modulus of elasticity, total elongation and other physical properties of the threaded bar material required for the design, inspection and installation of the anchors. Elongation tests shall be specified in ASTM Designation A421 and A416. Mill reports, certificate and test results shall be submitted to the Commissioner not less than seven days before installation.

## 2.2 GROUT

- A. Cement grout to be used for grouting the permanent double corrosion protected anchor into the drill hole shall be proportioned to satisfy the requirements of ACI Standard 318 Section 18.16. When tested by U.S. Army Corps of Engineers guideline CRD-C81-64, Method of Test for Expansion of Grout Mixtures, the mix shall have an expansion of 3 percent, and no bleeding shall be evident.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 DRILLING

- A. Soil Anchorage - The anchorage length of each soil tie-down anchor shall equal or exceed the minimum free stressing length plus bond length specified in Paragraph 2.1.C above.
  - 1. The anchor free stressing length into the soil shall be considered to start at the bottom of the mat foundation.
  - 2. The anchorage diameter shall be at least 6 inches. Holes shall be kept clean until the soil anchors are installed.
- B. Rejection of Holes: Holes rejected because of non-conformance to alignment tolerances or because they intercept other holes shall be filled with grout and another hole shall be drilled at the Contractor's expense. The Commissioner will select the location of the replacement hole.

### 3.3 ANCHOR PLACEMENT

- A. Each anchor hole shall be cleaned of all drill cuttings, sludge, and debris before the anchor is inserted and grouted.
- B. Anchors shall be placed with double corrosion protection according to the manufacturer's specifications.
- C. Centralizers, spacers or other suitable centering devices shall be placed at maximum 10-ft intervals or in a sufficient number to ensure adequate grout cover over the soil anchor assembly throughout the entire anchor length. Centralizers and spacers may be made of any material, (except wood) not deleterious to the pre-stressing steel or PVC sheathing, and shall be in accordance with the manufacturer's recommendations.
- D. A smooth plastic tubing, fitting snugly over the corrugated sheathing, shall be provided in the free stressing length and shall guarantee unobstructed elongation during stressing.
- E. Anchor centerlines shall be normal to the bearing plates.
- F. No welding shall be allowed in the vicinity of the soil anchors.

### 3.4 GROUTING

- A. Anchors shall be grouted with cement grout having a minimum 28-day strength of 4,000 psi.
  - 1. Grout from the bottom of the hole to the top of the ground surface until uncontaminated grout returns to the surface.
  - 2. Grout shall be pumped into the drill hole before soil tie-down anchor insertion into the hole.

### 3.5 ANCHOR STRESSING AND TESTING EQUIPMENT

- A. All stressing and testing shall be carried out using a center hole hydraulic jack and pump system.
- B. The ram travel of the jack shall be long enough to permit a minimum anchor elongation equal to the theoretical elastic elongation of the bond length and free stressing length at 80 percent of the maximum travel of the ram. If stressing is performed in increments of load, the ram travel shall be long enough to permit the theoretically computed anchor elongation of the bond length and free stressing length under each load increment at 90 percent of the maximum travel of the ram.



- C. The hydraulic pump must be capable of fully applying each load increment in less than 2 minutes but without transmitting dynamic or impact loads to the anchor.
- D. The hydraulic jack and pressure gauge shall be calibrated as a set. Proof of calibration must be submitted to the Commissioner for review and approval two weeks before use.
- E. The pressure gauge dial face shall be scribed such that the smallest graduation is not greater than 100 psi.

Elongation of the anchor shall be measured with a dial gauge fixed to a tripod or some other support device at a sufficient distance from the anchor so as not to be affected by the load being applied to the anchor. The dial gauge should permit reading to a minimum accuracy of 0.001 inches. The maximum elongation of the threaded bar shall be less than 90% of the full travel of the dial gauge ram.

### 3.6 ANCHOR TESTING - PERFORMANCE TESTING

- A. Performance testing should be performed on 10 percent of the permanent anchors. Until Performance testing is completed and approved, no additional anchors shall be installed, except at the Contractor's risk. Drilling of anchor holes may proceed. All anchors shall be tested before the mat foundation is constructed. It is the contractor's means and methods to successfully transfer the test load to subgrade so that settlement will not be an issue.
- B. The 10 percent of anchors to be performance tested shall be drilled at the locations, chosen by the Contractor and shown on the shop drawings. Locations are subject to the approval of the Commissioner.
- C. The performance testing shall be performed after the grout has attained the minimum compressive strength.
- D. Performance testing shall proceed by cyclically and incrementally loading and unloading the anchor as follows:
  - 1. Definition:
    - a. P = Design Loads as shown in the Contract drawings.
    - b. AL = Load necessary to maintain alignment of stressing and testing equipment.
  - 2. Loading Schedule:
    - a. AL, 0.25P.
    - b. AL, 0.25P, 0.5P.
    - c. AL, 0.25P, 0.5P, 0.75P.
    - d. AL, 0.25P, 0.5P, 0.75P, 1.0P.
    - e. AL, 0.25P, 0.5P, 0.75P, 1.0P, 1.2P.
    - f. AL, 0.25P, 0.5P, 0.75P, 1.0P, 1.2P, 1.33P.
- E. Each load step shall be held for a minimum of 1 minute or until the rate of movement is less than 0.001 inches per minute. At the 1.33P load, a creep test shall be performed by holding the load constant and recording movement readings at 1, 2, 3, 4, 5, 6, and 10 minutes. If the total creep movement between 1 and 10 minutes exceeds 0.04 in, the test load will be maintained for an additional 50 minutes. Whereupon, the movements will be recorded at 20, 30, 40, 50, and 60

minutes. Upon completion of creep test, reduce load and lock-off as specified herein in Section 3.8.

### 3.7 ANCHOR STRESSING - PROOF TESTING

- A. Every anchor, except the Performance-tested anchors, shall first be Proof-tested. It is the contractor's means and methods to successfully transfer the test load to the subgrade so that settlement will not be an issue.
- B. Proof testing shall proceed by incrementally loading the anchor as follows:
  - 1. Loading Schedule:
    - a. AL, 0.25P, 0.5P, 0.75P, 1.0P, 1.2P, 1.33P.
- C. Each load step shall be held for a minimum of 1 minute or until the rate of movement is less than 0.001 inches per minute. At the 1.33P load, a creep test shall be performed by holding the load constant and recording movement readings at 1, 2, 3, 4, 5, 6, and 10 minutes. If the total creep movement between 1 and 10 minutes exceeds 0.04 in, the test load will be maintained for an additional 50 minutes. Whereupon, the movements will be recorded at 20, 30, 40, 50, and 60 minutes. Upon completion of creep test, reduce load and lock-off as specified herein in Section 3.8.
- D. Proof testing of the anchors may be performed before or after the construction of the foundation footing. However, if the Contractor elects to perform proof testing after the footing has been constructed, he does so at his own risk and will be required to replace any anchor that does not meet the acceptance criteria given in Section 3.7. This includes, but is not limited to any and all modifications to the pile cap to accept the replacement anchor.
- E. After the soil anchor grout has had an adequate setting time to attain a minimum design compressive strength, tension the anchor in accordance with the approved shop drawings and the following test procedures and requirements.

### 3.8 ACCEPTANCE CRITERIA

- A. Acceptance criteria at the maximum specified test load of 133% of the design load are as follows:
  - 1. The total movement measured at the anchor head shall be at least 80 percent of the theoretical elastic elongation of the total free stressing length.
  - 2. The total movement measured at the anchor head shall be less than the theoretical elastic elongation of the anchor length measured from the head of the jack to the center of the bond length.
  - 3. The creep movement measured at the anchor head under the maximum specified test load shall be less than 0.04 inches between the 1-minute and 10-minute readings. If this value is exceeded, then the total creep movement within the period of 6 and 60 minutes shall not exceed 0.08 inches.
- B. If any permanent anchor fails to meet acceptance criteria, re-test the anchor and determine the actual capacity which will produce the acceptance criteria. Additional anchors would then be installed in accordance with these specifications at a location specified by the Commissioner and tested to verify if the total capacity of the anchors exceeds the specified transfer load. No payment shall be made for additional anchors, anchor testing or any necessary structural connections. The expenses of all structural redesign and review shall be entirely borne by the Contractor.

**3.9 LOCK-OFF AND LIFT-OFF ANCHOR TESTING**

- A. All Performance-tested anchors shall be reloaded to the specified 133% of the design load and then reduced to the submitted approved lock-off load as specified below.
- B. The lock-off load for the specified as shown on the foundation drawing, but not more than 133% of the design load. The tensioning process shall be so conducted that the applied load and the elongation of the anchor may be measured at any time. The zero point for measurement of anchor elongation shall be established by the application of an initial alignment load equal to 10% of the specified transfer load. During the tensioning of each anchor, records shall be kept of gauge pressure and of anchor elongation at each specified jacking force. The anchor elongation shall be measured using a dial gauge capable of measuring to 0.001 inches.
- C. Pressure gauges shall be checked every week and at any time that there are indications of erratic results, the pressure gauge shall be checked against a master gauge, which shall be kept on site for this purpose. All tensioning shall be done in the presence of the Commissioner.
- D. Immediately after the lock-off, make a lift-off test for each anchor to confirm the transfer load. If the load in an anchor under check as determined by lift-off, is within five percent of the lock-off load, the anchor shall be deemed acceptable. If such load loss is greater than five percent of the lock-off load, the anchor shall either be rejected or subjected to re-stressing and further checking as directed by the Commissioner. The anchor, if rejected, shall be unloaded, the anchor head recession filled in with grout and a replacement anchor shall be installed as directed by the Commissioner at no additional expense to the City of New York.

**3.10 QUALITY CONTROL**

- A. The City of New York will retain a Special Inspection agency to perform special inspection of the installation of all the permanent soil tie-down anchors, including drilling, grouting, and anchor testing.
- B. The Commissioner will review all submittals related to the materials, installation, and testing of the soil tie-down anchor before the start of work.
- C. Cooperate with the Commissioner in the performance of the required tests.
- D. Replace all anchors that that are rejected by the special inspection.

**3.11 FINISHING**

- A. Permanent protection of the soil tie-down anchor head against corrosion shall be provided in accordance with the manufacturer's specifications. Fill recessed area around satisfactorily tested anchor with non-shrink cement grout. Submit anchor head corrosion protection materials and procedures to the Commissioner for approval as part of the shop drawing submittal.

**END OF SECTION 31 68 00**

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**SECTION 32 05 16****AGGREGATE MATERIALS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Aggregate materials for precast concrete unit paving.
2. Aggregate material for compacted base courses.

B. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete"
2. Section 03 33 00 "Architectural Concrete"
3. Section 03 48 00 "Precast Concrete Specialties"
4. Section 32 14 13 "Precast Concrete Unit Paving"
5. Section 32 91 13 "Soil Materials"
6. Section 32 91 19 "Landscape Grading"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCES**

- A. NYSDOT Standard Specifications (latest edition), Section 300 - Bases and Subbases, Section 703 - Aggregates.

- B. NYSDOT Standard Specifications (latest edition) section 203-3.12 compaction.
- C. AASHTO - M147 - Materials for Aggregate and Soil-Aggregate.
- D. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- E. ASTM D2487 - Classification of Soils for Engineering Purposes
- F. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures.
- G. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- H. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Test Reports, Gradation and Mechanical Analysis, and Samples.
- B. Submit gradation and material analysis for all types of aggregate materials to Commissioner for approval prior to ordering or delivering to site.
- C. Materials Source: Submit name of imported materials suppliers to Commissioner.
- D. Samples: Submit 1 lb. sample in sealed plastic bags labeled with source of all aggregates used as finish materials. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.

#### 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Every effort shall be made to maximize postindustrial/post-consumer recycled content. Certification of recycled content shall be in accordance with the Submittal Requirements herein.

### PART 2 - PRODUCTS

#### 2.1 AGGREGATE MATERIALS

- A. Aggregates for precast unit paver system: properly graded, non-frost susceptible crushed stone conforming to the following size and gradation requirements:





1. The granular base course aggregate material shall meet the requirements of the latest edition of the NYS Department of Transportation Standard Specification Section 304 "Subbase Course". Composition of the base course shall be Type 4 Subbase as indicated in the following table:

<u>Passing Sieve (Dry Analysis)</u>	<u>Percent Passing by Weight</u>
2"	100%
1/4"	30-65%
1/8"	75-90%
No. 40	5-40%
No. 200	0-10%

2. The granular leveling bed material for unit pavers shall be crushed bluestone screenings, free from clay lumps, organic or other deleterious material. Fines shall be evenly mixed throughout the aggregate. Screenings shall be graded within the following limits:

<u>Passing Sieve (Dry Analysis)</u>	<u>Percent Passing by Weight</u>
1/4"	100%
No. 4	90-100%
1/8"	75-90%
No. 20	30-50%
No. 40	20-40%
No. 80	10-25%
No. 200	5-15%

- B. Aggregate Material for compacted base course shall be clean crushed trap rock or ledgerstone conforming to the following limits:

<u>Passing Sieve (Dry Analysis)</u>	<u>Percent Passing by Weight</u>
2"	100%
1/4"	30-75%
No. 40	5-40%
No. 200	0-10%

- C. Recycled Concrete Aggregate (RCA) will not be accepted as base or setting courses for pavements, aggregates borders, strips or other site elements.
- D. Bank run gravel and rounded sands shall be rejected for use as aggregate materials.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, including crowns and cross sections, and is dry.

### 3.3 STOCKPILING

- A. Stockpile materials on site as needed at locations designated by the Commissioner.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

### 3.4 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent standing surface water.

### 3.5 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.
- C. Proof roll sub-grade thoroughly using a 10-ton roller with two passes, the second pass perpendicular to the first.

### 3.6 AGGREGATE PLACEMENT

- A. Place aggregate sub-base on the prepared sub-grade in layers of uniform thickness, conforming to the cross-section and thickness indicated on the plans. Maintain the optimum moisture content for compacting the aggregate sub-base during placement operations.
- B. When a compacted aggregate sub-base course is shown to be 6" thick or more, place the material in equal layers, except no single layer more than 8" or less than 3" in thickness when compacted.
- C. Level and contour surfaces to elevations and gradients indicated. Place in such a manner to minimize segregation. No aggregate sub-base shall be placed under adverse weather conditions.
- D. Compact and roll each layer of aggregate sub-base course to 95% maximum density.
- E. All compaction requirements shall be in accordance with NYSDOT Standard Specification section 203-3.12. The depth of each sub-base course shall not exceed the compactor's capability. Each compactor lacking the original manufacturer identification plates, or with altered or illegible plates, will not be recognized as acceptable compaction equipment and shall be removed from the site.
- F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- G. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

- H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- I. When the pavement sub-base becomes mixed with the sub-grade or any other material, it shall be removed and replaced with the appropriate material. The movement of any traffic over the fine graded aggregate sub-base is not recommended. When damage or contamination occurs, it must be restored before paving begins.

### 3.7 TOLERANCES

- A. Fine grading of the pavement sub-base finish course shall not vary more than 1/2 inch above or below true grade at any point.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Flatness: Maximum variation of 1/2 inch measured with a 10-foot straight edge.

### 3.8 FIELD QUALITY CONTROL

- A. Quality Control Testing during construction: Allow testing service to inspect, test and approve each aggregate sub-base layer before further backfill or construction work is performed. Testing service shall review and test material and determine optimum moisture at which maximum density can be obtained in accordance with ASTM D 1557, modified proctor.
- B. Field Compaction testing will be performed in accordance with ASTM D1556 (sand cone method), ASTM D2167 (rubber balloon method), or ASTM D2922 (nuclear method).
- C. If tests indicate work does not meet specified requirements, remove work, replace and re-test.
- D. Frequency of Tests: Make at least one field density test for each layer of aggregate sub-base every 2,000 sq. ft.

### 3.9 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 32 05 16**



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**SECTION 32 12 16****ASPHALTIC PAVING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 32 13 15 - Concrete Curbs and Pavement
- C. Section 32 17 23 – White Pavement Markings

**1.2 SUMMARY**

- A. Section includes:
  - 1. Provide material, labor, equipment, and services required to install asphaltic concrete paving and related work within the lot lines as shown on Drawings.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. The Contractor must provide the following submittals to the Commissioner for all work in this section:
  - 1. Material Certificates
  - 2. Product Warranty
  - 3. Product Data
  - 4. Manufacturer's Certificate

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Regulatory Requirements
  - 1. Work of this Section shall comply with the requirements of the 2014 NYC Building Code, the NYC Department of Buildings, the NYC Department of Environmental Protection, and the New York City Department of Transportation.
  - 2. Requirements for asphaltic concrete, including, but not limited to handling, equipment, transportation etc., not specified herein shall conform to the more stringent of the New York City Department of Highway Standard Specifications, New York State Department of Transportation Standard Specifications, and AASHTO "Standard Specification for Transportation, Materials, Methods of Sampling and Testing".

**1.8 REFERENCES**

- A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. Standard Specifications - New York City Department of Transportation Bureau of Highway Operations.
- C. Construction Specifications for Asphaltic Concrete and Other Plant-Mix Types - The Asphalt Institute, Fourth Edition.
- D. Standard Specifications - Construction and Materials - New York State Department of Transportation.
- E. American Society of Testing and Materials (ASTM)
- F. American Association of State Highway and Transportation Officials – "Standard Specification for Transportation, Materials, Methods of Sampling and Testing".

**1.9 DEFINITIONS**

- A. Subbase: Either the compacted subgrade or compacted aggregate base that is to receive the base course.
- B. Base Course: Asphaltic concrete mixture, usually referred to as plant-mix (described by the term binder mixture by NYCDOT), that is used as a base for the final asphaltic wearing surface when a Portland cement concrete base is not used.

- C. Surface Course: Final asphaltic concrete wearing surface, usually referred to as surfacing mix (described by the terms fine or extra fine asphaltic concrete mixture by NYCDOT), placed over plant-mix or Portland cement concrete base.

## 1.10 ENVIRONMENTAL REQUIREMENTS

- A. Asphaltic Concrete:
  - 1. Do not install asphaltic concrete paving when there is frost on the subbase or base; when the subbase or base is wet; or when the air temperature is 40°F or below.
  - 2. Materials containing frost will be rejected.
- B. Prime coat: Apply prime coat when air temperature is above 50°F and when temperature has not been below 35°F for 12 hours immediately prior to application. Do not apply when subbase is wet.
- C. Tack coat: Apply tack coat when air temperature is above 50°F and when temperature has not been below 35°F for 12 hours immediately prior to application. Do not apply unless base is completely dry.
- D. Pavement Sealer: Apply sealer under conditions similar to prime and tack coats.
- E. Joint Sealer: Apply joint sealer when air and substrate temperatures are above 40°F and rising for 12 hours after application.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Asphaltic Concrete: Materials shall comply with Section 3.01 of NYCDOT Standard Specifications for each item.
- B. Prime Coat: Cut-back asphalt type, AASHTO M82, (ASTM D2027) MC-30, MC-70 or MC-250.
- C. Tack Coat: Emulsified Asphalt; AASHTO M140 (ASTM D977) or M208 (ASTM D2397); SS-1h, CSS-1 or CSS-1h, Diluted with one part water to one part emulsified asphalt.
- D. Pavement Sealer: Polymer modified asphalt emulsion sealer meeting ASTM D2939, D140, D244, and D529; containing no coal tar, and less than 10 grams per liter of volatile organic compounds.
  - 1. Neyra Jennite AE polymer modified asphalt sealer
  - 2. VelveTop PM Polymer Modified Asphalt Sealer
  - 3. SealMaster Polymer-Modified Masterseal Sealer
  - 4. Or approved equal
- E. Reflective Cracking Membrane:
  - 1. Woven or Non-woven polypropylene fabric pre-coated with a rubberized adhesive base at least 18" in width used for preventing cracks in substrate emanating through the asphalt topping.
  - 2. Product:
    - a. Petrotac by Amoco Fabrics and Fibers Co., with Celotex primer



- b. Polyguard NW 75 by Polyguard Products, Inc., with 650 RC Liquid Adhesive and Mastic to prime surface.
- c. Bituthene S-5300 by W.R. Grace & Co
- d. Or approved equal

F. Joint Sealer: Cold-applied low modulus pourable two-component sealant comprised of polymeric compounds compatible for both Portland cement concrete and asphaltic concrete surfaces providing a flexible, rubber-like finish. Material shall not become brittle to temperatures as low as -20°F.

## 2.2 EQUIPMENT

- A. Provide proper compaction equipment to properly compact asphaltic concrete pavement.

## 2.3 MIXES

- A. Bituminous material shall come from one source only.
- B. Bitumen and aggregate composition shall be plant mixed entirely.
- C. Composition:
  - 1. Aggregate:

Percent Passing by Weight of Aggregate

Sieve Size	Surface Course (NYCDOT Extra Fine Surfacing Mix)	Surface Course (NYCDOT Fine Surfacing Mix- NYS Type 7F)	Base Course (NYC Binder- mix – NYSDOT Type 3)	Variation from Job Mix Formula* (Fine and Binder mix only)
1 1/2"	-	-	100	-
1"	-	-	95-100	-
1/2"	100	100	70-90	+6 (bin. mix only)
3/8"	98-100	-	-	-
1/4"	-	90-100	48-74	+7 (bin. mix only)
1/8"	-	45-70	32-62	+7 (+6 for fine)
No. 4	70-90	-	-	-
No. 8	38-65	-	-	-
No. 20	-	15-40	15-39	+7
No. 40	-	8-27	8-27	+7
No. 50	6-25	-	-	-





No. 80	-	4-16	4-16	+4
No. 200	2-8	2-6	2-8	+2

\*This is the tolerance from the approved job mix, but may never be out of the accepted range

2. Asphaltic Cement (Bitumen)

Percent Bitumen by Total Weight Job Mix Formula*	Variation from Mix	Soluble in Chloroform
Plant-mix	4.5-6.5	+.4
Fine Surfacing	5.8-7.0	+.4
Extra Fine Surfacing Mix	5.0-8.0	-

D. Penetration grade of the asphaltic cement shall be 85-100.

E. The Contractor has the option to provide either the fine or extra-fine surfacing mix.

2.4 SOURCE QUALITY CONTROL

A. Inspection

1. The Contractor will assign an inspector at the plant to ensure that the mix provided is that of the design mix.
2. Provide the inspector with any required testing apparatus to ensure conformance.
3. Notify the Commissioner 72 hours in advance of each asphaltic concrete placement so that the inspector can cover the work at the plant.

B. Testing:

1. The Testing Laboratory will determine the maximum theoretical density of each mix in accordance with ASTM D2041 and do an extraction and gradation test from samples obtained in the field.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

A. Refer to DDC General Conditions for execution requirements.

3.2 EXAMINATION

A. Verify that all grades and/or concrete slabs onto which asphaltic concrete is to be placed are at the required levels prior to placement. Verify that all miscellaneous concrete work has been installed. Notify the Commissioner in writing of conditions that will interfere with the proper completion of this Work. Do not begin work until all improper conditions are remedied. Installation of aggregate subbase is described in Section 31 00 00 - Earthwork.

3.3 PREPARATION

A. Protection:

1. Provide tarpaulins for use during conditions such as rain, chilling winds or unavoidable delay to cover and protect paving materials.
2. Protect pavement from debris and damage from equipment and other work.
3. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Clean surfaces of bituminous materials when smearing occurs.

**B. Surface Preparation:**

1. Remove all loose and foreign materials before proof rolling and application of herbicide and prime coat.
2. Proofroll prepared subbase surface to check for unstable areas and areas requiring additional compaction.
3. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
4. Subbase shall be dry and free from any standing water.
5. Apply weed control agent in accordance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase prior to application of prime coat.
6. Apply prime coat at rate of 0.20 to 0.50 gal per sq yd over compacted subbase. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and to allow for evaporation of volatiles.
7. Asphaltic concrete placed on Portland cement concrete pavements or existing asphaltic concrete pavement:
  - a. Any joints (expansion, contraction, construction, etc.) in the base shall be covered with the reflective cracking membrane.
  - b. The surface onto which the membrane is placed shall be dry and free of debris. Clean joints over 1/8" wide by pneumatic means and fill with asphaltic joint filler.
  - c. Prime surface to receive membrane as specified by the membrane manufacturer. Place the membrane in strict accordance with the manufacturer's instructions. Ends shall be overlapped 4" to 6".
  - d. Placement of the surface course shall closely follow membrane laydown. Do not place more membrane than can be overlaid that working day.

### 3.4 WOOD FORMS

- A. Provide temporary wood forms at perimeter of areas to be paved where permanent side supports (i.e., curbs, gutters or edgings) have not been constructed. Forms are to remain in place until surface course has been thoroughly rolled and compacted to required thickness.
- B. Form out areas to be depressed, such as high jump pits, etc.
- C. Oil wood forms before placing any paving materials against them. Stake forms securely to line and grade, using at least 3 bracing stakes or pins to each ten feet of length, to properly resist pressure and impact of roller without springing form.
- D. Forms are to rest firmly upon the thoroughly compacted subbase through their entire length.
- E. Clean and re-oil forms each time before reuse.

### 3.5 PLACEMENT

- A. General:

1. Prior to installation of pavement, verify all miscellaneous concrete items have been installed.
2. Establish and maintain required lines and elevations.
3. Place asphaltic concrete mixture on prepared surface, spread and strike-off. Spread mixture at the temperature required by Table 404-1 of the NYSDOT Standard Specification. Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.
4. Begin rolling when mixture will bear roller weight without excessive displacement. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
5. After final compression, field density shall be not less than 92% of the theoretical maximum density as determined by ASTM D2041.

**B. Asphaltic Concrete Base Course - Plant-Mix:**

1. Provide plant-mix base unless Portland cement concrete base is shown on Drawings or specified herein.
2. Spread sufficient plant-mix to develop a uniform 4" thickness after rolling and compaction.
3. Sprinkle with clean water and compact with a vibratory 10-ton or greater roller. Smaller weight rollers may be required due to load prohibitions on existing structures. Provide multiple rollers for large areas. In areas where the use of a roller is impracticable, heavy mechanical tampers may be used to consolidate the material. Laydown temperature of mixture shall be adjusted to take into account the longer time of the many multiple passes required by smaller compactors or mechanical tampers to achieve the required density. Refer to NYCDOT Standard Specifications for other requirements.

**C. Asphaltic Concrete Surface Course - Surfacing Mix:**

1. Prior to placement of surface course, apply tack coat to contact surfaces of previously constructed asphaltic or Portland cement concrete and surfaces abutting or projecting into asphaltic concrete pavement. Distribute at rate of 0.05 to 0.15 gal per sq yd of surface. Allow to dry until at proper condition to receive paving.
2. Place surface course over base only when base is dry and free from standing water.
3. Spread in loose layer and of such depth to result in a uniform course having the thickness of 1 1/2" after compaction and rolling (1" for surface course over concrete base).
4. Compact the material with approved roller to a smooth even surface and to the levels indicated.
5. Roller shall be a minimum 10-ton tandem type having a rear wheel minimum compression of 225 lbs per lineal inch. Refer to subparagraph B.3 immediately above for other requirements.
6. Motion of roller shall be slow enough to avoid displacement of the surface rolled.
7. Keep roller wheels moistened with water to prevent adhesion of the materials to wheels, but without use of excessive amount. Use of any liquids other than water for this purpose is prohibited.
8. If the operation of laying materials is interrupted, the end of the laid material shall be left unrolled until the work is resumed so that there will be no joints in the topping.
9. If it is necessary to pass the roller over or to permit traffic to pass over such temporary end, thus consolidating it, cut back the material before recommencing laying operations in order to present a fresh clean surface for contact with the newly placed material.
10. Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of the asphaltic concrete course. Clean contact surfaces and apply tack coat.



11. The use of liquid bitumen or hot smoothing irons in finishing such joints is prohibited.
12. At locations adjacent to curbing and gutters inaccessible to rollers, compression shall be effected with iron tampers weighing not less than 25 lbs, having a maximum bearing area of 48in<sup>2</sup>.
13. Any surfacing material (ie. sealer, paint, wearing surface, etc.) to be placed on the asphaltic concrete surface shall only be done after the asphaltic concrete has cured and the oils have dissipated. Consult with the product manufacturer for their exact requirements.
14. Where asphaltic concrete abuts concrete walls, existing asphalt pavement or concrete pavements apply asphalt joint sealant. Neatly tape all sides of joints, including vertical surfaces where existing) to prevent damage and smearing of material on surfaces and protect until cured.

### 3.6 FINISH

- A. The rolled finish surface shall be free from porosity, fissures, or blemishes, true to crown and grade; free from depression, waves, bunches, or unevenness so as to allow complete runoff.
- B. Should defects in composition compactness or surface finish appear in the completed work, remove defective areas to full depth of the course and replace with thickness and finish specified.
- C. With permission of the Commissioner, minor surface defects may be restored with approved sealing compound.
- D. Cracking, blistering, running, or deviation from requirements specified above that occur during the guarantee period are considered defects under the warranty conditions of the Contract.

### 3.7 PATCHING

- A. Remove and replace paving areas mixed with foreign materials and defective areas in a manner acceptable to the Commissioner. Cut-out such areas and fill with fresh, hot, asphaltic concrete. Compact by rolling to maximum surface density and smoothness.

### 3.8 PAVEMENT SEALER APPLICATION

- A. Do not apply pavement sealer on pavements covered with other materials, ie. unit pavers, resilient surfacing. Apply on all other pavements.
- B. After asphaltic concrete surface course has been tested and approved for allowable tolerances and the surface is hardened to a degree acceptable to the sealer manufacturer (a minimum of 30 days), apply the sealer in accordance with the manufacturer's instructions.
- C. Sweep or mechanically clean surfaces thoroughly free of dust, dirt and foreign materials; remove oil and grease spots with household detergent. Flush entire surface with water; remove all remaining water puddles. Apply primer if recommended by the manufacturer.
- D. Dampen pavement as recommended by the manufacturer; pour sealer mix in spots or ribbons, then spread evenly with push broom or squeegee. Mechanical applicators may be used, and mix must be periodically agitated for uniformity. Two coats shall be applied, allowing for complete drying, tack free, between coats. Surface shall be uniform, with no holidays or pinholes.
- E. Allow sealer to dry about 24 hours minimum depending on weather conditions before opening surface to traffic. Temperature for drying conditions shall not be less than 50°F for 48 hours after application.

- F. Apply at a minimum rate per coat of 1.10 gallons of sealer concentrate for every 100 sq ft of surface, or more concentrate if required by the sealer manufacturer. Concentrate shall be mixed with water and clean, dry, silica sand in quantities recommended by the manufacturer. Typical sand content is 5 pounds per gallon of concentrate, and shall meet fineness rating recommended by manufacturer. Maximum water content is 15% of undiluted concentrate volume.
- G. Apply Line Markings per manufacturer's recommendations.

### 3.9 TOLERANCES

- A. The thickness of the plant-mix and surface course shall not vary by more than 1/2".
- B. The finish elevation for the plant-mix shall not vary from plan grade by more than 1/2", the surface course by more than 1/4".
- C. The smoothness tolerance for the plant-mix is 1/4", the surface course 1/8", when measured as described under "Field Quality Control".

### 3.10 FIELD QUALITY CONTROL

- A. Testing and Inspection:
  - 1. The City of New York's inspector will take samples of the asphaltic concrete to check conformance with the design mix and will verify the in-place density.
  - 2. Pay for any tests such as cores required by the Commissioner when such tests show non-conformance with the Drawings and Specifications.
  - 3. Test finished surface of each asphaltic concrete course for smoothness, using 10-foot straightedge applied parallel with, and at right angles to, centerline of paved area.
  - 4. Check the final surface for depressions by applying water in the presence of the Commissioner. Water should not pond and should flow to all catch basins and trench drains.
- B. Survey: Provide a survey showing elevation of finished surface on 25 foot intervals.

### 3.11 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of Commissioner.

### 3.12 PROTECTION

- A. After final rolling, do not permit vehicular traffic on asphaltic concrete pavement until it has cooled and hardened so as not to be marked and in no case sooner than 6 hours.
- B. Provide barricades and warning devices as required to protect pavement and the general public.
- C. Cover openings of structures in the area of paving until permanent coverings are placed.

**END OF SECTION 32 12 16**



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**SECTION 32 13 15****CONCRTE CURBS AND PAVEMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 32 12 16 - Asphaltic Paving

**1.2 SUMMARY**

- A. Section includes:
  - 1. Furnish material, equipment, labor, services required to provide for concrete curbs, pavements and footings. Work includes the installation of formwork, reinforcement, expansion joints and other items listed herein within the site. Provide special formwork or form liners for concrete with smooth finishes. Allow ample time and facility for the Work of other Divisions to be installed.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:
  - 1. Material Certificates
  - 2. Product Warranty
  - 3. Product Data
  - 4. Manufacturer's Certificate

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements".
- B. Regulatory Requirements:
  - 1. 2014 New York City Building Code: Work of this Section shall conform to all requirements of the 2014 NYC Building Code and all applicable regulations including safety, health, noise, and anti-pollution regulations. Where more severe requirements than those contained in the 2014 NYC Building Code are given in this Section, the requirements of this Section shall govern.
  - 2. Industry Standards: The ACI Standards listed under references apply to Work of this Section. Where more severe requirements than those contained in the Standards are given in this Section or the 2014 New York City Building Code, requirements of this Section or the Building Code shall govern. The Contractor shall keep a copy of ACI SP-15 - "Field Reference Manual" at the site.
- C. Certifications:
  - 1. Acquire cement and aggregate from same source for all work. If a change in suppliers is required, a new mix submittal must be produced with the new material and submitted for approval.
- D. Coordination:
  - 1. Coordinate this work with the work of other Divisions so that items to be installed are done so correctly and in proper sequence.

**1.8 REFERENCES**

- A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by 2014 New York City Building Code, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. American Society of Testing and Materials (ASTM) standards, latest editions.
- C. American Concrete Institute (ACI) standards, latest editions.
- D. "Placing Reinforcing Bars - CRSI-WCRSI Recommended Practices", latest edition. Concrete Reinforcing Steel Institute.



**1.9 DEFINITIONS****A. Exposed to view:**

1. Situated so that it can be seen from eye level from a public location. A public location is that which is accessible to persons not responsible for operation or maintenance of the building.

**1.10 DESIGN REQUIREMENTS:****A. Performance Characteristics:**

1. Curbs: Normal weight concrete with a minimum compressive strength of 3500 psi, air entrained, and a maximum water to cement ratio of 0.45.
2. Exterior slabs on grade (pavements, stairs, etc): Normal weight concrete with a minimum compressive strength of 3500 psi, air entrained, and a maximum water to cement ratio of 0.40.

- B. Mix design for concrete with smooth form is to contain a high-range water reducer (super plasticizer).

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Rough Formwork: Shall be Commercial Douglas Fir, DFPA: 5/8" thick minimum.

- B. Overlaid Plyform Formwork: Basis-of-Design Product: Subject to compliance with requirements provide B-Matte Formguard by Simpson Timber Company or comparable product by one of the following:

1. Dayton Richmond Concrete Accessories
2. Forest Products Supply Co.,
3. Or approved equal.

- C. Smooth Form Finish Formliner: Basis-of-Design Product: Subject to compliance with requirements provide #340 Smooth Face by Greenstreak or comparable product by one of the following:

1. Architectural Polymers
2. Sika
3. Or approved equal.

- D. Release Agent: Basis-of-Design Product: Subject to compliance with requirements provide VOC compliant material such as those of the Cresset Chemical Company for coating forms or comparable product by one of the following:

1. W.R. Meadows
2. TK Products
3. Or approved equal

- E. Form Ties: Wire ties not permitted. Form ties for exposed concrete shall be adjustable, leave no metal closer than 1 1/2" to the surface, and free of devices which leave holes or depressions larger than 7/8" back of exposed surface.
- F. Reinforcing Bars: All reinforcing bars shall be of deformed type of new billet steel conforming to current requirements of ASTM A615 Grade 60. No rail or re-rolled steel will be permitted. All bars shall be epoxy coated in accordance with ASTM A775.
- G. Welded Steel Wire Fabric: Wire Fabric shall conform to the requirements of ASTM A185. All wire mesh shall be epoxy coated in accordance with ASTM A884.
- H. Supports for Reinforcement: Support for reinforcement supported by ground shall be coated wire bar supports or bar supports made of dielectric material or other acceptable materials or precast concrete block, 4" square minimum, having a compressive strength equal to that of the concrete being placed. Wire bar supports shall be coated with dielectric material for a minimum distance of 2" from the point of contact with the epoxy-coated reinforcing bars.
- I. Cement: Shall conform to ASTM C150 Type II and shall be of the non air-entrained type.
- J. Admixtures:
  - 1. The use of admixtures shall comply with the requirements of Section BC 1903.6 of the 2014 NYC Building Code. The final soluble chloride content in concrete, percent by weight of cement, due to the addition of admixtures and other ingredients shall not exceed 0.05 at 28 days.
  - 2. Air-entraining admixtures shall conform to ASTM C260.
  - 3. Chemical admixtures shall conform to ASTM C494.
  - 4. Slag cement: ASTM C989, Grade 100 or 120. Basis-of-Design Product: Subject to compliance with requirements provide GranCem slag cement as manufactured by the St. Lawrence Cement Company or comparable product by one of the following:
    - a. Lehigh Cement Company
    - b. LafargeHolcim
    - c. Or approved equal
  - 5. The amount of cement required by the 2014 NYC Building Code may be reduced by 8% with the use of slag cement that has been reviewed and approved by the Commissioner.
- K. Water: Shall be clean potable water free of injurious foreign matter conforming to the requirements of Section BC 1903.4 of the 2014 New York City Building Code.
- L. Aggregate: Aggregate shall conform to ASTM C33, No.57, No.67 or No.8. Maximum size of coarse aggregate shall conform to paragraph 3.3.2 of ACI 318.
- M. Curing Compounds:
  - 1. Clear Curing and Sealing Compound (A.I.M. Regulations - VOC Compliant, 350 g/l): Liquid type membrane forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class A, 25% solids content minimum. Moisture loss shall be not more than 0.40 Kg/m<sup>2</sup> when applied at 300 sq. ft./gal. Manufacturer's certification is required.
  - 2. Curing Compounds: Basis-of-Design Product: Subject to compliance with requirements provide "Super Diamond Clear VOX" by The Euclid Chemical Company or comparable product by one of the following:



- a. Master Builders
- b. W.R. Meadows
- c. Or approved equal

**N. Bonding Agent:**

1. Epoxy/acrylic resin that will not form a vapor barrier with the concrete with the following properties:
  - a. Bond strength of 1800 psi in 2 hours when tested in accordance with ASTM C882.
  - b. Flexural strength of 2000 psi in 28 days when tested in accordance with ASTM C78.
  - c. Tensile strength of 600 psi in 28 days when tested in accordance with ASTM C496.
2. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. "CR246 Sto Bonding and Anti-corrosion Agent" by Sto Concrete Restoration Division
  - b. Armatec 110 by Sika Corp.
  - c. Euclid Chemical
  - d. Or approved equal

**O. Expansion Joint Filler: Closed-Cell Polyurethane or Closed-Cell Expanded polyethylene Joint Filler - Resilient, compressible, semi-rigid**

1. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. W.R. Meadow's Ceramar
  - b. A.C. Horn's Closed Cell Plastic Foam Filler, Code 5401
  - c. Sonneborn's Sonoflex F
  - d. Or approved equal.

**P. Expansion Joint Sealant: Type 1A Sealant**

1. For Horizontal Joints: Two-part, self-leveling polyurethane sealant for traffic bearing construction. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. Mameco's Vulkem 255
  - b. Pecora's Urexpan NR-200
  - c. Bostik's Chem-Calk 550 or Products Research & Chemical's RC-2SL
  - d. Or approved equal.
2. For Vertical Joints: Two-part, non-sag polyurethane sealant. Subject to compliance with requirements, products that may be incorporated into the Work include the following:
  - a. Mameco's Vulkem 227
  - b. Pecora's Dynatrol II
  - c. Bostik's Chem-Calk 500 or Products Research & Chemical's RC-2
  - d. Or approved equal.

## 2.2 MIXES

- A. General: Concrete for all parts of the Work shall be of the specified quality capable of being placed without excessive segregation and, when hardened, of developing all characteristics required by the Specifications and Drawings.
- B. Strength: Strength requirements given in Section 1.9 of this Specification are based on 28-day compressive strength, unless high early strength is specified, in which case required strengths are based on 7-day compressive strength.
- C. Method of Proportioning:
  - 1. Proportion concrete mix of strength listed in B above in accordance with the requirements of Section BC 1905.2.3 of the 2014 NYC Building Code. The Testing Laboratory and the Commissioner will review the design mix.
  - 2. Mix designs are specific to material used, concrete producer, and method of placement. Each mix design must be reviewed and accepted by the Commissioner.
  - 3. Proportion and produce normal weight concrete to have a maximum slump of 4" or less. A tolerance of up to 1" above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. The slump shall be determined by ASTM C143. Concrete containing High Range Water Reducer shall have a slump not exceeding 9", unless otherwise approved by the Commissioner. The concrete shall arrive at the job site at a slump of 2" to 3", be verified by the Commissioner, and the HRWR admixture added to increase the slump to the approved level.
- D. Concrete shall be air-entrained with an air content for the grading size of coarse aggregate as follows:
  - 1. No.8.....7 1/2%
  - 2. No.57 or 67.....6%
  - 3. Tolerance on air content as delivered shall be +1.5%.

## 2.3 SOURCE QUALITY CONTROL

- A. Tests:
  - 1. The Commissioner will review the proposed materials for compliance with the Specifications prior to construction.
  - 2. The Testing Laboratory will perform field tests as work progresses as listed in "Field Quality Control".
- B. Inspection:
  - 1. Testing Laboratory:
    - a. Concrete work is subject to Quality Control Inspection.
    - b. The Commissioner will assign a licensed concrete testing laboratory to perform the required field testing. The Testing Laboratory will review the mix design, perform field testing, and inspect the work as it progresses. The listing of services to be performed by the testing Laboratory are given in Section 1.6 of ACI 301.
    - c. The Testing Laboratory must be present when the concrete is being placed. The Commissioner may elect to have the laboratory present at the plant to witness the batching and mixing of the concrete.

2. Notification

- a. Notify the Commissioner in writing at least forty-eight hours in advance of each concrete placement.
- b. During the placement of the concrete, notify the Commissioner immediately of any delay at the concrete plant or at the job site. Do not mix concrete or add admixtures unless the Commissioner and Testing Agency Technician are present.

3. Contractors Responsibility for Quality Control

- a. The Commissioner and the Testing Laboratory shall receive the producer's Computer Batch Ticket for each truck.
- b. The tests and inspections, as provided in the 2014 New York City Building Code, do not in any way relieve the Contractor of responsibility to construct the Work in accordance with the Drawings and Specifications and to use safe, standard methods of construction at all times, safeguarding the public, workmen, and structure. The Contractor shall be solely responsible for the physical control of the materials and concrete mixes, and shall see that such mix designs, tests, and controls are in accordance with the 2014 New York City Building Code and Specifications. The Contractor's superintendent shall attest that the work was installed in accordance with the documents.

## PART 3 - EXECUTION

### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

### 3.2 EXAMINATION

- A. Prior to placement of concrete, verify that the concrete cover over the reinforcement is that specified on Drawings.
- B. Verify that reinforcement and all other embedded items are provided and held securely, positioned accurately, and will not be a detriment to concrete placement.
- C. Examine all adjoining work on which this Work is in anyway dependent for proper installation and workmanship. Report to the Commissioner any condition that prevents the performance of this Work.

### 3.3 PROTECTION

- A. Protect concrete members on grade and the subgrade from freezing before and after installation. Provide blankets and other items necessary.
- B. Protect adjacent finish materials and previously poured concrete against spatter during concrete placement.
- C. Provide and maintain barricades and safeguards around openings, etc. to protect workmen from injury and to comply with the 2014 New York City Building Code and OSHA regulations.

### 3.4 FORMWORK

- A. Provide formwork wherever necessary to confine concrete to the required shapes shown on Drawings. Follow all procedures of Section 2 of ACI 301, ACI 347, and Section BC 1906 of the 2014 NYC Building Code. Formwork, reinforcement, and embedded items shall be clean of all accumulated mortar from previous concreting and other foreign material. Restore or replace any formwork as required.
- B. Cover the surfaces of the rough or overlaid plyform formwork (when used) with an approved form release agent that will effectively prevent absorption of moisture, prevent bond with the concrete, and which will not stain the concrete surfaces. Do not apply oil or release agents on formwork for concrete to receive additional concrete (such as at construction joints). Apply at a rate that will help achieve the finish specified below. Follow manufacture's recommendations.
- C. Adequately support and substantially brace formwork to hold lines and shape. Securely brace forms against lateral deflection. Formwork shall be tight jointed to prevent leakage of concrete.
- D. Place chamfer strips in the corners of forms to produce beveled edges (chamfers) on permanently exposed surfaces.
- E. Provide "Rough Form Finish" for surfaces not exposed to view. Use plywood or metal forms coated with a release agent.
- F. Provide "Smooth Form Finish" for surfaces exposed to view and the elements. Use dress, square-edged lumber with form liner or overlaid plyform forms with applicable release agent. Do not exceed manufacture's recommendations for number of re-uses for the form liner or overlaid plyform. Arrange the forms or form liner in an orderly and symmetrical fashion, keeping the number of seams to a practical minimum.
- G. Remove forms in such a manner as to assure the complete safety of the structure as required by Section BC 1906.5 of the 2014 NYC Building Code. Formwork not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations and as required by H below.
- H. When restoration of surface defects or finishing is required at an early age, remove forms as soon as the concrete has hardened sufficiently to resist damage from removal operations.

### 3.5 REINFORCEMENT

- A. Place reinforcement in accordance with CRSI "Placing Reinforcement Bars", Section 3 of ACI 301, and Section BC 1907.5 of the 2014 NYC Building Code.
- B. Unless otherwise permitted, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.
- C. Support and fasten together all reinforcement to prevent displacement by construction loads or placing of concrete.
- D. Lifting of bars and welded wire fabric into position during placement of concrete is not permitted.
- E. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories within 1/2" of the concrete surface shall be non-corrosive or protected against corrosion.

- F. Provide minimum protective cover given in Section BC 1907.7 of the 2014 NYC Building Code if not indicated on Drawings.
- G. All splices not shown on the Project Drawings shall be shown on the shop drawings and approved by the Commissioner.
- H. All embedment lengths not shown on the Project Drawings shall be shown on the shop drawings and approved by the Commissioner.

### 3.6 PREPARATION

- A. Remove ice, excess water, trash, and rubbish from forms.
- B. Remove hardened concrete from inner surfaces of conveying equipment and all formwork, reinforcement, and dowels.
- C. Prepare previously placed concrete to be in contact with new concrete in the manner described under "Construction Joints".
- D. Prepare existing concrete to be in contact with new concrete by roughening and cleaning the surface and applying a bonding agent. Surface must be free of laitance. Concrete must be placed after agent cures and within 24 hours of applying bonding agent in accordance with the directions of the manufacturer.
- E. Do not place concrete on frozen ground.

### 3.7 JOINTS AND EMBEDDED ITEMS

- A. Construction Joints:
  - 1. Make joints not shown on Drawings at locations that will least impair the strength of the structure and comply with requirements of Section BC 1906.8 of the 2014 NYC Building Code. Such location is subject to the approval of the Commissioner.
  - 2. Continue reinforcement across joints. Provide longitudinal keys at least 1 1/2" deep in walls and provide other keys as required.
  - 3. Thoroughly clean concrete surface of oil, grease, and other contaminants and remove all laitance prior to placement of adjoining concrete. Roughen surface of the concrete in an approved manner that will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate, or damaged concrete at the surface. Dampen surface immediately prior to placement.
- B. Expansion Joints:
  - 1. Do not extend reinforcement or other embedded metal items bonded to concrete continuously through expansion joint. Provide smooth dowels greased on one end at the joints or insert into pvc sleeve of length greater than the dowel length by .75" minimum.
  - 2. Provide expansion joint filler at the joint of the sizes indicated on the Drawings or specified herein.
- C. Embedded items:
  - 1. Place all fence sleeves, shoes, and other embedded items required for the Work of other Divisions or for their support prior to concreting.



2. Provide ample notice and opportunity for items of other Division to be introduced and/or furnished for installation before concrete is placed. Coordinate the Work of the other Divisions so all items are placed in their proper location.
3. Set metal pipe sleeves, sockets, shoes, etc. into concrete to receive fence posts or any other items, all as indicated on details.

### 3.8 MIXING AND PLACING CONCRETE

#### A. General:

1. Notify Commissioner at least 48 hours in advance of each concrete placement. Do not place concrete without approval of the Commissioner.
2. Do not allow rainwater to increase mixing water nor damage surface finish.
3. When placing concrete in cold weather (below 40oF), concrete shall have an accelerating admixture added.
4. Production of concrete, including batching and mixing, shall be done in accordance with the requirements of Section 4 of ACI 301 and Section BC 1905.8 of the 2014 New York City Building Code.
5. Placement of concrete shall be done in accordance with the requirements of Section 5 of ACI 301 and Sections BC 1905.9 through 1905.13 of the 2014 New York City Building Code. All consolidation shall be done by vibration.

#### B. Mixing:

1. Batch, mix, and transport ready-mixed concrete in accordance with the appropriate sections of ASTM C94 and Section BC 1905.8.2 of the 2014 NYC Building Code. Truck mixers and agitators shall meet the requirements of the Truck Mixers Manufacturer's Bureau or shall comply with Section 8.1.2 of ASTM C94 and shall be NYSDOT approved. All trucks shall have working revolution counters and site gages.
2. Batch and mix other concrete in accordance with subsection 4.3.1 of ACI 301.
3. Use of chemical admixtures must be approved by the Commissioner.
4. Unless otherwise approved by the Commissioner, concrete shall be deposited within 1 1/2 hours or 300 revolutions of the mixing drum, whichever comes first, after introduction of water to the cement or cement to the aggregate. When the ambient temperature rises above 90oF, the time shall be decreased to 1 hour.
5. Tempering and control of mixing water
  - a. Mix concrete only in quantities for immediate use. Concrete which has started to set shall not be retempered, but shall be discarded. Water shall not be added at the site.
  - b. For concrete containing HRWR (Superplasticizer), if loss of slump occurs, HRWR may be redosed at the site as long as a "flash set" has not occurred. Redosage procedures must be discussed and approved by the Commissioner and the admixture manufacturer.

#### C. Placing: Place concrete in accordance with ACI 304R, ACI 318, and Sections BC 1905.9 and BC 1905.10 of the 2014 NYC Building Code.

1. Consolidate all concrete by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items and into corners of forms, eliminating all air or stone pocket or weakness. Internal vibrators shall be the largest size and most powerful that can be used in the Work, as described in Table 5.1.5 of ACI 309R, with a minimum frequency of 7000 revolutions per minute and shall be operated by competent workmen. Over-vibrating and use of vibrators to transport concrete within forms is not permitted.





Insert and withdraw vibrators at many points, from 18" to 30" apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 sec duration. Keep a spare vibrator on the job site during all concrete placing operations.

2. Cold Weather Concrete Protection: When the mean daily temperature of the atmosphere is less than 40oF during concreting, or within 24 hours thereafter, follow the procedures outlined in ACI 306R to protect the concrete. Temperature of the plastic concrete shall be no lower than 55oF. Heat all forms, reinforcing steel, and surfaces to receive concrete above the freezing point and keep them completely free of frost, snow, and ice.
3. Hot Weather Protection: When the mean daily temperature of the atmosphere is over 90oF during concreting, follow the procedures outlined in ACI 305R to protect the concrete.

### 3.9 FINISHING OF FORMED SURFACES AND RESTORATION OF SURFACE DEFECTS

#### A. General:

1. Remove forms as soon as practicable.
2. Restore surface defects, including tie holes and cracks, immediately after form removal. Patches shall be of quality to match the specified finish.
3. Remove oil, grease, compounds, and other contaminants from surfaces and areas to be restored.
4. Provide finishes specified below immediately after form removal.
5. Provide curing and protection.

#### B. Restoration of Surface Defects:

1. Restore surface defects in accordance with subsection 5.3.6 of ACI 301. At the Commissioner's discretion, repair mortars and coatings shall be employed to rectify defects. Materials shall be as selected by the Commissioner.

#### C. Tie Holes and Other Restorations:

1. Remove ties, nails, and other form accessories below the concrete surface when the surface is exposed to view and/or the elements. For surfaces not exposed to view or the above mentioned conditions, remove metal to the surface.
2. Undercut surfaces of holes. After cleaning and thoroughly dampening the holes, fill them solid with the patching mortar. The mortar shall match the color of the existing concrete for concrete exposed to view as specified in paragraph B above.

#### D. Formed Finishes:

1. Rough Form Finish: Provide for concrete not exposed to view.
  - a. Restore concrete surface as indicated above.
  - b. Chip or rub off fins exceeding 1/4" in height.
2. Smooth Form Finish: Provide for concrete exposed to view. Provide for concrete exposed to view. Concrete shall have a CS 3 or better finish as defined by the Cresset Chemical Company standards and shall have been placed without the need for patching or removal of fins, etc.
  - a. Restore concrete surfaces as indicated above.
  - b. Chip or rub off fins completely and grind smooth.
  - c. Provide smooth rubbed finish as follows:

- 1) Produce on newly hardened concrete no later than the day following form removal.
- 2) Wet the surfaces and rub with a No. 16 carborundum brick or other equal abrasive to obtain a smooth, even surface of uniform appearance without applying any cement or other coating.
- 3) Obtain the final finish by thoroughly rubbing with a No. 30 carborundum brick. The surface shall be wet for a period of 3 days. The Commissioner shall be the sole judge if the finish is proper.

E. Acceptance of Concrete Finish:

1. If the finish produced is not acceptable to the Commissioner, the Contractor shall be responsible for all expenses incurred to produce an acceptable finish by whatever means determined by the Commissioner. Remove stains, rust, efflorescence, and other surface deposits to the satisfaction of the Commissioner.

3.10 PAVEMENTS AND SLABS

A. General:

1. Mixing and placing shall be carefully coordinated with finishing. Do not place concrete more rapidly than it can be spread, straightedged, and darried or bull floated. Provide leveling, floating, troweling, etc. at the correct time interval after pouring to prevent dusting and a non-durable surface as specified in ACI 302.1R. These operations must be performed before bleeding water has an opportunity to collect on the surface.
2. To obtain good surfaces and avoid cold joints, the size of finishing crews shall be planned with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete.

B. Finishing:

1. Slope pavements uniformly toward drains. If pitch or elevations are not shown on Drawings, provide a minimum of 1/8" per foot.
2. Finish pavement surface to a true smooth plane and texture with a toothed roller or float with a wood float. Score concrete pavement in squares of approximately 5'-0" and/or as shown on Drawings. Each rectangular slab shall have all edges neatly rounded with proper tools and be bounded on all sides by a troweled border about 1" in width.
3. Level ramp, step and driveway surfaces with wood float and follow with a broom finish perpendicular to direction of traffic.

C. Placement:

1. General:

- a. Aggregate base material and preparation is given in Section 31 00 00 - Earthwork.
- b. Where pavements to remain are damaged or destroyed as a result of the Work, patch, restore, or replace as required. Color to match existing.
- c. Subgrade and/or aggregate base shall be free of frost before concrete placing begins.
- d. Control Joints:

- 1) Primary Method: Soff-Cut System method, by Soff-Cut International, Corona, CA (800)776-3328. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within 2 hours after

final finish at each saw cut location. Use 1/8 inch thick blade, cutting 1 1/4 inch into slab.

- 2) Optional Method (Where Soff-Cut System Method Equipment is Not Available): Properly time cutting with the set of the concrete. Saw-cut control joints within 12 hours after finishing. Start cutting as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/4-inch-thick blade, cutting 1/4 slab depth.

- e. Dampen subgrade or aggregate base immediately prior to placement of concrete.
- f. Pour slab to required thickness after installation of reinforcement.

## 2. Pavements

- a. Provide 4" thick concrete slab unless otherwise indicated.
- b. Provide 6x6-W2.9xW2.9 WWF placed 1 1/2" from top surface.

## 3. Driveways

- a. Provide 7" thick concrete slab.
- b. Provide 4x4-W4xW4 placed 2" from top surface.

## 4. Expansion joints

- a. Provide expansion joints for all exterior concrete pavement, slabs under asphalt, driveways, etc. specified under this Section. Expansion joints shall occur at intervals not to exceed 20' in each direction or as indicated on Drawings.
- b. Provide continuous expansion joints at the following locations: Driveways and other concrete pavements abutting area walls, buildings, retaining or any other walls, check pieces, steps, curbs.
- c. Expansion joint shall be 1/2" wide, full depth minus 1/4" to allow for the poured joint sealer.

### 3.11 MISCELLANEOUS CONCRETE WORK

- A. Provide curbs, footings, walls, ramps, and other miscellaneous concrete work.

### 3.12 PATCHING AND BONDING TO EXISTING CONCRETE

- A. Provide bonding agent whenever new concrete is to be poured against existing concrete, whenever the time between concrete pours is longer than that allowed for proper bond, and wherever bonding agent is indicated on the Drawings to be applied.
- B. Remove loose concrete from surface to be bonded with new concrete and clean. Remove rust from reinforcement and structural steel by power chipping and power driven brushes.
- C. Apply bonding agent in accordance with manufacturer's specifications. Pour concrete as soon as bonding agent has cured and within 24 hours after placement. If the 24-hour period has elapsed, then the bonding agent must be reapplied.

### 3.13 CURING AND PROTECTION

- A. General:



1. Begin curing concrete immediately after placement and finishing. Protect all freshly deposited concrete from premature drying and excessively hot or cold temperatures and maintain it with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete. Detailed procedures are given in ACI 308.
2. Do not apply curing compounds to surfaces receiving additional concrete. Provide only wet curing.

**B. Procedure:**

1. Concrete surfaces not in contact with forms:
  - a. Ponding or continuous non-manual sprinkling.
  - b. Absorptive mat or fabric, sand, or other covering kept continuously wet.
  - c. Curing compounds conforming to ASTM C1315.
2. Concrete surfaces in contact with forms:
  - a. Minimize moisture loss from forms exposed to heating by the sun by keeping forms wet until they are removed.
  - b. After form removal, cure with one of the methods listed in 1 above.
3. Continue curing until a total of 7 days has elapsed during which the temperature of the air in contact with concrete has remained above 50oF. Prevent rapid drying during and at the end of the curing period.
4. Remove all curing compounds with cleaners recommended by curing compound manufacturer.

**C. Cold Weather Curing:**

1. Concrete must be protected from water loss. This shall be accomplished by the application as soon as possible without harm to the concrete surfaces of either (a) exhaust steam, or vapor-resistant paper or polyethylene film, or (b) curing compounds. In all other respects, curing shall conform to applicable provisions of this Section. Concrete temperature shall be maintained between 50oF and 70oF.

**D. Hot Weather Curing:**

1. During the period June 1 to October 1 or when hot weather conditions require it, maintain continuous water curing for a minimum period of twenty-four hours. Provide for wind breaks, shading, and other necessary provisions.
2. After 24 hours, curing shall be by one of the methods specified under B above. In all other respects, curing shall conform to applicable provisions of this Specification. Upon termination of the specified moist curing, every effort should be made to reduce the rate of drying by avoiding air circulation.

- E. Protection from mechanical injury:** Protect concrete from mechanical disturbances during curing period as described under "Protection and Cleaning".

**3.14 TOLERANCES**

- A. Construct formwork so that concrete surfaces will conform to the tolerance limits listed in ACI 117.**

- B. Establish and maintain in an undisturbed condition and until final completion and acceptance of the project sufficient control points and bench marks to be used for reference purposes to check tolerances.
- C. Place reinforcing bars in accordance with the tolerances given in Section BC 1907.5.2 of the 2014 NYC Building Code.
- D. Move bars as necessary to avoid interference with other reinforcement, conduits, or imbedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangements are subject to approval by the Commissioner.
- E. Place concrete to meet tolerances specified in ACI 117, unless specified otherwise herein.

### 3.15 FIELD QUALITY CONTROL

- A. Tests - Tests to be performed by the Testing Laboratory during construction are as follows:
  - 1. Compliance of materials to Specifications tested from production samples.
  - 2. Determination of the slump of the concrete for each sample taken and whenever consistency of the concrete appears to vary using ASTM C143. The Testing Laboratory will reject any concrete that does not meet the slump requirements.
  - 3. Determination of water content of freshly mixed concrete utilizing the procedure of AASHTO TP23. Concrete that does not meet the maximum water to cement ratio or the proportions given in the approved design mix will be immediately rejected regardless of slump.
  - 4. Strength tests: The frequency of conducting strength tests of concrete shall be in accordance with Section BC 1905.6.2 of the 2014 NYC Building Code, with additional cylinders taken for an additional strength test and one cylinder for a 7 day break. Strength tests shall be performed for each 50 cubic yards, or portions thereof, of concrete placed in any one day's concreting. Specimens will be stored at the site in the insulated curing box provided by the Contractor. Each group of specimens is considered one strength test. One cylinder will be broken at 7 days for information. Strength test shall be at 28 days for acceptance. The cylinders for the additional strength test will be utilized for either a strength test or other types of testing only if the 28-day breaks are low or durability of the concrete is in question. If one specimen in a test manifests evidence of improper sampling, molding, or testing, it shall be discarded and the average strength of the remaining cylinders shall be considered the test result. Should all specimens in a test show any of the above defects, the entire test shall be discarded.
  - 5. Determination of air content and unit weight of concrete sample for each strength test in accordance with ASTM C173 or C231 and ASTM C138.
  - 6. Determination of temperature of concrete sample for each strength test.
  - 7. Determination of water soluble chloride content in the concrete, percent by weight of cement, of each sample.
- B. Inspection:
  - 1. Refer to "Source Quality Control" for responsibility and procedure.
  - 2. The lab will inspect placement of reinforcement and thickness of members prior to placement.
  - 3. Keep a record of all inspections, the name of the persons making them, and the name of the foreman in charge of formwork at the site. Submit to the Commissioner a copy of the inspection records prior to each concrete placement.
  - 4. Cooperate in the making of all tests by the Laboratory Technician by:



- a. Providing an insulated curing box of sufficient size and strength to contain all specimens made in any four consecutive working days. Furnish an outlet to provide the necessary temperature in the storage box, pending delivery to the Laboratory of the test cylinders.
- b. Providing a buggy for transporting the concrete taken from the mixer (and/or point of placement) to the location of the curing box for testing and the preparation of specimens.
- c. Protecting the property of the Laboratory and keeping test specimens free from vibration and other disturbances.
- d. Providing a microwave of the size specified in AASHTO TP23 and a portable generator.

**C. Evaluation and Acceptance of Concrete:**

1. Strength tests on concrete will be evaluated according to Section BC 1905.6.3.3 of the 2014 NYC Building Code by the Commissioner. If the tests fail, the adequacy of the concrete will be checked according to the requirements of Section BC 1905.6.5 of the 2014 NYC Building Code. Concrete exposed to the elements with indications of poor durability will be rejected regardless of strength and will be subject to petrographic examination.
2. Pay for additional expense of labor and materials required at the job for all damages resulting from testing. Remove and replace concrete work that is not of adequate strength or weather resistance and cannot be made to work by remedial methods acceptable to the Commissioner at own expense. The Contractor shall be held responsible for all delays and damages to the work of other Divisions that occur as a result of non-conformance.
3. Pay for all expenses borne by the City of New York resulting from low strength test procedures or evidence of poor durability (such as high slump) specified above.

**3.16 PROTECTION AND CLEANING**

- A. During the curing period, and thereafter as conditions may require, protect the concrete from damaging mechanical disturbances, particularly excessive load stresses, heavy shock, and excess vibration. Protect all finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water.

**3.17 ACCEPTANCE OF CONCRETE WORK**

- A. The provisions of Subchapter 1.6 of ACI 301 apply to the acceptance of the concrete work.
- B. Concrete work judged inadequate by structural analysis, core test, results of load test or deemed unacceptable due to appearance or durability concerns shall be restored, reinforced with additional construction if so directed by the Commissioner, or be replaced if so directed by the Commissioner at the Contractor's expense.

**END OF SECTION 32 13 15**

**SECTION 32 14 13****PRECAST CONCRETE UNIT PAVING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Precast concrete unit pavers set on aggregate setting beds.
2. Aluminum edge restraints.
3. Filter Fabric.
4. 1/2" Drainage Mat.
5. Protection Board.
6. Mortar Setting Bed Beneath Pavers Adjacent to Drain Cover

B. Related Sections:

1. Section 32 05 16 "Aggregate Materials"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCES:**

- A. American Society of Testing and Materials (ASTM) (latest edition):

1. C 33 Specification for Concrete Aggregates.



2. C 136 Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140 Sampling and Testing Concrete Masonry Units.
4. C 144 Standard Specifications for Aggregate for Masonry Mortar.
5. C 936 Specifications for Solid Interlocking Concrete Paving Units.
6. C 979 Specification for Pigments for Integrally Colored Concrete.
7. D 698 Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5 lb (24.4 N) Rammer and 12 in. (305 mm) drop.
8. D 1557 Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10 lb (44.5 N) Rammer and 18 in. (457 mm) drop.
9. D 2940 Graded Aggregate Material for Bases or Subbases for Highways or Airports.
10. C 29 Bulk Density and Voids in Aggregate Materials.

B. Precast/Prestressed Concrete Institute:

1. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
2. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.
3. PCI MNL-122 - Architectural Precast Concrete.
4. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

1.7 SUBMITTALS

- A. Product Data: Submit characteristics of paver unit, dimensions, special shapes, and materials, including but not limited to:
1. Pavers
  2. Setting Materials
  3. Joint filler
  4. Edge Restraints
- B. Shop Drawing: Provide pattern description.
- C. Samples:
1. Paver: Submit two samples of each color of each type of paver, illustrating style, size, color range and surface texture of units being provided.
  2. Edge Restraints: Submit two section samples of metal edging and ground spike fastener system.

1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Every effort shall be made to maximize postindustrial/post-consumer recycled content. Certification of recycled content shall be in accordance with the Submittal Requirements herein.
- C. Mockups: Build mockups to verify selection made under sample submittals and to demonstrate aesthetic effect, patterns, and set quality standards for material and execution.



## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Store liquids in tightly closed containers protected from freezing.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Concrete Unit Paver in Plaza: Solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67.
  - 1. Basis-of-design Product: Subject to compliance with requirements provided: Hanover Parallelogram Prest Brick, Hanover Architectural Products 5000 Hanover Road, Hanover, PA17331, (717) 637-0500, or comparable product by one of the following:
    - a. QCP, 731 Parkridge Avenue, Norco, CA 92860, 1-866-703-3434; Product: Qline Jogline Paver
    - b. Techo-Bloc, 5255, Albert-Millichamp, St-Hubert, QC J3Y 8Z8, 1-877-832-4625; Product: Diamond Granitex
    - c. Or approved equal.
  - 2. Dimension:
    - a. 5 7/8" x 16 9/16" x 3" thick
  - 3. Color:
    - a. 50/50 mix of Limestone Gray and Charcoal
  - 4. Finish:
    - a. Tutor, or a comparable finish as selected by the Commissioner for the manufacturer's standard range.
- B. Concrete Unit Paver at Building Façade:
  - 1. Basis-of-design Product: Subject to compliance with requirements provided: Unilock Series Paver, Unilock, 51 International Boulevard, Brewster, NY 10509, 201 264-5763, or approved equal or comparable product by one of the following:
    - a. Wausau Tile Inc., PO Box 1520 Wausau, WI 54402-1520, 715-359-3121
    - b. Hanover Architectural Products 5000 Hanover Road, Hanover, PA17331, (717) 637-0500
    - c. Or approved equal.
  - 2. Dimension

- a. 11.75" x 11.75" x 2.75" thick
- 3. Color:
  - a. Ice Gray, or a comparable color as selected by the Commissioner for the manufacturer's standard range.

**C. Steel Edge with Steel Stake**

- 1. Basis-of-design: 1/4" thick x 5" deep steel edging, painted black finish, secured with 12" steel ground stakes or comparable product by one of the following
  - a. Permaloc CleanLine XL, Permaloc Corporation, 13505 Barry Street, Holland, MI 49242, 1.800.356.9660,
  - b. Sure-Loc, 310 E. 64<sup>th</sup> Street Holland, MI 49423, 616-392-3209
  - c. Colmet
  - d. Or approved equal.
- 2. Dimension:
  - a. 1/4" x 5"
- 3. Finish:
  - a. Painted Matte Black, or a comparable color as selected by the Commissioner for the manufacturer's standard range.

**2.2 Filter Fabric.**

- A. Material: Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured according to test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
  - 2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751
  - 3. Permittivity: 0.5 per second, minimum; ASTM D 4491
  - 4. UV Stability: 50 percent after 500 hours exposure; ASTM D 4355

**2.3 1/2" Drainage Mat**

- A. Material: Rigid, dimple-core composite with non-woven geotextile filter fabric affixed on both sides.
  - 1. Thickness: 0.40 inches
  - 2. Compressive Strength: 11,000 psf
  - 3. Core flow: 18g/min/sq. ft.
  - 4. Fabric Flow: 140g/min/sq. ft.
  - 5. Fabric Puncture: 250 lbs
  - 6. AOS: 70 US Sieve
  - 7. Grab Tensile: 100 lbs

2.4 Protection Board.

- A. Material: Non-woven polyester, scanned for metal
  - 1. Dry weight: 28 oz per square yard (ASTM D5261)
  - 2. Static Puncture: 1120 lb (ASTM D6241)
  - 3. Water Storage: 0.1 gal/ft<sup>2</sup> (ASTM E2398)
  - 4. Capillary Rise: 6.5 in (conductivity probe)

2.5 Mortar Setting Bed

- A. Mortar Setting Bed: Shall be type “S” mortar.

2.6 Aggregate setting bed

- A. See Section 32 05 16 “Aggregate Materials”

**PART 3 - EXECUTION**

3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

3.2 INSTALLATION

- A. Concrete Unit Pavers:
  - 1. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
  - 2. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
  - 3. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
    - a. For concrete pavers, a block splitter may be used.
  - 4. Prepare subgrade in accordance with Section 32 05 16 – Aggregate Materials.
  - 5. Place 5” sub-base of compacted broken stone in accordance with Section 32 05 16 – Aggregate Materials.
  - 6. Unit Pavers shall be carefully laid on setting bed according to the patterns and grades shown on the plans.
  - 7. The surface shall be tested with a ten-foot straight edge laid parallel with the centerline and any depression exceeding one-quarter inch (1/4") shall be corrected and brought to the proper grade.
  - 8. Joints shall be filled with polymeric sand and wiped clean.
- B. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
  - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
  - 2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch (25 mm) below top edge.

**3.3 QUALITY CONTROL**

- A. Final surface elevations should not vary more than 3/8" under a 10-foot straightedge, unless otherwise stated. The top of the pavers should be 1/8" to 1/4" above the final elevations to compensate for possible minor settling.
- B. Remove and replace pavers which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.
- C. Cleaning: Remove mortar stains and all other types of soiling from exposed paver surfaces, wash and scrub clean.
- D. Provide final protection and maintain conditions in a manner acceptable to installer, which ensures paver work being without damage or deterioration at time of substantial completion.

**3.4 WASTE MANAGEMENT**

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 32 14 13**

**SECTION 32 17 23****WHITE PAVEMENT MARKINGS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Work includes:
1. Cleaning and priming the pavement surface in preparation of new pavement markings.
  2. Furnishing and application of hot extruded reflectorized white thermoplastic pavement markings in specified constant widths and at locations indicated on the plans, or as ordered by the Commissioner.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. The Contractor must provide the following submittals to the Commissioner for all work in this section:
  - 1. Product Data
  - 2. Layout Drawings

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Painted markings shall be a reflectorized thermoplastic pavement striping material, hereinafter referred to as “composition,” of a type that is applied to the pavement surface in a molten state by mechanical means with surface application of glass beads and which, upon cooling to normal pavement temperature, produces an adherent reflectorized stripe of a specified constant width and of a uniform cross-section, between 1/8” and 3/16” in thickness, and is capable of resisting deformation.

**2.2 EQUIPMENT**

- A. Maintain striping equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of striping / marking operations.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 CLEANING / REMOVAL OF OLD MARKINGS**

- A. At locations of existing striping to be removed, remove all existing pavement markings without compromising asphalt integrity or surface finish.

**3.3 INSTALLATION OF NEW MARKINGS**

- A. Install thermoplastic markings in accordance with approved manufacturer’s recommendations.

**3.4 FIELD QUALITY CONTROL**

- A. Lay out the striping and receive approval from the Commissioner on the installation prior to installing the markings.

**END OF SECTION 32 17 23**

**SECTION 32 31 19****DECORATIVE METAL FENCES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:
1. 3'-0" HT aluminum fence on top of CIP concrete wall and CIP concrete security wall
- B. Refer to related sections:
1. Section 03 30 00 "Cast-in-Place Concrete"
  2. Section 03 33 00 "Architectural Concrete"
  3. Section 32 05 16 "Aggregate Materials"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.
1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% (75% for structural and reinforcing steel) combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

## 1.6 SUBMITTALS

- A. Product Data: Submit characteristics of metal members, dimensions, and special shapes.
- B. Shop Drawings: Submit manufacturer's shop drawings stamped by engineer licensed in the State of New York, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, fabrication, fasteners, hardware, finish, options, and accessories.
- C. Samples:
  - 1. Submit color samples for each finish, (1) total, illustrating style, thickness, and finish.
    - a. Polyester powder coat finish.
  - 2. Infill panel: minimum of two (2) pieces at 24 inches long.
- D. Manufacturer's Installation Instructions: Submit substrate requirements, installation methods, and material analysis.
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements.

## 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”
- B. Special Experience
  - 1. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
  - 2. The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- C. Every effort shall be made to maximize post-industrial/post-consumer recycled content.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Basis-of-design Product: Subject to compliance with requirements provide; Ametco “Galaxy” Fence Infill, Ametco Manufacturing Corp. 4326 Hamann Parkway Willoughby, OH 44096 (800) 321-7042 or Comparable product by one of the following:
  - 1. Ameristar | ASSA ABLOY 1555 N. Mingo Road, Tulsa, OK 74116 (888) 333-3422,
  - 2. FE Industries (914) 668-4500



3. Or approved equal.
- B. 3'-0" HT aluminum fence on CIP concrete wall.
1. Post Sleeve: 2-1/2" square x 3'-0" tall hot-dipped galvanized steel
  2. Post: 1/8" thick x 2-1/4" square x 9" tall hot dipped galvanized steel welded to base plate
  3. Base Plate: 1/2" thick x 6" square hot dip galvanized steel
  4. Infill Panels: Open mesh aluminum fencing, 1/2" x 2" extruded aluminum tubes on 3-1/2" centers.
  5. Color/Finish: Black Polyester Powder Coat, or a comparable color and finish as selected by the Commissioner for the manufacturer's standard range.
  6. Mount: Surface mounted to concrete wall
  7. Fasteners: Per manufacturer's specification

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for site clearing, earthwork, cast-in-place concrete curbs and walls, pavement work, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, underground structures, benchmarks, and property monuments.

#### 3.4 INSTALLATION

- A. Install fencing in accordance with manufacturer's installation instructions and reviewed shop drawings.
- B. Install fencing on established boundary lines inside property line.
- C. Post Setting: Set posts on concrete curb/wall as indicated on drawings. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations
- D. Secure fencing infill panels with standard stainless fasteners to fence posts after posts have been set on curbs/walls.
- E. Do not install bent, bowed, or otherwise damaged components. Remove damaged components from site and replace.
- F. Hang infill panels using hardware provided by manufacturer for each fence.

3.5 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 32 31 19**

**SECTION 32 91 13****PLANTING SOILS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes:

1. Planting soils for all at-grade conditions

B. Related Sections:

1. Section 32 05 16 "Aggregate Material"
2. Section 32 91 19 "Landscape Grading"
3. Section 32 93 00 "Landscape Planting"
4. Section 32 94 50 "Cellular Tree Planting System"

**1.1 REFERENCES**

A. American Society for Testing and Materials (ASTM) Standards, Methods:

1. C 136-01: "Standard Test Method For Sieve Analysis of Fine and Course Aggregates" (Dry Sieving).
2. D 422-63 (2002): "Standard Test Method For Particle-Size Analysis of Soils" (Hydrometer).
3. D 698: "Standard Test Methods For Laboratory Compaction Characteristics of Soil Using Standard Effort" (Standard Proctor).
4. ASTM D3385 - 09 Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.
5. D 1556-00: Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
6. D 2167-94: Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
7. D 2922-01: Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. D 4972-01: "Standard Test Method For pH of Soils" using distilled water.
9. F 1647-02a: "Standard Test Method For Organic Matter Content of Putting Green and Sports Turf Zone Mixes.

B. Solvita Manual, Version 3.5, as published by Woods End Research Laboratory, Mt. Vernon, Maine.

C. Recommended Soil Testing Procedures for the Northeastern United States, 2nd Edition, Northeastern Regional Publication No. 493, Agricultural Experiment Stations of Connecticut,

Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia: Tests include the following:

1. Test for soil Organic Matter by loss of weight on ignition, as described in Northeastern Regional Publication No. 493, p. 59.
2. Test for soil CEC by exchangeable acidity method as described in Northeastern Regional Publication No. 493, p. 64.
3. Test for soil Soluble Salts shall be by the 1:2 (v:v) Soil:Water Extract Method as described in Northeastern Regional Publication No. 493, p. 74.
4. Test for Buffer pH by the SMP method as described in Northeastern Regional Publication No. 493, p. 20.

D. New York State Department of Environmental Conservation, Division of Solid and Hazardous Materials:

1. Recycling of Organic Waste Through Composting, Land Application, and Other Means, 6 NYCRR Subparts 360-1 through 360-5.

E. Code of Federal Regulations Title 40, Chapter I-Environmental Protection Agency:

1. 40 CFR Part 503 rule, Table 3, page 9392, Vol. 58 No. 32.

F. American Society of Agronomy

G. State of New York, Department of Transportation, latest edition.

H. American Association of Nurserymen, American Standards for Nursery Stock, (ANSI Z60.1), latest edition, published by the American Association of Nurserymen, 1250 I Street, N.W., Suite 500 Washington, D.C. 20005.

I. ANSI: American National Standards Institute.

## 1.2 DEFINITIONS

A. Subgrade: Soil material and levels resulting from the approved rough grading work. Subgrade soil shall be existing soil or other materials which are either undisturbed or have been placed resulting from the approved rough grading work. Loosening of all subgrade areas prior to placement of Planting Soils is included in this Section.

B. Planting Soils: Planting Soils are composed of a blend of three base components: base loam, organic material and sand. The quality of the blend depends on the quality of the original components. Contractor is responsible for locating and obtaining approval of sources for base loam, organic material and sand that meet the Specification requirements. Contractor is then responsible for mixing the components. Approximate mixing ratios are provided, but may require adjustment, depending on the final materials and with the approval of the Commissioner, in order to meet Specification requirements for each blend.

## 1.3 SUSTAINABLE DESIGN REQUIREMENTS

A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

#### 1.4 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

#### 1.6 SUBMITTALS

- A. At least 30 days prior to ordering materials, submit to the Commissioner samples, certifications, manufacturer's product data and certified test results for materials as specified below for approval in conformance with the requirements of this Specification. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Commissioner. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Commissioner reserves the right to reject, on or after delivery, material that does not meet these Specifications.
- B. Product Data: Submit most recent printed information from manufacturer.
  1. Organic Material: identify the material(s) from of which is it composed and identify the location where material was composted.
  2. Fertilizers
  3. Ground Limestone
  4. Superphosphate
- C. Samples: Submit 1 gallon planting soil samples in two phases. Submit samples concurrent with horticultural soil test reports in both phases. Submit as phase one, planting soil base components for approval. Only after approval of phase one components, submit as phase two, soil blend mixes / mediums for approval. Each sample shall be a composite of a minimum of ten (10) individual samples taken from representative portions of a pile or source combined, thoroughly mixed and bagged. In addition to providing samples in quantities as required by testing agencies, submit one gallon split-samples of Base Components and Planting Soils to the Commissioner for review. Do not order materials until Commissioner's approval has been obtained. Delivered materials shall closely match the approved samples.
  1. Phase One Submittals of Planting Soil Base Components:
    - a. Base Loam
    - b. Organic Material
    - c. Sand
  2. Phase Two Submittals of Planting Mediums: mixing and batching of mediums to be prepared in the same manner as bulk soils will be prepared prior to delivery to site.
    - a. Horticultural Subsoil
    - b. High Use Lawn Soil
    - c. Planting Bed Soil

3. Phase Three Submittals of Planting Mediums: After Planting Soil test batches have been accepted, mix and amend as necessary in production, batches of up to 500 cubic yards for each soil type listed in 1.6.C.2. Each batch must be sampled, tested for gradation and organic content, and approved prior to delivery to the job site.
- D. Sources for Soil Components and Soil Mixes: Submit information identifying sources for all soil components and the firm responsible for mixing of soil mixes.
  1. Commissioner shall have the right to reject any soil supplier.
  2. Submit certification that accepted supplier is able to provide sufficient quantities of materials and mixes for the entire project.
- E. Horticultural Soil Test Reports: Submit reports in two phases. Submit reports concurrent with samples in both phases. Submit as phase one, reports for planting soil base components above for approval. Only after approval of phase one components, submit as phase two, reports for soil blend mixes /mediums for approval. Test results must be less than 60 days old and represent materials that are available for delivery to the site in the quantity required.
- F. Submit reports for each of the above samples: Submit sample from each proposed source for testing and approval. Deliver samples to both the testing laboratory and the project soil scientist and pay expenses. Send report directly to Commissioner.
  1. Testing for Base Loam, Plant Bed Soil, Sand-Based Structural Soil, High Use lawn Soil, Meadow Soil, Wetland Soil, Bio-infiltration Soil, and Horticultural Subsoil.
    - a. Inform testing agency soil test is for both tree and shrub planting and lawn applications.
    - b. Mechanical and chemical analysis shall be conducted by a public extension service agency or a certified private testing laboratory in accordance with the current “standards” of the American Society of Agronomy.
    - c. Gradation tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
    - d. Test for agricultural suitability analysis including:
      - 1) particle size and characteristics
      - 2) soil pH by water pH and buffer (smp) pH tests.
      - 3) percentage organic content
      - 4) nitrate nitrogen
      - 5) ammonium nitrogen
      - 6) phosphorus
      - 7) potassium
      - 8) calcium
      - 9) aluminum
      - 10) magnesium
      - 11) manganese
      - 12) Micronutrients
      - 13) Toxins including but not limited to lead, cadmium, arsenic and mercury.
    - e. Test results: test data and recommendations for soil amendments including but not limited to: nitrogen, phosphorus, potassium and limestone.
  2. Testing for Organic Amendment Materials
    - a. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

- b. Test for agricultural suitability analysis as defined in Article 2.02 – Organic Amendment Materials (Compost).
  - 3. Testing for Sand
    - a. Test for particle size gradation and pH

## 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”
- B. Special Experience
  - 1. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
  - 2. The manufacturer providing the material or equipment specified in this section must, for the past five (5) years, have been regularly engaged in the manufacture of material equipment similar in type to that required for this Project. Such similar material or equipment provided by the manufacturer must have been in satisfactory service for not less than five (5) years.
- C. Qualifications for Inspecting and Testing Horticultural Materials: Qualifications of Contractor’s Agricultural Chemist / Testing Laboratory / Agency shall be submitted to and approved by Commissioner prior to start of procurement of soil materials, placing or amending planting soil materials, and planting operations on Project.
  - 1. Agricultural Chemist: Employed by public or private soils testing laboratory, qualified and capable of performing tests, making soil recommendations, and issuing reports as specified herein.
  - 2. Soils Testing Laboratory: An independent laboratory with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed and capable of making soil recommendations, and issuing reports as specified herein.
    - a. Soil and Compost Materials Testing Laboratories:
      - 1) Physical and Chemical Testing of Soils: Hummel & Company, Inc.  
35 King Street, P.O. Box 606, Trumansburg, NY 14886  
Phone 607 387 5694, Fax 607 837 9499.
      - 2) Soil Testing Laboratory  
Rutgers, The State University  
ASB II  
57 US Highway 1 South  
New Brunswick, NJ 08901-8554
      - 3) Physical and Chemical Testing of Soils or Compost: University of  
Massachusetts West Experiment Station, Amherst Massachusetts, 01003  
Phone 413-545-2311, Fax 413-545-1931.
      - 4) Physical and Chemical Testing of Soils or Compost: Woods End Research  
Laboratory, PO Box 297, Mt. Vernon, Maine 04352  
(207) 293 2457 – phone, (207) 293 2488.

- 5) Agricultural Analytical Services Lab; compost testing  
111 Ag Analytical Svcs Lab  
University Park, PA 16802  
814-863-0841 – phone, 814-863-4540
  - 6) Or approved equal.
- D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions, to coordinate requirements for testing, and to coordinate this Work with related and adjacent work.
- E. Inspections and Testing of Horticultural Soil Materials: The following conditions and requirements shall apply:
1. Material Testing, General: Engage and pay for the services of a qualified Agricultural Chemist / Soils Testing Laboratory / Agency to perform all materials testing and inspections of Project-related Base Components and Planting Soils, as well as any other material testing and soil mix material testing required in this Section or additionally required by the Commissioner.
    - a. Cooperate in obtaining samples and performing tests of in-place materials and shall furnish incidental field labor in connection with any tests to be performed by Contractor's Testing Laboratory / Agency.
  2. Construction Monitoring:
    - a. During landscape construction operations, Commissioner may be present at the site to observe and monitor placing and amending soil material operations and shall be permitted free and unrestricted access to the site and work.
    - b. Commissioner reserves the right to take and analyze at any time such additional samples of horticultural soil and soil amendment materials as deemed necessary for verification of conformance with the Contract Documents. Furnish samples for this purpose upon request and shall perform material testing as requested. The Commissioner may, at their discretion, take additional tests or order additional tests made by the Testing Laboratory/Agency respective to conditions.
    - c. Based on observations and evaluation of quality control tests, the Contractor's or Testing Laboratory/Agency shall make recommendations to the Commissioner regarding conformance of the soil material and placing operations to Contract Documents and compatibility of actual subsurface conditions to required subsurface conditions.
    - d. Commissioner will evaluate the recommendations of the Contractor's Testing Laboratory/Agency and will judge the compliance of the work with Contract Documents, issue any changes or revisions required to Contract Documents to accommodate subsurface conditions which differ from design assumptions, or direct remedial work where the completed work does not comply with Contract Documents.
    - e. Planting Soils and/or other components delivered to the site may be periodically sampled and tested for compliance at the request of the Commissioner. Materials not matching the approved previously submitted Samples shall be removed from site at no additional expense to the City of New York.
  3. Materials in question shall not be used, pending test results of conformance to specified requirements.



## 1.8 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: deliver materials in unopened containers bearing manufacturer's name and guaranteed statement of analysis. Transport materials without damage. Protect finishes from abrasion, dirt, oils, grease, and chemicals. Pack materials to protect from weather.
- B. Base Components and Planting Soils shall not be handled, hauled, or placed when wet, during or immediately after a heavy rainfall, or frozen. Soil should be handled only when the moisture content is less than or equal to the optimum water content as determined for the Standard Proctor test. The Commissioner shall be consulted to determine if the soil is too wet to handle.
- C. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, injury and theft.
- D. Sequence deliveries to avoid delay. On-site storage space is permissible only with written notice from Commissioner. Deliver materials only after preparations for placement of planting soil have been completed.
- E. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.
- F. Soil that is to be stockpiled longer than two weeks, whether on- or off-site, shall not be placed in mounds greater than six feet high. Provide all means and methods required to prevent anaerobic conditions at no additional expense to the City of New York.
- G. Vehicular access to the site is restricted. Before construction, submit for approval a plan showing proposed routing for deliveries and site access.
- H. Work and Protection Plans
  - 1. On-Site Soil Storage: Submit proposed locations and means and methods for storage/stockpiling of soil materials on-site.
  - 2. Soil Placement, and Settlement Plans: Submit a plan of implementation with a schedule describing the proposed methods intended for placing horticultural planting soils and for allowing natural settling of installed soils.
- I. Data Submitted for Information and Reference:
  - 1. Copies of permits necessary to transport materials off site.
  - 2. Location of legal disposal sites for waste materials from this work of Project, if any.

## 1.9 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: do not deliver or handle soils when dry, wet, or frozen.
  - 1. No planting Soil shall be trucked, placed, compacted or otherwise handled when its moisture content is greater than optimum as determined by ASTM 698. In addition, no soil shall be compacted if its moisture content is sufficiently high that its saturated hydraulic conductivity falls below its minimum rate as specified below. Normally, but not always, this requirement will be met when the moisture content is at or below optimum. Conduct moisture content tests using the Speedy Moisture Test or other approved Equipment as necessary to ensure conformation with maximum allowable moisture contents. Coordinate procedures to allow for drying of planting soils that exceed maximum allowable moisture contents.
  - 2. Additional Field Tests

- a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.
- b. If the soil will not retain shape it is too dry and should not be worked.
- c. If the soil retains shape and will not crumble, it is too wet and should not be worked.
- d. If the soil glistens or free water is present after lightly patting the sample, the soil is too wet and should not be worked

## PART 2 - PRODUCTS

### 2.1 BASE LOAM

- A. Base Loam shall be imported and shall be free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam shall also be free of quack-grass rhizomes, Agropyron Repens, and the nut-like tubers of nutgrass, Cyperus Esculentus, and all other primary noxious weeds. Base Loam shall not be delivered or mixed while in a frozen or muddy condition. Base Loam for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

U.S. Sieve Size Number	Percent Passing	
	Minimum	Maximum
10	---	100
18	85	100
35	70	95
60	50	85
140	36	57
270	32	60
0.002mm	3	15

- B. Base loam with more than 46% passing the 270 sieve or with more than 6 percent clay must have a well developed and stable crumb (ped) structure as determined by an agricultural chemist.
- C. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
- D. The organic content shall be between 4.0 and 8.0 percent.
- E. The pH shall be 7.2 or less.

### 2.2 ORGANIC MATERIAL (COMPOST)

- A. Organic Material (Compost) as Amendment For Soil Mediums:
  1. Organic Material (Compost) for amending planting medium: stable, humus-like material produced from the aerobic decomposition of organic residues consisting of Leaf or Yard Waste Compost which shall have been composted for a minimum of one year (12



months). Compost shall be free of debris such as plastics, metal, concrete or other debris and stones larger than 1/2", larger branches and roots and wood chips over 1/2" in length or diameter. Compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by laboratory tests.

- a. The ratio of carbon to nitrogen shall be in the range of 12:1 to 25:1.
- b. Stability shall be assessed by the Solvita procedure. Protocols are specified by the Solvita manual (version 4.0). The compost must achieve a maturity index of 6 or more as measured by the Solvita scale.
- c. Pathogens/Metals/Vector Attraction reduction shall meet all State of New York requirements for applications to soils with human activity.
- d. Organic Content: at least 20 percent (dry weight). One hundred percent of the material shall pass a 3/8-inch (or smaller) screen. Debris such as metal, glass, plastic, wood (other than residual chips), asphalt or masonry shall not be visible and shall not exceed one percent dry weight. Organic content shall be determined by weight loss on ignition or H<sub>2</sub>O<sub>2</sub> for particles passing a Number 10 sieve according to procedures performed by the West Experiment Station at the University of Massachusetts, Amherst or equal. For loss by ignition, a 50-cc sub-sample of the screened and mixed compost is ground to pass the number 60 sieve. Two to three grams ( $\pm 0.001g$ ) of ground sample, dried to a constant weight at 105 degrees C is placed into a muffle furnace. The temperature is slowly raised (5C/minute) to 450C and maintained for three hours. The sample is removed to an oven to equilibrate at 105C and the weight is taken. Organic matter is calculated as loss on ignition.
- e. pH: between 6.5 to 7.2 as determined from a 1:1 soil-distilled water suspension using a glass electrode pH meter American Society of Agronomy *Methods of Soil Analysis*, Part 2, 1986.
- f. Salinity: Electrical conductivity of a one to five soil to water ratio extract shall not exceed 2.0 mmhos/cm (dS/m).
- g. Compost: screened to 1/2 inch maximum particle size and shall contain not more than 3 percent material finer than 0.002mm as determined by hydrometer test on ashed material.
- h. Nutrient content: determined by the University of Massachusetts Soil Testing Laboratory or equivalent laboratory and utilized to evaluate soil required amendments for the mixed soils. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Chromium, Iron, Manganese, Lead, Soluble Salts, Cation Exchange Capacity, soil reaction (pH), buffer pH, and micronutrients.

## 2.3 SAND

### A. Sand as Amendment for Soil Mediums

1. Sand shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock and free from loam or clay, surface coatings, mica, other deleterious materials with the following gradation

U.S. Sieve Size Number	Percent Passing	
	Minimum	Maximum
10	100	-
18	65	90
35	35	60
60	15	30
140	0	8
270	0	3
0.002mm	0	0.5

2. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
3. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.0 or less. (D70/D20 <3.0)
4. Saturated hydraulic conductivity of the sand shall be not less than 30 inches per hour, according to ASTM D5856-95 (2000), when compacted to a minimum of 90% Standard Proctor, ASTM 698.
5. The pH shall be less than 7.5

#### 2.4 PLANTING BED SOIL

- A. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of one part by volume Sand to one part by volume Base Loam to one part by volume Compost (1S:1.0L:1C) to create a uniform blend which meets the following requirements.
- B. Gradation for Material Passing the Number 10 Sieve:

U.S. Sieve Size Number	Percent Passing	
	Minimum	Maximum
10	100	-
18	73	90
35	54	74
60	33	53
140	22	34
270	18	24
0.002mm	2.5	6

1. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.

2. Ratio of the particle size for 80% passing (D<sub>80</sub>) to the particle size for 30% passing (D<sub>30</sub>) shall be 8 or less. (D<sub>80</sub>/D<sub>30</sub> <8)
3. Saturated hydraulic conductivity of the mix: not less than 2 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 86% Standard Proctor, ASTM 698.
4. Organic content: between 5.0 and 7.0 percent by weight.

## 2.5 HORTICULTURAL SUBSOIL

- A. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of three parts by volume Sand to three parts by volume Base Loam to 1.0 part by volume Compost (3.0S:3.0L:1.0 Compost) to create a uniform blend which meets the following requirements.
- B. Gradation for Material Passing the Number 10 Sieve:

U.S. Sieve Size Number	Percent Passing	
	Minimum	Maximum
10	100	-
18	70	90
35	50	74
60	27	48
140	18	28
270	16	22
0.002mm	2	6

1. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
2. Ratio of the particle size for 80% passing (D<sub>80</sub>) to the particle size for 30% passing (D<sub>30</sub>) shall be 6.5 or less. (D<sub>80</sub>/D<sub>30</sub> <6.5)
3. Saturated hydraulic conductivity of the mix: not less than 3 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 86% Standard Proctor, ASTM 698.
4. Organic content: between 2.0 and 3.5 percent by weight.

## 2.6 LOW MOW TURF SOIL

- A. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of two parts by volume Sand to one part by volume Base Loam to one part by volume Compost (2S:1.0L:1C) to create a uniform blend which meets the following requirements.
- B. Gradation for Material Passing the Number 10 Sieve:

U.S. Sieve Size Number	Percent Passing	
	Minimum	Maximum
10	100	-
18	70	90
35	45	72
60	26	40
140	15	22
270	11	14
0.002mm	2	5

1. Maximum size shall be one inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.
2. Ratio of the particle size for 70% passing (D<sub>70</sub>) to the particle size for 30% passing (D<sub>20</sub>) shall be 5.0 or less. (D<sub>70</sub>/D<sub>20</sub> <5.0)
3. Saturated hydraulic conductivity of the mix: not less than 4 inches per hour according to ASTM D5856-95 (2000) when compacted to a minimum of 88% Standard Proctor, ASTM 698.
4. Organic content: between 4.0 and 5.0 percent by weight.

## 2.7 PRE-PLANT FERTILIZER

- A. Complete, fertilizer made from all-natural ingredients complying with State and Federal fertilizer laws. Fertilizer shall contain the following available plant food by weight, unless soils test indicate a need for different composition:

	Nitrogen	Phosphorus	Potash
Deciduous Trees and Shrubs	2%	3%	3%
Evergreen Trees and Shrubs	2%	3%	3%

- B. Fertilizer: Pro Start 2-3-3 as manufactured by North Country Organics, Bradford, Vermont 05033, ph# 802.222.4277; Earth Emulsion 2-3-3 as manufactured by Grower's Secret, 5143 Port Chicago Highway, Suite A, Concord, CA 94520, ph# (888) 467-9426, 2-3-3 All Natural Organic Rich Humus Soil Builder as Manufactured by Sustane Natural Fertilizers & Soil Builders, 31 East Elm Avenue, Staatsburg, New York 12580, ph# (914) 474-1198 or approved equal.
- C. Fertilizer to be delivered in original unopened standard size bags showing weigh, analysis ingredients and manufacturer's name.

## 2.8 SOIL AMENDMENTS

- A. Superphosphate: finely ground phosphate rock, commonly used for agricultural purposes and shall contain not less than 20 percent available phosphoric acid.
- B. Ground Limestone: dolomitic limestone and contain not less than 50 percent of total carbonates and 25 percent total magnesium with a neutralizing value of at least 100 percent. Material shall

be ground to such fineness that 40 percent will pass 100 mesh U.S. standard sieve and 98 percent will pass through 20 mesh U.S. standard sieve.

## 2.9 EQUIPMENT

- A. Chisel Plow or disk harrow or bucket of backhoe: for subsoil cultivation.
- B. Rotovator or disk harrow: for planting mixture/soil cultivation.

## 2.10 WATER

- A. Water: furnished by Contractor, unless otherwise specified, and suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment furnished by Contractor.

## 2.11 EROSION CONTROL MAT

- A. Subject to compliance with requirements, provide GEOCOIR / DeKoWe 400 as manufactured by Belton industries (Basis of Design), or an equivalent product by one of the following approved manufacturers:
  - 1. GEI Works
  - 2. ACF Environmental
  - 3. Or approved equal.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

## 3.2 EXAMINATION

- A. Verification of Conditions: in the event field conditions are not as shown on Drawings and outlined in the Specifications, notify Commissioner in writing.
  - 1. Spot and Invert Elevations: verify field elevations of site improvements such as drainage and utility fixtures, pavements, existing plantings, and subsurface piping conform to drawings.
- B. Rough grade: verify specified elevations and prior earthwork operations have shaped, trimmed, and finished rough grade.

## 3.3 PREPARATION

- A. Contractor to clear working areas with Dig Safely New York prior to doing excavation on site. If work is to be done around underground utilities, appropriate utility must be notified of impending work. Hand excavate areas adjacent to utilities. Contractor shall be responsible for damages done by himself or his installers to existing utilities, which shall be restored by Contractor.

- B. Prior to installation field locate and protect from damage site improvements such as drainage and utility fixtures, pavements, and existing plantings.
- C. Dust Control: upon acceptance of finish grade provide dust control.
- D. Erosion Control: upon acceptance of finish grade provide erosion control.
- E. Agricultural Chemicals: protect site improvements from contact with agricultural chemicals, soil amendments, and fertilizers.

### 3.4 PREPARATION OF PLANTING MEDIUM FOR PLANTING BEDS

- A. Correct deficiencies in soil as directed by soil test results. Thoroughly incorporate amendments into planting mixture to ensure even distribution.
- B. Incorporate pre plant fertilizer at a rate of 30 pounds per cubic yard of planting bed medium. Amendment rate will be 6 times square foot application rate per cubic yard of planting mixture.

### 3.5 SUBGRADE INSPECTION AND PERCOLATION TESTING

- A. For off-structure areas, after subgrade levels have been reached, the Commissioner shall inspect soil conditions to evaluate subsurface drainage conditions. Carry out up to 20 standard septic percolation tests in locations identified by the Commissioner. Locations where percolation rates are less than 0.5 inches per hour shall be evaluated for possible installation of subsurface drainage or deep decompaction.

### 3.6 DECOMPACTION OF PLANTING AREAS

- A. After subgrade levels have been inspected and tested, and immediately prior to placing Planting Soils, loosen the entire subgrade area to a minimum depth of four inches utilizing the bucket of a backhoe or equivalent equipment.
- B. Using a wide-track bulldozer size D-5 or smaller, compact the scarified subgrade to approximately 84% - 86% compaction ASTM 698 Standard Proctor. Provide shovel dug test pits to the full depth of the decompaction, where located per the direction of Commissioner, in order for Commissioner to review whether the work has been completed. Backfill the pits after the review(s).
- C. After the soils have been loosened, inspected and written approval has been provided, Planting Soils may be spread by using a wide-track bulldozer size D-5 or smaller or may be dumped and spread with the bucket of a backhoe from the edge of the loosened area. No rubber-tired equipment or heavy equipment except for a small bulldozer shall pass over the subsoils (subgrade) after they have been loosened. If Contractor plans to utilize such areas for use of heavy equipment, this work should be carried out prior to beginning the process of loosening soils or filling in that area, or it will have to be rescarified and meet this specification requirement.

### 3.7 PREPARATION OF TREE PITS

- A. After tree planting pits have been excavated to the dimensions shown on the plans, the entire bottom area of the pit shall be loosened to a minimum depth of four inches utilizing the bucket of a backhoe or equivalent equipment. The entire loosened area shall then be compressed lightly with the bucket of the backhoe. The central portion of the pit, beneath the rootball, shall be compressed adequately to support the rootball and prevent settlement.



### 3.8 PLACEMENT OF HORTICULTURAL SUBSOIL

- A. In lawn areas place and spread Horticultural Subsoil in lifts not greater than twelve inches and compact to a density between 84 and 87 percent Standard Proctor Maximum Dry Density. In plant bed and meadow areas place and spread Horticultural Subsoil in lifts not greater than twelve inches and compact to a density between 82 and 85 percent Standard Proctor Maximum Dry Density. The surface area of each lift, including the subgrade after it has been compacted, shall be scarified by raking prior to placing the next lift.
- B. Place and spread horticultural subsoil to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.

### 3.9 PLACEMENT OF PLANT BED SOIL

- A. Over Horticultural Subsoil Layer, place and spread Planting Bed Medium in lifts not greater than twelve inches and compact to a density between 80 and 83 percent Standard Proctor Maximum Dry Density. The surface area of each lift, including the subgrade after it has been compacted, shall be scarified by raking prior to placing the next lift.
- B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.

### 3.10 PLACEMENT OF LOW MOW TURF SOIL

- A. Place and spread High Use Lawn Soil one lift not greater than twelve inches and compact to a density between 85 and 88 percent Standard Proctor Maximum Dry Density. The surface area of each lift, including the subgrade after it has been compacted, shall be scarified by raking prior to placing the next lift.
- B. Place and spread planting medium to a depth greater than required such that after settlement, finished grade conforming to the lines, grades and elevations shown on the Drawings. Ensure proper drainage in an uninterrupted pattern free of hollows and pockets.
- C. Remove stiff clods, lumps, brush, roots, stumps, litter and other foreign material and stones over one inch in diameter and dispose of legally off site.

### 3.11 FIELD QUALITY CONTROL

- A. Tests: after soil preparation operations are complete and prior to planting, take soil sample for testing and recommendations as established in Article 1.6 - Submittals.
- B. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade layer elevations shall slope parallel to the finished grade as shown on the Contract Documents. Provide a written report to the Commissioner that the subgrade has been adjusted to the required elevations to provide a uniform thickness of planting media across the area. Perform no work of placing and spreading

soil until elevations have been confirmed and written report has been accepted by the Commissioner.

- C. As provided in Article 1.9 – Project / Site Conditions, No Base Materials or Soil Medium shall be handled, planted, or seeded in any way if it is in a wet or frozen condition. A moist Soil Medium is desirable for planting.
- D. Observation: Commissioner to review in the field soil preparation operations:
  - 1. Preparation of Planting Mixtures

### 3.12 CLEANING

- A. Clean up debris generated under work of this section.
- B. Site Improvements
  - 1. Wash and sweep clean site improvements such as drainage and utility fixtures, pavements, existing plantings, and site furnishings.
  - 2. Clean site furnishings of grout, adhesives, concrete, and other debris.

### 3.13 PROTECTION

- A. Protect work of this section until Final Acceptance.
- B. Select equipment and otherwise phase the installation of the Soil Medium to ensure that wheeled equipment does not travel over prepared subsoil, placed fills or ordinary borrow or already installed soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Commissioner. If it is determined by the Commissioner that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened and uncompacted as the work progresses or place one-inch (25 mm) thick steel plate ballast (or equivalent ballast approved by the Commissioner) over the length and width of any travel way to cover Soil Medium to protect it from compaction.
- C. Disturbed areas outside the limit of work shall be protected and as required, graded smooth and spread with Soil Medium to meet finished grades.
- D. Soil Mediums delivered to the site shall be protected from erosion. Materials shall be spread immediately. Otherwise, materials that set on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to Commissioner and surrounded by silt fence

### 3.14 ACCEPTANCE

- A. Confirm that the final grade of the Soil Mediums is at the proper finish grade elevations. Adjust grade as required to meet the contours and spot elevations noted on the Plans. Request the presence of the Commissioner to inspect final grade. Do not proceed with the remaining work of this Contract until the Commissioner has given his/her written approval of the final grade.

**END OF SECTION 32 91 13**

**SECTION 32 91 19****LANDSCAPE GRADING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

- 1. Topsoil placement and establishment of finish grade for final landscape planting and seeding.

- B. Related Sections:

- 1. Section 32 05 16 "Aggregate Materials"
  - 2. Section 32 91 13 "Planting Soils"
  - 3. Section 32 93 00 "Landscape Planting"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

- 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

- B. Confirm grades.

- C. Confirm positive water drainage

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Planting Soils: Refer to Section 32 91 13 – Planting Soils
- B. Aggregates: Refer to Section 32 05 16 – Aggregate Materials

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Verify earthwork and site grading has been completed and inspected.
- B. Verify sub-grade has been contoured and compacted.

**3.3 SUBGRADE PREPARATION**

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove subsoil contaminated with petroleum products.
- C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

**3.4 PLACING TOPSOIL**

- A. Place topsoil in areas where seeding and landscaping is required to the following compacted thickness:
  - 1. Groundcover – 18 inches.
  - 2. Tree Planting – 36 inches
  - 3. Place topsoil during dry weather.
  - 4. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of sub-grade.
  - 5. Remove roots, weeds, rocks, and foreign material while spreading.
  - 6. Manually spread topsoil close to existing vegetation to prevent plant damage.
  - 7. Leave stockpile area and site clean and raked, ready to receive seeding.

**3.5 TOLERANCES**

- A. Top of Topsoil: Plus or minus ½ inch.

**3.6 PROTECTION**

- A. Protect landscaping and other features remaining as final work.

- B. Protect existing structures, fences, sidewalks and other site features.

3.7 CLEAN-UP

- A. Remove all excess materials and debris from the site.

**END OF SECTION 32 91 19**

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**SECTION 32 93 00**

**LANDSCAPE PLANTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

- A. Section Includes:

1. All landscape planting
2. Staking and guying, including necessary hardware as specified or shown
3. Erosion control mat
4. Pruning
5. Pest and disease control
6. Root Barriers
7. Maintenance under contract and guarantee

- B. Related Sections:

1. Section 32 91 13 "Planting Soils"
2. Section 32 91 19 "Landscape Grading"
3. Section 32 94 50 "Cellular Tree Planting System"

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.

- B. Refer to the following sections:

1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

## 1.5 REFERENCES

- A. Tree and shrub transplanting manual, latest edition, International Society of Arboriculture (I.S.A.).
- B. American Standard for Nursery Stock, latest edition, American Association of Nurserymen, Inc.

## C. ABBREVIATIONS

- 1. Cal. Indicates the caliper of the trunk of the tree.
- 2. B & B Indicates tree or shrub to be balled and burlapped.
- 3. B.R. Indicates a tree or shrub to be delivered "bare root".
- 4. Cont. Indicates tree or shrub to be container grown (size per industry standard).
- 5. O.C. Indicates "on center" or spacing between plants in all directions.
- 6. HT. Indicates overall height of tree.

## D. DEFINITIONS:

- 1. Backfill: Soils used to replace or the act of replacing earth in an excavation.
- 2. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- 3. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- 4. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.
- 5. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- 6. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- 7. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- 8. Finish Grade: Elevation of finished surface of planting soil.
- 9. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- 10. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- 11. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- 12. Planting Area: Areas to be planted.



13. Planting Soils: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 00 Planting Soils.
14. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, perennials, bulbs, corms, tubers, or herbaceous vegetation.
15. Root Flare: Also called "trunk flare." The area at the base of the plant's stem (trunk) where the stem broadens to form roots; the area of transition between the root system and the stem or trunk.
16. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees at or below the soil surface or within the root ball or container, which will, over time, constrain healthy plant growth and the long term viability of the tree.
17. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
18. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
19. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Nursery Stock, ANSI Z60.1 Compliant. Notice of intent to perform work shall be submitted to the Commissioner at least 14 calendar days prior to planting.
  1. Submit to Commissioner invoices or certificates of deposit from nursery(ies) guaranteeing timely delivery of all specified and tagged plant materials. If any plant materials are unavailable at the time of submittal, contact Commissioner to determine acceptable alternatives. Indicate the following:
    - a. Confirmed size and grade of materials to be planted.
    - b. Source of origin and health of plant materials, each type.
  2. Submit a schedule itemizing the landscape planting work to be performed to the Commissioner. This schedule shall be submitted within fifteen (15) calendar days after Contract Notice to Proceed.
    - a. Include in this schedule, anticipated dates for commencement and sequencing of landscape planting work, including, but not limited to, selections and tagging, layouts and layout approval, placement of trees, and commencement of the maintenance period.
- B. Product Data:
  1. Submit to Commissioner technical descriptive data for each manufactured or packaged product of this Section. Include manufacturer's product testing and analysis and installation instructions for manufactured or processed items and materials.



2. Submit to Commissioner a list of sources clearly stating plant material, size, form, and quantities available at that nursery for inspections. Verify and inspect the source prior to scheduling the Commissioner inspection and tagging trip and that the plant material meets the requirements of the specifications and drawings.
3. Submit to Commissioner locations of soil material sources.

**C. Plant Material:**

1. Plant Sources: Submit to Commissioner a list of sources clearly stating plant material species, cultivar, size, form, and quantities available at each nursery.
2. Photographic Documentation Prior to Nursery Visit: Provide digital photographs for each required species, cultivar showing size and condition for review by the Commissioner to determine that the plant material meets the requirements of the specifications and drawings.
  - a. Take photographs from an angle depicting true size and condition of the typical plant to be furnished.
  - b. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished.
  - c. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

**D. Certificates:**

1. Furnish to Commissioner certification that each tree is true to name and in conformance with these Specifications. In addition, furnish to Commissioner certificates of inspection as may be required by New York City Department of Environmental Protection, the Environmental Protection Agency, and New York State Department of Environmental Conservation that plant material is free of disease or hazardous insects.
2. Furnish to Commissioner certificates/cultivars by supplying nursery.
3. Prior to the use on site of any chemical insect or disease control materials, submit to Commissioner a list of the control materials and quantities intended for use in controlling insects and disease prevalent and expected on the site. Submittal shall include data demonstrating the compatibility of the control materials and methods of installation or application with the specified planting types and varieties. The use of any chemical insect or disease control materials shall not be allowed except by written approval and consent of Commissioner.
4. If any chemical insect or disease control materials are to be used, they must be applied prior to the tree's delivery to the site. No chemical insect or disease control materials are to be applied on-site.

**E. Samples for Verification: For each of the following:**

1. Shredded Bark Mulch: 1 Quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

**F. Soil Tests: Where planting is to occur in existing soils provide soil test for each identifiable soil type on the project site, as designated on the plans. Test results should identify soil characteristics and include recommendations for amendments suitable for proposed plantings.**

**1.8 INFORMATIONAL SUBMITTALS**

- A. Maintenance Plan: Schedule of routine maintenance activities to be carried out by Contractor during the guarantee period. Submit before start of required maintenance periods.

**QUALITY ASSURANCE**

- B. Qualifications:

1. The contractor or subcontractor performing the work of this section must, within the last five (5) consecutive years prior to the bid opening have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work.
2. It shall be the responsibility of the Contractor to see that the specifications are being adhered to. Failure of the Commissioner to immediately reject unsatisfactory workmanship or to notify the Contractor of his/her deviation from the specifications shall not relieve the Contractor of his/her responsibility to restore and/or replace unsatisfactory work.

**1.9 REGULATORY REQUIREMENTS**

- A. Procure and pay for permits and licenses required for work of this section.

**1.10 PROJECT/SITE CONDITIONS**

- A. Work shall be scheduled and conducted in a cooperative manner in order to give the least possible interference or annoyance to the City of New York staff working on the site and occupants of properties adjacent to the site.
- B. Construction Sequencing: Planting shall take place only after the installation of concrete pavement materials.
- C. The Contractor shall be responsible for pedestrian and vehicular safety and control within the work site. He/she shall provide the necessary warning devices and signalers needed to give safety, warning and protection to persons and vehicular traffic within the area.
- D. During site preparation, planting and after care, the Contractor shall be responsible for all damage to existing features above and below ground (benches, utility lines, irrigation pipes, lampposts, path surfaces, existing vegetation) incurred as a result of work operations. Restorations and/or replacements shall be made to the satisfaction of the Commissioner.
- E. Environmental Requirements and Planting Schedule:
1. Plant only within the following dates, weather permitting. Do not plant when the ground is frozen, excessively wet, or the soil is otherwise in an unsatisfactory condition for planting:
    - a. The Spring Season for all planting materials shall be that period from March 1 through May 15.
    - b. The Fall Season is divided into two parts, made necessary by the handling characteristics of two plant types.
      - 1) September 1 through October 15 shall be the fall planting season for deciduous and evergreen materials.

- 2) October 15 through December 1 shall be the fall planting season for deciduous materials only.

F. Environmental Requirements for Soils:

1. Soil mixes shall not be handled, hauled or placed during rain or wet weather or when near or above field capacity.

1.11 PLANT MATERIAL INSPECTION

- A. Plants shall be subject to inspection and approval by Commissioner at the place of growth and again upon delivery and prior to planting for conformity to specification requirements as to quality, size and variety. Such approval shall not impair the right of rejection due to damage suffered in handling, transportation and/or planting. Rejected plants shall be removed immediately from the site. Contractor shall be present at all inspections.
- B. Written requests for inspection of plant material at their place of growth shall be submitted to the Commissioner at least 14 days prior to digging. The Commissioner may refuse inspection if in his/her judgment an insufficient quantity of plants is available for inspection. The Contractor shall, at his expense, supply the Commissioner with such labor and assistance as may be necessary in the handling of material for proper inspection.
- C. Inspection of plant materials for spring planting shall occur during the previous fall season, or at a time prior to planting when sufficient plant growth has occurred to assess and evaluate plant species, size, and condition.
- D. Tagging of trees shall be as follows: if such quantities exist, for every 20 trees planted, 22 trees will be tagged assuring appropriate replacement for (a) trees damaged prior to transplanting and (b) trees requiring replacement under terms of the one-year guarantee.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in unopened bags or containers, each clearly bearing the name, guarantee, and trademark of the producer, material composition, manufacturers' certified analysis, and the weight of the material.
- B. Inspection
  1. Plants shall be subject to inspection and approval by Commissioner at the place of growth and again upon delivery and prior to planting for conformity to specification requirements as to quality, size and variety. Such approval shall not impair the right of rejection due to damage suffered in handling, transportation and/or planting. Rejected plants shall be removed immediately from the site. Contractor shall be present at all inspections.
    - a. Written requests for inspection of plant material at their place of growth shall be submitted to the Commissioner at least 14 days prior to digging. The Commissioner may refuse inspection if in his/her judgment a sufficient quantity of plants is not available for inspection. The Contractor shall, at his expense, supply the Commissioner with such labor and assistance as may be necessary in the handling of material for proper inspection.



2. Tagging of trees shall be as follows: if such quantities exist, for every 20 trees planted, 22 trees will be tagged assuring appropriate replacement for (a) trees damaged prior to transplanting and (b) trees requiring replacement under terms of the two-year guarantee.

C. Plant Material, Conditions of Moving and Delivery:

1. The use of an anti-desiccant shall not be allowed except by written approval and consent by Commissioner.
  - a. If approved, spray deciduous plants with an anti-desiccant, immediately before moving plant material from its source, applying an adequate film over trunks, branches, twigs, and foliage.
  - b. Approval shall be required for any subsequent instance of use.
2. Dig and handle plants with care to prevent injury to trunks, branches and roots.
3. Do not prune prior to delivery. Do not bend or bind-tie trees in such manner as to damage bark, break branches or destroy natural shape. Pack and ship in order to ensure arrival at the site in good condition. Provide protective covering during delivery. No plants will be accepted if the rootball is cracked or broken, or trunks scarred, or branches broken.
4. Plant Materials:
  - a. Deliver after preparations of planting areas have been completed and approved and place plants immediately.
  - b. If planting is delayed more than 24 hours after delivery, set balled and burlapped plants on the ground in a "shade house", erected by Contractor, with rootballs well protected with soil, wet peat, or other acceptable material. Protect balls and roots from freezing, sun, drying winds, and/or mechanical damage. Water as necessary until planted.

1.13 GUARANTEE PERIOD AND REPLACEMENTS

- A. The guarantee period for all new Landscape Plantings shall begin on the date of substantial completion.
- B. All plant material shall be guaranteed by the Contractor to be in good, healthy and flourishing condition, for a period of two (2) years from the date of substantial completion.
- C. Service for plant establishment period: Maintain temporary irrigation for a period of two (2) years from the date of substantial completion with the intent of establishing the planting.
- D. Replace, as soon as weather conditions permit, and within a specified planting period, all plants determined dead and/or dying by the Commissioner during and at the end of the guarantee period.
  1. Plants shall be free of dead or dying branches and shall bear foliage of normal density, size and color.
  2. Trees having lost their central leader or exhibit crown dieback at the end of the one-year guarantee shall be replaced.
  3. Replacements shall match the adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this specification. Labor and all materials needed for the installation of replacements shall be included in the guarantee.

- E. Make periodic inspections, during the guarantee period to determine what changes, if any, should be made in the care of the plants. Any recommended changes shall be submitted in writing to the Commissioner.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

#### A. General Requirements:

1. Furnish and plant all plants as specified and in the quantities listed.
2. All plants shall be nursery grown.
3. Plants shall be true to species and cultivar specified. Certification of cultivars by supplying nursery must be supplied in writing to Commissioner.
4. Plants shall be in accordance with the American Nurserymen Association Standards in all ways, unless otherwise specified in writing by Commissioner.
5. All plants shall be of specimen quality, symmetrical, so trained or favored in development and appearance as to be unquestionably and outstandingly superior in forms and compactness. They shall indicate vigorous growth, be well branched and densely foliated when in leaf, free of disease, insects, eggs, larvae and shall have well developed root systems.
6. Trees with multiple leaders will not be accepted. Trees with a damaged or crooked leader, bark or abrasions, sun-scald, disfiguring knots, insect damage will not be accepted.
7. The depth of planting must be checked for all trees being tagged at the nursery. If the root/trunk flare (the intersection of the trunk and the buttress roots), is not visible, it must be located. Any tree with significant adventitious root growth or evidence of girdling roots shall be subject to rejection by the Commissioner, on a case-by-case basis. Any soil above the root/trunk flare shall be removed prior to digging (see root ball preparation detail drawing). Following the removal of any excess soil above the root/trunk flare, the tree shall be hand dug and drum laced. Machine digging shall be grounds for rejection of the tree. The rootball size shall be determined from the elevation of the root/trunk flare in accordance with the American standard for nursery stock for the caliper size of the tree.
8. Size:
  - a. Caliper measurement shall be taken on the trunk at DBH. (Approximately 5'0" above the natural ground line. Height and spread dimensions refer to the main body of the plant and not from branch tip to tip. If a range of size is given, no plant shall be less than the minimum size and not less than 50% of the plants shall be as large as the maximum size specified. Plants that meet measurements but do not possess a normal balance between height and spread shall be rejected.
  - b. Plants larger than specified may be used only if approved by Commissioner. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant, in accordance with the American standard for nursery stock.

#### B. PLANT SIZES AND DIMENSIONS

1. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
2. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not



- measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
3. Height and spread dimensions refer to the main body of the plant and not from branch tip to tip. If a range of size is given, no plant shall be less than the minimum size and not less than 50% of the plants shall be as large as the maximum size specified. Plants that meet measurements but do not possess a normal balance between height and spread shall be rejected.
  4. Plants larger than specified may be used only if approved by Commissioner. If larger plants are approved, the root ball shall be increased in proportion to the size of the plant, in accordance with the American standard for nursery stock.
  5. Stock furnished shall be a fair average of the minimum and maximum sizes specified. Larger plants cut back to sizes specified will not be accepted.
  6. Container grown herbaceous plants, groundcover, and vines shall be well rooted in the container size indicated on the Plant Schedule, grown in the container at least one year prior to planting. Bulbs, corms, tubers and rhizomes shall be Top Size, or as indicated on the Plant Schedule. Annual flowering plants shall be vigorous, well rooted, with no indications of disease or stress.

**C. QUALITY**

1. All plants shall be typical of their species or variety. They shall have normal, well-developed branches and vigorous fibrous root systems. They shall be sound, healthy, vigorous plants free from defects, disfiguring knots, sun scald injuries, dead or broken branches, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation.
2. Trees: All trees shall be B&B, major trees branched 6-7' from the ground, minor trees as specified. Sizes shall be as indicated. Rootball size shall correspond to American Association of Nurserymen Standards for the corresponding caliper size. Well-branched top and fibrous root system essential.
3. Shrubs: Sizes shall be as indicated. Rootball or container sizes shall correspond to A.A.N. Standards for the corresponding shrub height. Heavy root system, all shrubs shall be well branched to the ground. Sizes shall be as indicated.
4. Vines, Groundcover, And Herbaceous Plants: Container size shall be as indicated on the plans. All plants shall have vigorous root systems and have grown in the container for at least one year prior to planting.
5. Plugs: Plugs shall have vigorous root systems.
6. Annuals: Annual flowering plants shall be vigorous, well rooted, with no indications of disease or stress.
7. Bulbs, Corms, Tubers And Rhizomes: All bulbs, corms, tubers and rhizomes shall be top size, firm, and non-desiccated.

**D. SOURCES**

1. All plants shall be sourced from reputable nurseries and be either field or container grown. All trees and shrubs shall have been growing under similar climatic conditions as the project site two (2) years prior to the date of the contract. Plants held in storage will be rejected if they show signs of growth during storage. Collected material shall not be accepted.
2. Plant material subject to availability and adherence to the requirements of this specification, may be purchased, or, time permitting, contract grown, from:
  - a. Halka Nurseries, Millstone Twp, NJ;
  - b. LP Statile Inc., Springfield Twp, NJ
  - c. Weston Nurseries, Chelmsford, MA



- d. Hardscrabble Farms, North Salem, NY
- e. Rosedale, Nursery, Hawthorne, NY
- f. North Creek Nursery, Landenburg, PA;
- g. Talmage Farm, Riverhead, NY;
- h. The Plantage, Cutchogue, NY;
- i. Kurt Bluemel, Inc., Baldwin, MD
- j. Greenbelt Native Plant Center, Staten Island, NY
- k. Pineland Nursery, Columbus, NJ
- l. Wild Earth, Freehold, NJ
- m. Sylva Native, New Freedom, PA
- n. or approved equal nurseries.

**E. NATIVE PLANTS, where indicated**

- 1. Native plant material must be derived from the local genotypes of the native Plants specified. For purposes of this native plant material paragraph, "local" shall mean within 150 miles from the planting site.
- 2. All plants must have been grown in a hardiness zone no warmer than Zone 7 or colder than Zone 6 as determined by the USDA Agricultural Research Service, Plant Hardiness Zone Map. Plant quality shall be typical of their species. Plant material should exhibit the range of variation typical of local genotypes of the species. They shall have normal branching and vigorous fibrous root systems. They shall be sound, healthy plants, free from sunscald injuries, or other mechanical injury, plant diseases, insect eggs, borers and all forms of infestations. Except as may otherwise be specified, all other sections of this Landscape Planting Specification shall also apply to the Native Plants.
- 3. All plants shall be nursery grown unless otherwise stated. Collected material will not be accepted.

**F. PLANT MATERIAL ORDERING**

- 1. Notify the Commissioner of the unavailability of any tree, shrub, herbaceous plant, or bulb species designated in the contract documents.
- 2. Schedule permitting, and with the Commissioner's approval, plant materials may be contract grown or pre-purchased provided the species, cultivar, size, quantities and other characteristics outlined in the Plant Schedule are satisfied at the time of planting.

**2.2 SOIL AMMENDMENTS**

**A. MYCORRHIZAL FUNGI INNOCULANT**

- 1. Three ounce (3 oz.) premeasured dry formulation packet, such as Mycor Tree Saver Transplant, as manufactured by Plant Health Care, Inc., Pittsburgh, PA. Rhizanova Tree Transplant, as manufactured by Becker Underwood, Inc., Ames, IA. MycoApply, as manufactured by Mycorrhizal Applications, Grants Pass, OR., or approved equal.
- 2. Packets shall contain, as a minimum: one thousand (1000) live spores of Vesicular-Arbuscular fungi, including: Entrophosphora columbiana, Glomus clarum, Glomus etunicatum, and Glomus sp.; seventeen million five hundred thousand (17,500,000) live spores of Ectomycorrhizal fungi (Pisolithus tinctorius); Biostimulant ingredients including Yucca schidigera extract; soluble sea kelp extract derived from Ascophylum nodosum; humic acids; and acrylamide copolymer gel as a water absorbent medium.

**B. WATER RETENTION ADDITIVE**



1. Water Retention Additives shall be a granular polyacrylamide polymer of a potassium base and not a sodium base that slowly releases moisture into the root zone such as Terra Sorb, as manufactured by Plant Health Care, Inc., Pittsburgh, Pa., SoilMoist, as manufactured by JRM Chemical, Inc., Cleveland, OH., Geohumus as manufactured by Geohumus International GMBH, Germany, or approved equal.

#### C. INORGANIC SOIL AMENDMENTS

1. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
2. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
3. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
4. Provide lime in form of ground dolomitic limestone or mollusk shells
5. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
6. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
7. Aluminum Sulfate: Commercial grade, unadulterated.
8. Perlite: Horticultural perlite, soil amendment grade.
9. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
10. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
11. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
12. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

#### D. ORGANIC SOIL AMENDMENTS

1. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
2. Organic Matter Content: 50 to 60 percent of dry weight.
3. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
4. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.
5. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
6. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
7. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

#### E. FERTILIZERS

1. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

2. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
3. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
4. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
5. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
6. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
7. Size: 21-gram tablets.
8. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
9. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

### 2.3 TREE STABILIZATION

- A. 2" Diameter X 8'L cedar stakes. Guy as indicated on drawings.

### 2.4 Root Barrier

- A. Root Barriers in plant beds: mechanical guides that redirect tree roots down and away from utilities while preserving a trees health.
  1. Basis-of-design Product: Subject to compliance with requirements provided: DeepRoot linear root barrier UB 36-2, DeepRoot Green Infrastructure, LLC 101 Montgomery Street, Suite 2850, San Francisco, CA 94104, (415) 781-9700 or comparable product by one of the following:
    - a. GreenBlue Urban, 4405 Anderson Road, Knoxville, TN 37918 (866) 282-2743; Product: ReRoot
    - b. Citygreen USA, 515 S. Flower Street, 36<sup>th</sup> Floor, Los Angeles, CA 90071 (888) 999-3990; Product: RootStop
    - c. Or approved equal.

### 2.5 MISCELANEOUS MATERIALS

- A. Erosion Control Blanket
- B. Biodegradable jute blanket and staples. Install as per manufacturer's requirements.
- C. Weed-Control Barriers – Not Used.
- D. Pesticides – Where Called For or Required. Commissioner's permission for use required. Notify within 7 days of proposed use.
- E. General: Pesticide registered and approved by EPA, acceptable to the regulations of the New York City Department of Environmental Protection, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by the Commissioner after having advised the Commissioner explicitly of their restricted nature.

- F. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- G. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.
- H. Landscape Edging – Not Used.
- I. Tree Grates – Not Used.
- J. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- K. Burlap: Non-synthetic, biodegradable.
- L. Landscape Fabric: Shall be a one hundred percent (100%) continuous monofilament polypropylene spun bond fabric with UV inhibitors. The landscape fabric shall prevent weed germination and reduce maintenance while allowing water, herbicides, and fertilizers to pass through. The fabric shall demonstrate the following minimum characteristics:
  - 1. Area Weight (ASTM 5261): 4.0 oz/yard
  - 2. Tensile Strength (ASTM D 4595): 48.57 lbs./ inch
  - 3. Strength @ 5% Elongation: 22.86 lbs./ inch
  - 4. Energy Absorption: 22 lbs./ inch
  - 5. Grab Strength (ASTM D 4632): 167.42 psi
  - 6. Burst Strength (ASTM D 3786) 166.79 psi
  - 7. Tear Strength (ASTM D 4533): 83.15 lbs.
  - 8. Puncture (ASTM D 4833): 56.18 lbs.
  - 9. Hydraulic Properties: opening size (ASTM D 4751) 210 microns, US Sieve 70
  - 10. Staples shall be a least six (6") inches in length and made of a rust-resistant material, such as aluminum, galvanized steel, or approved equal that will adequately secure the landscape fabric to the planting bed.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 PLANTING OPERATION

- A. The Commissioner reserves the right to be on site to direct the installation of all plantings. No plants shall be installed until their location has sited them to his/her satisfaction. The Commissioner will make every effort to expedite the work in a timely manner.
- B. For the purpose of inspection, the Commissioner shall have free access to all parts of work involved in planting operation. No work shall be covered or concealed prior to inspection.
- C. Plants shall be protected at all times from sun or drying winds. Plants that cannot be planted immediately upon delivery shall be kept in the shade and well watered by the Contractor. Plants shall not remain unplanted for longer than one day after delivery.

### 3.3 EXAMINATION

- A. Prior to work at planting and areas, ascertain the location of all electric cables, conduits, under drainage systems and utility lines. Take proper precautions so as not to disturb or damage sub-surface elements. Contractor failing to take these precautions shall be responsible for making requisite restorations to damaged utilities at Contractor's own expense.
- B. Verify that required underground utilities are available, in proper location, and ready for use. Coordinate with other trades as necessary.
- C. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
- D. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
- E. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Commissioner and replace with new planting soil.
- F. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
- G. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
- H. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- I. Verify that all work requiring access through or adjacent to areas where plants are to be placed has been completed and no further access will be required. In the event that access will be required, this must be coordinated with the Commissioner.
- J. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.4 PREPARATION

- A. The Commissioner reserves the right to direct the installation of all plantings. No plants shall be installed until their location has sited them to the Commissioner's satisfaction.
- B. For the purpose of inspection, the Commissioner shall have free access to all parts of work involved in planting operation. No work shall be covered or concealed prior to inspection.
- C. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- D. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- E. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Commissioner's acceptance of layout before excavating or planting. Make minor adjustments as required.
- F. Lay out plants at locations directed by Commissioner. Stake locations of individual trees and shrubs and outline areas for multiple plantings.



- G. Apply antidesiccant if approved to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
- H. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- I. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- J. Plants shall be protected at all times from sun or drying winds. Plants that cannot be planted immediately upon delivery shall be kept in the shade and well watered by the Contractor. Plants shall not remain unplanted for longer than one day after delivery.

### 3.5 PLANT AREA ESTABLISHMENT

- A. Planting Soil and Landscape Grading sections.
- B. Confirm Finish Grading has been accepted. Restore areas if eroded, or settled beyond designated Finish Grades.
- C. Erosion Control Fabric: Place after tree planting, but prior to shrub, perennial, groundcover and vines.
- D. Landscape Fabric:
  - 1. Place landscape fabric across the entire area of each tree, shrub, mineral mulch area (do not use landscape fabric at grass and perennial planting areas) so that it lays loosely on the soil and in contact with the soil at all points.
  - 2. Remove any large sharp stones from the planting bed, along with invasive perennial weeds, such as mugwort, or hedge garlic, which may be treated with herbicide.
  - 3. Vertically anchor the edge of the fabric into the ground utilizing a small overlap and a blunt shovel along the perimeter of the bed to a depth of six inches (6").
  - 4. Landscape Fabric must be secured into the soil with staples placed at eighteen (18") inch intervals along the edges of the fabric, through both layers, or as directed by the Commissioner.
  - 5. Mark the fabric with chalk or paint to lay out the locations of specific plants and then cut a cross shape into the fabric no larger than the size of the root ball or container of the plant.
  - 6. Fold the corners under the fabric and dig a planting hole, reserve the soil for another use, place the plant, and reset the folds of the fabric to their original position, water the area thoroughly, and place mulch over the fabric as directed under the Item "Plant Material".

### 3.6 EXCAVATION FOR TREE PLANTING

- A. No plant pits shall be dug until the proposed locations have been staked on the ground by the Contractor and approved by the Commissioner.
- B. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

- C. Excavate approximately three times as wide as ball diameter for stock.
- D. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
- E. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
- F. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
- G. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
- H. Structural Soil When the depth of the rootball exceeds the depth to the filter fabric underlying the Structural Soil installation, score the filter fabric in an 'X' and excavate sufficiently to permit the top of the ball to rest at finished grade.
- I. Maintain supervision of excavations during working hours.
- J. Keep excavations covered or otherwise protected when unattended.
- K. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- L. Obstructions: Notify Commissioner if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- M. Drainage: Notify Commissioner if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- N. Fill excavations with water and allow to percolate away before positioning trees and shrubs.
- O. Planting beds for Shrubs, Vines, Herbaceous, and Groundcover plants shall be excavated to the dimensions and depths indicated on the plans and backfilled with approved topsoil. Bulbs, Corms, Tubers, Rhizomes and Annuals shall be planted in the existing unamended soil or prepared planting beds with improved soil and/or a water absorbent medium, as designated on the drawings.

### 3.7 TREE, SHRUB AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. ORIENTATION: Where possible, orient trees in the same cardinal direction as grown in the field in order to minimize damage to the bark of the trunk.



- D. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades. Set the tree or shrub straight and in the center of the pit, with the most desirable side facing toward the predominant view. Care shall be exercised in setting the plants plumb.
1. Topsoil removed from excavations may be used as planting soil if so directed by the Commissioner. Soil amendments should be added based on soil test recommendations. Subsoil excavated from the planting pit should be removed from the project site.
  2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops and sides of root balls. Do not remove burlap, rope and wire baskets from below root balls. Remove pallets, if any, before setting. All plastic or synthetic fabric must be removed from the ball at the time of planting. Wire must not be galvanized or aluminum wire.
  3. All ropes, stones, etc. shall be removed from the pit before backfilling.
  4. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  5. Soil for backfill shall be loose and friable and not frozen or compacted.
  6. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  7. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
- E. Continue backfilling process. Water again after placing and tamping final layer of soil.
1. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades. Set the tree or shrub straight and in the center of the pit, with the most desirable side facing toward the predominant view. Care shall be exercised in setting the plants plumb.
  2. Topsoil removed from excavations may be used as planting soil if so directed by the Commissioner. Soil amendments should be added based on soil test recommendations. Subsoil excavated from the planting pit should be removed from the project site.
  3. Carefully remove root ball from container without damaging root ball or plant.
  4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  5. Soil for backfill shall be loose and friable and not frozen or compacted.
  6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
  7. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch above adjacent finish grade. Set the tree or shrub straight and in the center of the pit, with the most desirable side facing toward the predominant view. Care shall be exercised in setting the plants plumb.
1. Topsoil removed from excavations may be used as planting soil if so directed by the Commissioner. Soil amendments should be added based on soil test recommendations. Subsoil excavated from the planting pit should be removed from the project site.
  2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.

3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.
  4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- G. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
- H. Vine, Perennial, and Groundcover plants shall be carefully removed from containers or flats immediately prior to planting and set to the same depths as they were grown in the nursery bed or container, to the correct spacing indicated on the plans.
1. Roots shall be arranged in their natural position and topsoil worked in among them, taking care to avoid bruising or damaging the roots, and fertilizer tablets added to the top four inches (4") of backfill soil in the correct proportion for the respective pot size.
  2. No later than one hour after planting, all plants shall be thoroughly settled in with water.
  3. Climbing Vines shall be unfurled and tied to and/or woven through adjacent supporting wires, fences, trellis, etc.
- I. Annual flowering plants shall be carefully removed from the flats or cell-packs to avoid damaging roots or stems and planted in prepared planting beds at the same depth they were growing in the containers. Soil shall be thoroughly firmed around each crown, and plants thoroughly watered in no longer than one hour after planting.
- J. Bulbs shall be planted in the locations indicated on the plans and to the depths and spacing indicated on the Plant Schedule. Spring Flowering Bulbs, Corms, Tubers, and Rhizomes shall be planted in late September or October, no more than six (6) weeks before frost. Summer and Fall Flowering Bulbs, Corms, Tubers, Rhizomes and Plugs shall be planted in spring, after the last killing frost, or as directed by the Engineer. All of the above shall be planted according to best horticultural practice. Prior to planting, bulbs shall be stored in a cool, dry, well-ventilated location for no longer than two (2) weeks before planting.

### 3.8 SOIL AMENDMENTS

- A. Mycorrhizal fungi inoculants shall be added to the top six to eight inches (6-8") of backfill soil in each planting pit and thoroughly mixed to distribute the inoculants. The material shall be applied according to the following chart:

Size of rootball or container	Ounces per plant
1 gallon	1
2 gal.	2
3 gal.	3
5 gal.	3
7 gal.	3
10 gal.	3
15 gal.	3
20" B&B	6
24" B&B	9
30" B&B	9
36" B&B	12



42" B&amp;B

12

1. After mixing, the plants shall then be thoroughly settled in with water. Care shall be taken to avoid bruising or breaking the roots when tamping the soil. All large and fleshy roots that are bruised or broken shall be pruned, making a clean cut before planting.

### 3.9 PLANTING DEPTH

- A. Plants shall be placed on firmed final planting mix soil. Trees must be planted at the depth where roots spread from trunk as shown in diagram. The root flair shall be visible and at finished grade.
- B. All ropes and strings must be cut, non-biodegradable material must be removed, and the top 1/3 of the burlap folded back from the top of the ball. When tree root balls arrive on site in wire cages, after final placement has been approved, cut and remove the top half of the wire cage.
- C. When placement of the trees has been approved by the Commissioner, and only at that time, backfill soil shall be placed in all excavated areas. Soil must be firmed at six (6) inch intervals and thoroughly settled with water. Trees shall stand plumb after installation. See figure 1.1 depicting proper planting depth:

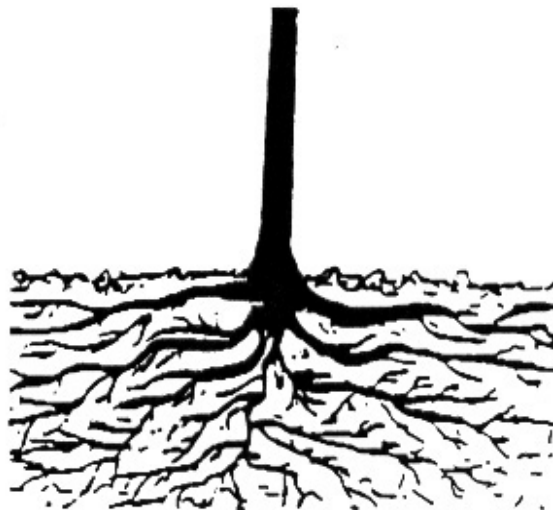
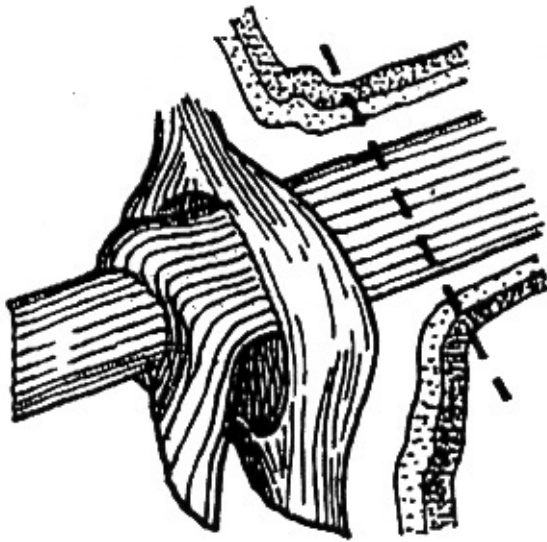


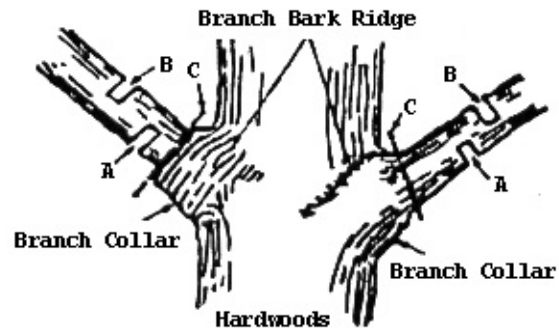
Figure 1.1

- D. Staking, Guying, and Wrapping:
  1. One (1) Rootball Kit with Tensioning Ratchet Straps, 3/4" (19mm) round, 4' (1.2m) long hand drive steel with large striking head, or deadman anchor, or anchor plate is to be installed per tree as per manufacturer installation method. Duckbill Rootball Kits as manufactured by Duckbill Earth Anchors, Foresight Products, LLC, Commerce City, CO, ArborGuy as manufactured by GreenBlue Urban, Knoxville, TN, Platipus Tree Anchoring as manufactured by Platipus Earth Anchoring Systems, Raleigh, NC, or approved equal.
  2. There shall be no tree wrapping left on tree after planting is complete.
- E. Pruning:

1. All on-site pruning shall be supervised by the Commissioner.
2. Each cut should be made carefully, at the correct location, leaving a smooth surface with no jagged edges or torn bark. The correct anatomical location is just beyond the branch collar. (See figures 1.2 and 1.3, taken from the I.S.A. certification study manual).
3. Large or heavy limbs should be removed using three cuts. The first cut undercuts the limb one or two feet from the parent trunk or branch. The second cut is the top cut which is made slightly further out on the limb than the undercut. The third cut is to remove the stub.



**Figure 1.2**



**Figure 1.3**

4. The natural character of the plant shall be preserved.
5. All deadwood, suckers, broken, or badly bruised branches shall be removed.
6. Pruning at the time of planting shall be avoided. Trees shall not be pruned to compensate for the loss of root mass due to digging.
7. Pruning shall be done with clean, sharp tools. No leaders shall be cut.
8. Evergreen plants shall not be pruned except to remove dead or broken branches.

### 3.10 WARRANTY MAINTENANCE OF TREES AND SHRUBS AFTER PLANTING

- A. Warranty maintenance shall begin immediately after each plant is planted, and shall continue until acceptance.
- B. Warranty maintenance Establishment Period begins from the date of substantial completion for a period of two (2) years with the intent of establishing the planting.

- C. Warranty maintenance shall consist of watering, mulching, tightening, and restoration of staking systems, resetting plants to proper grade and application of horticultural oils during dormant season.
- D. Maintain temporary irrigation with the intent of establishing the plant material, providing water to new trees and plant beds twice a month beginning each year on the first day of April and lasting until the last day of October. Warranty Maintenance shall include but is not limited to:
  - 1. Watering all trees and plant beds using soaker hoses or sprinklers connected to spigots on the 116 Precinct Station House and 105<sup>th</sup> Precinct Annex house
  - 2. The use of water trucks
  - 3. Using best practices
- E. Contractor must notify Commissioner when pest control is to take place.

### 3.11 ACCEPTANCE

- A. The Commissioner shall inspect all work for acceptance upon written request of the Contractor. The request shall be received at least fourteen (14) calendar days before the anticipated date of inspection.
- B. Upon completion and re-inspection of all restorations or renewals necessary, the Commissioner shall certify in writing as to the acceptance of the work.

### 3.12 FINAL INSPECTION AND FINAL ACCEPTANCE

- A. At the end of the guarantee period, the Commissioner will inspect all guaranteed work at the written request of the Contractor. The request shall be received fourteen (14) calendar days before the anticipated date for final inspection. Upon completion and re-inspection of all restorations or renewals necessary, the Commissioner shall certify in writing as to the final acceptance of the project.

### 3.13 WASTE MANAGEMENT

- A. Separate and dispose of waste in accordance with the DDC General Conditions.

**END OF SECTION 32 93 00**



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**SECTION 32 94 50**

**CELLULAR TREE PLANTING SYSTEM**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].

**1.2 SUMMARY**

A. Section Includes

1. Provisions of Rigid Plastic Cellular Soil Cell Matrix and related materials.
2. Provisions of Rigid Plastic Cellular Soil Cell Matrix accessories including but are not limited to, Soil Cell Matrix Body, Soil Cell Matrix Top, Soil Cell Matrix Infill, Infill Material, Geocomposites, Root Barrier, Moisture Barrier, Filter Fabric, and Lateral Aeration Piping.

B. Related Sections:

1. Section 32 91 13 "Planting Soil"
2. Section 32 91 19 "Landscape Grading"
3. Section 32 93 00 "Landscape Planting"

**1.3 DEFINITIONS**

- A. Soil Cell: Load bearing engineered plastic module with vertical and lateral interlocks designed to create void space beneath pavements in order to support tree root growth.
- B. Soil Cell Matrix: Assembled and interconnected volume of soil cell modules.
- C. Lateral Piping System: Perforated piping system for circulation of air and distribution of water and nutrients, connected to surface inlet.
- D. Vertical Piping System: Large diameter plastic pipe system for inspection, circulation of air and connected to surface inlet.
- E. Root and Moisture Barrier: Linear membrane to prevent root and moisture penetration.
- F. Root Barrier: Linear root barrier with vertical integral root training ribs.
- G. Filler Soil: Correctly balanced soil mix to provide optimum growth conditions for tree root systems within the soil cell matrix.
- H. Finish Grade: Elevation of the finished pavement or planting surface.
- I. Geocomposite / Geogrid with integrated non-woven Geotextile: High strength geogrid comprised of stretched monolithic polypropylene flat bars with welded junctions and a

mechanically bonded filter geotextile welded within the geogrid structure. Used for reinforcement of granular pavement base.

- J. Geotextile / Geofabric / Filter Fabric: A Fabric composed of high tenacity polypropylene or polyester fibers, woven into a network, inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.
- K. Geogrid: Net-shaped woven polyester fabric with PVC coating, uniaxial or biaxial geogrid, inert to biological degradation, resistant to naturally occurring chemicals, alkalis, and acids. Used for reinforcement of granular pavement base.
- L. Tree Pit Opening: The pavement opening within which a tree is planted.
- M. Granular Base Course: Compacted granular material to specified requirements.
- N. Tree Pit: Excavated space filled with appropriate soil media for tree planting.
- O. Reinforcing Collar: A trench between the soil cell matrix and surrounding soil, lined with geocomposite, filled with granular base course and compact.
- P. Backfill: Clean, native excavated soil, free from organic matter, frozen materials, stones larger than 3" (74mm) in diameter, debris and other foreign substances.
- Q. Compaction: The method of mechanically increasing the density of soil. Soil compaction is measured using the Proctor Test (ASTM D1557-91)
- R. Planting Soil: Soil as defined in Section 32 91 13 Planting Soils.
- S. Reinforcing Collar: A trench between the soil cell matrix and surrounding soil, lined with geocomposite, filled with granular base course and compacted.
- T. Ribbed Root Barrier: Linear Ribbed root barrier with vertical integral root training ribs.
- U. Rootball Anchor System: A below grade system comprised of cables, spearhead or deadman anchors and web strap used for anchoring a rootball into the ground.
- V. Sub-grade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill.

#### 1.4 SUSTAINABLE DESIGN REQUIREMENTS

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.



1. Recycled Content: Metal materials, products, anchors, framing, and accessories shall contain a minimum of 35% combined pre-consumer/post-consumer recycled content (the percentage of recycled content is based on the weight of the component materials). Certification of recycled content shall be in accordance with the LEED Building Submittals requirements of this Section.

#### 1.5 LEED BUILDING SUBMITTALS:

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.7 SUBMITTALS

- A. Schedule: Prepare a schedule for the work of this section. Include a detailed activity list, start and finish dates, milestones and date of substantial completion. Provide Commissioner with a copy of proposed schedule and obtain Commissioner's acceptance of schedule.
- B. Shop Drawings: Shop drawings shall show all information needed to fabricate, supply and install soil cell system including aggregate sub-base, horizontal and vertical dimensions and elevations.
- C. Product Data: Submit manufacturer's product data for each type of product to be used. For soils and aggregates provide testing agency laboratory analysis.
- D. Qualification Data: Submit proof of qualifications of installer and installer's site supervisor.

#### 1.8 DESIGN

- A. Soil Cell Matrix:
  1. Structural Design: Design soil cell matrix, sub-grade and subsequent fill layers to resist dead, live, lateral and environmental loads, with settlement, deflection and displacement within design limits.
  2. Wheel Load Rating: AASHTO H-20.
  3. Matrix Void Space: Minimum 95% free volume.

#### 1.9 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"
- B. Pre-Installation Meeting: Convene a pre-installation site meeting at least 7 days prior to commencing work at site. Require attendance of parties directly affecting work of this section, including Commissioner and, if appointed, testing agency. Review work activities and schedule. Tour site and inspect and discuss site physical conditions. Review required inspections.
- C. Installer Qualifications: Work shall be performed by an experienced installer with a successful track record in performing work of the same scope and quality as required by these specifications. Installer shall be properly trained by manufacturer of soil cells.

- D. **Installer's Site Supervision:** Appoint an experienced full-time site supervisor to be responsible for site activities for duration of work. Do not change site supervisor without Commissioner's prior written approval.
- E. **Site Mock-Up:** Prior to installation of soil cells, construct on site a 9 square meter mock-up of the entire system including granular sub-base, placement of filler soil and granular base course. Materials and techniques used in construction of mock-up shall be acceptable to Commissioner who shall be present during mock-up construction. Mock-up may remain part of permanent installation if acceptable to Commissioner.
- F. **Manufacturer's Representative:** Arrange for a representative of the soil cell manufacturer to be available to visit site within 48 hours' notice.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in strict accordance with manufacturer's instructions
- B. Make provision on site to properly receive, handle and store materials. Provide sheltered and weather-tight storage to protect materials from the elements.
- C. Store soil cell modules on pallets, with pallet wrap intact until required for installation. Position pallets on firm, level base.
- D. Protect geosynthetics from physical damage and from temperatures excess of 70 degrees C. Do not expose geosynthetics to direct sunlight for more than 7 days.
- E. Store and protect bulk materials by covering with tarpaulins and in a manner to prevent erosion.

#### 1.11 PROJECT/SITE CONDITIONS

- A. **Ambient Conditions:** Perform work on site when ambient conditions are conducive to proper performance and in accord with recommendations of soil cell manufacturer. Take all reasonable precautions to guard against effects of adverse weather conditions.
- B. **Site Information:** Before commencing work on site examine available documentation pertaining to site and determine nature and location of above ground and underground utilities. Report demonstrable and potential conflicts with work of this section to Commissioner.
- C. **Existing Soil Conditions:** Before proceeding with full scale excavation work, confirm nature of existing soil conditions and in particular the drainage characteristics of existing soil. Refer to clause 2.8 Source Quality Control.
- D. Abandoned utilities encountered during excavation shall be removed and their ends plugged.
- E. Active utilities encountered during excavation and not indicated in Contract Documents shall be reported immediately to Commissioner and utility owner who shall determine measures necessary to restore, relocate or remove utility.



## PART 2 - PRODUCTS

### 2.1 Manufacturer

- A. Basis-of-Design Product: Subject to compliance with requirements provided GreenBlue Urban, Knoxville, TN; RootSpace or comparable product by one of the following:
  - 1. SilvaCell as manufactured by DeepRoot Green Infrastructure, San Francisco, CA.
  - 2. Stratavault as manufactured by Citygreen Urban Landscape Solutions, Los Angeles, CA.
  - 3. Or approved equal.

### 2.2 Rigid Plastic Cellular Soil Cell Matrix

- A. Material:
  - 1. Soil Cell Matrix Structure, Soil Cell Matrix Top, and Soil Cell Matrix Infill Panels shall be reinforced with fiberglass, 100% recycled polypropylene.
- B. Form and Configuration: Engineered plastic modules designed to assemble together to create a matrix under pavements. Interconnected skeletal matrix shall provide void space of at least 95% to accommodate filling with soil media or storing storm water.
- C. Interlocking uprights and decks are assembled on-site to create modules which can be uniformly stacked in height, not to exceed 10' in height (per project design).
- D. The soil cell system shall have the ability to be assembled as a complete, interlocked unit or as independent modules.
- E. The system shall have the capability of accommodating utilities up to 16" (400 mm) within the system. Subject to site and engineering requirements.
- F. Dimensions of Modular Units: Injection molded, polypropylene with nominal dimensions as follows:
  - 1. Matrix Body Upright Structure Dimension
    - a. 24"H x 20"W x 4"D
    - b. Ultimate Load Strength:
      - 1) Matrix Body: 260kpa (37.7 psi)
      - 2) Matrix Top: 260kpa (37.7 psi)
      - 3) Matrix Infill: 260kpa (37.7 psi)
  - 2. Matrix Top Dimension
    - a. 3"H x 20"W x 20"L
  - 3. Matrix Infill Panel Dimension
    - a. 20.5"H x 13"W x 1.5"D

### 2.3 GEOSYNTHETICS

- A. Geocomposites:



1. Composition: Geogrid with integrated non-woven Geotextile.
2. Geogrid: Stretched monolithic polypropylene flat bars with welded junctions.
3. Geotextile: Mechanically bonded filter geotextile welded within geogrid structure
4. Color: White
5. Physical Properties:

a. Geogrid Physical Properties:

Property	Units	Value
Mass per unit area	g/m <sup>3</sup>	250
Max tensile strength ( <i>machine direction/cross machine direction</i> )	kN/m	≥ 40 / ≥ 40
Elongation at nominal strength ( <i>machine direction/cross machine direction</i> )	%	≤ 8 / ≤ 8

b. Geotextile Properties

Property	Units	Value
Mass per unit area	g/m <sup>3</sup>	150
Max tensile strength ( <i>machine direction/cross machine direction</i> )	kN/m	7.5 / 11
Elongation at nominal strength ( <i>machine direction/cross machine direction</i> )	%	40 / 30
Puncture Force (x-s)	N	1,670
Opening size	mm	0.13
Water Permeability – flow rate H50	l/sm <sup>2</sup>	110

B. Ribbed Root Barrier:

1. Material: High-density polyethylene.
2. Minimum Thickness: 1.00 mm.
3. Depth: 40”.
4. Form: Linear rolls with integral vertical ribs.
5. Length: 100’ sections
6. Seams shall be overlapping 8” and sealed on both sides with joint tape.
7. Form: Linear sheet with integral vertical ribs.

8. Color: Black.
  9. Physical Properties: As specified in Appendix 'A' of this section.
- C. Ribbed Root Barrier: Designed to redirect tree roots down and away from pavement surfaces. Ribbed Root Barriers shall be manufactured to meet the following requirements:
1. Material shall be 100% recycled high-density polyethylene (HDPE).
  2. Minimum Thickness: 0.04" (1.00 mm)
  3. Form: Linear Rolls with integral vertical ribs.
  4. Depth: 40"
  5. Length: 100'
  6. Color: Black
  7. Seams shall be overlapped 8" (200 mm) and sealed on both sides with joint tape.
- D. Root and Moisture Barrier: Designed to protecting building foundations and underground utilities from tree root growth and moisture intrusion. Root & Moisture Barrier shall be manufactured to meet the following requirements:
1. Material shall be 100% recycled high-density polyethylene (HDPE).
  2. Minimum Thickness: 1.00 mm.
  3. Form: Linear rolls.
  4. Depth: 40"
  5. Seams shall be overlapping 8" and sealed on both sides with joint tape.
  6. Color: Black.
  7. Physical Properties: As specified in Appendix 'A' of this section.
- E. Filter Fabric:
1. Description: Fabric of polypropylene or polyester fibers, nonwoven, needle-punched continuous filament in flat and sock form.
  2. Physical Properties: As specified in Appendix 'A' of this section.
  3. Cellular Tree Planting Products.

## 2.4 AERATION AND INSPECTION PIPING

- A. Lateral Aeration Piping System:
1. Lateral Pipe: Flexible, perforated, 60 mm in diameter.
  2. Vertical Riser: Flexible, perforated, 60 mm in diameter, connecting lateral piping to surface inlet.
  3. Connectors: Molded connectors to effect proper jointing.
  4. Material: 100% high density polyethylene.
  5. Configuration: Optimize oxygen exchange with tree pit soil, facilitate supplementary irrigation and nutrient dosing and, where applicable, distribution of harvested storm water.
- B. Vertical Drainage Inspection Pipe: 100mm diameter rigid 100% high density polyethylene.
- C. Vertical Soil Inspection Pipe: 150 mm diameter rigid 100% high density polyethylene.

## 2.5 BIORETENTION SOIL

- A. As specified in 32 91 13 "Planting Soils"

## 2.6 AGGREGATES

- A. Granular Base Course: ASTM D1241-07, Type 1, Gradation B consisting of stone, gravel or slag with natural or crushed sand and fine mineral particles passing a No. 200 sieve, graded as follows:

SIEVE	PERCENT PASSING
37.5 mm	100
25 mm	75-95
9.5 mm	40-75
4.75 mm	30-60
2.0 mm	20-45
425 um	15-30
75 um	5-15

## 2.7 ROOTBALL ANCHORING SYSTEM

- A. Rootball Guying & Tree Tie
1. Composite Anchor
    - a. Ratchet: Mild Steel/Polyester
    - b. Cable: Stainless Steel
    - c. Hardware: Mild Steel
    - d. Anchor: Composite Plastic/aluminum

## 2.8 SOURCE QUALITY CONTROL

- A. Provide testing agency with representative samples of existing, on-site soil and of each type of fill proposed for use.
- B. Testing agency shall perform the following laboratory tests on each soil and fill sample:
1. Sieve analysis
    - a. Particle size distribution
    - b. Liquid limit
    - c. Plastic limit
    - d. Plasticity index
    - e. Hydraulic conductivity
    - f. Compaction
- C. Compaction testing shall be in accordance with ASTM D698 – 07e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (Standard Proctor Density).

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 EXAMINATION**

- A. Examine area to receive cellular tree planting system to confirm area is ready to receive work. Coordinate with adjacent work by others.

**3.3 PREPARATION**

- A. Tree Pit Layout: Layout tree pit locations and dimensions using string lines, survey pegs and marking paint. Obtain Commissioner's approval of layout before proceeding with excavation.
- B. Tree Pit Depths: Confirm excavation depths with reference to finished pavement elevations. Allow for granular base course layer and, where applicable, drainage layer.

**3.4 TREE PIT EXCAVATION**

- A. Excavation: Accurately excavate to dimensions shown on Drawings. Allow 200 mm additional clearance in length and width. Excavation side walls shall be clean and straight, within 15 degrees of vertical. Measure and confirm that correct horizontal and vertical dimensions have been achieved.
- B. Reinforcing Collar: Further excavate top perimeter of tree pit to a depth of 300 mm and to a width of 200mm, sufficient to accommodate a narrow foot compacting plate. Excavated surfaces shall be clean and straight,
- C. Protect sub-grade from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and do not allow water to accumulate in excavations.

**3.5 SUB-GRADE PREPARATION**

- A. Remove unstable bottom material, including large stones, debris and compressible soils. Scarify and mix sub-grade surface and moisture condition as required. Accurately construct and fine grade the sub-grade to required lines and levels. Compact sub-grade to 95% Standard Proctor Density.
- B. Finished sub-grade shall be flat, uniform, dense, smooth, free from loose stones and foreign matter, and sloped to a grade of 5%.

**3.6 TREE PIT GRANULAR BASE COURSE**

- A. Install granular base course to depth shown on Drawings on sub-grade and under first layer of soil cell modules. Compact granular base course to minimum 95% Standard Proctor Density.

**3.7 SOIL CELL INSTALLATION**

- A. Prior to installation of soil cell modules, confirm tree pit dimensions and mark location of trees with surveyor pegs. Rectify discrepancies and errors.

- B. Install soil cell modules in strict accordance with manufacturer's written instructions and installation diagrams. Prior to placement, check each soil cell module for damage. Reject cracked, chipped and otherwise damaged modules. Ensure that modules in contact with granular base course are firmly seated, with no rocking. Ensure that modules are mechanically interconnected both horizontally and, in multiple layers, vertically.

### 3.8 AERATION AND INSPECTION PIPING

- A. Lateral Aeration Piping: Install piping within top layer of soil cell modules in a complete connected circuit, within 600 mm of outer edge of matrix. Fit junctions and risers at maximum spacing of 3.6 meters.
- B. Vertical Inspection Piping: Place vertical piping within central opening of soil cell module.
- C. Trim vertical pipes to 150 mm above finished pavement and support in vertical position by temporary staking. Seal open ends of pipes.

### 3.9 ROOT BARRIERS AND ROOT MOISTURE BARRIERS

- A. Install root barriers and root and moisture barriers as shown on Drawings. Overlap barrier joints 150 mm and tape both sides of joint. Top edge of barriers shall be level with adjacent construction. Ensure that earth surfaces in contact with barriers are flat and free of sharp debris and stones so as to avoid puncturing barriers. Install root barriers with ribs facing inward.

### 3.10 SOIL FILLING

- A. Obtain Commissioner's prior approval to load soil cell matrix with filler soil. Install filler soil after soil cell matrix is fully assembled and piping systems and barriers are in place.
- B. Except as shown otherwise on Drawings completely fill all void spaces with filler soil. Place filler soil using an excavator bucket and spread with rakes or shovels
- C. Keep outer trench free of filler soil.
- D. Vibrate matrix using plate vibration or needle vibration equipment to shake filler soil into voids.

### 3.11 GEOCOMPOSITE LAYER

- A. Install a single layer of geocomposite over the entire top area of soil cell matrix. At perimeter, extend geocomposite over upper side walls of soil cell matrix and over bottom of adjacent trench.
- B. Overlap geocomposite joints 150mm. Allow for pipe penetrations with two intersecting slits cut with a sharp knife.

### 3.12 GRANULAR REINFORCING COLLAR

- A. Fill collar trench with granular base course material so that the collar is level with top of soil cell matrix.
- B. Place granular base course in 150 mm lifts and compact each lift to 95% Standard Proctor density.
- C. Do not displace geocomposite from base of trench.

3.13 TREE PIT OPENINGS

- A. Confirm exact location of tree pit openings. Cut geocomposite layer and fold back to expose opening. Position perimeter formwork.
- B. Line opening with root barrier with ribs facing inward. Extend root barrier down to top of soil cell matrix and up to level of finished pavement. Lap root barrier joints 150 mm and tape both sides of joint.

3.14 GRANULAR BASE COURSE FOR PAVEMENT

- A. Place granular base course material over geocomposite to depth shown on drawings. Place granular base course in 100 mm lifts and compact each lift to 95% Standard Proctor Density.

3.15 UTILITIES WITHIN SOIL CELL MATRIX

- A. Up to 140 mm in diameter may be inserted within matrix if desired.
- B. Over 140 mm up to 180 mm in diameter will require special treatment.

3.16 SITE QUALITY CONTROL

- A. Compaction Tests: Testing agency shall perform compaction testing on sub-grade and on each layer of fill to determine compliance with specified compaction. Determine method and frequency of testing in consultation with Commissioner.

3.17 CLEANING

- A. Upon completion of work on site, clean areas within contract limits. Remove tools, equipment, debris, rubbish and excess materials. Leave site in broom clean condition.

3.18 SOIL CELL SCHEDULE

RootSpace SERIES	LOCATION
RootSpace 600 SERIES, or equivalent product by Silvacell, Stratavault, or approved equal.	AS NOTED ON PLAN

3.19 PROTECTION

- A. Protect installed work. Protect open holes and soil in anticipation of tree planting

**END OF SECTION 32 94 50**



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**SECTION 33 02 00****PROTECTION OF EXISTING UTILITIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).
- B. Section 31 00 00 – Earthwork
- C. Section 31 10 00 – Site Clearing, Removals and Preparation

**1.2 SECTION INCLUDES:**

- A. Identification and field markout of all on-site utility lines to remain in operation during construction.
- B. Identification and field markout of all on-site utility lines to be removed and/or abandoned.
- C. Submission of procedures to be used to ensure the safety of the utility.
- D. Restoration from any damage during construction operations.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 PROJECT RECORD DOCUMENTS:**

- A. Accurately record actual locations of capped utilities and utility lines encountered during construction.

**1.6 REGULATORY REQUIREMENTS:**

- A. Notify affected utility companies before starting work and comply with their requirements.
- B. Contact the “Call Before You Dig” service for an official utility mark out prior to excavation.

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 IDENTIFICATION:**

- A. Locate all existing utilities which are to remain in service during construction as shown on the contract drawings.
- B. Any conditions found to differ from what is shown on the contract drawings shall be immediately brought to the attention of the Commissioner.

**3.3 PROTECTION:**

- A. Flag, barricade or suitably protect existing utilities during construction operations and equipment movement.

**3.4 LATERAL DISCONNECTION:**

- A. Where a utility line is to be disconnected from portions to remain following construction, the lateral pipes shall be cut and suitably plugged/capped in accordance with the contract documents and NYC DEP regulations.

**3.5 RESTORATIONS:**

- A. Any damage to existing, operational utilities by the Contractor during the on-going construction operation shall be immediately restored to operational standards at the contractor's expense.

**END OF SECTION 33 02 00**

**SECTION 33 10 00****WATER UTILITIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).
- B. Section 31 00 00 - Earthwork
- C. Section 32 12 16 - Asphaltic Paving
- D. Section 32 13 15 - Concrete Curbs and Paving
- E. Section 33 02 00 - Protection of Existing Utilities

**1.2 SUMMARY**

- A. Work includes:
  - 1. Construction of the water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire water line, valves, flexible connections, fire hydrants and hydrant fenders. Set lines, elevations, and grades for water distribution system work for duration of work including careful observation of benchmarks, property corners, monuments, or other reference points.
  - 2. This section does not include work within the building footprint.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.

- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

#### 1.5 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

#### 1.6 SUBMITTALS

- A. The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:
  - 1. Material Certificates
  - 2. Product Warranty
  - 3. Product Data
  - 4. Manufacturer's Certificate

#### 1.7 QUALITY ASSURANCE

- A. Refer to DDC General Conditions, Section 01 40 00 "Quality Requirements".
- B. Perform work in accordance with NYCDEP, utility company and NYCDOB requirements.
- C. Valves: Manufacturer's name and pressure rating must be marked on valve body.

#### 1.8 TESTING AGENCY

- A. Retain an independent testing agency to perform material testing as required. The Contractor shall provide any necessary assistance to the testing agency and provide the testing agency with the intended construction schedule at least one week prior to the start of construction.

#### 1.9 CONTRACTOR RESPONSIBILITIES

- A. Contractor is responsible for coordinating the work of this trade with other trades on-site.
- B. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.

#### 1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

#### 1.11 PERMITS AND APPROVALS

- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by The City of New York. Copies of all permits shall be supplied to the Commissioner prior to the commencement of work authorized by the permit.
- B. Connections with existing facilities shall be performed in accordance with the requirements of NYCDOB and NYCDEP. The Contractor shall be required to comply with all such requirements, including securing all permits, and payment of all permit and/or connection fees.

## 1.12 PROJECT RECORD DOCUMENTS

- A. Refer to the DDC General Conditions for project record drawings requirements
  - 1. Record drawings for work of this section shall include, but shall not be limited to, an as-built survey of all new water, sewer, electric and gas service lines.

## 1.13 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by 2014 New York City Building Code, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
  - 1. New York City Department of Environmental Protection Bureau of Water and Sewer Rules, Standard Details, and Specifications.
  - 2. American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), and American Water Works Association (AWWA)
  - 3. ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - 4. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - 5. ASTM B88 - Seamless Copper Water Tube.
  - 6. ANSI/AWS A5.8 - Brazing Filler Metal.
  - 7. ANSI/AWWA C104 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
  - 8. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
  - 9. ANSI/AWWA C111- Rubber-Gasket Joints for Ductile Iron and Grey Iron Pressure Pipe and Fittings.
  - 10. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
  - 11. ANSI/AWWA C500 - Gate Valves, 3 through 48 inches NPS, for Water and Sewage Systems.
  - 12. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
  - 13. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
  - 14. ANSI/AWWA C508 - Swing Check Valves for Waterworks Service, 2 inches through 24 inches NPS.
  - 15. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 inches through 12 inches NPS, for Water and Sewage Systems.
  - 16. ANSI/AWWA C600 - Installation of Ductile Iron Water Mains and Appurtenances.
  - 17. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.
  - 18. UL 246 - Hydrants for Fire - Protection Service.

## PART 2 - PRODUCTS SOIL

### 2.1 MATERIALS

- A. As required by NYC DEP for water main and building service work.

### 2.2 GEOTEXTILES AND GEOGRID MATERIALS

- A. As required by NYC DEP for water main and building service work.

## 2.3 WATER PIPE MATERIALS AND ACCESSORIES

- A. Ductile Iron Pipe: Cement-Lined, ANSI A21.10 (AWWA C-151) Class 56 for pipe 6 inch diameter and larger; Class 52 for smaller than 6 inch diameter:
  - 1. Fittings: Ductile iron, standard thickness.
  - 2. Joints: AWWA C151, mechanical joints.
  - 3. Cement mortar lining: AWWA C-104.
  - 4. Retainer glands: Ductile Iron, 350 psi pressure rating.
- B. Gate Valves – 3 inches (75 mm) and over
  - 1. Manually operated, inside non-rising stem, ductile iron body/bonnet/seal plate, non-packing, bronze seated, double disc, seating wedge mechanism gate valve; model and manufacturer as approved by the NYCDEP Bureau of Water and Sewer.

## 2.4 CONCRETE MATERIALS

- A. Concrete for Thrust Blocks: Place thrust blocking consisting of 3,000 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 lbs/sq. ft. when water main pressure is 100 psi.

## 2.5 PRODUCTS

- A. All products shall be as approved by NYC DEP and Commissioner. No substitutions will be accepted without prior approval by NYC DEP and Commissioner.

# PART 3 - EXECUTION

## 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

## 3.2 EXAMINATION

- A. Obtain NYCDEP permit to perform the work.
- B. Contact NYCDEP for field inspection.
- C. Verify existing conditions.
- D. Verify building service connection points with plans.
- E. Verify that existing water main size, location, and invert are as indicated on the drawings.

## 3.3 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.

- C. Prepare pipe connections to equipment with flanges or unions.
- D. Hydrants removed from site shall remain property of The City of New York, with relocation or disposal at the Commissioner's discretion.

### 3.4 CLEANING

- A. After the system has been cleaned, the Contractor shall thoroughly inspect the system and all restorations shown to be necessary shall be promptly made by the Contractor.
- B. All Work of cleaning and restoration as specified herein shall be performed at the Contractor's expense and to the complete satisfaction of Commissioner.
- C. Disinfection of Water Piping System
- D. Sterilize distribution system with a solution of not less than 50 parts per million of chlorine with water prior to domestic operation. Thoroughly flush lines before introduction of chlorinating materials and after the contact period of at least 24 hours. De-chlorinate water prior to flushing into storm sewer system.
- E. Open and close valves in lines being sterilized several times during contact period. System shall be flushed with clean water until residual chlorine content is less than 1.0 part per million.
- F. After sterilization, test water for bacterium in accordance with AWWA specifications. Do not place distribution system in service until approval is obtained from New York City Department of Environmental Protection.

### 3.5 BEDDING

- A. Excavate pipe trench in accordance with Section 31 00 00 "Earthwork".
- B. Form and place concrete for pipe thrust restraints at any change of pipe direction.
- C. Place bedding material at trench bottom.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact in accordance with Construction Documents.

### 3.6 INSTALLATION PIPE

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with NYCDEP, state, and 2014 New York City Building Code. Unless otherwise approved, water mains shall be separated from sanitary sewer pipes a minimum distance of 10 feet horizontal and 18 inches vertical.
- B. Install ductile iron piping and fittings to ANSI/AWWA C600.
- C. Route pipe in straight line.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Install access fittings to permit disinfection of water system performed under this section.

- F. Slope water pipe and position drains at low points.
- G. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- H. Coordinate with NYCDEP for new wet tap to existing main.
- I. Establish elevations of buried piping to ensure not less than 4 ft of cover over the top of pipe under proposed grading. Locations where shallow cover cannot be avoided must be brought to the attention of The City of New York for review.
- J. Backfill trench in accordance with Construction Documents.
- K. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each on-site wet tap connection under conditions which least interfere with operation of existing pipeline. NYCDEP will provide wet tap to their main.

### 3.7 INSTALLATION – VALVES

- A. Install gate valves as indicated on Drawings, supported on concrete pads with the valve stem vertical. Install valve boxes in a manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished grade Form and place cast in place concrete base pad, with provision for storm sewer pipe end sections, or place precast reinforced concrete pad at the location and elevation specified on the plans.

### 3.8 INTERFACE WITH EXISTING FACILITIES

- A. Construct water service lines to within 5 feet of the building entry point.

### 3.9 CONSTRUCTION WITHIN THE PUBLIC RIGHT-OF-WAY

- A. Construction within the public right-of-way shall conform to all requirements of the City of New York, NYCDOB, NYCDEP, and NYCDOT.

### 3.10 FIELD QUALITY CONTROL

- A. Water line installation and testing shall be certified to the NYCDOB by a plumber licensed in the State of New York. The Contractor shall cooperate with the Commissioner as required to facilitate testing and inspection of the work.
- B. Test water distribution system installed below grade and outside the building in accordance with NYCDEP and NYCDOB and the following procedures:
  - 1. All pipework shall be tested at a hydrostatic pressure equal to 150 psi. The pipe work shall maintain said pressure for not less than two hours.
  - 2. Furnish, install, and operate the necessary connections, pumps, meters, and gauges. Leakage shall not exceed that permitted by AWWA Specifications C600 64 for mechanical joint and push on joint pipe. Prior to running any field test, a meter shall be tested, sealed, and approved by NYCDEP and NYCDOB at Contractor's expense.
  - 3. Locate and restore any leaks. Repeat testing until process results are satisfactory and in compliance with this section.
  - 4. Furnish a copy of the results of the meter test and the hydrostatic pressure test to the Commissioner upon completion of water distribution system backfilling operations





- C. Contractor shall call for NYCDEP inspection of all waterline work and shall be responsible for obtaining all NYCDEP signoffs, including but not limited to tap release letters and meter release letters.
- D. All waterline work, including but not limited to meters, taps, and backflow prevention device shall be constructed in accordance with the latest version of RCNY Title 15 Chapter 20 Rules Governing and Restricting the Use and Supply of Water.

**3.11 INSPECTION AND TESTING**

- A. Final Inspection: Upon completion of the Work and before backfill is placed and final acceptance by the Commissioner, the entire drainage system shall be subject to a final inspection in the presence of the Commissioner. The Work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed to the satisfaction of the Commissioner.

**END OF SECTION 33 10 00**



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**SECTION 33 31 00****SANITARY SEWER SYSTEM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 31 00 00 – Earthwork
- C. Section 33 02 00 – Protection of Existing Utilities
- D. Section 33 49 00 – Storm and Sanitary Structures

**1.2 SUMMARY**

- A. Section includes:
  - 1. Sanitary sewerage piping, fittings, accessories and bedding.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCES**

- A. ASTM A746-03 – Ductile Iron Gravity Sewer Pipe
- B. ANSI/AWWA C111/A21.11 – Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

- C. ASTM D1785-15 – Standard Specification for Poly(Vinyl Chloride) Plastic Pipe, Schedules 40, 80, and 120

## 1.6 SUBMITTAL PROCEDURES

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

## 1.7 SUBMITTALS

- A. The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:
  - 1. Material Certificates
  - 2. Product Warranty
  - 3. Product Data
  - 4. Manufacturer's Certificate

## 1.8 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”

## 1.9 COORDINATION

- A. Coordinate the Work with the building sanitary sewer connection point shown by the plumbing plans, and connection to the on-site sewer system.

## 1.10 PROJECT RECORD DOCUMENTS

- A. Refer to the DDC General Conditions for project record drawing requirements.
- B. Accurately record actual locations of pipe runs, connections, outlet structures, headwalls, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.

## 1.11 PERMITS AND APPROVALS

- A. Obtain street opening permit, and all permits and inspections for the sanitary sewer system construction as required by New York City Department of Environmental Protection (NYCDEP), New York State Department of Environmental Conservation (NYSDEC), New York City Department of Transportation (NYCDOT), and New York State Department of Transportation (NYSDOT).

# PART 2 - PRODUCTS

## 2.1 SEWER PIPE MATERIALS

- A. Ductile Iron Sanitary Sewer
  - 1. Class 56 type, inside nominal diameter of as specified on plans, bell and spigot end.
  - 2. All piping shall be in accordance with the 2014 New York City Building Code.

**B. Polyvinyl Chloride (PVC) Sanitary Sewer**

1. All PVC Sanitary pipe shall meet the requirements of AWWA C900.
2. Nominal outside diameters and wall thicknesses of PVC pipe shall conform to the requirements of AWWA C900. Integral bell joint pipe shall be furnished in 4", 6", 8", 10", and 12" sizes, in Class 200(DR14). Pipe shall be furnished in lengths of 20 feet.
3. Pipe shall incorporate a formed bell complete with a single rubber gasket conforming to ASTM F477. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139.
4. Pipe shall be homogenous throughout and free from voids, cracks, inclusions and other defects, and shall be as uniform as commercially practicable in color, density and other physical characteristics.
5. Every pipe shall pass the AWWA C900 hydrostatic proof test requirements of 4 times the pressure class for 5 seconds.

**2.2 PIPE ACCESSORIES**

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. PVC Fittings and couplings shall conform to the requirements of the PVC pipe for classification and size. Rubber gaskets for elastomeric joints shall conform to ANSI/ASTM F477. Lubricant for the joints shall be furnished by the pipe manufacturer. The rubber gaskets shall be factory installed in the bell of the pipe, fittings, and couplings. The plain end of the pipe shall be marked by the manufacturer to show the depth of penetration into the bell or coupling.

**2.3 CLEANOUTS**

- A. Lid and Frame: Heavy Duty cast iron construction, H20 rated.
- B. Shaft Construction: Cast Iron shaft of internal diameter as specified on plans with 4,000 psi concrete collar for cleanouts located in paved areas.
- C. Base Pad: Cast in place concrete, 4,000 psi leveled top surface to receive cast iron shaft sections, sleeved to receive sanitary sewer pipe sections.

**PART 3 - EXECUTION****3.1 EXECUTION REQUIREMENTS**

- A. Refer to DDC General Conditions for execution requirements.

**3.2 PREPARATION**

- A. Hand trim excavations to required elevations.
- B. Remove large stones or other hard matter, which could damage pipe or impede consistent backfilling or compaction.

**3.3 BEDDING**

- A. Excavate pipe trench in accordance with Section 31 00 00 – Earthwork for work in this Section.

- B. Place and compact bedding material at trench bottom. Hand trim bedding for accurate placement of pipe to elevations indicated.
- C. Maintain moisture content of bedding material between 1% below and 3% above optimum during compaction.

### 3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with ANSI/ASTM or AWWA requirements or manufacturer's instructions. Seal joints shall be watertight.
- B. Lay pipe to slope gradients noted on Construction Drawings.
- C. Lay pipe beginning at low point of system, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream.
- D. Refer to Section 31 00 00 for trenching requirements. Do not displace or damage pipe when compacting.
- E. Refer to Section 33 49 00 for manhole requirements.
- F. Connect to building sanitary sewer outlet within New York City public sewer systems.
- G. Pipe shall be installed in accordance with AWWA C605.

### 3.5 INSTALLATION - CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast in place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Mount lid and frame level in grout, to finished grade elevation indicated on plan.

### 3.6 INTERFACE WITH EXISTING FACILITIES

- A. Requirements: Make all required connections of the proposed drainage facilities into existing facilities, where and as shown on the Drawings in accordance with the Suffolk County Department of Public Works.
- B. Compliance with The City of New York Requirements: Connections made into existing facilities shall be performed in accordance with the requirements of the New York City Department of Buildings (NYCDOB), New York City Department of Environmental Protection (NYCDEP), and New York City Department of Transportation (NYCDOT). The Contractor will be required to comply with all such requirements, including securing of all required permits, and expenses thereof. The expense of making the connections in accordance with all such requirements shall be included in the Contract Sum.

### 3.7 CONSTRUCTION WITHIN THE PUBLIC RIGHT-OF-WAY

- A. Construction within the public right-of-way shall conform to all requirements of the New York City Department of Environmental Protection (NYCDEP), and New York City Department of Transportation (NYSDOT).

### 3.8 MODIFICATIONS OF EXISTING STRUCTURES

- A. General: Alter, reconstruct, or convert existing structures where and as shown on the Drawings, or as approved by the Commissioner. In general, alterations shall be performed with the same type of material used in the original construction unless otherwise indicated on the Drawings or approved by the Commissioner.
- B. Damage to Existing Installations: Exercise extreme care during such alteration, reconstruction or conversions so as not to damage any portions of the structure or pipe shown to remain. Any such damage shall be restored by the Contractor at his own expense and to the satisfaction of The City of New York.

### 3.9 LATERALS

- A. General: Make all required lateral connections from the building to the on-site sewer system as shown on the Drawings or approved by the Commissioner. Work shall include making the connections into the on-site system, furnishing and installing all lateral pipe from the on-site sanitary sewer system to points located five (5) feet outside of the proposed building lines and properly sealing the ends with watertight plugs.
- B. Coordinate trades and the exact location and elevation of the utility point of entry into the building. For laterals not immediately connected to building utility, stake and mark end of lateral as per Section 31 00 00 - Earthwork.

### 3.10 FIELD QUALITY CONTROL

- A. Backfill placement and quantity control will be performed in accordance with Section 31 00 00 "Earthwork".
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest at no additional expense to The City of New York.
- C. Inspection and Testing - Cooperate with the Commissioner to facilitate testing and inspection of the work. Clean and "Lamp" the lines in the presence of the Commissioner before final acceptance of the work. Infiltration and Exfiltration Testing shall be determined by the Commissioner and shall meet New York City Department of Building and New York City Department of Environmental Protection standards.
  - 1. The complete sanitary sewer system, including all mains, lateral sewers and manholes shall be tested for both infiltration and exfiltration. Provide all materials equipment and services as necessary to perform the tests as described herein except as noted.
  - 2. Infiltration Testing - The ends of any service sewers shall be securely plugged and the sewer main plugged at the manhole at the low end. The uppermost manhole shall be filled with water to a level of 4 feet above the top of the sewer or 4 feet above the groundwater level. The water shall stand for 2 hours to allow the sewer system to reach its maximum absorption. Subsequently, the uppermost manhole shall be refilled to the original 4 feet height.
    - a. Rate of infiltration shall be determined by means of V-notch weirs or other approved measuring devices in an approved manner and at such times and locations as may be directed by the Commissioner. The maximum leakage limit shall be 100 gallons per inch of diameter, per day, per mile.



- b. For shorter stretches, less than 500 feet in length, rate of 100 percent in total excess of the above figures may be permitted, providing the total infiltration is in excess of the maximum allowable, the leaking joints shall be re-laid if necessary, or other remedial construction shall be performed by and at the expense of the Contractor. The section of sewer shall then be re-tested after restorations are completed to determine compliance with the specifications.
3. Low Pressure Air Exfiltration Testing - The sewer mains or laterals shall be tested for leakage by the use of low-pressure air as specified hereinafter and as approved by the Commissioner. Provide test plugs, air compressor, and installers properly instructed by the manufacturer for conducting the test. The test length shall not exceed one (1) interval of pipe between two (2) manholes. Take all necessary precautions to prevent blowouts.
4. After the pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psi. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any groundwater that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize.
5. After the stabilization period (3.5 psi minimum pressure in the pipe), the portion of line being tested shall be acceptable if the time required in minutes for the pressure to decrease from 3.5 to 3.0 psi (greater than the average back pressure of any groundwater that may be over the pipe) is not less than the time indicated in the following table:

Pipe Size (in.)	Time (Min.)
4	2.5
6	4
8	5
10	6.5
12	7.5
15	9.5

- D. Correction of Defective Work - If leakage exceeds the specified amount, the Contractor shall at their own expense make the necessary restorations or replacements required to permanently reduce the leakage to within the specified limit and the tests shall be repeated until the leakage requirement is met.
  1. Any defects found in the system are to be restored at the expense of the Contractor so to conform strictly to the Specifications and to the satisfaction of the Commissioner. All restorations shown necessary by the tests are to be made, broken or cracked pipe replaced, all deposits removed, and sanitary sewer left true to line and grade and entirely clean, free from lumps of cement, protruding gaskets, bulkheads, etc., and ready for use before final acceptance by the Commissioner.
- E. Pipe to Manhole Connections - Connections of pipe to manholes shall be water tight. Connections of polyvinyl chloride sewer pipe to the manholes shall be made using a flexible compression gasket that meets or exceeds ASTM C-478, ASTM C-923 and ASTM F-2510.

**END OF SECTION 33 31 00**



**SECTION 33 40 00****STORM DRAINAGE UTILITIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract].
- B. Section 31 00 00 – Earthwork
- C. Section 33 49 00 – Storm and Sanitary Structures

**1.2 SUMMARY**

- A. Section includes:
  - 1. Site storm sewerage drainage piping, fittings and accessories, and bedding.
  - 2. Catch basins, paved area drainage and site surface drainage.
  - 3. Building storm drainage lateral construction.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures".

**1.6 SUBMITTALS**

- A. The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:
  - 1. Material Certificates
  - 2. Product Warranty
  - 3. Product Data
  - 4. Manufacturer's Certificate

**1.7 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

**1.8 REFERENCES**

- A. 2014 New York City Building Code.
- B. NYCDEP Bureau of Water and Sewer Rules and Specifications, latest revision.
- C. ANSI/ASTM C14 Concrete Sewer, Storm Drain, and Culvert Pipe.
- D. ANSI/ASTM C76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- E. ANSI/ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- F. ASTM C507 Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
- G. ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials
- H. ASTM C478 – Precast Reinforced Concrete Manhole Sections
- I. ASTM D3350 - Polyethylene Plastics Pipe and Fittings Materials
- J. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- K. ASTM A536 – Ductile Iron Castings
- L. ANSI C150 – Ductile Iron Pipe (DIP) Class 56, Ceramic Epoxy lined Tyton Joints
- M. ANSI C151 – Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for water or other liquids.
- N. AASHTO M294 and M252 – Corrugated polyethylene pipe, smooth interior

**1.9 DEFINITIONS**

- A. Bedding: Fill placed under, beside and around pipe, prior to subsequent backfill operations.

**1.10 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual locations of pipe runs, connections, catch basins, and invert elevations.

- B. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.

## 1.11 COORDINATION

- A. Coordinate the Work with the roof drain connection locations from the buildings.

## PART 2 - PRODUCTS

### 2.1 SEWER PIPE MATERIALS AND ACCESSORIES

- A. Ductile Iron Pipe: Comply with requirements of AWWA C104 Cement Mortar Lining, AWWA C110 Ductile Iron Fittings, AWWA C111 Joints and Fittings, AWWA C150 Thickness, AWWA C151 Ductile Iron Pipe. All buried Ductile Iron Pipe (DIP) shall be mechanical joint unless otherwise shown on the drawings, specified herein, or directed by the Commissioner. Mechanical Joint DIP and fittings shall be minimum Class 52, unless otherwise specified.
- B. High-Density Polyethylene Pipe: Comply with requirements of ASTM D1248, Type III, Category 4, grade P33, Class C or ASTM D3350 Cell Classification 324420C. All High Density Polyethylene (HDPE) pipe shall be N-12 Sure Lock pipe, watertight, and manufactured by ADS or approved equal and shall have NYCDOB MEA Approval. HDPE pipe is permitted in lieu of RCP for pipes sizes 30 inches and smaller, except for underground detention basins, where 36-inch and 60-inch diameter HDPE shall be used.
- C. Reinforced Concrete Pipe: Comply with requirements of ASTM C 76 installed with flexible plastic (Bitumen) gaskets at all joints. Gaskets shall comply with ASTM C443, and shall be installed in strict accordance with pipe manufacturer's recommendations. For all pipe installations with cover less than two (2) feet, Class IV RCP shall be used.

### 2.2 CATCH BASINS AND AREA DRAINS

- A. Precast Catch Basins: 4,000 psi concrete reinforce for H20-16 loading in accordance with ASTM C478 of size, shape and depth as indicated on the Drawings.
- B. Base Pad: Cast-in-place or precast reinforced concrete pad.
- C. Lid and Frame: Shall be ADA compliant, H-20 rated, and be fitted with vandal resistant bolts. The basis of design is IronSmith 'ADA' 9031DR-24, 24" Square, 1/4" Slots, Gray Cast Iron, Raw Natural Finish, H20 rated. Alternatives include:
  - 1. Iron Age: 'Regular Joe', 24" Square, Gray Cast Iron, Raw Natural Finish, H20 rated.
  - 2. Urban Accessories: 'Standard ADA', 24" Square, 1/4" openings, Manufacturer's Frame, Ductile Cast Iron with Baked on Oil Finish, H20 rated.
  - 3. Or approved equal.
- D. Hood: Standard cast iron hood and hook. The basis of design is Campbell Foundry Cast Iron Trap. Alternatives include:
  - 1. General Foundries Inc., USF 5500 Hood
  - 2. Neenah Foundry, R-3711
  - 3. Or approved equal.
- E. Steps: Per details shown on plans or approved equal.

## 2.3 TRENCH DRAIN

- A. Subject to compliance with requirements, trench drain shall be model Z812 manufactured by Zurn Drains (Basis-of-Design) or approved equivalent product from one of the following:
  - 1. Josam
  - 2. NDS
  - 3. Or approved equal.
- B. Grate: Shall be ADA compliant, H-20 rated, and be fitted with vandal resistant bolts. The basis of design is IronSmith 'ADA' 9032, 11-1/2" Custom Width, 1/4" Slots, Gray Cast Iron, Raw Natural Finish, H20 rated. Alternates include:
  - 1. Iron Age 'Regular Joe', 1/4" Slots, Gray Cast Iron, Raw Natural Finish, H20 rated
  - 2. Urban Accessories: 'Jamison', 1/4" Slots, Manufacturer's Frame, Ductile Cast Iron with Baked on Oil Finish, H20 rated
  - 3. Or approved equal.

## 2.4 CLEAN OUTS

- A. Lid and Frame: Subject to compliance with requirements, cleanout lid and frame shall be heavy-duty, H20 rated, cast iron construction manufactured by Neenah Foundry (Basis-of-Design), or approved equivalent product from one of the following:
  - 1. General Foundries Inc.
  - 2. Campbell Foundry
  - 3. Or approved equal.
- B. Shaft Construction: HDPE shaft of internal diameter as specified on the plans.
- C. Concrete Collar: Cast-in-place concrete, 3,000-psi level top surface.

## 2.5 INLINE CHECK VALVE

- A. Check valves are to be all rubber and the flow operated check type with slip-in cuff connection. The entire check valve shall be ply reinforced throughout the body, saddle and bill, which is cured and vulcanized into a one-piece unibody construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure any component of the valve to a valve housing. The port area of the saddle shall contour into a circumferential sealing area (the "bill") that is concentric with the pipe which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe inside diameter. The saddle area of the valve must be flat, not conical, and integral with the rubber body above centerline in order to not produce any areas or voids that can collect or trap debris. The valve must be easily installed in pipes with poor end condition without the need to modify or utilize the headwall or structure to seal and anchor the valve. Once installed, the valve shall not protrude beyond the face of the structure or end of the pipe.
- B. The check valve shall incorporate multiple concave grooves molded integrally into the flat saddle wall thickness extending longitudinally a minimum of 80% of the length of the saddle to reduce opening resistance and reduce head loss.

- C. The check valve shall incorporate a custom shaped notch in the end of the bill to reduce cracking pressure. The notch shall be at the invert/bottom of the bill and symmetrical about the valve centerline. The longitudinal length of the notch shall be no greater than half the length of the bill.
- D. The outside diameter of the upstream and downstream sections of the check valve must be circumferentially in contact with the inside diameter of the pipe.
- E. Slip-in style check valves will be furnished with a set of stainless steel 304 expansion clamps. The clamps, which will secure the valve in place, shall be installed in the upstream or downstream cuff of the valve, depending on installation orientation, and shall expand outwards by means of a turnbuckle. Each band shall be pre-drilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Verify the trench cut and excavation base to be hard, smooth, and dry.
- B. Verify excavation location, dimensions and elevation with contract drawings.

#### 3.3 PREPARATION

- A. Set all lines, elevations, and grades for utility work and maintain for the duration of work. Provide careful maintenance of bench marks, property corners, monuments, or other reference points.
- B. Protect and maintain in operating condition, existing utilities encountered during utility installation. Restore any damage to surface or subsurface improvements shown on the drawings.
- C. Coordinate structure placement with inlet and outlet pipe or duct sleeve locations and inverts required by other sections.
- D. Coordinate all building sewer connection locations and elevations with civil and plumbing plans. Comply with 2014 New York City Construction Codes.
- E. Hand trim excavations to required elevations and thoroughly compact as per DDC General Conditions.
- F. Install dewatering systems that will be required to construct the proposed utilities to the design elevations and using the methods described herein. Water pumped out of excavations shall be disposed of per NYCDEP and DDC General Conditions, and will not be discharged directly to the City's storm drainage system without prior approval of NYCDEP.
- G. Remove large stones or other hard matter which may damage piping or impede consistent backfilling or compaction.
- H. Subgrade areas identified by the Commissioner as unsuitable shall be excavated to suitable material or a maximum of two additional feet, backfill with bedding material and compact as specified in Section 31 00 00 "Earthwork".

### 3.4 BEDDING

- A. Excavate pipe trench in accordance with Section 31 00 00 “Earthwork” for work of this section.
- B. Place and compact bedding material at trench bottom. Hand trim bedding for accurate placement of pipe to elevations indicated.
- C. Maintain moisture content of bedding material between 1% below and 3% above the optimum.

### 3.5 INSTALLATION – PIPE

- A. Place pipe on minimum 6-inch-deep bed of compacted bedding aggregate.
- B. Install pipe, fittings, and accessories in accordance with ASTM C12, ASTM D2321, manufacturer's instructions and/or 2014 New York City Construction Codes. Seal joints to be watertight.
- C. Lay pipe to slope gradients noted on civil drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Place and compact bedding aggregate at sides and to the springline of the pipe as per Section 31 00 00.
- E. All sewer pipe joints installed within ground water or partially submerged within ground water shall be installed with water tight joints.
- F. Pipe joints shall not be installed within the leachate collection stone trench.
- G. Refer to Section 31 00 00 “Earthwork” for trenching and backfill requirements. Do not displace or damage pipe when compacting.
- H. Refer to Section 33 49 00 “Storm and Sanitary Manholes” for manhole requirements.

### 3.6 INSTALLATION CATCH BASINS & AREA DRAINS

- A. Form bottom of excavation clean and smooth and to correct elevation. Place minimum of 6" compacted bedding aggregate.
- B. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections, or place precast reinforced concrete pad at the location and elevation specified on the plans.
- C. Level top surface of base pad to receive concrete shaft sections, sleeved to receive storm sewer pipe sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.
- F. Outlet structures shall be constructed in accordance with the section and elevations shown on the Contract Drawings.

**3.7 INSTALLATION – CLEANOUTS**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete collar, with provision for storm pipe end sections.
- C. Mount lid and frame level in grout to elevation indicated on plans.

**3.8 INSTALLATION – INLINE CHECK VALVE**

- A. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

**3.9 FIELD QUALITY CONTROL**

- A. Clean the entire drainage system of all debris and obstructions. This shall include, but not be limited to, removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. Thoroughly flush the system clean and furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. Do not flush debris into existing storm drains or streams; remove all debris from the system. Perform all removals and disposal in accordance with Contract Specifications for Construction Waste Management & Disposal.
- B. After the system has been cleaned, thoroughly inspect the system. Promptly make restorations as necessary.
- C. Perform all work of cleaning and restore as specified herein at own expense and to the complete satisfaction of the Commissioner.
- D. It shall be the Contractor's responsibility to comply with all regulations of the New York City Department of Environmental Protection (NYCDEP), New York City Department of Buildings (NYCDOB), and New York City Department of Transportation (NYCDOT).
- E. The inline check valve shall be tested for verification of the manufacturer's hydraulic testing, backpressure, and cracking pressure limits.

**3.10 FINAL INSPECTION**

- A. Upon completion of the Work and before backfill is placed and final acceptance by the Commissioner, the drainage system shall be subject to a final inspection in the presence of the Commissioner. The Work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed to the satisfaction of the Commissioner.

**END OF SECTION 33 40 00**

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**SECTION 33 49 00****STORM AND SANITARY STRUCTURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract [City of New York Standard Construction Contract]. Section 31 00 00 – Earthwork
- B. Section 33 31 00 – Sanitary Sewer System
- C. Section 33 40 00 – Storm Drainage Utilities
- D. Geotechnical Report prepared by Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C., dated October 15, 2018.

**1.2 SUMMARY**

- A. Section includes:
  - 1. Monolithic concrete manholes with masonry transition to lid frame, covers, anchorage and accessories.
  - 2. Modular precast concrete manhole sections with tongue and groove joints with masonry transition to lid frame, covers, anchorage and accessories.
  - 3. Storm water treatment device.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 SUBMITTAL PROCEDURES**

- A. Refer to DDC General Conditions Section 01 33 00 “Submittal Procedures”.

**1.6 SUBMITTALS****1.7 The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:**

- A. Shop Drawings: Indicate manholes locations, elevations, invert elevations, piping, sizes and elevations of penetrations.
- B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.

**1.8 QUALITY ASSURANCE**

- A. Refer to DDC General Conditions Section 01 40 00 “Quality Requirements”.

**1.9 REFERENCES**

- A. ANSI/ASTM C55 Concrete Building Brick.
- B. ASTM A48 Gray Iron Castings.
- C. ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections.
- D. ASTM C857 – Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- E. ASTM C858 – Standard Specification for Underground Precast Concrete Utility Structures
- F. ASTM C891 – Standard Specification for Installation of Underground Precast Concrete Utility Structures
- G. ASTM C923 Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
- H. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- I. ASTM D4101 - Standard Specification for Copolymer steps construction
- J. ASTM D4097 - Standard Specification for Contact-Molded Glass - Fiber-Reinforced Thermoset Resin Corrosion - Resistant
- K. International Masonry Industry All Weather Council (IMIAC): Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
- L. New York City Department of Environmental Protection (NYCDEP) Specifications and applicable 2014 New York City Building Code requirements.

## PART 2 - PRODUCTS

### 2.1 MANHOLE

- A. Manhole Sections: Reinforced precast concrete.
  - 1. 4,000 psi concrete reinforced for H20-16 loading or greater in accordance with ASTM C478 with self-sealing butyl gaskets in accordance with ASTM C923.
  - 2. Construct manholes of precast concrete sections as required by Drawings to size, shape, and depth indicated.
- B. Manhole Sections: Reinforced cast-in-place concrete.
  - 1. Cast-in-place Manholes shall be constructed of 4,000 psi concrete reinforced for H20-16 loading or greater.
  - 2. Forms shall be accurately made of steel sheets and shapes of sufficient strength to form dense watertight walls to true dimensions.
  - 3. Concrete shall be deposited in evenly distributed layers of about 18 inches, with each layer vibrated to bond it to the preceding layer.
- C. Mortar and Grout
  - 1. Masonry cement used for laying up dimension masonry shall conform to the requirements of ASTM C91.
  - 2. Grouting material for use in grouting anchor bolts, flanges, dowels and other miscellaneous items in concrete shall be a non-metallic, non-shrink grout which when mixed with water, will harden rapidly to produce a permanent anchoring bond. It shall be free of any corrosion promoting agents.
- D. Reinforcement: Grade 60 deformed steel rebars with galvanized finish. Reinforcing shall conform to the latest revised edition of the AISC code.
- E. Bitumastic Coating: The entire exterior surface of all manholes shall be coated with two (2) coats of an approved bitumastic material to produce a dry film thickness of 0.07 inches (7 mils) per coat.
- F. Clear Inside Dimensions: 48 inch diameter or as indicated on plans.
- G. Design Depth: As indicated on plans.
- H. Clear Lid Opening: 24 inches diameter minimum.
- I. Pipe Entry: Provide openings as indicated
- J. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls, and point up irregularities and rough edges with non-shrink grout.
- K. Inverts: Shape inverts for smooth flow across structure floor as shown on Drawings. Use concrete and mortar to obtain proper grade and contour and finish surface with fine textured wood float. Provide benches in all sanitary sewer manholes.

### 2.2 MANHOLE CASTINGS

- A. Lid and Frame: Per details shown on plans or approved equal.

- B. Manhole Steps: Cast iron or approved equal.
- C. Base Pad: Precast reinforced concrete or cast-in-place concrete with leveled top surface.

### 2.3 STORM WATER TREATMENT DEVICE (SWTD)

- A. Precast Concrete Structure: Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:
  - 1. Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
  - 2. Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
  - 3. Cement shall be Type III Portland Cement conforming to ASTM C 150;
  - 4. Aggregates shall conform to ASTM C 33;
  - 5. Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
  - 6. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
  - 7. Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.
- B. Internal Components and appurtenances shall conform to the following:
  - 1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
  - 2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
  - 3. Fiberglass components shall conform to the ASTM D-4097
  - 4. Access system(s) conform to the following:
  - 5. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.
- C. The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using a particle size distribution having a mean particle size (d50) of 125 microns unless otherwise stated.
- D. The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff ( $20 \pm 5$  mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.
- E. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle



re-suspension. In order to not restrict the City of New York's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

- F. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- G. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Commissioner. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All expenses associated with preparing and certifying this documentation shall be born solely by the Contractor.
- H. The SWTD shall have completed field tested following TARP Tier II protocol requirements.

### PART 3 - EXECUTION

#### 3.1 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

#### 3.2 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify that built in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is to the correct depth and that the bottom is hard and smooth.

#### 3.3 PREPARATION

- A. Set all lines, elevations, and grades for utility and drainage system work and maintain for the duration of work. Provide careful maintenance of bench marks, property corners, monuments, or other reference points.
- B. Protect and maintain in operating condition, existing utilities encountered during utility installation. Restore any damage to surface or subsurface improvements shown on the drawings.
- C. Verify location, size, elevation, and other pertinent data required to make connections with existing sewer systems indicated on the Contract Drawings.
- D. Coordinate structure placement with inlet and outlet pipe or duct sleeve locations and inverts required by other sections.
- E. Coordinate all building utility connection locations and elevations with architectural, structural, and plumbing drawings.
- F. Install dewatering systems that will be required to construct the proposed utilities to the design elevations and using the methods described herein. Water pumped out of excavations shall be

disposed of on-site for sedimentation removal, and will not be discharged directly to the City's storm drainage system.

- G. Subgrade areas identified by the Commissioner as not being capable of supporting the proposed structure shall be excavated to suitable material or a maximum of two additional feet, backfill with bedding material and compact as specified.

### 3.4 INSTALLATION OF PRE-CAST MANHOLE SECTIONS

- A. Place granular base pad, trowel top surface level for placement of manhole barrel base section. Place manhole base plumb and level to correct elevation.
  - 1. Cast in place bases: After completion of excavation, setting of reinforcing steel and placing inlet and outlet pipes, but prior to placing concrete for invert slab, set concrete blocks on granular base pad to support first manhole barrel section which shall be lowered into excavation, grooved end first. Align and adjust to proper grade prior to placing invert slab, which shall be poured immediately after setting of first manhole barrel section.
- B. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer recommendations. Place gasket on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional primer on exterior of joint, if necessary, for completely watertight joint.
- C. Castings belonging to reset/converted structures shall be salvaged and reused, if possible.
- D. Set cover frames and covers securely to correct line and grade elevations.
- E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

### 3.5 MASONRY CONSTRUCTION

- A. Maintain masonry courses to a uniform dimension. Form vertical and horizontal joints of uniform thickness.
- B. Lay masonry units in running bond.
- C. Form flush mortar joints.
- D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- E. Install joint reinforcement 16 inches on center.
- F. Place joint reinforcement in first and second horizontal joints above base pad and below lid frame opening.
- G. Set cover frames and covers securely to correct line and grade elevations.
- H. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- I. Coordinate with other sections of work to provide correct size, shape, and location.

**3.6 INSTALLATION OF STORM WATER TREATMENT DEVICE (SWTD)**

- A. Exercise care in the storage and handling of the SWTD components prior to and during installation. Any restoration or replacement expenses associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.
- B. The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours' notice shall be provided to the manufacturer prior to their performance of the services included under this subsection
- C. Fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. Trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.
- D. Remove all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the City of New York.

**END OF SECTION 33 49 00**



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**SECTION 33 49 10****OTHER UTILITIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS:**

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum and (5) the Contract (City of New York Standard Construction Contract).
- B. Section 33 02 00 - Protection of Existing Utilities
- C. Section 31 00 00 – Earthwork

**1.2 SECTION INCLUDES:**

- A. Furnish labor, materials, services, equipment, and other necessary items required to excavate, install and backfill the piping, conduit, duct banks and manhole/pull box structures related to the on-site primary and secondary electrical service, site lighting, and telephone/data in accordance with the Contract Documents.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. This project is targeting the goal of LEED v4 Silver. The Contractor is required to follow the specified requirements and implement practices and procedures to meet the project's environmental performance goals.
- B. Refer to the following sections:
  - 1. Section 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
  - 2. Section 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS FOR LEED BUILDINGS
  - 3. Section 01 81 19 – INDOOR AIR QUALITY REQUIREMENTS FOR LEED BUILDINGS
- C. LEED BUILDING PERFORMANCE REQUIREMENTS: The following criteria are required for the products included in this section. Certification of these products shall be in accordance with the LEED Building Submittals requirements of this Section.

**1.4 LEED BUILDING SUBMITTALS:**

- A. The LEED BUILDING Submittal information shall be assembled into one package per specification section (or per trade) and sent to the Commissioner for review.
- B. Refer to DDC General Conditions for LEED BUILDING Submittal requirements.

**1.5 REFERENCES**

- A. The National Electric Code, Latest Edition
- B. New York City Fire Department Standard Details and Specifications, Latest Edition

- C. National Grid Specifications, Blue Book, 2015 Edition

#### 1.6 COORDINATION:

- A. All work in this Section shall be coordinated with the Commissioner and electric and telephone/data utility companies and shall comply with all requirements, details, regulations, etc. of said companies. Coordinate with each utility to define where his limit of work exists.

#### 1.7 SUBMITTAL PROCEDURES:

- A. Refer to DDC General Conditions Section 01 33 00 "Submittal Procedures"

#### 1.8 SUBMITTALS

- 1.9 A. The Contractor must provide the following submittals to the Commissioner for approval prior to purchase of materials:

- 1. Material Certificates
- 2. Product Warranty
- 3. Product Data
- 4. Manufacturer's Certificate

#### 1.10 QUALITY ASSURANCE

- A. Refer to DDC General Conditions Section 01 40 00 "Quality Requirements"

### PART 2 - PRODUCTS

#### 2.1 CONDUIT, FITTINGS AND CABLE:

- A. Electric and Telephone/Data: Refer to Division 26 and 27 of the Technical Specifications and the Contract Drawings.

#### 2.2 STRUCTURES:

- A. Manholes, pull boxes and junction boxes shall comply with all requirements, specifications, details, and recommendations of the governing utility company and as indicated on the Contract Drawings.

#### 2.3 BEDDING AND BACKFILL:

- A. Refer to Section 31 00 00 – Earthwork

#### 2.4 CONCRETE ENCASEMENT:

- A. Concrete for encasement of electric duct banks shall be 3,500 psi concrete.

### PART 3 - EXECUTION

#### 2.5 EXECUTION REQUIREMENTS

- A. Refer to DDC General Conditions for execution requirements.

**2.6 EXAMINATION**

- A. Verify existing conditions.
- B. Verify building service connection points with architectural plans.

**2.7 BEDDING**

- A. Excavate all utility trenches and place bedding in accordance with Specification Section 31 00 00 “Earthwork”.

**2.8 PREPARATION**

- A. Conduit:
  - 1. Remove scale and dirt, on inside and outside of conduit, prior to assembly.
  - 2. Prepare conduit in accordance with manufacturer's recommendations.

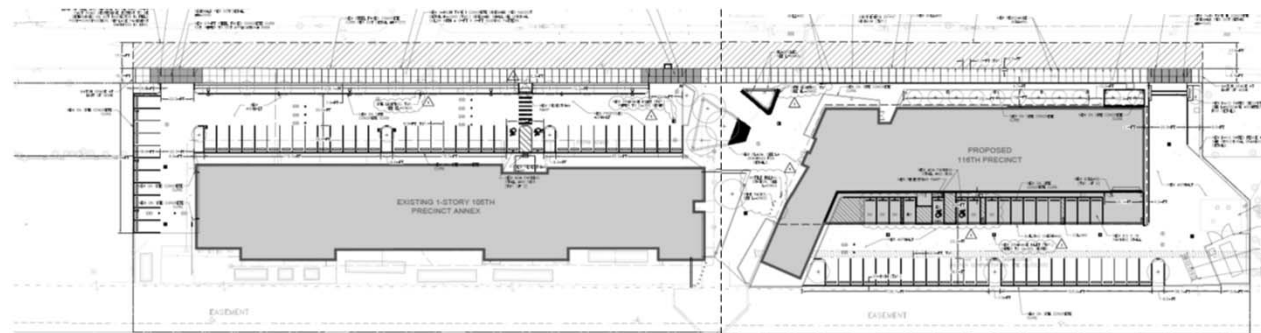
**2.9 INSTALLATION**

- A. Conduit:
  - 1. Maintain minimum conduit separation in accordance with 2014 New York City Construction Codes.
  - 2. Establish elevations of conduit in accordance with Section 31 00 00 – “Earthwork” and the Contract Drawings.
  - 3. Place forms for concrete encased duct banks. Install conduit to conserve space and to allow for expansion and contraction without stressing conduit or joints. Pour concrete and vibrate to ensure there are no voids.
  - 4. Backfill trench in accordance with Section 31 00 00 – “Earthwork”.
- B. Structures:
  - 1. Install manholes, handholes, junction boxes and/or pullboxes in accordance with Construction Drawings.
- C. Service Connections:
  - 1. Construct service lines to within 5 feet of the exterior building wall at the building entry point unless otherwise indicated on the Contract Drawings. Cap and stake ends of conduits.
  - 2. Connections with existing facilities shall be performed in accordance with the requirements of the Commissioner. The Contractor shall be required to comply with all such requirements, including securing all permits, and payment of all permit and/or connection fees related to this section.
  - 3. Any product, which is damaged or disturbed through any cause prior to acceptance of the Work, shall be restored, realigned, or replaced as directed by The Commissioner, at no expense to The City of New York.

**END OF SECTION 33 49 10**



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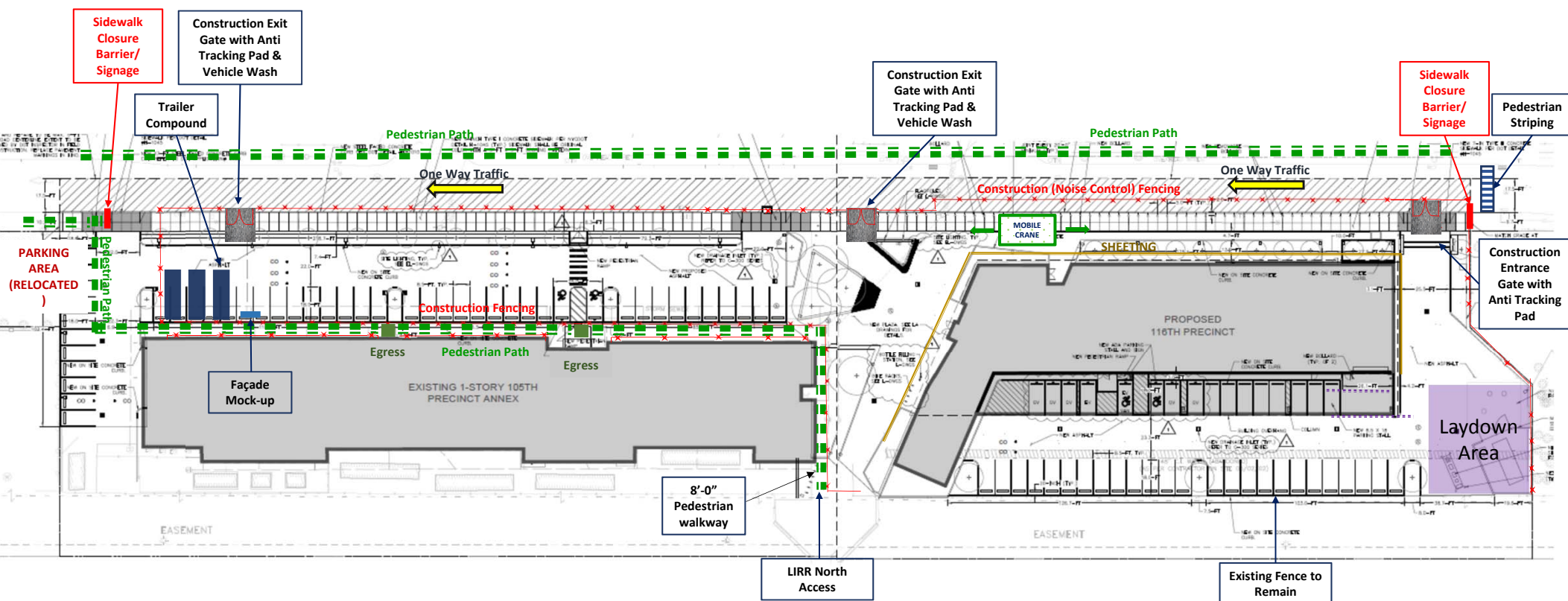


Legend:



Additional Parking allocated  
for NYPD use by DOT.

## 116<sup>th</sup> PRECINCT HOUSE EXISTING CONDITION AND CONSTRUCTION PLAN



**Notes:**

- 1.) Construction Fence to Follow NYC Noise Control Code
- 2.) Street Closure, Curb Cuts and Sidewalk Closure Permits
- 3.) Signage diverting people around the construction site.
- 4.) Pedestrian path to be maintained as handicap with security separation from 105<sup>th</sup> Precinct Annex

# **116<sup>th</sup> PRECINCT HOUSE SITE LOGISTICS PLAN**

Construction Activities Impacting the Safety of Pedestrians on the North Access to LIRR should it remain open:

- Foundation Excavation along the west portion of the new 116<sup>th</sup> Precinct
- Excavation and Tie-in of utilities between the Existing 105<sup>th</sup> Annex and the new 116<sup>th</sup> Precinct
- Excavation/ Installation of large detention systems
- Active traffic during concrete foundation pour (Concrete Trucks), steel, building enclosure, equipment/ material deliveries, etc.
- Material staging and movement between the Existing 105<sup>th</sup> Annex and the new 116<sup>th</sup> Precinct
- Steel and Precast Erection hazards with the use of Mobile Crane









**Notes:**

- 1.) North access to LIRR underpass will remain open. • A 8'-0" walkway will be provided for pedestrians during construction of the 116th Precinct during the following activities:
  - Foundation excavation and installation
  - Installation and Tie-in of utilities
  - Excavation/ Installation of Detention System
  - Material Staging and Movement
  - Active Traffic: Concrete Foundation, Building Enclosure, Equipment & Material Deliveries
  - Mobile Crane: Steel and Precast Erection
- 2.) West pedestrian access to LIRR Rosedale Station to remain open.
- 3.) ADA access to LIRR Station via south entrance to underpass will remain open

**Legend:**

-  New Pedestrian Crosswalk
-  New Pattern
-  Access Points
-  Elevator/ Handicap Accessible

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# REMEDIAL ACTION PLAN

for

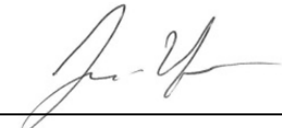
**NYPD 116<sup>th</sup> Precinct  
Block 13265, Lot 30  
Queens, NY 11422  
CEQR No. 18NYP002Q**

*Prepared For:*

**Dattner Architects  
1385 Broadway, 15<sup>th</sup> Floor  
New York, NY 10018**

*Prepared By:*

**Langan Engineering, Environmental, Surveying,  
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Professional Engineer License No. 089491**

**May 8, 2019**

***Revised June 10, 2019***

**LANGAN**

**170495201**



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## APPENDICES

Appendix A:	Previous Reports
Appendix B:	Construction Health and Safety Plan

## **EXECUTIVE SUMMARY**

This Remedial Action Plan (RAP) was prepared on behalf of Dattner Architects for the proposed development at 244-04 North Conduit Avenue (Block 13265, Lot 30) in the Rosedale neighborhood of Queens, New York (the "Site"). The Site consists of the New York City Police Department (NYPD) 105<sup>th</sup> Precinct Satellite Office and associated driveways, parking lots, and landscaped areas along North Conduit Avenue. A site location map is shown on Figure 1. Pursuant to the January 12, 2018 City Environmental Quality Review (CEQR) No. 18NYP002Q Negative Declaration, RAP review and approval is required by the New York City Department of Environmental Protection (DEP). This RAP is consistent with the DEP requirement to remediate known and potential contamination that is encountered at the Site during the proposed development activities. The plan includes provisions for managing soil in accordance with applicable federal, state, and local requirements, and guidelines for temporary on-site stockpiling and off-site transportation and disposal of soil.

### Site Description

The Site is located at 244-04 North Conduit Avenue (New York City Tax Block 13265, Lot 30) in the Rosedale neighborhood of Queens. The eastern portion of the Site is used as a parking lot for the 105<sup>th</sup> Precinct Satellite Office, which is located on the western half of the Site. The surface of the Site, outside of the existing building footprint, is covered with asphalt, concrete and landscaped areas. The perimeter of the Site is surrounded by vegetation, landscaped areas, and paved sidewalks. The total extent of the Site encompasses about 127,000 square feet; the parking lot located on the eastern half of the Site encompasses about 60,000 square feet, the 105<sup>th</sup> Precinct Satellite Office located on the western half of the Site encompasses about 19,000 square feet, and the remainder of the western portion of the Site encompasses about 48,000 square feet.

The Site is bound by North Conduit Avenue to the north, vacant land to the east, the Long Island Rail Road (LIRR) to the south, and the Rosedale Municipal Parking Field beyond the 105<sup>th</sup> Precinct Satellite Office to the west. A site plan is provided as Figure 2. The surrounding area is occupied by residential, vacant lots, transportation/utilities and commercial uses. The properties located north of the Site beyond North Conduit Avenue consist of residential dwellings with vacant vegetated land to the east. The main line for the LIRR and the Rosedale Station, which are elevated, are located to the south. South Conduit Avenue and Route 27 are located south of the station and run parallel to the LIRR. Several commercial properties including three service stations and a tire repair shop are located beyond Route 27.

### Proposed Development

The proposed development includes construction of a 45,000-square-foot two-story building with a below-grade cellar level in the eastern portion of the Site. A new at-grade parking lot will border the new building to the south. The building will be occupied by the NYPD as their 116<sup>th</sup> Precinct Stationhouse in the Rosedale neighborhood of Queens, New York.

The cellar portion of the proposed building will be towards the northeast of the Site, with a small part of the first floor (without a cellar level) extending south. The cellar level will encompass about 15,200 square feet. The cellar will have a floor slab elevation of elevation (el.) 6.5 feet<sup>1</sup> requiring general excavation to about 14.5 feet below grade surface (bgs). Several features including an elevator pit within the cellar, footings outside of the cellar excavation footprint, stormwater retention structures, and fueling station will require additional excavation to about el. 17.5 to el. -1 or about 5.5 to 22 feet bgs, respectively. Construction excavation is anticipated to include dewatering to about 4 feet below the groundwater table.

Stormwater retention structures will be constructed south of the new NYPD 116<sup>th</sup> Precinct Stationhouse and adjacent to the existing NYPD 105<sup>th</sup> Precinct Satellite Office located in the western half of the Site. Excavation depths to support this construction will range from about el. 17.5 to el. 15 or about 5.5 to 6 feet bgs. A fueling station will be constructed within the southeastern part of the Site and will include a fueling station and a vault containing two fuel tanks: a 6,000-gallon regular grade gasoline tank and a 4,000-gallon diesel tank. Excavation for the fuel tank vault will extend to about el. 6.6, which is about 14.5 feet bgs. Excavation for the filling station will extend to about el. 12, which is about 9 feet bgs. A refuse building will also be constructed in the southeastern part of the Site and excavation in this area will extend to about el. 17, which is about 4 feet bgs. Isolated landscaped areas will be included along areas of the Site and building perimeter. An estimated 9,150 cubic yards of soil/fill is anticipated to be excavated from the Site as part of development. Support of excavation (SOE) construction will be implemented to facilitate excavation, as required. Excavation areas are presented in Figures 4 and 5.

The layout of the Site development is presented in Figures 6 and 7.

### Previous Reports

Previous reports reviewed as part of RAP preparation are included in Appendix A and include the following:

- August 21, 2017 Geophysical Engineering Survey Report, prepared by NOVA Geophysical Engineering on behalf of City of New York Department of Design and Construction (DDC)

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<sup>1</sup> Elevation datum is North American Vertical Datum of 1988

- December 15, 2017 (reissued October 15, 2018) Geotechnical Engineering Report, prepared by Langan on behalf of Dattner Architects
- March 2018 Phase II Limited Site Investigation (LSI) Results Report, prepared by AECOM on behalf of New York City Police Department Capital Construction Unit
- May 9, 2018 Geotechnical Data Report, prepared by CDM Smith on behalf of City of New York Department of Design and Construction

Phase II LSI soil sample analytical results revealed pesticides, lead and mercury in shallow soil samples (0 to 2 feet bgs) at concentrations exceeding the New York State Department of Environmental Conservation (NYSDEC) Part 375 Unrestricted Use (UU) Soil Cleanup Objectives (SCOs). Two pesticides were identified in groundwater at concentrations exceeding NYSDEC's Ambient Water Quality Standards and Guidance Values (AWQSGVs).

Soil vapor sampling identified volatile organic compounds (VOCs) in the eastern portion of the Site. Although there is no standard for soil vapor sample result comparison, they were compared to the following for reference: 1) Upper Fence Background Indoor Air values from the New York State Department of Health's (NYSDOH) 2003 publication, Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes; and 2) the 90<sup>th</sup> Percentile Background Indoor Air values as identified the United States Environmental Protection Agency's (USEPA) 2001 publication, Building Assessment and Survey Evaluation (BASE) Database for indoor air in office and commercial buildings. The Phase II LSI sample locations are shown on Figure 3.

#### Remediation Plan Summary

This RAP describes remedial activities to be implemented concurrently with the proposed building development. A Construction Health and Safety Plan (CHASP) is included in this RAP as Appendix B. The CHASP addresses site-specific hazards and safety requirements in relation to the identified and reasonably anticipated subsurface contaminants. The following is a summary of the remedial approach developed for the Site (details are provided in Section 4.0):

- General excavation to about el. 6.5 (about 14.5 feet bgs) within the cellar footprint
- Excavation to about el. 17.5 to el. -1 or about 5.5 to 22 feet bgs for the foundation, footings, sheeted pit excavations, fueling station, and refuse building
- Excavation and backfill to support site grading, stormwater retention structures, landscaped areas, a fueling station and a refuse building
- Dewatering to about 4 feet below the groundwater table to support excavation below the water table and to provide a satisfactory working surface for the foundation construction
- Characterization, handling, transportation, and disposal of excavated fill and native overburden in accordance with NYSDEC regulations Part 360: Solid Waste Management

Facilities and Part 364: Waste Transporter Permits, and other applicable local, state, and federal regulations

- If encountered, registering and removing any petroleum storage tanks in accordance with NYSDEC requirements, reporting spills as required to NYSDEC and remediating spill conditions in accordance with NYSDEC requirements
- Capping residual impacted soil that may remain at the Site with impervious surface cover (e.g., concrete) or a minimum of one foot of clean material (i.e., native crushed stone or soil meeting Title 6 of the New York Codes, Rules and Regulations [6 NYCRR] Part 360 and 6 NYCRR Part 375 Restricted Commercial Use SCOs)
- Installation of a waterproofing/vapor barrier system (with a minimum thickness of 20 mils) installed per manufacturer's specifications below the new building's cellar and at-grade first floor slab and along the subgrade foundation sidewalls to mitigate potential soil vapor intrusion into the building

## **1.0 INTRODUCTION**

This Remedial Action Plan (RAP) was prepared on behalf of Dattner Architects for the proposed development at 244-04 North Conduit Avenue (Block 13265, part of Lot 30) in the Rosedale neighborhood of Queens, New York (the "Site"). The Site consists of the New York City Police Department (NYPD) 105<sup>th</sup> Precinct Satellite Office and associated driveways, parking lots, and landscaped areas along North Conduit Avenue. A site location map is shown on Figure 1. Pursuant to the January 12, 2018 City Environmental Quality Review (CEQR) No. 18NYP002Q Negative Declaration, RAP review and approval is required by the New York City Department of Environmental Protection (DEP). This RAP is consistent with the DEP requirement to remediate known and potential contamination that is encountered at the Site during the proposed development activities. The plan includes provisions for managing soil in accordance with applicable federal, state, and local requirements, and guidelines for temporary on-site stockpiling and off-site transportation and disposal of soil.

## **2.0 SITE BACKGROUND**

### **2.1 Site Description**

The Site is located at 244-04 North Conduit Avenue (New York City Tax Block 13265, Lot 30) in the Rosedale neighborhood of Queens. The eastern portion of the Site is used as a parking lot for the 105<sup>th</sup> Precinct Satellite Office, which is located on the western half of the Site. The surface of the Site, outside of the existing building footprint, is covered with asphalt, concrete and landscaped areas. The perimeter of the Site is surrounded by vegetation, landscaped areas, and paved sidewalks. The total extent of the Site encompasses about 127,000 square feet; the parking lot located on the eastern half of the Site encompasses about 60,000 square feet, the 105<sup>th</sup> Precinct Satellite Office located on the western half of the Site encompasses about 19,000 square feet, and the remainder of the western portion of the Site encompasses about 48,000 square feet.

### **2.2 Historic and Current Use of Site and Surrounding Area**

The eastern portion of the Site was vacant until about 1902 when the northern portion along North Conduit Avenue was occupied by the New York and Long Island Traction Company to operate a trolley line. The line remained active until about 1926. The eastern portion of the Site was utilized for automobile parking for Long Island Rail Road (LIRR) commuters around 1954. The eastern portion of the Site remained a commuter parking lot until about the mid-2000s when the Site was converted into a parking lot for the 105<sup>th</sup> Precinct Satellite Office, which is located in the western portion of the Site.

The Site is bound by North Conduit Avenue to the north, vacant land to the east, the LIRR to the south, and the Rosedale Municipal Parking Field beyond the 105<sup>th</sup> Precinct Satellite Office to the west. A site plan is provided as Figure 2. The surrounding area is occupied by residential, vacant

lots, transportation/utilities and commercial uses. The properties located north of the Site beyond North Conduit Avenue consist of residential dwellings with vacant vegetated land to the east. The main line for the LIRR and the Rosedale Station, which are elevated, are located to the south. South Conduit Avenue and Route 27 are located south of the station and run parallel to the LIRR. Several commercial properties including three service stations and a tire repair shop are located beyond Route 27. Sidewalk elevations in front of the Site along North Conduit Avenue gently slope from about elevation<sup>2</sup> (el.) 22.5 (east) to el. 21.5 (west), as referenced to the North American Vertical Datum of 1988 (NAVD88).

## **2.3 Proposed Development**

The proposed development includes construction of a 45,000-square-foot two-story building with a below-grade cellar level. A new at-grade parking lot will border the new building to the south. The building will be occupied by the NYPD as their 116<sup>th</sup> Precinct Stationhouse in the Rosedale neighborhood of Queens, New York.

The cellar portion of the proposed building will be towards the northeast of the Site, with a small part of the first floor (without a cellar level) extending south. The cellar level will encompass about 15,200 square feet. The cellar will have a floor slab elevation of el. 6.5 feet requiring general excavation to about 14.5 feet below grade surface (bgs). Several features including an elevator pit within the cellar, footings outside of the cellar excavation footprint, stormwater retention structures, and fueling station will require additional excavation to about el. 17.5 to el. -1 or about 5.5 to 22 feet bgs, respectively. Construction excavation is anticipated to include dewatering to about 4 feet below the groundwater table.

Stormwater retention structures will be constructed south of the new NYPD 116<sup>th</sup> Precinct Stationhouse and adjacent to the existing NYPD 105<sup>th</sup> Precinct Satellite Office located in the western half of the Site. Excavation depths to support this construction will range from about el. 17.5 to el. 15 or about 5.5 to 6 feet bgs. A fueling station will be constructed within the southeastern part of the Site and will include a fueling station and a vault containing two fuel tanks; a 6,000-gallon regular grade gasoline tank and a 4,000-gallon diesel tank. Excavation for the fuel tank vault will extend to about el. 6.6, which is about 14.5 feet bgs. Excavation for the filling station will extend to about el. 12, which is about 9 feet bgs. A refuse building will also be constructed in the southeastern part of the Site and excavation in this area will extend to about el. 17, which is about 4 feet bgs. Isolated landscaped areas will be included along areas of the Site and building perimeter. An estimated 9,150 cubic yards of soil/fill is anticipated to be excavated from the Site as part of development. Support of excavation (SOE) construction will be implemented to facilitate excavation, as required. Excavation areas are presented in Figures 4 and 5. The layout of the Site development is presented in Figures 6 and 7.

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<sup>2</sup> Elevation datum is North American Vertical Datum of 1988

### **3.0 SITE ENVIRONMENTAL CONDITIONS**

The following environmental reports were available for review:

- August 21, 2017 Geophysical Engineering Survey Report, prepared by NOVA Geophysical Engineering on behalf of City of New York Department of Design and Construction
- December 15, 2017 (reissued October 15, 2018) Geotechnical Engineering Report, prepared by Langan on behalf of Dattner Architects
- March 2018 Phase II Limited Site Investigation (LSI) Results Report, prepared by AECOM on behalf of New York City Police Department Capital Construction Unit
- May 9, 2018 Geotechnical Data Report, prepared by CDM Smith on behalf of City of New York Department of Design and Construction (DDC)

These reports are summarized in the following subsections and provided in Appendix A.

#### **3.1 Geophysical Engineering Survey Report (August 21, 2017)**

NOVA performed a geophysical engineering survey (GES) consisting of a ground penetrating radar (GPR) survey at the Site. The purpose of this survey was to locate and identify underground storage tanks (USTs), anomalies, utilities and other subgrade structures and to clear and mark proposed boring locations. The results of the GES identified the following at the Site:

- The GES identified scattered anomalies throughout the Site. Based on their rates and proximity, these anomalies were inconsistent with USTs
- Several utilities (sewer, water, gas, telecommunications and electrical) were located on the Site
- Two large linear anomalies were located along the southeast region of the Site at a depth of about 7 to 10 feet bgs and were orientated east to west

#### **3.2 Geotechnical Engineering Report (December 15, 2017 [reissued October 15, 2018])**

The Geotechnical Engineering Report included data from 11 soil borings and eight shallow probes, three observation wells, and two test pits. The borings were drilled to about 37 to 102 feet bgs and bedrock was not encountered. This report revealed that the general stratigraphy at the Site consists of a layer of uncontrolled fill to depths ranging from 5 to 6 feet bgs. The fill was underlain by interbedded layers of sand, silt, and clay. The static groundwater level was measured to be at el. 7.5, which is about 13.5 feet bgs. The design groundwater elevation was reported at el. 11.



### **3.3 Phase II Limited Site Investigation Results Report (March 2018)**

The March 2018 Phase II LSI included a geophysical survey and soil, groundwater and soil vapor sampling. AECOM advanced eight soil borings and collected 17 soil, three groundwater and four soil vapor samples throughout the eastern half of the Site.

Soil sample results were compared to the New York State Department of Environmental Conservation (NYSDEC) Part 375 Unrestricted Use (UU), Residential and Commercial Soil Cleanup Objectives (SCOs) and were analyzed for:

- Volatile Organic Compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method 8260
- Semivolatile Organic Compounds (SVOCs) by USEPA Method 8270
- Pesticides/Polychlorinated Biphenyls (PCBs) by USEPA Method 8081/8082, and
- Target Analyte List (TAL) Metals by USEPA Methods 6610 and 7471

Groundwater sample results were compared to NYSDC's Ambient Water Quality Standards and Guidance Values (AWQSGVs) and were analyzed for:

- VOCs by USEPA Method 8260
- SVOCs by USEPA Method 8270
- Pesticides/PCBs by USEPA Method 8081/8082
- Filtered and unfiltered TAL Metals by USEPA Methods 6010 and 7471, and
- Total Cyanide by USEPA Method 9010C

Soil vapor sample results were analyzed for VOCs by USEPA Method TO-15. Since New York State does not have any standards, criteria or guidance values for the concentrations of VOCs in subsurface vapors, the results were compared to the following for reference: 1) Upper Fence Background Indoor Air Values from the New York State Department of Health's (NYSDOH) 2003 publication, Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes; and 2) the 90<sup>th</sup> Percentile Background Indoor Air values as identified in the USEPA 2001 publication, Building Assessment and Survey Evaluation (BASE) Database for indoor air in office and commercial buildings.

The Phase II analytical results revealed the following with respect to soil, groundwater, and soil vapor quality beneath the Site:

#### Soil:

- Pesticides – 4'-DDE was detected above the UU SCO in shallow soil sample SB-5 (concentration of 0.0132 milligrams per kilogram [mg/kg]), collected from 0 to 2 feet bgs; 4,4'-DDT was detected above the UU SCO in shallow soil samples SB-5 and SB-2,

collected from 0 to 2 feet bgs (maximum concentration of 0.0143 mg/kg); and alpha-chlordane was detected above the UU SCO in shallow soil samples SB-1, SB-2, SB-3, and SB-5, collected from 0 to 2 feet bgs (maximum concentration of 0.1250 mg/kg).

- Metals - Lead (maximum concentration of 105 mg/kg at SB-1) and mercury (maximum concentration of 0.210 mg/kg at SB-3) were detected above the UU SCOs in the shallow soil samples (0 to 2 feet bgs) collected from SB-1 and SB-3, respectively.
- No VOCs, SVOCs or PCBs were detected above the UU SCOs.

Groundwater: The analytical results revealed that the pesticide dieldrin (maximum concentration of 0.129 micrograms per liter [µg/L]) was detected above the AWQSGV in groundwater samples GW-1, its duplicate sample GW-1(DUP) and GW-3. In addition, the pesticide chlordane (maximum concentration of 0.692 µg/L) was detected above the AWQSGV in groundwater sample GW-1 and its duplicate sample GW-1(DUP).

Soil Vapor: Total VOCs in soil vapor samples ranged from 220.3 micrograms per cubic meter (µg/m<sup>3</sup>) in SV-2 to 434.61 µg/m<sup>3</sup> in SV-3 (excluding acetone, which is a common laboratory contaminant). Total VOCs in the outdoor ambient air samples ranged from 61.48 µg/m<sup>3</sup> in AMB-1 to 161.0 µg/m<sup>3</sup> in AMB-4. The following VOCs in soil vapor and ambient air samples exceeded both NYSDOH 2003 Background Indoor Air Values Upper Fence and USEPA 2001 Background Indoor Air Values 90<sup>th</sup> Percentile:

- Acetone
- 1,3-Dichlorobenzene
- cis-1,2-Dichloroethene
- Methyl Ethyl Ketone
- Methyl methacrylate
- Methylene Chloride
- Tetrahydrofuran
- Trichloroethene (TCE)

Tetrachloroethene (PCE) was detected in soil vapor sample SV-1 at a concentration of 2.3 µg/m<sup>3</sup>. PCE's daughter product, TCE was detected in soil vapor samples ranging from 0.19 µg/m<sup>3</sup> in SV-3 to 0.64 µg/m<sup>3</sup> in SV-1. Cis-1,2-dichloroethene was detected in soil vapor sample SV-1 at a concentration of 0.50 µg/m<sup>3</sup>. Vinyl chloride concentrations detected in soil vapor samples ranged from about 0.099 µg/m<sup>3</sup> in SV-1 to 0.28 µg/m<sup>3</sup> in SV-2. Petroleum-related compounds including benzene, toluene, ethylbenzene, and total xylenes (BTEX) were detected in soil vapor samples in concentrations ranging from 3.10 µg/m<sup>3</sup> in SV-1 to 36.90 µg/m<sup>3</sup> in SV-2; BTEX compounds were

detected in ambient air samples at concentrations ranging from about 2.60 µg/m<sup>3</sup> in AMB-3 to 11.40 µg/m<sup>3</sup> in AMB-2.

The Phase II LSI report recommended installation of a vapor barrier membrane under the new building concrete slab as a mitigation measure.

### **3.4 Geotechnical Data Report (May 9, 2018)**

The Geotechnical Data Report provided data for the subsurface investigation performed from April 19 to 24, 2018 along the eastern part of the Site. The report included the advancement of 22 geotechnical borings, three observation wells, and five test pits. The geotechnical borings were drilled to about 12 to 102 feet bgs and bedrock was not encountered. Groundwater was encountered between el. 7.5 and 7.6 (about 13.5 to 13.6 feet bgs). The general stratigraphy at the Site typically consists of a layer of fill including sand, clayey silt, asphalt, glass fragments, roots, and cobbles varying between 5 and 6 feet in thickness, underlain by interbedded layers of sand, silt, clayey silt, and trace of gravel and organics.

## **4.0 PROPOSED SITE REMEDIATION**

This section describes remedial actions to achieve the Site's Remedial Action Objectives (RAO). This plan includes appropriate actions to protect human health and the environment, and highlights the provisions necessary to protect against contact with impacted material at the Site. Remedial measures will be performed in accordance with applicable federal, state, and city regulations and the Construction Health and Safety Plan ([CHASP] see Appendix B). The CHASP addresses potential worker and community exposure issues in relation to identified and reasonably anticipated contaminants during remedial activities. The DEP will be notified one week prior to commencing remediation at the Site, and remediation will be performed under Langan observation.

### **4.1 Remedial Action Objectives**

RAOs have been established through the remedy selection process stated in the NYSDEC Division of Environmental Remediation (DER)-10 / Technical Guidance for Site Investigation and Remediation (May 2010). At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by VOCs, pesticides, and metal impacts at the Site through the proper application of scientific and engineering principles. The remediation goal for this Site is to reduce, to the extent practicable, site soil contamination through removal and mitigate any subsequent exposure through long-term engineering controls.

## **4.2 Remediation Activities**

### *4.2.1 Soil Excavation and Removal*

Within the cellar footprint, the proposed excavation is anticipated to extend to el. 6.5 (about 14.5 feet bgs). However, deeper excavation within the cellar is required for the elevator pit area, which will extend to el. -1 (about 22 feet bgs). Outside of the cellar footprint, there will be several additional features that will require excavation, including footings which will extend to about el. 12 (about 9 feet bgs), stormwater retention structures which range from about el. 17.5 to 15 (about 5.5 to 6 feet bgs), a fueling station with tank vault which will extend to about el. 12 (about 9 feet bgs) and el. 6.6 (about 14.5 feet bgs), and a refuse building which will extend to about el. 17 (about 4 bgs). To support excavation below the water table, dewatering will be required to lower the groundwater table to about 4 feet below the excavation bottom.

Soil analytical data will be submitted to the proposed disposal facilities to assist in meeting disposal facility analytical requirements for material acceptance. Additional waste characterization sampling will be performed for off-site disposal in a manner suitable to the receiving facility and in conformance with applicable permits. All soil removal operations will be conducted in accordance with Title 6 of the New York Codes, Rules and Regulations (6 NYCRR) Part 360: Solid Waste Facilities and Part 364: Waste Transporter Permits.

Langan will observe and document the excavation and load-out of regulated fill and soil. Prior to loading dump trucks, Langan will field screen excavated soil for evidence of environmental impacts and document that waste types are segregated as necessary. Once container, dump truck, or trailer loading is complete, the material will be transported to off-site permitted or registered disposal and/or recycling facilities. Where required, transport of materials will be performed by licensed haulers under appropriate regulatory permits (6 NYCRR Part 364 Waste Transporter Permits in New York State) and in accordance with appropriate local, state, and federal regulations. Loaded vehicles leaving the Site will be appropriately lined, securely covered, manifested, and placarded in accordance with all applicable transportation requirements. Egress points for truck and equipment transport from the Site will be cleaned of dirt and other materials during Site remediation and development, as required.

### *4.2.2 Soil Stockpiling*

If necessary, stockpile areas will be constructed for staging of fill and soil, pending loading, or characterization testing. Separate stockpile areas will be constructed to avoid comingling of different material types. Stockpile areas will meet the following minimum requirements:

- Suspect impacted soil will be placed onto a minimum 8-mil-thick layer of a polyethylene sheeting or equivalent to protect surface soil
- Different material types will be stockpiled separately and will not be comingled

- Stockpiles will be covered with 8-mil sheeting, which will be securely anchored to the ground or floor surface, upon reaching their capacity. Active stockpiles that have not reached their capacity will be covered at the end of each work day
- Each stockpile area will be encircled with silt fences and hay bales, as needed, to contain and filter particulates from rainwater that has drained off the soils, and to mitigate the potential for surface water infiltration
- The stockpile areas will be inspected daily and noted deficiencies, including broken sheeting covers, will be promptly addressed

#### *4.2.3 Miscellaneous Debris and Liquids Removal*

Miscellaneous debris will be removed and disposed or recycled, as per applicable federal, state, and local regulations. Containers of liquids will be characterized, removed and disposed at permitted landfills or recycling facilities.

#### *4.2.4 Contingencies*

##### *Potential Underground Storage Tanks*

If any USTs are encountered during remedial activities, these USTs will be decommissioned and removed in accordance with NYSDEC UST closure requirements. The NYSDEC Petroleum Bulk Storage (PBS) registration forms will be completed as required. In addition to the waste characterization testing required by the disposal facility, the contents of any USTs will be tested for fingerprint analysis (if a spill condition exists) as well as full characterization testing for disposal, if appropriate. Following removal the tank grave, the tank and surrounding soil will be inspected and screened for evidence of potential impacts. Endpoint soil samples will be collected in accordance with the protocols provided in DER-10.

##### *Grossly-Impacted Soil*

If encountered, grossly-impacted soil (e.g., petroleum) will be removed in accordance with NYSDEC Commissioner Policy (CP) 51 policy and NYSDEC spill reporting will be completed. Impacted soils within the development excavation will be excavated to the greatest extent practical for off-site disposal at an appropriate facility. Post-excavation soil samples will be collected per NYSDEC DER-10 requirements.

#### *4.2.5 Groundwater Management*

Dewatering is anticipated where excavation is required below the water table in order to provide a satisfactory working surface for the foundation construction.

The contractor's dewatering engineer will design the dewatering system to properly support excavation to the required development depths. Disposal of dewatering effluent will be performed in accordance with all applicable local and federal regulations. A wellpoint system will likely be required to fully dewater the Site and limit the vertical flow of groundwater into the Site.

Prior to discharge to a New York City sewer, the contractor will obtain the appropriate permit (e.g., DEP Groundwater Discharge Permit). As an alternative to discharge to the sanitary sewer, the contractor may elect to collect the groundwater for characterization and off-site disposal.

#### *4.2.6 Air Monitoring*

Air monitoring will be performed during excavation, handling and load-out of regulated fill and soil with exceedances of the SCOs. Observations of dust generation will trigger additional dust control measures to mitigate dust conditions. Preventative measures for dust generation will include wetting surfaces, construction of an engineered Site entrance, truck wash area(s), covering potentially contaminated soil stockpiles, and limiting Site vehicle speeds. Organic vapors and particulate matter will be monitored at two air monitoring stations (one up-wind and one down-wind) during excavation activities in soil with SCO exceedances in accordance with the CHASP. Nuisance odors will also be monitored for and, if observed, mitigated.

#### *4.2.7 Site Cap and Import Material*

The planned development includes a 45,000-square-foot two-story building with a one below-grade cellar level and several other site features including concrete and asphalt impervious cover, stormwater retention structures, landscaped areas, a fueling station and a refuse building. Material import is anticipated to consist of general backfill beneath site cover to support grading and installation of the other site features. Material import is also anticipated in the landscaped areas.

##### *Pervious Site Cover*

The top one-foot layer of pervious areas, which will include landscaped or covered with grass (not capped with concrete/asphalt), will have a minimum of one foot of DEP-approved clean fill/topsoil (i.e., native crushed stone or soil meeting 6 NYCRR Part 360 and 6 NYCRR Part 375 Restricted Commercial Use SCOs). The clean fill/topsoil will be imported from an approved facility/source and graded across all landscaped/grass covered areas of the Site that are not capped with concrete/asphalt. The clean fill/topsoil will be segregated at the source/facility, and will be sampled by a qualified environmental professional at a minimum frequency of one sample for every 250 cubic yards. The samples will be analyzed for 6 NYCRR Part 375 list TCL VOCs per USEPA Method 8260, SVOCs per USEPA Method 8270, pesticides per USEPA Method 8081, PCBs per USEPA Method 8082, and TAL metals per USEPA Methods 6610/7000 series by a NYSDOH ELAP-certified laboratory.

Upon completion of the clean fill/topsoil investigation activities, a clean soil report will be submitted to DEP for review and approval prior to importation and placement on-site. The report will include, at a minimum, an executive summary, narrative of the field activities, laboratory data, and comparison of soil analytical results (i.e., 6 NYCRR Part 360 and 6 NYCRR Part 375 Restricted Commercial Use SCOs). Clean fill will not be allowed to be brought onto the Site before being approved by the DEP, and will be free of organic matter, wood, trash, etc. that cannot be properly

compacted or is subject to biodegradation. The clean fill/top soil should not be comprised of any construction and demolition debris.

#### *General Backfill beneath Cover*

General backfill beneath the site cover that is imported to the Site will comply with 6 NYCRR Part 360, meet the 6 NYCRR Part 375 Restricted Commercial Use SCOs, be free of organic, frozen, and other deleterious material, and will have a maximum particle size no greater than 4 inches. Material excavated from within the Site during construction of pile caps footings will be reused provided impacts are not observed, rock fragments greater than 4 inches and deleterious material are removed, and reuse complies with 6 NYCRR Part 360.

Recycled concrete aggregate (RCA) imported to the Site is acceptable and will be from facilities permitted or registered by NYSDEC, provided that its use complies with 6 NYCRR Part 360. The contractor is responsible to ensure that the facility is compliant with 6 NYCRR Part 360 registration and permitting requirements for the period of acquisition of RCA. RCA material is not acceptable for, and will not be used as cover material. RCA imported to the Site must be derived from recognizable and uncontaminated concrete, contain no deleterious debris, and contain no more than 5% by weight asphalt or brick.

#### *Source Screening and Testing*

Inspection of imported fill material will include visual and olfactory screening for evidence of contamination. Materials imported to the Site will be subject to inspection, as follows:

- Trucks with imported fill material will be in compliance with applicable laws and regulations and will enter the Site at designated locations
- The contractor is responsible to ensure that every truckload of imported material is inspected for evidence of contamination, and
- Fill material will be free of solid waste including pavement materials, debris, stumps, roots, and other organic matter, as well as ashes, oil, perishables or foreign matter

Imported fill will be sampled in accordance with Table 5.4(e)10 of NYSDEC DER-10 and at a minimum frequency of one sample for every 250 cubic yards. The samples will be analyzed for the following: 6 NYCRR Part 375 list TCL VOCs per USEPA Method 8260, TCL SVOCs per USEPA Method 8270, PCBs per USEPA Method 8082, pesticides per USEPA Method 8081, and TAL metals per USEPA Method 6010/7000 series. The results will be compared to applicable 6 NYCRR Part 360 criteria and Part 375 Restricted Commercial Use SCOs. The results will be submitted to DEP for review and approval prior to importation and placement on-site.

Virgin gravel, rock or stone a permitted mine or quarry is excluded from analytical testing requirements if it contains less than 10% by weight of material that passes through a size 80 sieve. RCA imported from compliant facilities will not require chemical testing if it contains less than 10% by weight of material that passes through a size 80 sieve, unless required by NYSDEC

under its terms for operation of the facility. RCA must conform to Section 304 of the New York State Department of Transportation Standard Specifications Construction and Materials Volume 1 (2002).

#### *4.2.8 Waterproofing Vapor Barrier System*

A waterproofing/vapor barrier system (minimum 20 mils thick) will be installed between the new building concrete cellar slab and underlying sub-grade layer, and extend along the sidewalls of the cellar from the base of excavation to surface grade. A continuous vapor barrier will also extend along the bottom of the at-grade portion of the new building and will connect to the waterproofing/vapor barrier to form a continuous vapor barrier in accordance with manufacturer's specifications. Utility and foundation penetration and incidental punctures will be appropriately sealed in accordance with manufacturer's specifications. A waterproofing/vapor barrier product has not been selected. When information on the proposed product becomes available, the manufacturer's specifications will be submitted to DEP for review and approval prior to installation. The vapor barrier plan is provided as Figure 8.

As-built waterproofing/vapor barrier system drawings will be submitted with the NYS Professional Engineer-certified Remedial Closure Report (RCR). The NYS Professional Engineer-certified RCR will include photographs of the installation process, a copy of a Professional Engineer/Registered Architect (PE/RA)-certified letter (on company letterhead) from the contractor responsible for installation oversight and field inspections, and a copy of the manufacturer's certificate of warranty.

### **4.3 Remedial Closure Report**

Upon completion of the remediation, the owner will provide the DEP with a NYS Professional Engineer-certified RCR for review and approval. The RCR will include a description of the remediation, photographs of remedial activities, sample data collected during remedy implementation, soil disposal records, a drawing showing the extent of excavation, and documentation of the waterproofing/vapor barrier installation. The PE-certified RCR will indicate that all remedial requirements have been implemented and document deviations where appropriate.



## FIGURES





#### LEGEND

— APPROXIMATE SITE BOUNDARY

#### NOTES:

1. BASE MAP TAKEN FROM THE USGS TOPOGRAPHIC QUADRANGLE MAP, LYNBROOK QUADRANGLE, NEW YORK, 7.5 MINUTE SERIES (2010)

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Project

**NYPD 116th PRECINCT**

BLOCK No. 13265, LOT No. 30

QUEENS

NEW YORK

Figure Title

**SITE LOCATION  
MAP**

Project No.

170495201

Date

04/17/2019

Drawn By

EB

Checked By

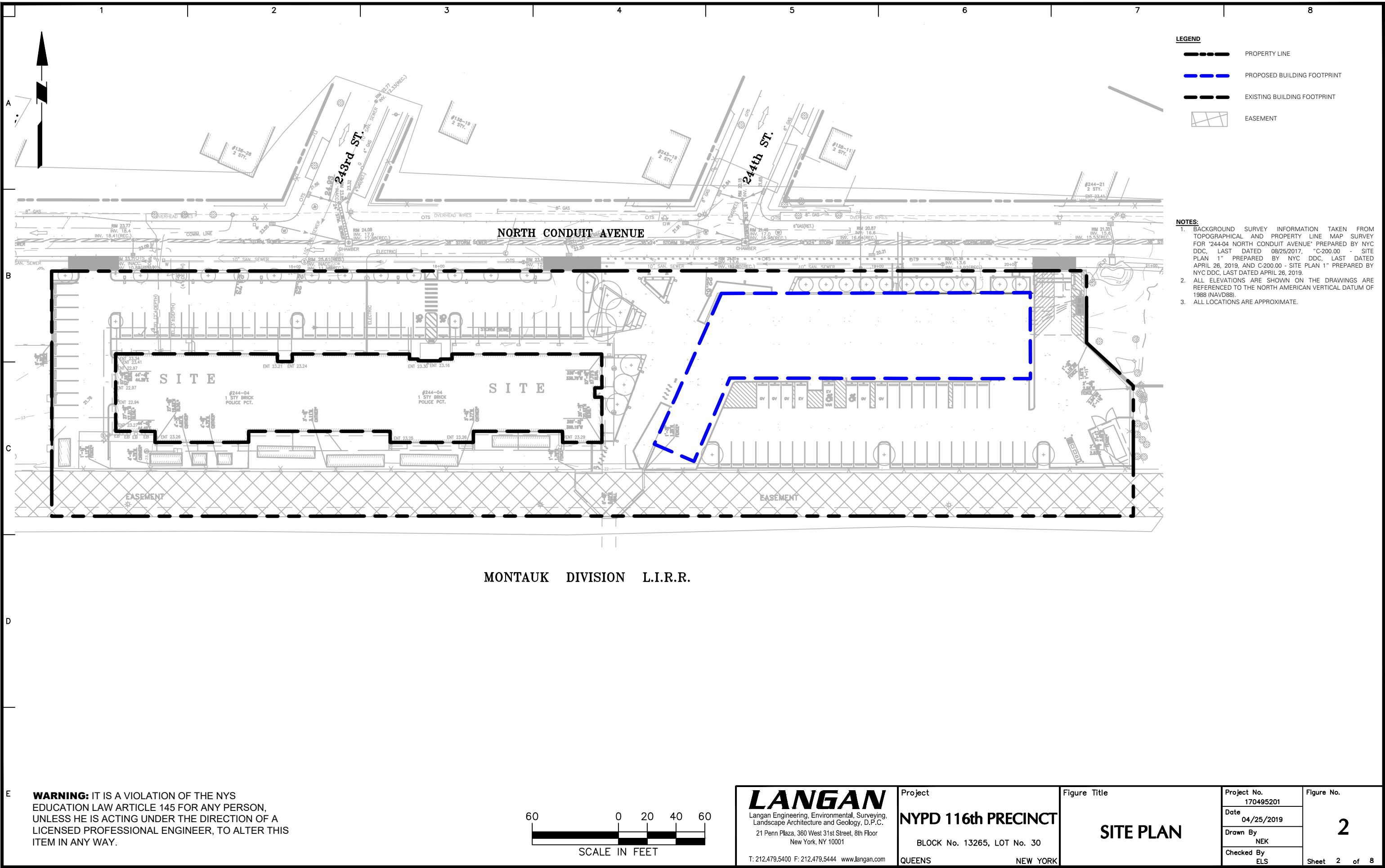
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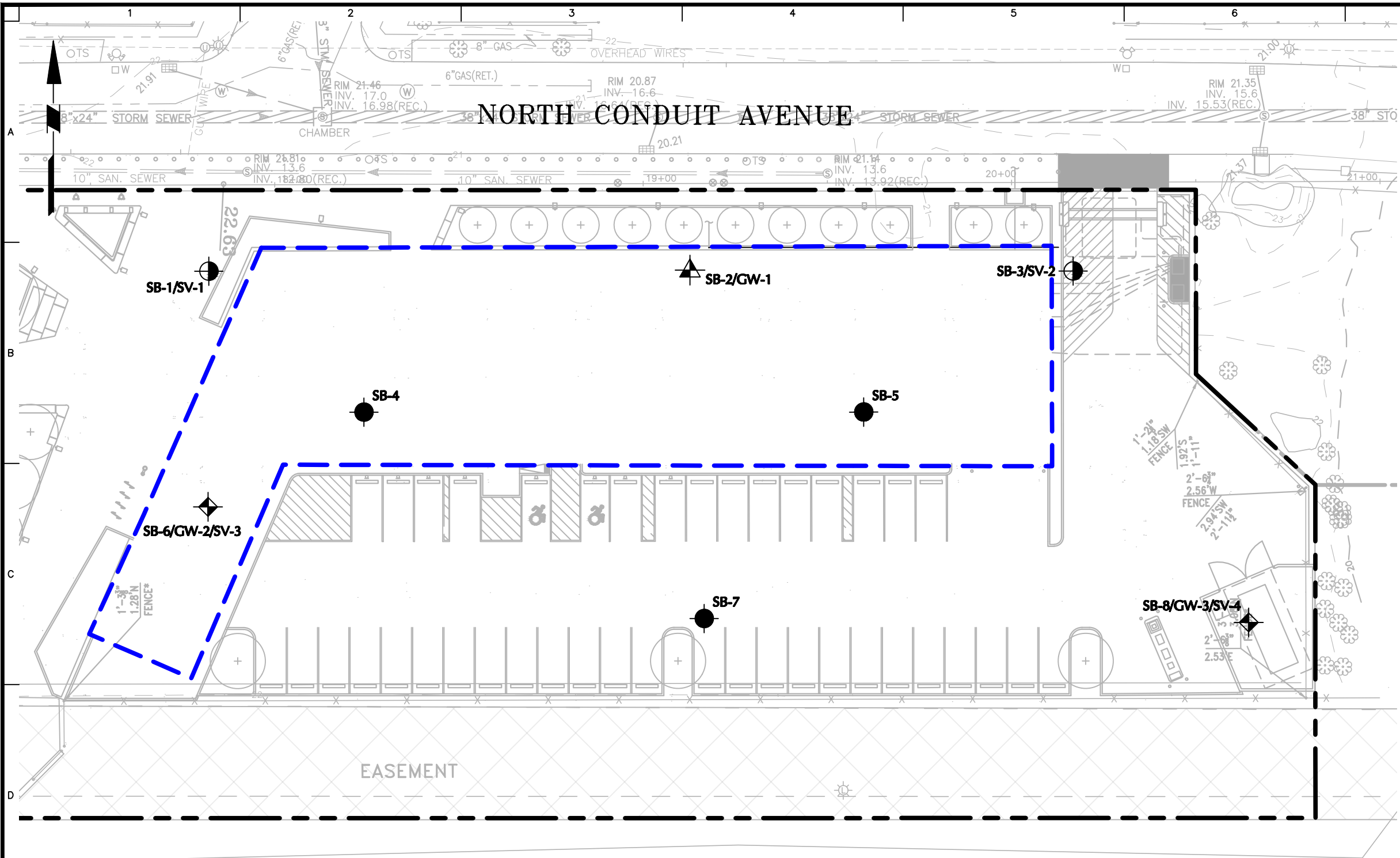
Figure No.

**1**

Sheet 1 of 4







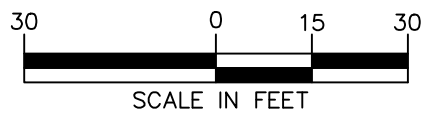
**LEGEND**

- PROPERTY LINE
- PROPOSED BUILDING FOOTPRINT
- EASEMENT
- SB-5: PREVIOUS SOIL BORING LOCATION (AECOM, MARCH 2018 PHASE II LIMITED SITE INVESTIGATION)
- SB-2/GW-1: PREVIOUS CO-LOCATED SOIL BORING AND OVERBURDEN MONITORING WELL LOCATION (AECOM, MARCH 2018 PHASE II LIMITED SITE INVESTIGATION)
- SB-3/SV-2: PREVIOUS CO-LOCATED SOIL BORING AND SOIL VAPOR POINT LOCATION (AECOM, MARCH 2018 PHASE II LIMITED SITE INVESTIGATION)
- SB-8/GW-3/SV-4: PREVIOUS CO-LOCATED SOIL BORING, OVERBURDEN MONITORING WELL AND SOIL VAPOR POINT LOCATION (AECOM, MARCH 2018 PHASE II LIMITED SITE INVESTIGATION)

**NOTES:**

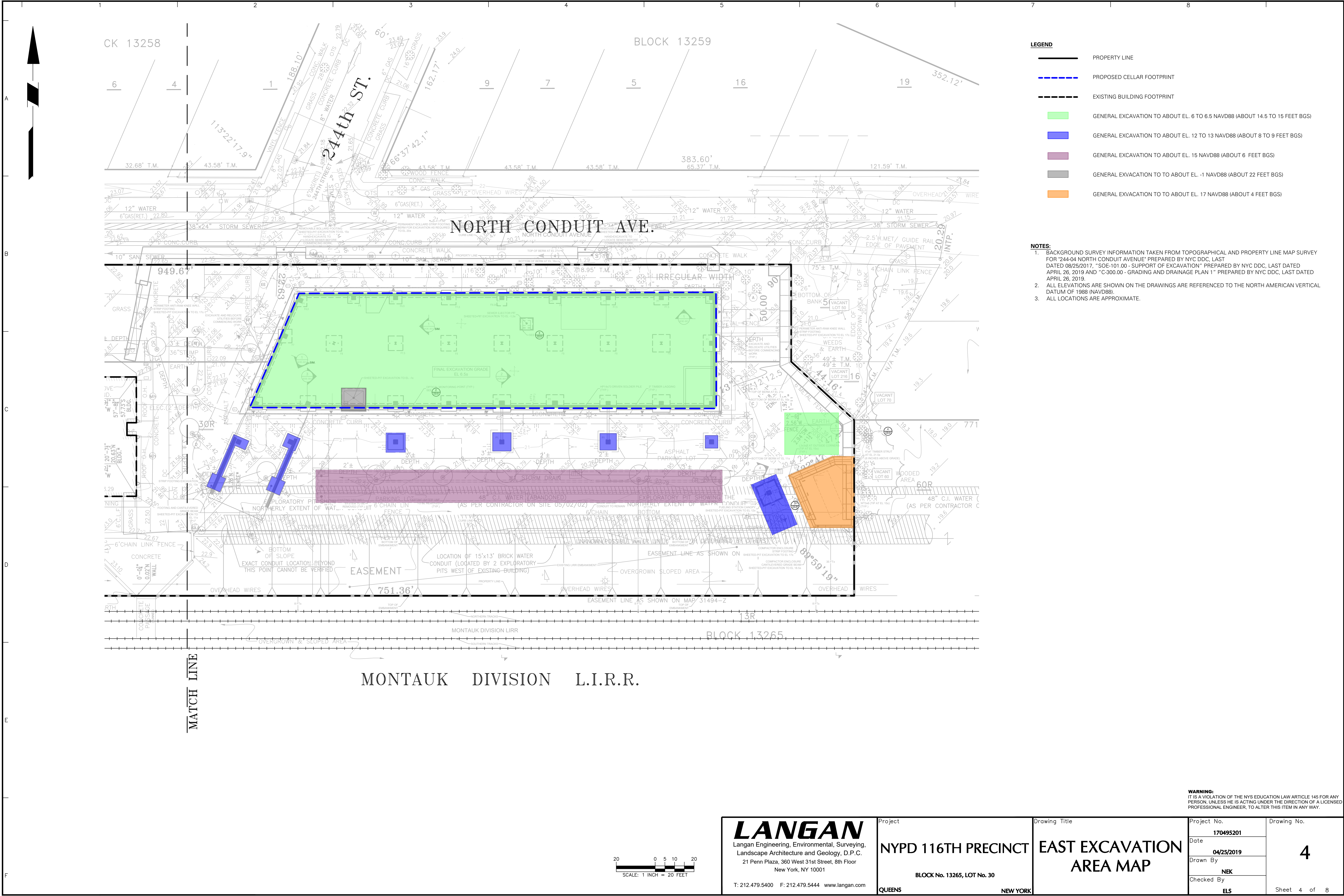
- BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244-04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/2017 AND "C-200.00 - SITE PLAN 1" PREPARED BY NYC DDC, LAST DATED APRIL 26, 2019.
- ALL ELEVATIONS ARE SHOWN ON THE DRAWINGS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
- ALL LOCATIONS ARE APPROXIMATE AND BASED ON THE MARCH 2018 PHASE II LIMITED SITE INVESTIGATION FIGURE 3 - PROPOSED SAMPLE LOCATIONS, PREPARED BY AECOM.

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			Date 04/25/2019	
			Drawn By NEK	
			Checked By ELS	

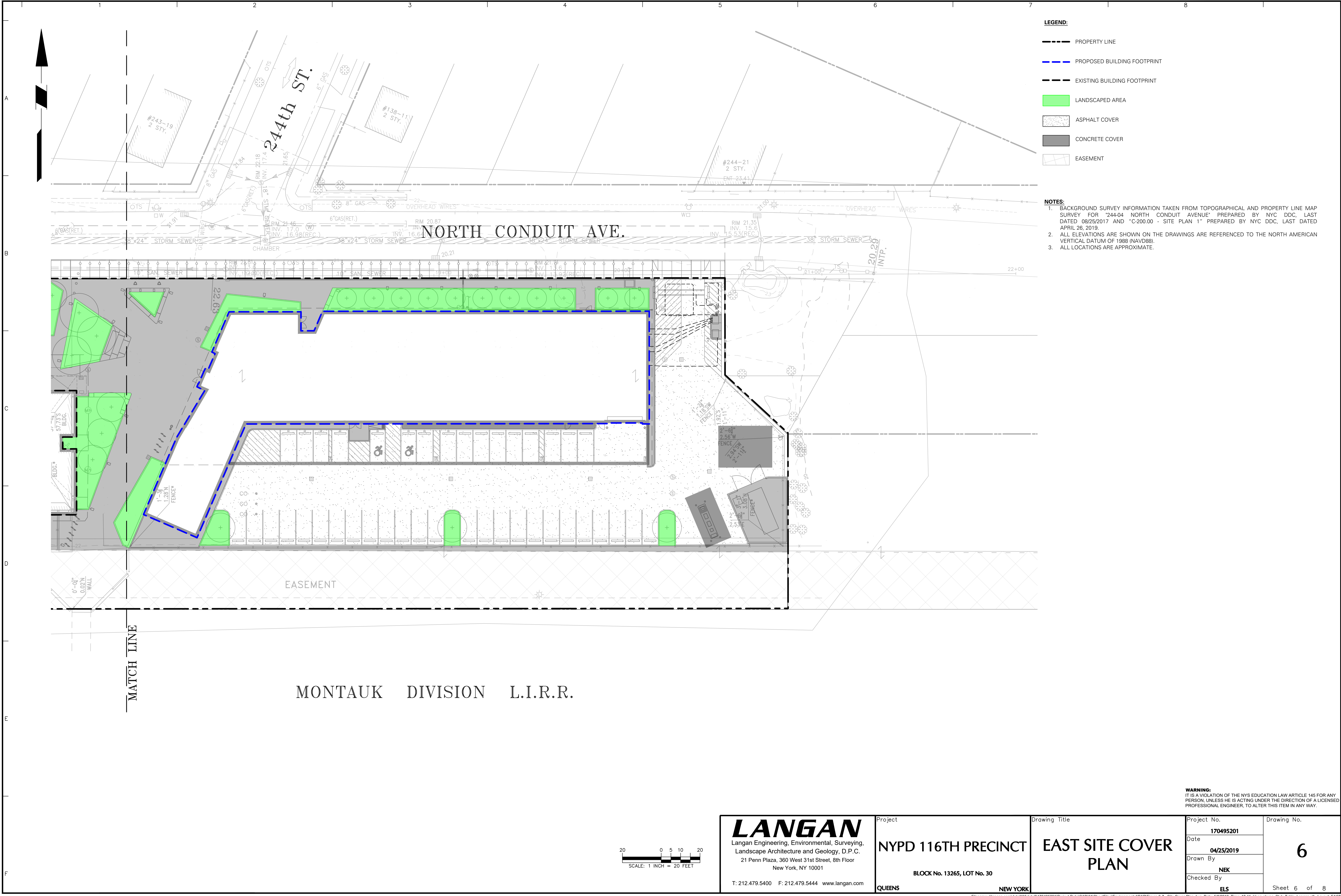












LEGEND:

- PROPERTY LINE
- PROPOSED BUILDING FOOTPRINT
- EXISTING BUILDING FOOTPRINT
- LANDSCAPED AREA
- ASPHALT COVER
- CONCRETE COVER
- EASEMENT

NOTES:

- BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244-04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/2017 AND "C-200.00 - SITE PLAN 1" PREPARED BY NYC DDC, LAST DATED APRIL 26, 2019.
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Project

NYPD 116TH PRECINCT

BLOCK No. 13265, LOT No. 30

QUEENS

NEW YORK

Drawing Title

EAST SITE COVER  
PLAN

Project No.

170495201

Date

04/25/2019

Drawn By

NEK

Checked By

ELS

Drawing No.

6

Sheet 6 of 8

SCALE: 1 INCH = 20 FEET





1. BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244-04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/2017 AND "C-201.00 - SITE PLAN 2" PREPARED BY NYC DDC, LAST DATED APRIL 26, 2019.
2. ALL ELEVATIONS ARE SHOWN ON THE DRAWINGS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV88).
3. ALL LOCATIONS ARE APPROXIMATE.

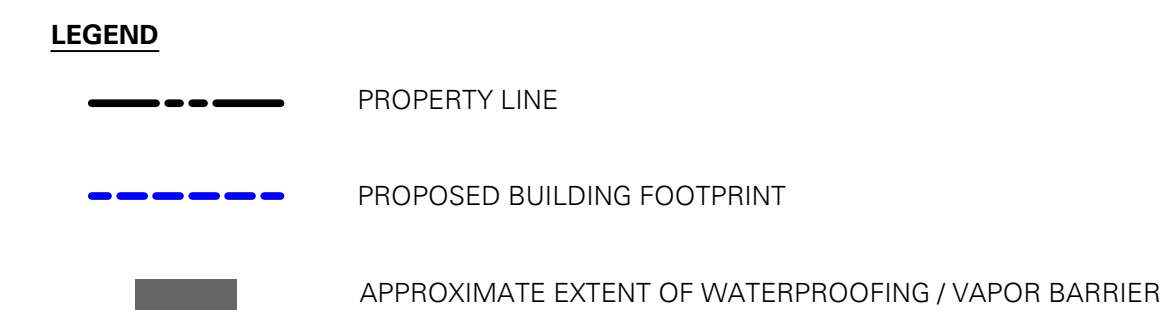
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Sheet 7 of 8

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**NOTES:**

1. BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244-04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/2017 AND "S0E-11.00 - SUPPORT OF EXCAVATION" PREPARED BY NYC DDC, LAST DATED APRIL 26, 2019.
2. ALL ELEVATIONS ARE SHOWN ON THE DRAWINGS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV88).
3. ALL LOCATIONS ARE APPROXIMATE.

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Project No.	Drawing No.
<b>170495201</b>	<b>8</b>
Date	
<b>04/25/2019</b>	
Drawn By	
<b>NEK</b>	
Checked By	
<b>ELS</b>	Sheet 8 of 8



**APPENDIX A**  
**PREVIOUS REPORTS**

# **GEOPHYSICAL ENGINEERING SURVEY REPORT**

**116<sup>th</sup> Precinct**

**244-04 North Conduit Avenue**

**Queens, New York 11422**

**NOVA PROJECT NUMBER**

**17-0339**

**DATED**

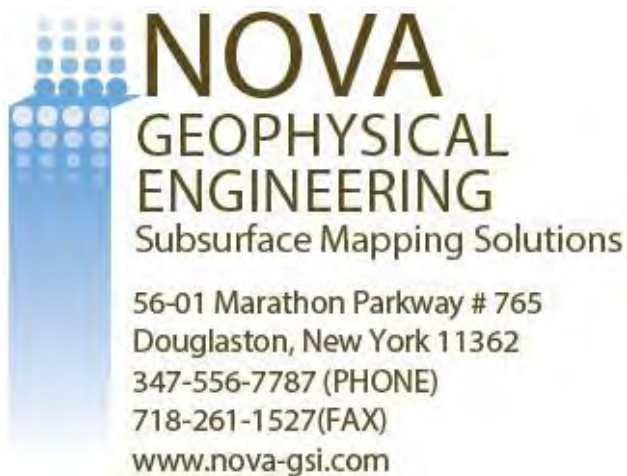
**August 21, 2017**

**PREPARED FOR:**

**NYC Department of Design and Construction**

**30-30 Thomson Avenue, Long Island City, NY 11101**

**PREPARED BY:**





# NOVA GEOPHYSICAL SERVICES

## SUBSURFACEMAPPINGSOLUTIONS

56-01 Marathon Parkway, # 765, Douglaston, New York 11362  
Ph. 347-556-7787 Fax. 718-261-1527  
www.nova-gsi.com

---

August 19, 2017

Jeffrey K. Au, P.E.

Deputy Director

Program Management Division

Office of Environmental and Geotechnical Services

**NYC Department of Design and Construction**

30-30 Thomson Avenue, Long Island City, NY 11101

O 718-391-1037

C 347-302-5130

E [auje@ddc.nyc.gov](mailto:auje@ddc.nyc.gov)

Re: Geophysical Engineering Survey (GES) Report

116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

Dear Mr. Au:

Nova Geophysical Services (NOVA) is pleased to provide findings of the geophysical engineering survey (GES) at the above referenced project site: 116<sup>th</sup> Precinct, 244-04 North Conduit Avenue, Queens, New York (the "Site"). Please see attached Site Location and Geophysical Survey maps for more details.

## INTRODUCTION TO GEOPHYSICAL ENGINEERING SURVEY (GES)

NOVA performed a Geophysical engineering surveys (GES) consisting of a Ground Penetrating Radar (GPR) survey at the site. The purpose of this survey is to locate and identify USTs, anomalies, utilities and other substructures and to clear and mark proposed boring areas on August 15, 2017.

The equipment selected for this investigation was Noggin's 250 MHz ground penetrating radar (GPR) shielded antenna and 3M DYNATL.

A GPR system consists of a radar control unit, control cable and a transducer (antenna). The control unit transmits a trigger pulse at a normal repetition rate of 250 MHz. The trigger pulse is sent to the transmitter electronics in the transducer via the control cable. The transmitter electronics amplify the trigger pulses into bipolar pulses that are radiated to the surface. The transformed pulses vary in shape and frequency according to the transducer used. In the subsurface, variations of the signal occur at boundaries where there is a dielectric contrast (void, steel, soil type, etc.). Signal reflections travel back to the control unit and are represented as color graphic images for interpolation.

GPR, Magnetics, Electromagnetics, Seismic, Resistivity, Utility Location, Borehole Logging & Camera



## GEOPHYSICAL METHODS

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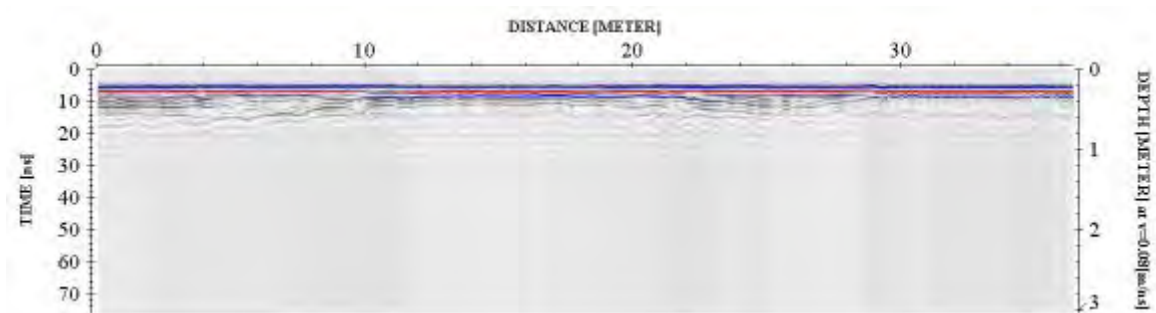
The project site was screened using the GPR to search the areas of interest and inspected for reflections, which could be indicative of major anomalies and substructures. Borehole locations were then individually cleared.

GPR data profiles were collected for the areas of the Site specified by the client. The surveyed areas consisted of grass, asphalt and concrete surfaces.

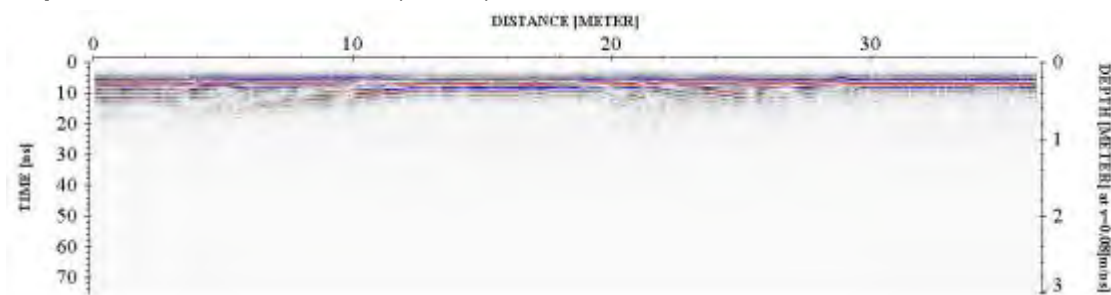
## DATA PROCESSING

In order to improve the quality of the results and to better identify subsurface anomalies NOVA processed the collected data. The processes flow is briefly described at this section.

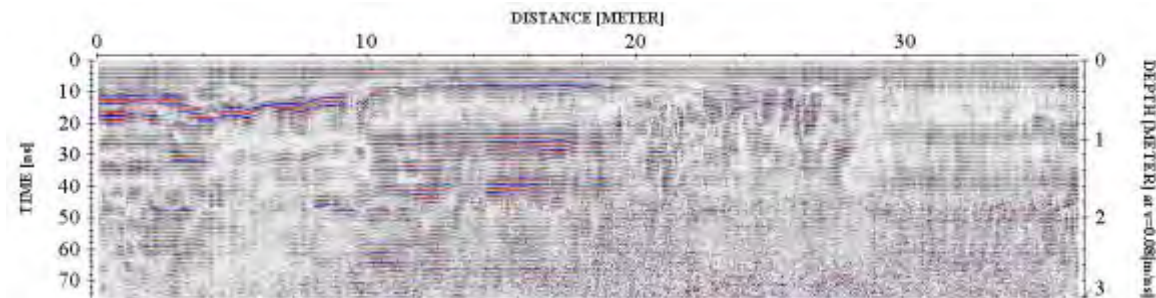
**Step 1.** Import raw RAMAC data to standard processing format



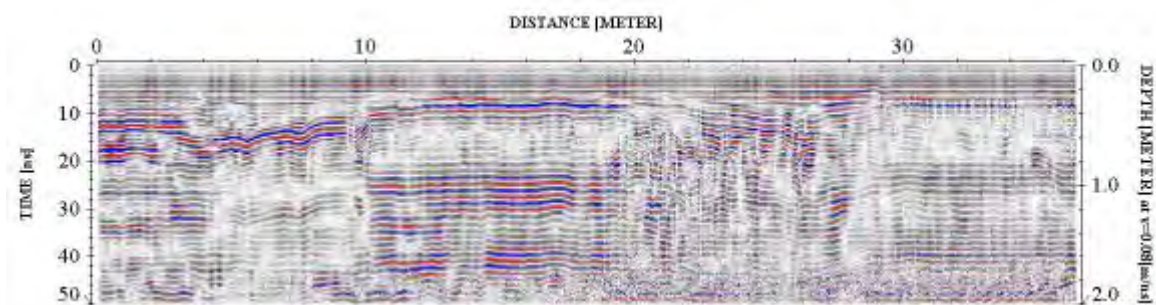
**Step 2.** Remove instrument noise (*dewow*)



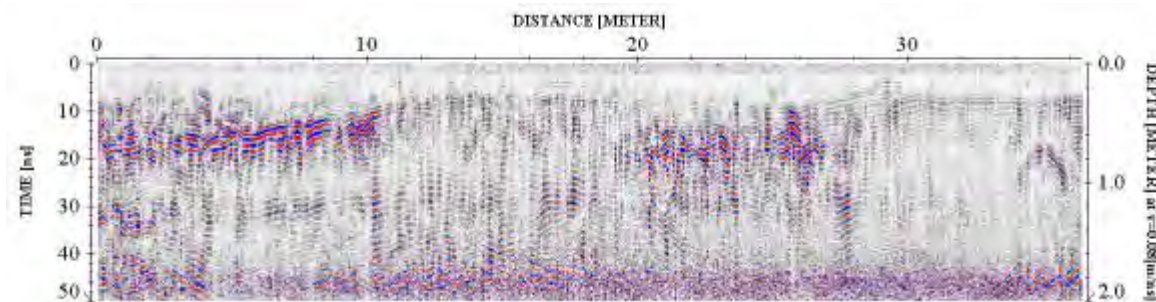
**Step 3.** Correct for attenuation losses (*energy decay function*)



**Step 4.** Remove static from bottom of profile (*time cut*)



**Step 5.** Mute horizontal ringing/noise (*subtracting average*)



The above example shows the significance of data processing. The last image (step 5) has higher resolution than the starting image (raw data – step 1) and describes the subsurface anomalies more accurately.

---

## PHYSICAL SETTINGS

---

Nova observed following physical conditions at the time of the survey:

**The weather:** Overcast/Light Rain

**Temp:** 80 Degrees (F).

**Surface:** Grass, asphalt and concrete surfaces

**Geophysical Noise Level (GNL):** Geophysical Noise Level (GNL) was very high at the site. The noise was a result of the site being located in an urban environment and close proximity to train tracks.

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## RESULTS

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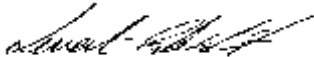
The results of the geophysical engineering survey (GES) identified following at the project Site:

- GES survey identified scattered anomalies located throughout the project site. Based on their rates and proximity, these anomalies were inconsistent with any USTs. These areas were indicated on the on-site markout.
- Several utilities (sewer, water, gas, telecommunications and electrical) were located on the site. These utilities were indicated on the survey map.
- Two large, linear anomalies were located on the site located approximately 7 to 10 feet below ground surface at the project site. These are indicated both on-site and on the survey map.
- Geophysical Survey Plan portrays the areas investigated during the geophysical survey.

If you have any questions please do not hesitate to contact the undersigned.

Sincerely,

**NOVA Geophysical Services**



Levent Eskicakit, P.G., E.P.  
Project Engineer

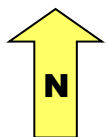
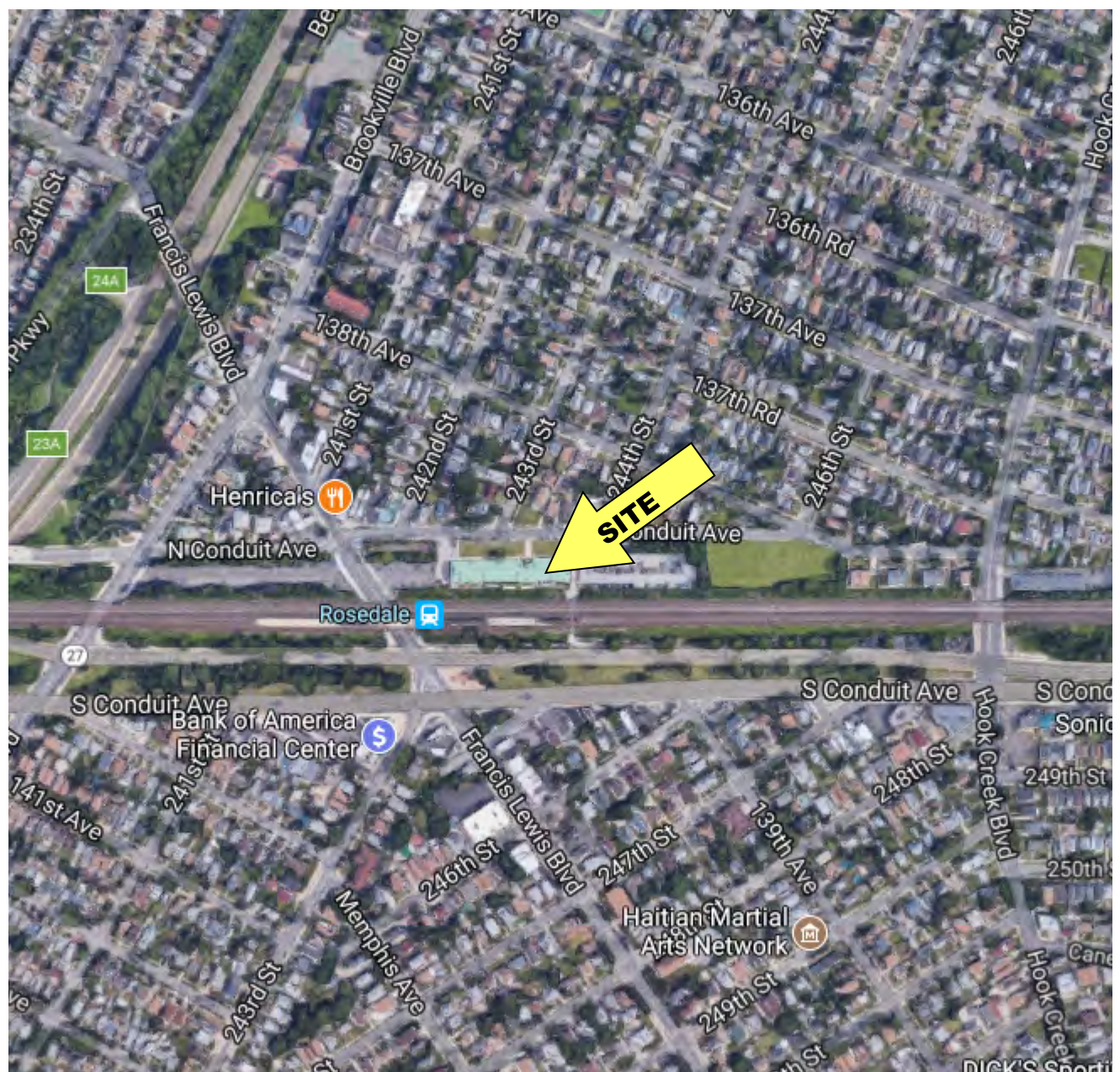
**Attachments:**

Figure 1 Site Location Map

Geophysical Survey Plan

Geophysical Images





500 ft.

**FIGURE 1**  
**SITE LOCATION MAP**

**NOVA**  
**GEOPHYSICAL**  
**ENGINEERING**  
Subsurface Mapping Solutions  
56-01 Marathon Parkway # 765  
Douglaston, New York 11362  
347-556-7787 (PHONE)  
718-261-1527 (FAX)  
www.nova-gsi.com

**SITE:** **116th Precinct**  
244-04 North Conduit Avenue  
Queens, New York 11422

**SCALE:** See Map





1- All anomalies were marked in the field.

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### GEOPHYSICAL SURVEY PLAN

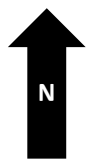
SITE : 116<sup>th</sup> Precinct  
 244-04 North Conduit Avenue  
 Queens, New York 11422

CLIENT: **NYC DDC**  
 DATE: August 15, 2017  
 Scale See Map

- Survey Area
- Gas Line
- Water Line
- Storm Drain

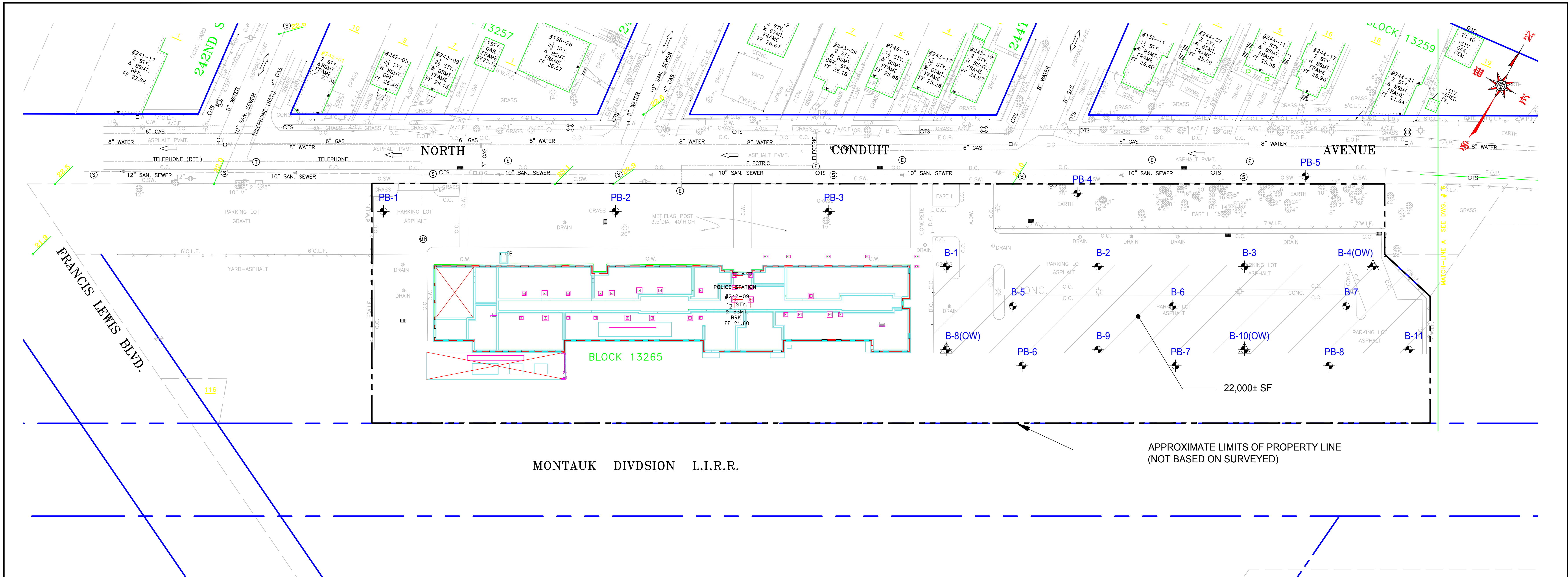
### INFORMATION

- Sewer Line
- Electrical Line
- Dry Well
- Large Anomaly



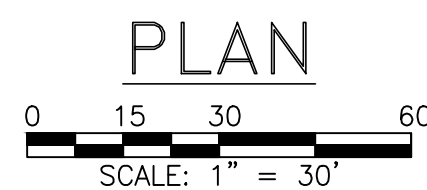
60 ft.





LEGEND

- B-X PROPOSED BUILDING GEOTECHNICAL BORING
- B-X(OW) PROPOSED BORINGS WITH OBSERVATOIN WELL
- PB-X PROPOSED PAVEMENT GEOTECHNICAL BORINGS



SUBSURFACE INVESTIGATION NOTES:

1. THE TOPOGRAPHIC SURVEY BASE PLAN, DATED 8/20/2004, PREPARED BY SITE-BLAUVELT ENGINEERS.
2. THE PROPERTY LINE OF THE SITE WAS NOT BASED ON THE AUGUST 2004 TOPOGRAPHIC SURVEY. IT IS SHOWN FOR ILLUSTRATION PURPOSES AND SHOULD BE CONSIDERED APPROXIMATE.
3. ALL BUILDING BORINGS (B-SERIES) SHALL BE 35-FT DEEP WITH THE EXCEPTION OF B-5, B-6 AND B-6, WHICH WILL BE TERMINATED AT 100 FT BELOW GRADE;
4. ALL PAVEMENT BORINGS (PB-SERIES) SHALL BE 10-FT DEEP;
5. FIELD WORK WILL BE SUPERVISED FULL-TIME BY DDC AND DDC'S CONSULTANTS.

"ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S BLUE INKED OR EMBOSSED SEAL SHALL BE CONSIDERED TO BE A TRUE VALID COPY"

"UNAUTHORIZED ALTERATIONS OR ADDITION TO A LAND SURVEYING DRAWING BEARING A LICENSED PROFESSIONAL LAND SURVEYOR'S SEAL IS A VIOLATION OF ARTICLE 145, SECTION 7209, PARAGRAPH 2 OF THE NEW YORK STATE EDUCATION LAW"

FIELD SURVEY WAS COMPLETED IN: MONTH JUNE, 2004

LOCATIONS, EXTENT AND SIZES OF UNDERGROUND UTILITIES AND SUBSTRUCTURES HAVE BEEN DETERMINED FROM RECORD INFORMATION, SUPPLEMENTED BY DATA OBTAINED IN THE FIELD. ACCURACY OF THIS UTILITY DATA IS NOT GUARANTEED, NOR IS THERE ANY GUARANTEE THAT ALL EXISTING UTILITIES AND SUBSTRUCTURES, WHETHER FUNCTIONAL OR ABANDONED, ARE SHOWN ON THIS MAP.

NOTE: ALL ELEVATIONS REFER TO BOROUGH OF QUEENS HIGHWAY WHICH IS 2.725 FEET ABOVE MEAN SEA LEVEL AT SANDY HOOK, NEW JERSEY AS ESTABLISHED BY THE U.S. COAST AND GEODETIC SURVEY.

			DESIGNED _____	SCALE AS SHOWN	_____ _____ _____ P.E.	CITY OF NEW YORK DEPARTMENT OF DESIGN AND CONSTRUCTION		CAPIS ID: P0002-116		<div><div>4231</div><div>SES</div></div> <div>DATE: 08/03/2017</div>		
			DRAWN _____			SURVEY PREPARED BY: SITE-BLAUVELT ENGINEERS 132 WEST 36TH STREET NEW YORK, NY 10018		PREPARED FOR: DIVISION OF PROGRAM MANAGEMENT SAFETY AND SITE SUPPORT ENVIRONMENTAL AND GEOTECHNICAL SERVICES			NEW 116TH PRINCINCT	
			TRACED _____								BOROUGH OF QUEENS PROPOSED BORING LOCATION PLAN	
NO.	DATE	DESCRIPTIONS	BY	APPR'D	CHECKED _____	CADD FILE _____				SHEET 1 OF 1		
REVISIONS												



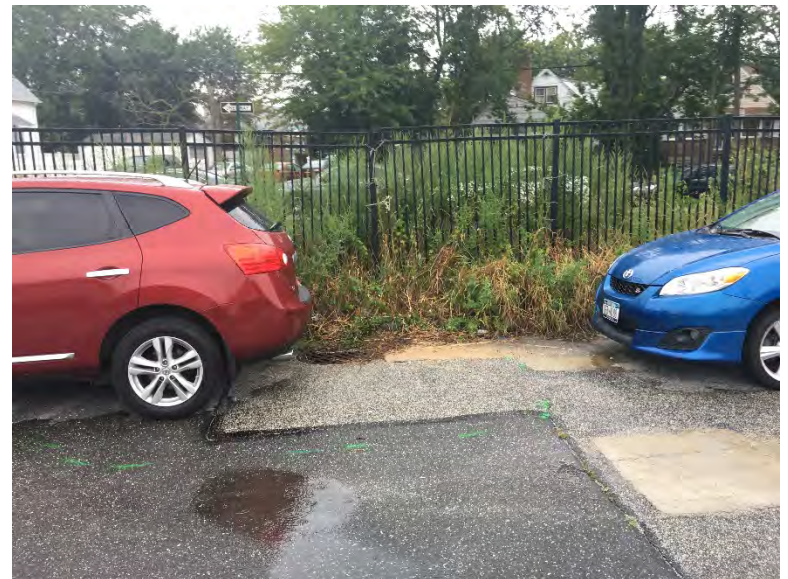
## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





## GEOPHYSICAL IMAGES

116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





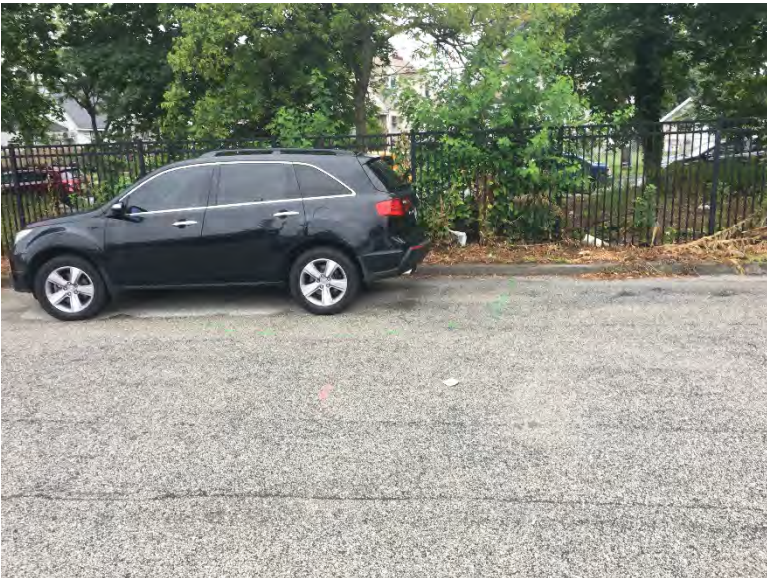
## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





## GEOPHYSICAL IMAGES

116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





---

# GEOTECHNICAL ENGINEERING REPORT

for

## 116TH PRECINCT STATION HOUSE Queens, New York

*Prepared For:*  
**Dattner Architects**  
1385 Broadway  
New York, NY 11201

*Prepared By:*  
**Langan Engineering, Environmental, Surveying  
and Landscape Architecture, D.P.C.**  
21 Penn Plaza  
360 West 31<sup>st</sup> Street, 8<sup>th</sup> Floor



---

**Terrence K. Cheung, P.E.**  
Professional Engineer License No. 089000



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**Jared M. Green, P.E.**  
Professional Engineer License No. 085383

**15 December 2017**  
**Reissued 15 October 2018**

**LANGAN**

**170495201**

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## **EXECUTIVE SUMMARY**

This report presents the results of the geotechnical investigation for the proposed Precinct Station House in the Rosedale neighborhood of Queens, New York.

The proposed development is a new 116th Police Precinct building, which has a footprint of about 15,200 square feet, for the New York Police Department (NYPD). According to the site scope plan, this proposed development includes excavating in the open-air parking lot to construct a two-story building with a below-grade level. This building will incorporate all the required programs and functions per the RFP for Project No. PO 002116. The development shares the same lot with the existing 105th Precinct Satellite Facility (west of the lot), which was completed in 2007.

A subsurface investigation consisted of drilling 11 borings and 8 shallow probes, installing 3 groundwater observation wells, and excavating 2 test pits. Subsurface conditions generally consist of a layer of uncontrolled fill underlain by interbedded layers of sand, silt, and clay. Bedrock was not encountered during this investigation. The static groundwater level was measured to be at el 7.5, which is about 13.5 feet below the ground surface (bgs). The design groundwater elevation is at el 11. The general excavation along the cellar extents will be at about to el 4, which is about 17 feet bgs and 3.5 feet below the measured groundwater level.

Two test pits, identified as TP-1 and TP-2, were excavated to determine extents, condition, and depths of the existing water conduit along the south side of the site. TP-1 was excavated in the eastern part of the conduit to about 18 feet bgs (about el 2.5). TP-2 was excavated in the western part of the conduit to about 13 feet bgs (about el 7.5).

The site is classified as Site Class D, and the Seismic Design Category (for Risk Category IV) is C. Liquefaction need not be considered in the foundation design.

We recommend a shallow foundation system consist of conventional spread or wall footings bearing on native Class 3b material, which has an allowable bearing capacity of 3 tons per square foot (tsf).

## **INTRODUCTION**

This report summarizes the subsurface investigation results and provides recommendations for foundation design and construction. All services were performed in general accordance with our agreement (30 October 2017), and recommendations are in accordance with the 2014 New York City Building Code.

Our understanding of the project is based on the site scope plan (dated 13 September 2017) prepared by DDC; our site visit; results of the subsurface investigation supervised and inspected by CDM Smith; and the information provided by the project architect (Dattner Architects).

Elevations in this report are from the topographical survey (dated 8 December 2017) prepared by the Division of Program Management at DDC and are referenced to the North American Vertical Datum of 1988 (NAVD88).

## **SITE DESCRIPTION**

The site is in the western part of the city block 1325, which is bordered by North Conduit Avenue on the north, Hook Creek Boulevard on the east, Sunrise Highway on the south, and Francis Lewis Boulevard on the west. The proposed 116th Precinct building is in the eastern portion of Lot 30, which has an area of about 45,000 square feet (sf). The western portion of this lot is occupied by an existing one-story building with no cellar level (105th Precinct Satellite Facility) and is located about 40 feet to the west of the proposed 116th Precinct building.

City-owned vacant lots border this lot on the east (Lots 50, 216, 60, and 70) and the west (Lots 20 and 16). Sidewalk elevations in front of the site along North Conduit Avenue gently slope from about el 22.5 (east) to el 21.5 (west).

A site location map is presented as Figure No. 1.

### **Adjacent Long Island Rail Road**

The Long Island Rail Road (LIRR) Rosedale Station and tracks border the site on the south. An embankment within Lot 30 and the easement for LIRR on the south has a slope of about 1V:2H with the top and bottom of the embankment at about el 37 and el 22, respectively. The width of the embankment is about 30 feet. The LIRR tracks are on the top of the embankment.

### Regional Geology

The New York State Museum and Science Service "Geologic Map of New York" indicates that the underlying geology of the site is predominantly coastal plain deposits, specifically the Monmouth Group, Matawan Group, and Magothy Formation. These formations consist of silty

clay, glauconitic (a micaceous iron potassium silicate) sandy clay sand, and gravel. Bedrock is known to be deeper than 100 feet in the vicinity of the site.

A surficial geology map is presented as Figure No. 2.

## **Flood Hazard**

We have reviewed the National Flood Insurance Rate Map for the City of New York published by the Federal Emergency Management Agency (FEMA), Community Panel No. 3604970261G; effective 5 December 2013. According to the FIRM's for the City of New York, Community-Panel Number 261, the site is outside of any Special Flood Hazard Area. The relevant part of the FEMA Flood Insurance Rate Map (FIRM) is presented as Figure No. 3.

## **PROPOSED DEVELOPMENT**

According to the site scope plan, the proposed development includes excavating in the open-air parking lot to construct a two-story building with a below-grade level.

The proposed building with cellar will be towards the north of the site, with a small part of the first floor (without a cellar level) extending toward the south. An on-grade parking lot borders this building to the south. The proposed first floor on the south will be offset about 14 feet from the toe of the LIRR embankment. The general excavation along the cellar extent will be about to el 4, which is about 17 feet bgs and about 3.5 feet below the measured groundwater level.

The preliminary structural column loads provided by the project structural engineer (Thornton Tomasetti) are as follows:

- Exterior column loads on the parking side (on the south) are about 325 tons.
- Exterior column loads on the street side (on the north) are about 70 tons.
- Interior column loads are about 120 tons.

## **SUBSURFACE INVESTIGATION**

Our understanding of the subsurface conditions is based on a review of available geologic information and the results of the geotechnical investigation provided by CDM Smith. The investigation performed by Aquifer Drilling & Testing, Inc. included drilling 11 borings (B-1 through B-11) and 8 shallow probes (PB-1 through PB-8), and installing 3 groundwater observation wells. Two test pits were excavated investigate the extents and the layout of the existing conduit towards the south of the site. A subsurface investigation plan is presented as Figure No. 4.

## **Geophysical Engineering Survey**

Nova Geophysical Services conducted (hired by others) Geophysical Engineering Surveys to mark out the locations for current and former utilities and clear the boring and probe locations. The geophysical report is included as Appendix A.

## **Borings and Probes**

Eleven borings were drilled to about 37 to 102 feet bgs using mud-rotary drilling techniques with a tri-cone roller bit and drilling fluid consisting of a mixture of bentonite and water. Eight probes were drilled to about 12 to 37 feet bgs the same method as the borings.

Before drilling, borings and probes were cleared for utilities using a hand-operated auger for the top 6 feet. Temporary flush-joint steel casings were used to support soil when necessary. Standard Penetration Tests (SPT)<sup>1</sup> were performed in the soil layers using an automatic hammer and a standard split spoon sampler (ASTM D1586). N-values were recorded, and soil samples were obtained continuously from 6 to 12 feet and at 5-foot intervals after that to the termination depth of the borings and probes. Two undisturbed soil samples were obtained in the clay layers by Shelby Tube in general accordance with ASTM D1587. Recovered soil samples were visually examined and classified in the field according to the Unified Soil Classification System (USCS), and assigned classification numbers in accordance with the New York City Building Code.

A boring location plan and logs by CDM Smith are presented in Appendix B.

## **Observation Wells**

Three groundwater observation wells were installed as part of the subsurface investigation in B-4(OW), B-6(OW), and B-8(OW). Each consisted of 2-inch-diameter PVC pipes installed to 35 feet bgs.

## **Test Pits**

Two test pits, identified as TP-1 and TP-2, were excavated along the existing water conduit along the south side of the site. The results of both test pits provided us the location, depths, and type of the existing water conduit. The sketches and photographs are presented in Appendix C.

---

<sup>1</sup> The Standard Penetration Test is a measure of the soil density and consistency. The SPT N-value is defined as the number of blows required to drive a 2-inch-outer-diameter split-barrel sampler 12 inches using a 140-lb hammer falling freely for 30 inches (ASTM D1586).

## **SUBSURFACE CONDITIONS**

The subsurface conditions generally consist of uncontrolled fill underlain by loose to dense sand with pockets of silts and soft to stiff clays. The subsurface profiles are included as Figure Nos. 5 through 7. Detailed descriptions of each subsurface stratum are given in the order of increasing depth.

### **Fill [Class 7]<sup>2</sup>**

A layer of uncontrolled fill consisting of gray and brown sand, silt, and gravel with various debris was encountered immediately below the surficial asphalt in all borings. The fill extended to the top of native sand deposits at about 6 feet bgs throughout the site, corresponding to about el 15. The N-values in the fill layer was not available because the soil was excavated using a hand-operated auger.

The fill, considered loose to medium-dense, is designated as Building Code Class 7 material, Uncontrolled Fill.

### **Sand [Classes 3a, 3b, and 6]**

Brown and gray fine to medium sand (with varying proportions of fine gravel, silt, and clay) was encountered beneath the fill to the terminations of all borings. The sand was loose to dense with N-values ranging between 2 and 60 blows per foot (bpf), averaging about 16 bpf. Peat, silt, and clay layers (to be discussed in the following sections) with thicknesses between about 2 and 7 feet was encountered at about 65 feet below grade.

Mechanical grain-size analyses were performed on 29 representative samples in this stratum. The material passing the No. 200 sieve ranged typically ranged from 1 to 5 percent (averaging 3 percent). The samples are classified as poorly-graded sand (SP), poorly-graded sand with silt (SP-SM), Silty Sand (SM), and Silty, clayey sand (SC-SM) in accordance with Unified Soil Classification System (USCS).

Two Atterberg-limit tests were performed on the silty and clayey sand samples in boring B-5. The liquid limit (LL) ranged between 17 and 19 percent, plastic limit (PL) ranged between 13 and 14 percent, and plasticity index (PI) ranged between 4 and 5 percent. The natural water content and organic content was found to be about 20 and 2 percent, respectively.

---

<sup>2</sup> Numbers in brackets indicate classification of material in accordance with the 2014 New York City Building Code

An isotropically-consolidated triaxial test was performed on one undisturbed sample in B-5 that was collected in the silty, clayey sand stratum. The major and minor effective stresses were 16.6 and 4.1 pounds per square inch (psi), respectively. The undrained compressive strength is about 6 psi.

The sand stratum is designated as Building Code Classes 3a, 3b, and 6 material, Dense to Medium-Dense to Loose Sand.

### **Peat [Class 6]**

A thin peat layer of about 2-foot thick with varying amount of sand, silt, and clay were encountered within the sand layer with the top of the layer at about 67 feet bgs, corresponding to el -46.

One undisturbed sample was collected at B-6 from this layer. Atterberg-limits was performed on this sample. The natural water content and organic content were about 187 and 80 percent, respectively. The compression ratio ( $C_c$ ) and recompression ratio ( $C_R$ ) were about 0.26 and 0.03, respectively. The over-consolidation ratio (OCR) is about 1.5.

The peat is designated as Building Code Class 6 material, Peats.

### **Silt [Classes 5a, 5b, and 6]**

Gray to brown silt of about 2- to 7-foot thick with varying amount of fine sand and clay was found within the sand layer with the top of the silt at about 65 to 75 feet bgs, corresponding to el -42 and -54. The silt has N-values ranging between 4 and 33 bpf, averaging about 19 bpf.

Natural water content and organic content tests were performed for one representative sample from boring B-6. The moisture content was about 47 percent, and organic content was about 3 percent. The samples are classified as Silt and Clay or Clayey Silt (ML) in accordance with USCS.

The silt stratum is designated as Building Code Classes 5a, 5b, and 6 materials, Dense to Medium-Dense to Varved Silt.

### **Clay [Class 4b, 4c, and 6]**

Lenses of clay with varying amount of silt and sand were encountered within the sand layer at about 65 feet bgs, corresponding to el -44. The clay has N-values ranging between 4 and 9 bpf.

Atterberg-limits tests were performed on two representative samples in B-6 and B-7. The liquid limit (LL) was about 56 percent, plastic limit (PL) was about 28 percent, and plasticity index (PI)



was about 28 percent. The natural water content ranged from between 37 and 44 percent, respectively.

The clay stratum is designated as Building Code Class 4b, 4c, and 6 material, Stiff to Soft Clay.

## **Groundwater**

The static groundwater levels from the observation wells were measured to be at about 13.5 to 14 feet bgs, corresponding to about el 7.5. Groundwater in TP-1 was measured to about el 7.5, which is consistent with the measurements from the observation wells. The groundwater elevation readings are summarized in Appendix B.

## **SEISMIC EVALUATION**

This section presents the results of our seismic evaluation for the site about the provisions outlined in the 2014 New York City Building Code. The following subsections provide recommended parameters for use in the seismic design of the proposed structure. These seismic parameters will require further evaluations following any additional borings required by the Building Code.

### **NYC Building Code Seismic Design Parameters**

The recommended Building Code seismic parameters are based on the average N-value of the soil. The N-values show a generally linear increase with depth. The soil profile below the foundation level is consistent with Site Class D "Stiff Soil Profile," and we assumed that the structure is in Structural Occupancy/Risk Category IV. Therefore, the design spectral accelerations result in Seismic Design Category (SDC) C. The seismic design parameters are presented in Table 1.

Table 1 – Seismic Design Parameters

Description	Parameter	Recommended Value	Building Code Reference
Mapped Spectral Acceleration for short periods:	$S_s$	0.281 g	Section 1613.5.1
Mapped Spectral Acceleration for 1-sec period:	$S_1$	0.073 g	
Site Class	Stiff Soil Profile <b>D</b>		Table 1613.5.2
Site Coefficient:	$F_a$	1.57	Table 1613.5.3(1)
Site Coefficient:	$F_v$	2.40	Table 1613.5.3(2)
5 percent damped design spectral response acceleration at short periods:	SDS	0.294 g	Section 1613.5.4
5 percent damped design spectral response acceleration at 1-sec period:	SD1	0.117 g	
Structural Occupancy	<b>IV</b>		Table 1604.5
Seismic Design Category (SDC)	<b>C</b>		Table 1613.5.6

## Liquefaction Evaluation

Soil liquefaction is a phenomenon primarily associated with saturated, loose, cohesionless soils near the ground surface (depths within 50 feet). As these soils are shaken, pore water pressure may develop that will temporarily force the soil particles apart such that the soil will temporarily behave more like a liquid than a granular mass. The liquefaction potential was evaluated using both the 2014 Building Code and the Youd et al. analysis (2001).

### 2014 NYC Building Code Liquefaction Evaluation

In accordance with the 2014 Building Code screening process, N-values versus depth is plotted on the Building Code Liquefaction Assessment Diagram presented as Figure No. 8. Nearly half of the N-value points fall within the “Liquefaction Evaluation Required” category, requiring the following liquefaction analysis.

### Youd et al. (2001) Liquefaction Analysis

The potential for soil liquefaction was evaluated further using the procedure outlined by Youd et al. (2001). The Youd et al. evaluation is based on the procedure for liquefaction evaluation

developed by Seed and Idriss (1982) and is considered to be the state-of-practice, as recommended by the National Earthquake Hazard Reduction Program. This evaluation presents an empirical relationship between the earthquake demand, represented by the Cyclic Stress Ratio (CSR), and the soil's resistance to dynamic loading, represented by the Cyclic Resistance Ratio (CRR). The CSR is related to the Peak Ground Acceleration (PGA) of the design earthquake and the in situ soil stresses. The CRR is related to SPT N-values obtained in the field. The field-measured N-values are normalized to  $N_{60,cs}$  values by applying correction factors to such variables as soil overburden pressure, hammer energy, and fines content.

Our analysis included a magnitude 5.73 earthquake and a peak ground acceleration of 0.24g (Site Class D). A plot of the calculated factor of safety versus depth using the Youd et al. (2001) procedure for each boring is presented as Figure No. 9. One of the about 90 data points has a factor of safety less than 1.0, and we considered this point to be an anomaly. Therefore, in our judgment, there is an adequate margin of safety against liquefaction for the site. Ground settlements resulting from the design earthquake are estimated to be at 1 inch or less. These settlements will occur within the site and its surrounding areas (i.e., sidewalk, roadway, neighboring buildings).

## **FOUNDATION RECOMMENDATIONS**

We recommend that the proposed structure bear on a shallow foundation system consisting of spread footings constructed on the native sand.

### **Shallow Foundation**

The Building Code Class 3b sand is a satisfactory bearing material, which is typically about 6 to 8 feet bgs, can be used to support the building. The recommended allowable bearing capacity is 3 tsf. We recommend that the proposed structure bear on shallow foundation system (i.e., spread or wall footings). The footings should not exert any significant lateral load to the existing water conduit to the south.

Individual spread footings should have a minimum size of 9 sf, and wall footings should have a minimum width of 2 feet. All footings should be protected from frost by extending a minimum of 4 feet below the lowest adjacent permanent exposed grade.

### **Settlements**

Gross settlements are estimated to be about  $\frac{3}{4}$  inch for exterior footings and  $\frac{1}{2}$  inch for interior footings. The majority of the settlements will occur during construction. Angular rotations are estimated to be less than 1/500.

### Subgrade Preparation and Protection

Foundation bearing surfaces should be level and clear of debris, standing or frozen water, and other deleterious materials. Soils should be excavated with care to avoid disturbance below the bearing elevation. Soil subgrades should be compacted using a vibratory trench roller, and vibratory plate or jumping-jack compactors should only be used where directed by the special inspector. The foundation subgrade should be inspected and approved by a professional geotechnical engineer, licensed in New York state, to ensure that the subgrade material is adequate to provide the recommended allowable bearing pressure. Approved subgrade surface should be protected until the footing construction is completed if concrete is not placed within 24 hours. Methods of protection include sealing with lean concrete (mud slab).

### Lateral Resistance

The proposed shallow footings can resist lateral loads through frictional resistance between the concrete and the soil subgrade and passive earth pressures. The recommended sliding friction coefficient with a factor of safety of 1.5, is 0.2 for waterproofed surfaces and 0.4 for concrete cast on the native soil. The recommended passive resistance is a triangular pattern with 300 pounds per one foot of depth.

## **Permanent Groundwater Control**

### Design Groundwater Elevation

We recommend a design groundwater level of el 11, which is about 3.5 feet above the highest measured groundwater elevation during the subsurface investigation. The design groundwater level will account for periods of prolonged precipitation or utility breaks.

### Pressure Slab

The cellar-floor slabs should be a structural pressure slab integrated with the foundations. The slab should be designed to withstand the dead and live loads. Additionally, the pressure slab must be designed to resist the hydrostatic uplift pressures resulting from design groundwater elevation at el 11, which is about 6 feet above the assumed bottom of the proposed cellar slab (at el 5).

### Soil Anchors

Soil anchors are drilled-in elements that resist uplift forces through friction bond with the soil. For preliminary design, we recommend using a minimum 5-inch-diameter drill hole with a single

1.25-inch-diameter, double-corrosion-protected, high-strength threaded bar set in 4,000 psi cement grout. The anchor should have a 30-foot bonded zone and a 15-foot un-bonded zone. An allowable tension resistance of 40 kips can be achieved on a single anchor. At least 10 percent of anchors should be performance-tested in accordance with PTI standards, and the remaining anchors should all be proof tested. Group effects must also be evaluated to determine appropriate anchor spacing and the length of the bond zone.

### Waterproofing

Since the observed groundwater was encountered at a depth higher than the proposed cellar level, waterproofing will be necessary. The foundation should be waterproofed with a membrane-type waterproofing such as the Preprufe and Bituthene products, and post-injectable waterstop by Grace Construction Products. For additional protection, we strongly recommend a waterproofing admixture product (such as Hycrete) could be added to the concrete used for below-grade foundation slab and walls. The use of bentonite waterproofing or negative-side crystalline waterproofing is not recommended. A 3-inch-thick concrete mud slab should be prepared below all slab surfaces.

For all waterproofing applications, diligent oversight during and after the installation of waterproofing materials is critical, especially during the placement of reinforcements for slabs, walls, and foundations. Only certified installers should be used to perform the work. Detailed daily observations should be performed to document any non-conformance or damage resulting from the contractor's activities.

### **First Floor Slab-on-Grade**

The slab-on-grade can bear on the fill layer excavating to at least 12 inches below the bottom of the slab. The subgrade should be compacted, and a 12-inch-thick layer of gravel should be placed and compacted before the slab-on-grade placement. The recommended subgrade modulus is about 150 psi per inch.

### **Below-Grade Walls**

Below-grade walls will be subjected to lateral pressures caused by soil and surcharge loads. Lateral pressures from earth and surcharge loads should be considered. Dynamic lateral loads need not be considered because the site is Seismic Design Category C (Building Code Section 1802.2). Our recommended lateral earth-pressure diagram is presented in Figure No. 10.

## **OTHER GEOTECHNICAL RECOMMENDATIONS**

### **Excavation**

The proposed excavation spread footings will require excavations to about 6 to 17 feet bgs. Site excavation can likely be performed using conventional earth-moving equipment (e.g., backhoes, excavators, etc.). All excavation operations should be performed in accordance with the Occupational Safety and Health Administration (OSHA) requirements.

The contractor must take appropriate measures to stabilize the work area and prevent lateral movement of the adjacent areas during the excavation. The excavation can be achieved by soil benching using a 1 (vertical) to 1.5 (horizontal) slope. The Occupational Safety and Health Administration (OSHA) indicates that an excavation must be protected from cave-ins by an adequate protective system (e.g., sloping of excavations, braced excavation systems).

### **Temporary Groundwater Control**

Lowering the water table to a minimum of 2 feet below the excavation bottom within the groundwater barrier will be necessary to provide a satisfactory working surface for the foundation construction. The general excavation is about 17 feet bgs, which is about 5 feet below the measured groundwater level.

Dewatering systems must be designed and installed by a specialty contractor with proven experience in this area. The contractor's dewatering engineer should design the dewatering system to properly address the various locations and depths of the excavations within the site. Disposal of pumped groundwater should be performed in accordance with all applicable local and federal regulations. A wellpoint system will likely be required to fully dewater the site and limit the vertical flow of groundwater into the site.

### **Fill Materials, Placement, and Compaction**

Structural fill beneath foundations, floor slabs, or behind walls should consist of a well-graded granular material having a maximum particle size of 4 inches in any dimension, and no more than 10 percent fines passing the No. 200 sieve. All fill should be free of trash, debris, roots, vegetation, peat, or other deleterious materials and should be approved by the geotechnical engineer before placement. Lean concrete or controlled low-strength material (CLSM) may be substituted for structural fill. Fill should not be placed on subgrades not inspected and approved by the inspecting geotechnical engineer.

## **ADDITIONAL RECOMMENDATIONS**

The following sections provide recommendations for LIRR submission and preconstruction conditions documentation at adjacent structures.

### **LIRR Review**

The proposed excavation for first-floor footings is about 14 feet away from the toe of the LIRR embankment. Also, the construction sequence involves dewatering to lower the groundwater table by 4 feet. Considering the proximity to the embankment and the effects of groundwater drawdown and excavation, the foundation drawings should be submitted to LIRR for review and approval.

### **Preconstruction Conditions Documentation**

We recommend that a comprehensive preconstruction conditions documentation of the adjacent 105th Precinct (on the west) and LIRR tracks and station (on the south) be undertaken before commencing excavation. The purpose of the observation is to provide a photographic or video-documentation representation (or both) of the existing general conditions and to identify obvious visual deficiencies. The preconstruction-conditions documentation should also identify areas requiring specific monitoring during construction, including optical surveying and vibration monitoring. The structural integrity of the structure is not commonly addressed in such documentation. This documentation could help protect the owner from potential claims of construction-induced damage.

The contractor must use prudent measures to monitor, support and protect the adjacent structures during all work. The contractor's engineer should examine all nearby buildings before the start of earthwork to develop a protection plan.

## **SERVICES DURING DESIGN, CONSTRUCTION DOCUMENTS, AND CONSTRUCTION QUALITY ASSURANCE**

During final design, we should be retained to consult with the design team as geotechnical questions arise. Technical specifications and design Figures should incorporate Langan's recommendations. When authorized, Langan will assist the design team in preparing specification sections related to geotechnical issues such as earthwork, ground improvement, shallow foundations, backfill and excavation support. Langan should also, when authorized, review the project plans — as well as contractor submissions relating to materials and construction procedures for geotechnical work — to confirm the designs incorporate the intent of our recommendations.

Langan has investigated and interpreted the site subsurface conditions and developed the foundation design recommendations contained here and is, therefore, best suited to perform quality-assurance observation and testing of geotechnical-related work during construction. The work requiring quality-assurance confirmation or special inspections per the Building Code includes, but is not limited to, earthwork, backfill, ground improvement, shallow and deep foundations, and excavation support.

Recognizing that construction observation is the final stage of geotechnical design, quality-assurance observation during construction by Langan is necessary to confirm the design assumptions and design elements, to maintain our continuity of responsibility on this project, and to allow us to make changes to our recommendations, as necessary. The foundation system and general geotechnical construction methods recommended here are predicated upon Langan assisting with the final design and providing construction observation services for the owner. If Langan is not retained for these services, we cannot assume the role of the geotechnical engineer of record, and the entity is providing the final design and construction observation services must serve as the engineer of record.

## **OWNER AND CONTRACTOR RESPONSIBILITIES**

The contractor is responsible for construction quality control, which includes satisfactorily constructing the foundation system and any associated temporary works to achieve the design intent while not adversely impacting or causing loss of support to neighboring property, structures, utilities, roadways, etc. Construction activities that can alter the existing ground conditions such as excavation, fill placement, foundation construction, ground improvement, and related activities, can also induce stresses, vibrations, and movements in nearby structures and utilities, and disturb occupants. Contractors are solely responsible for ensuring that their activities will not adversely affect the structures and utilities, and will not disturb occupants. Contractors must also take all necessary measures to protect the existing structures, utilities, etc. during construction. By using this report, the owner agrees that Langan will not be held responsible for any damage to adjacent structures, utilities, etc.

The preparation and use of this report is based on the condition that the project construction contract between the owner and their contractors will include (1) Langan being added to the project wrap and contractor's general liability insurance as an additional insured, and (2) language specifically stating that the foundation contractor will defend, indemnify, and hold harmless the owner and Langan against all claims related to disturbance or damage to adjacent structures, utilities, or properties.



## **LIMITATIONS**

The conclusions and recommendations provided in this report result from our interpretation of the geotechnical conditions existing at the site inferred from a limited number of borings performed by others, and from architectural information prepared by Dattner Architects. Actual subsurface conditions may vary. Recommendations provided are dependent upon one another, and no recommendation should be followed independently of the others.

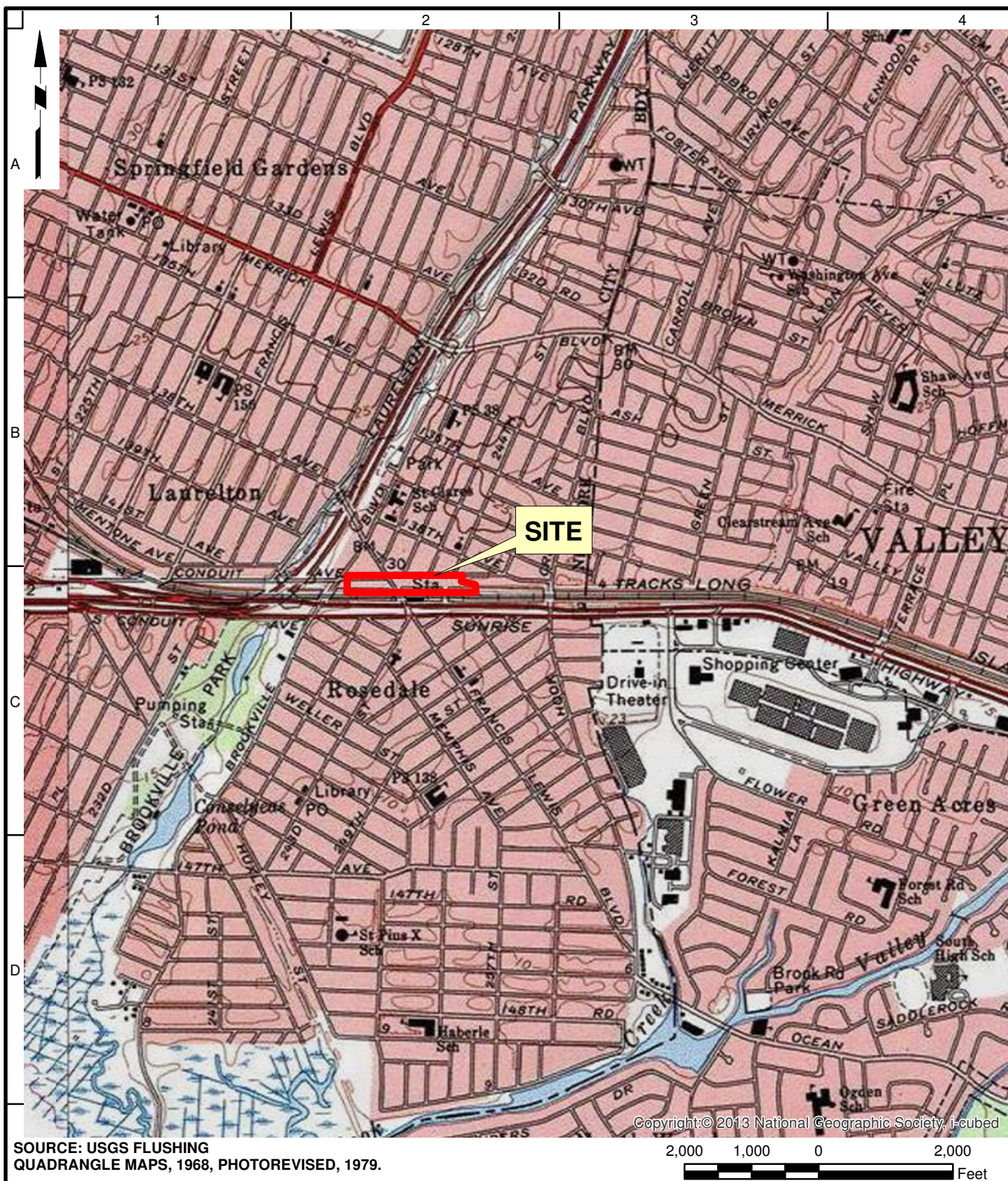
Any proposed changes in structures or their locations should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations. Information on subsurface strata and groundwater levels shown on the logs represent conditions encountered only at the locations indicated and at the time of the investigation. If different conditions are encountered during construction, they should immediately be brought to Langan's attention for evaluation, because they may affect our recommendations.

This report has been prepared to assist the owner, architect, and structural engineer in the design process and is only applicable to the design of the specific project identified. The information in this report cannot be used or depended on by engineers or contractors who are involved in evaluations or designs of facilities (including underpinning, grouting, stabilization, etc.) on adjacent properties beyond the limits of that which is the specific subject of this report.

Environmental issues (such as permitting or potentially contaminated soil and groundwater) are outside the scope of this study and should be addressed in a separate evaluation.

# FIGURES





**LANGAN**

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## 116TH POLICE PRECINCT

BLOCK No. 13265, LOT No. 30  
ROSEDALE

QUEENS

NEW YORK

Figure Title

## USGS SITE LOCATION MAP

Project No.

170495201

Date

10/15/2018

Scale

1 in = 2,000 ft

Drawn By

KC

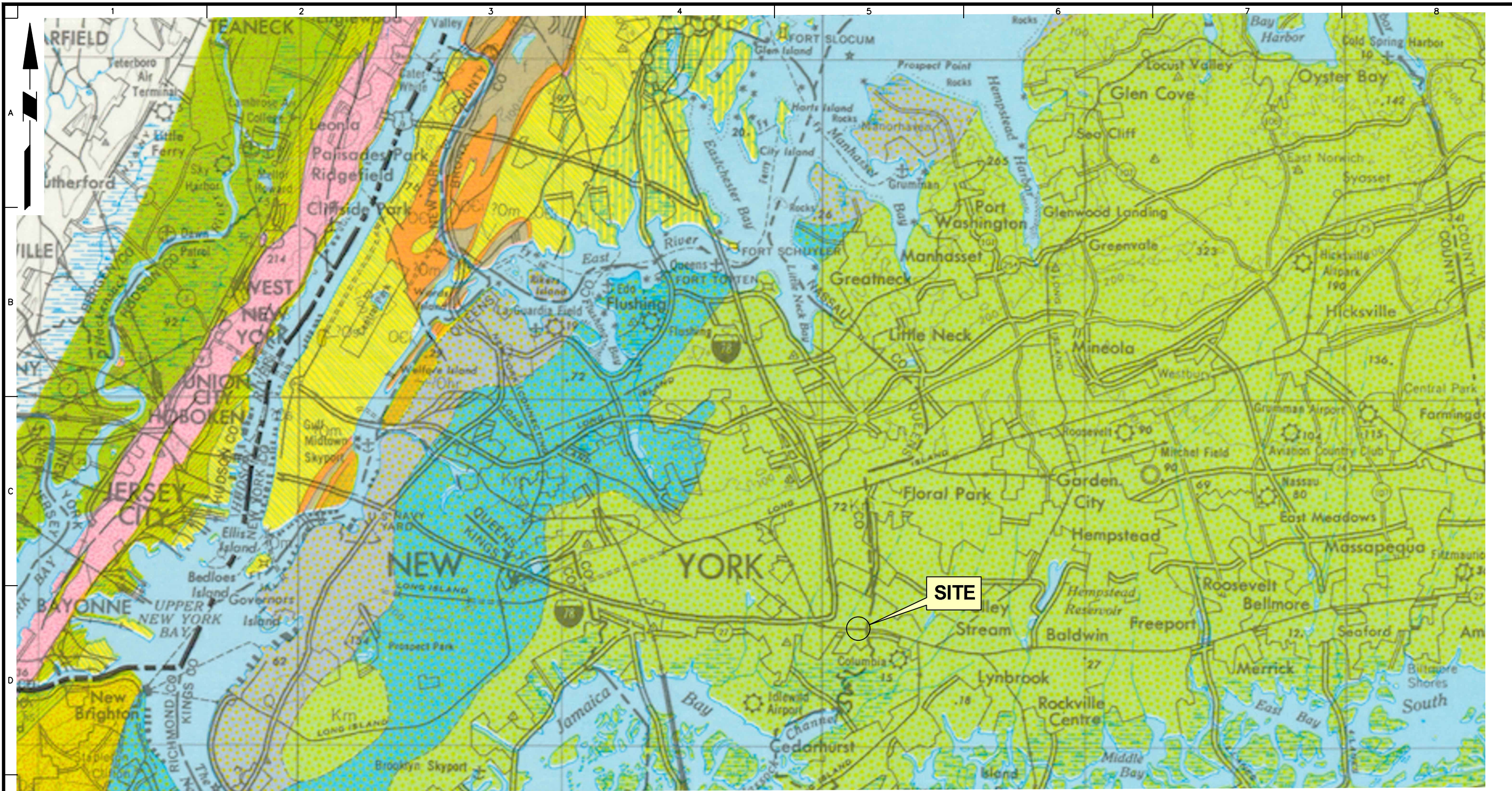
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TKC

Figure No.

1





**SOURCE:** "GEOLOGIC MAP OF NEW YORK, LOWER HUDSON SHEET," NEW YORK STATE MUSEUM AND SCIENCE SERVICE, 1995

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**116TH PRECINCT  
STATION HOUSE**

BLOCK No. 13265, LOT No. 30  
ROSEDALE  
QUEENS NEW YORK

Figure Title

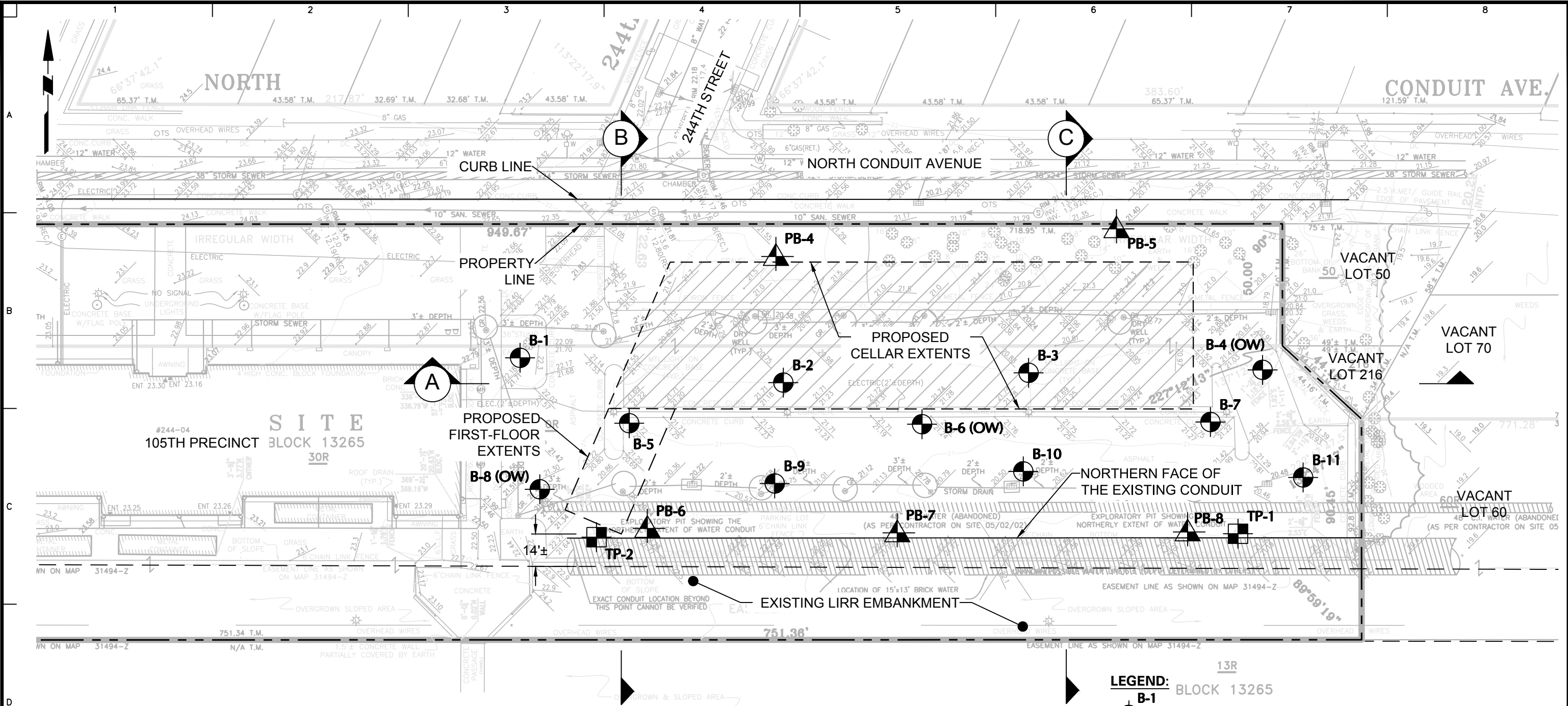
**SURFICIAL  
GEOLOGY  
MAP**

Project No. 170495201	Figure No.  <b>2</b>	
Date 10/15/2018		
Scale N.T.S.		
Drawn By RR		Checked By TKC









**GENERAL NOTES:**

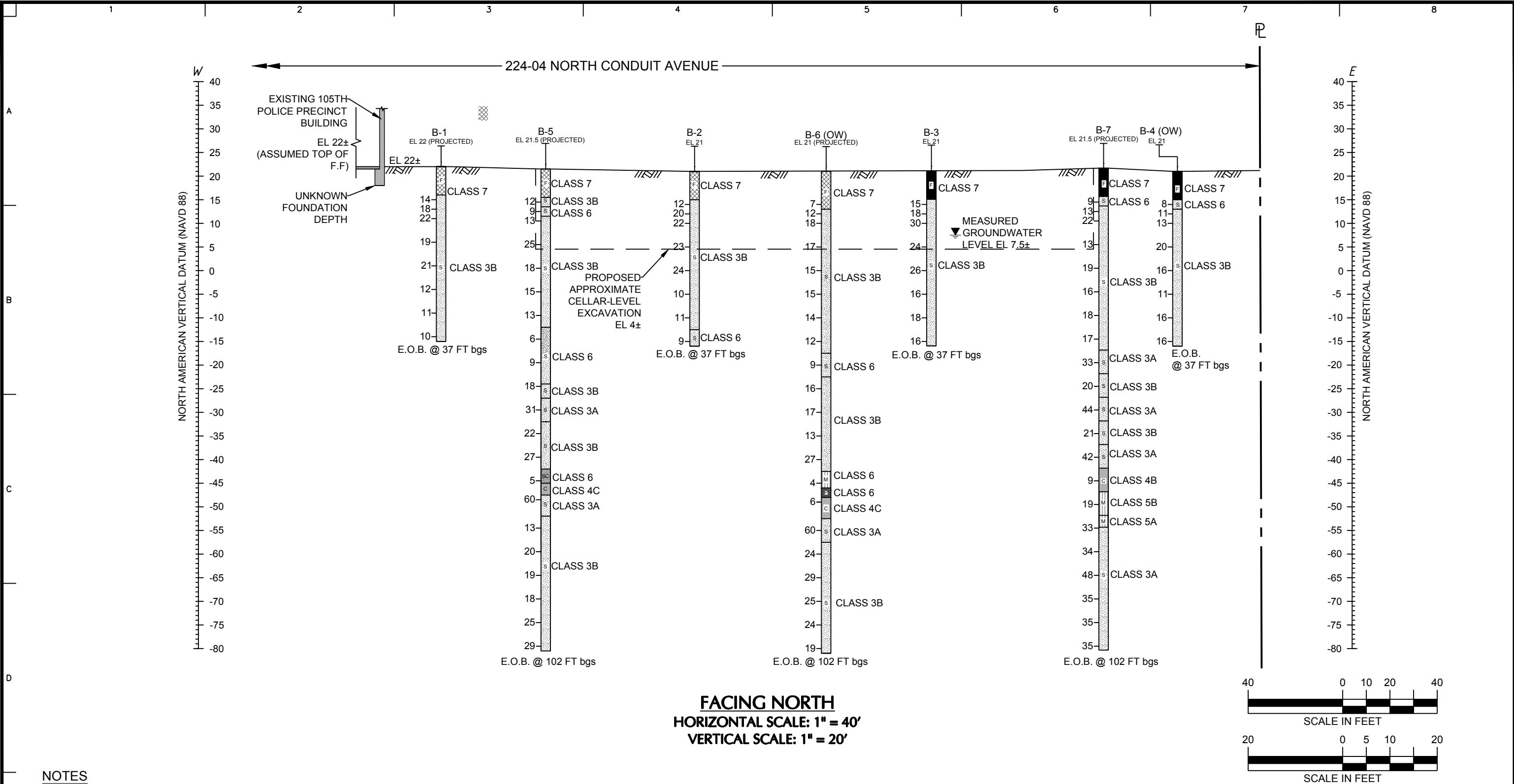
1. BACKGROUND SURVEY WAS TAKEN FROM THE DRAWING TITLED "TOPOGRAPHICAL AND PROPERTY LINE MAP", PREPARED BY THE NEW YORK CITY DEPARTMENT OF DESIGN AND CONSTRUCTION (NYC DDC), DIVISION OF PROGRAM MANAGEMENT, OFFICE OF SITE ENGINEERING, FOR THE 116TH POLICE PRECINCT DATED 11 SEPTEMBER 2018.
2. THE EXTENTS OF THE CELLAR AND FIRST-FLOOR LEVELS WERE DELINEATED FROM DRAWING NO. SK101-C1, "OPTION 2C ALT1-ENLARGED SITE PLAN", PREPARED BY DATNER ARCHITECTS, DATED 20 OCTOBER 2017.
3. ALL ELEVATIONS SHOWN HERE REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
4. ALL BORINGS AND PROBES WERE PERFORMED BY OTHERS UNDER THE INSPECTION OF CDM SMITH BETWEEN 16 AUGUST AND 8 SEPTEMBER 2017.
5. TEST PITS WERE PERFORMED BY TEST PIT CORP. UNDER THE INSPECTION OF LANGAN BETWEEN 27 AUGUST AND 11 SEPTEMBER 2018.

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STATION HOUSE**  
BLOCK No. 13265, LOT No. 30  
ROSEDALE  
QUEENS NEW YORK

Figure Title  
**SUBSURFACE  
INVESTIGATION  
PLAN**

Project No. 170495201	Figure No. <b>4</b>
Date 10/15/2018	
Scale 1" = 40'	
Drawn By RR	Checked By TKC



NOTES

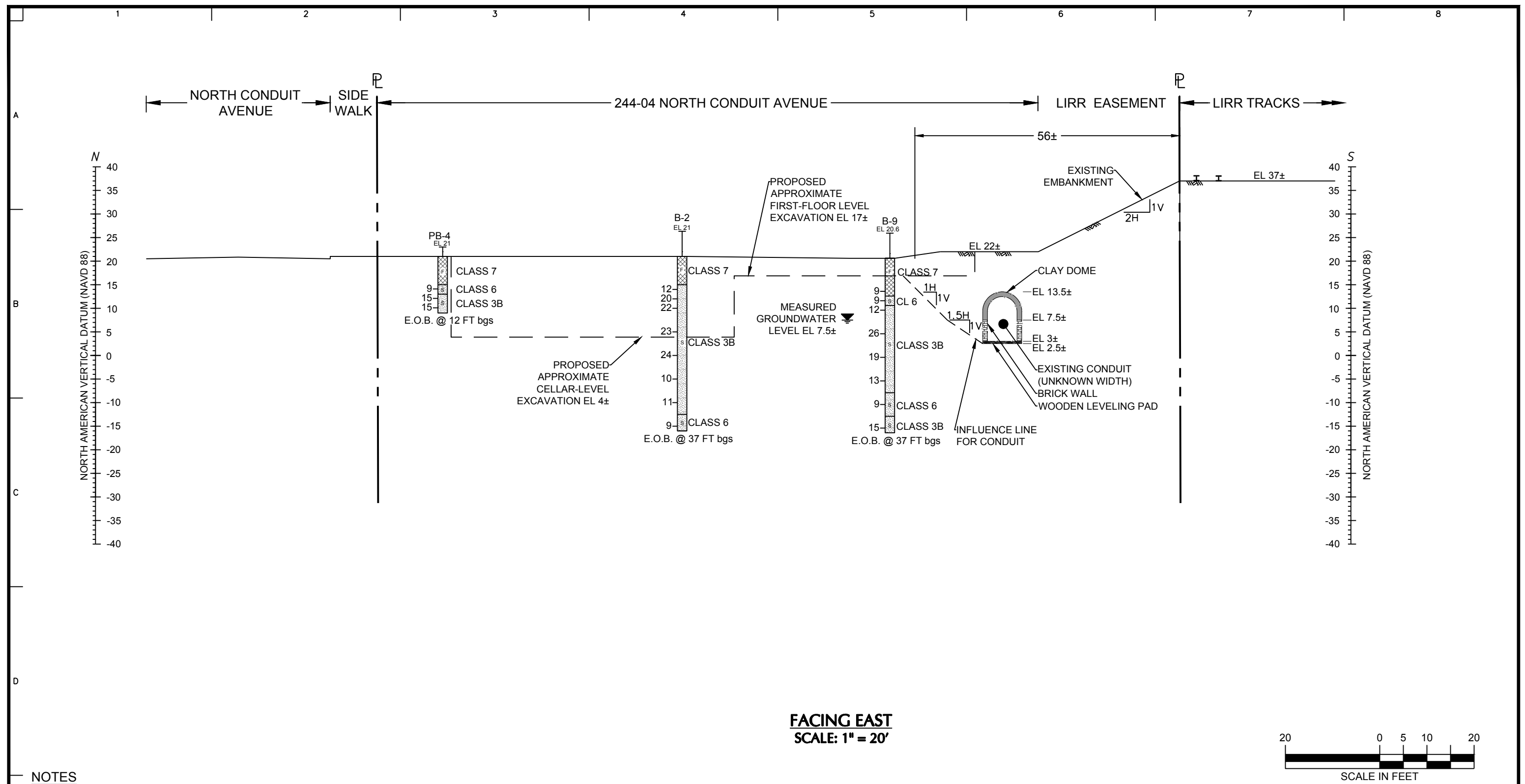
- REFER TO DRAWING NO. 4 FOR GENERAL NOTES
- THIS PROFILE REPRESENTS A GENERALIZED SOIL CROSS SECTION INTERPRETED FROM WIDELY SPACED BORINGS. SOIL AND GROUNDWATER MAY VARY IN TYPE, LOCATION, ELEVATION, AND ENVIRONMENTAL AND ENGINEERING PROPERTIES BETWEEN POINTS OF EXPLORATION. VARIATIONS IN SUBSURFACE CONDITIONS SHOULD BE EXPECTED BETWEEN BORINGS.

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BLOCK No. 13265, LOT No. 30  
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QUEENS NEW YORK

Figure Title  
**SUBSURFACE  
PROFILE A**

Project No. 170495201	Figure No. <b>5</b>
Date 10/15/2018	
Scale AS SHOWN	
Drawn By RR	Checked By TKC

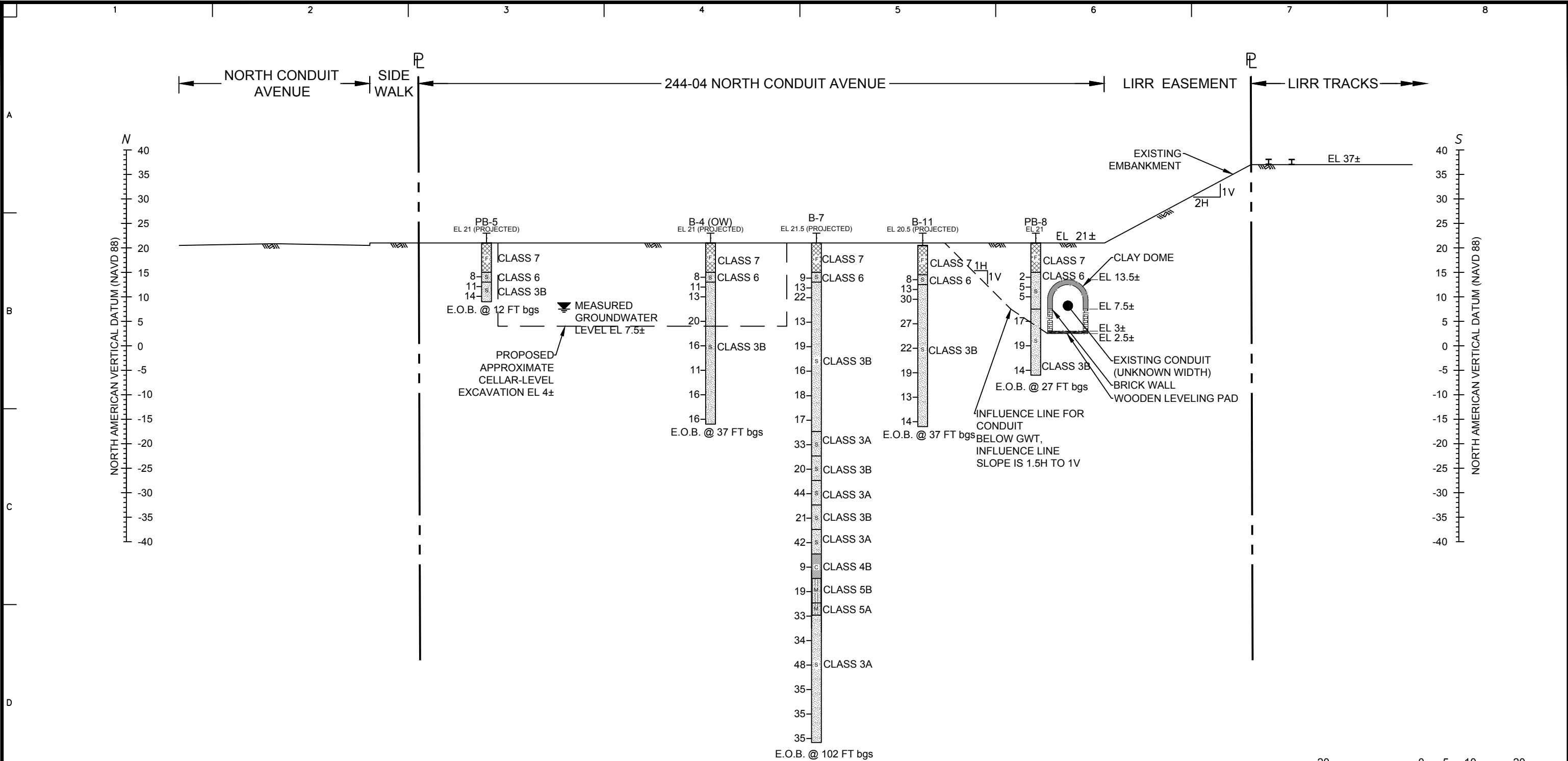


NOTES

1. REFER TO DRAWING NO. 4 FOR GENERAL NOTES
2. THIS PROFILE REPRESENTS A GENERALIZED SOIL CROSS SECTION INTERPRETED FROM WIDELY SPACED BORINGS. SOIL AND GROUNDWATER MAY VARY IN TYPE, LOCATION, ELEVATION, AND ENVIRONMENTAL AND ENGINEERING PROPERTIES BETWEEN POINTS OF EXPLORATION. VARIATIONS IN SUBSURFACE CONDITIONS SHOULD BE EXPECTED BETWEEN BORINGS.

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	<b>116TH PRECINCT STATION HOUSE</b>  BLOCK No. 13265, LOT No. 30 ROSEDALE QUEENS NEW YORK	<b>SUBSURFACE PROFILE B</b>	170495201	<b>6</b>
			Date	
			10/15/2018	
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RR	TKC			

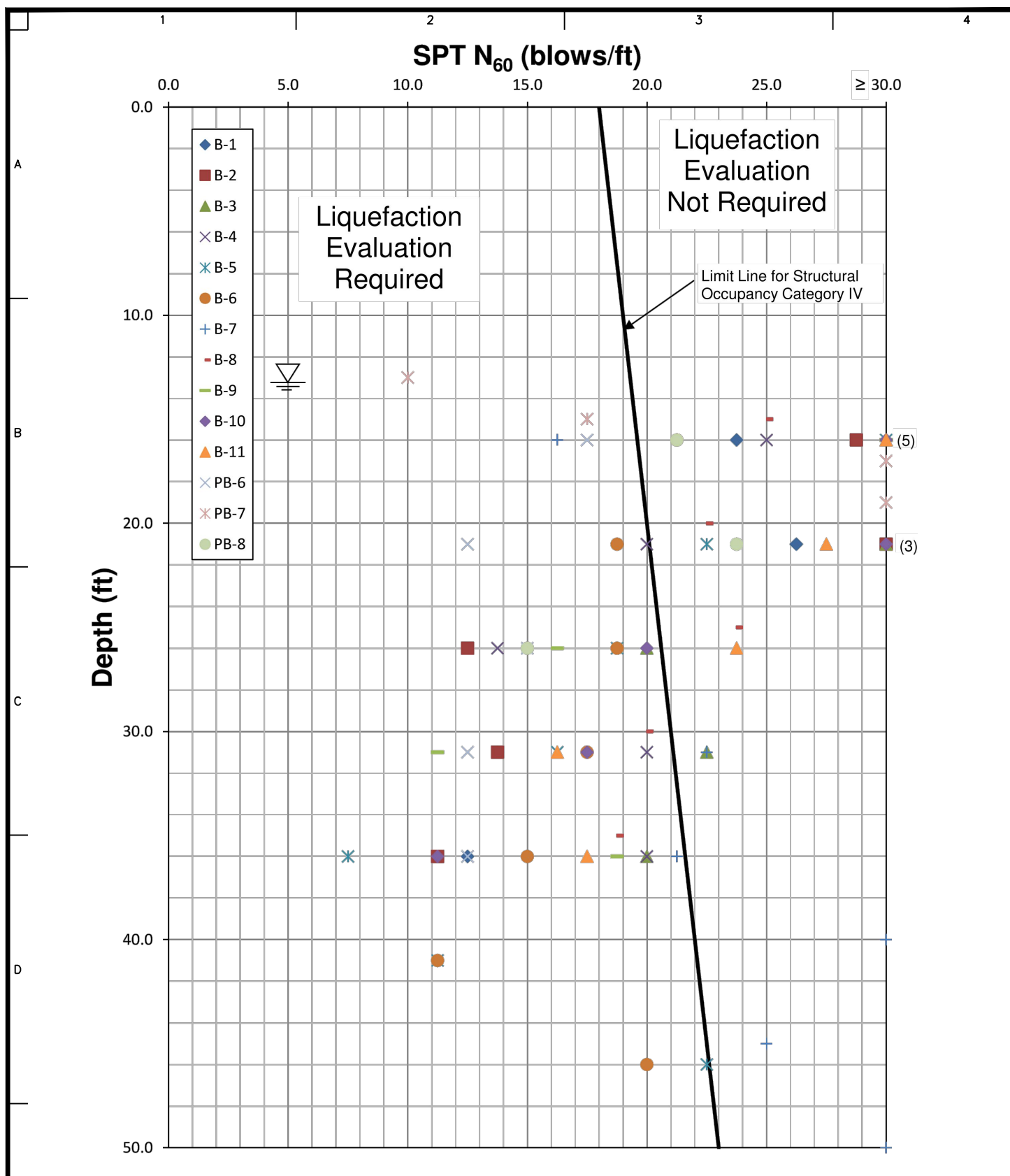




NOTES

- REFER TO DRAWING NO. 4 FOR GENERAL NOTES
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	<b>116TH PRECINCT STATION HOUSE</b>  BLOCK No. 13265, LOT No. 30 ROSEDALE QUEENS NEW YORK	<b>SUBSURFACE PROFILE C</b>	170495201	7
			Date	
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1" = 20'	Drawn By	Checked By		
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**116TH PRECINCT  
STATION HOUSE**

**BLOCK No. 13265, LOT No. 30  
ROSEDALE**

**QUEENS**

**NEW YORK**

Figure Title

**NYCBC  
LIQUEFACTION  
CHART**

Project No.  
170495201

Date  
10/15/2018

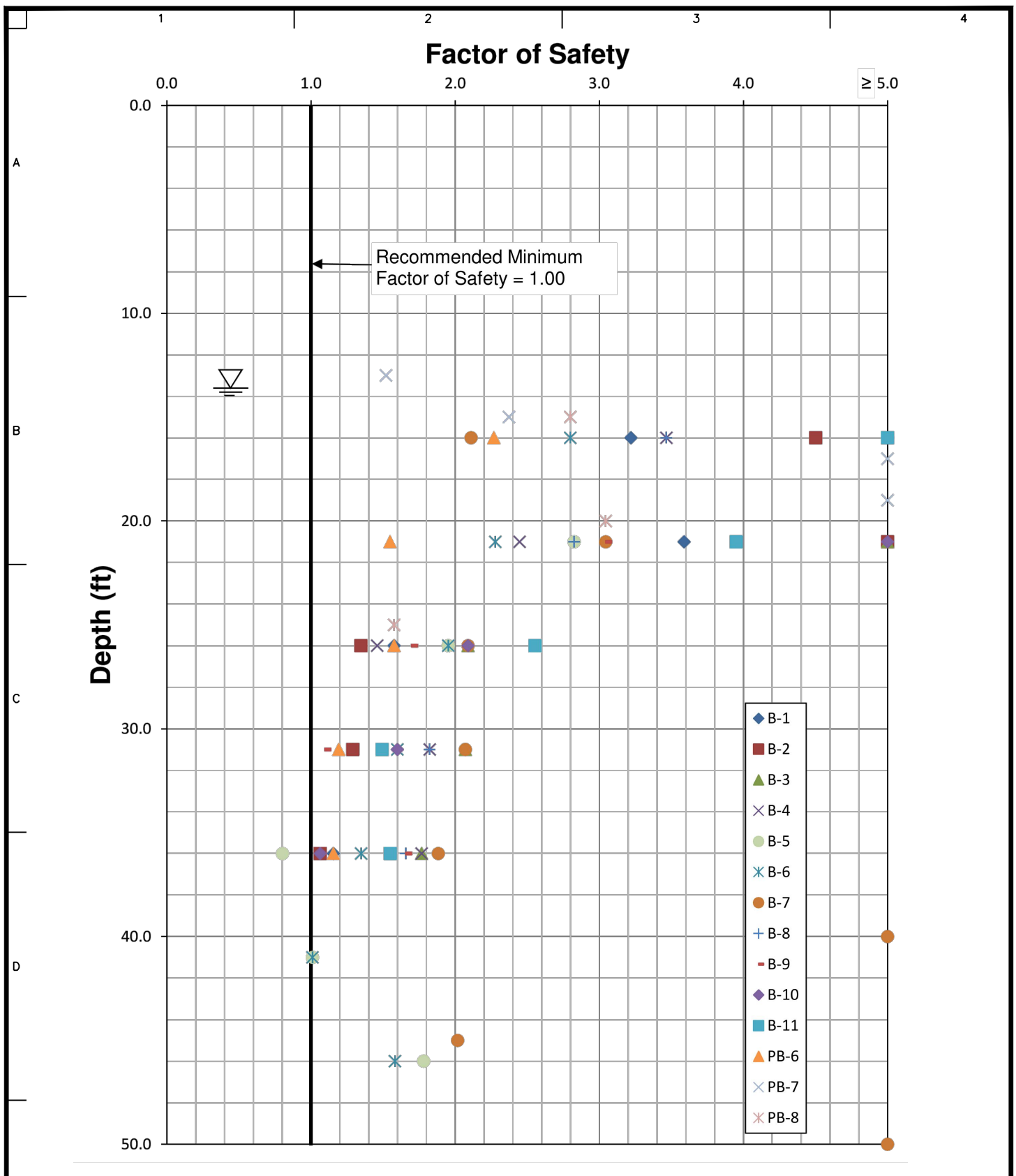
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Figure No.

**8**



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**116TH PRECINCT  
STATION HOUSE**

**BLOCK No. 13265, LOT No. 30  
ROSEDALE**

**QUEENS**

**NEW YORK**

Figure Title

**YOUD ET. AL  
LIQUEFACTION  
CHART**

Project No.  
170495201

Date  
10/15/2018

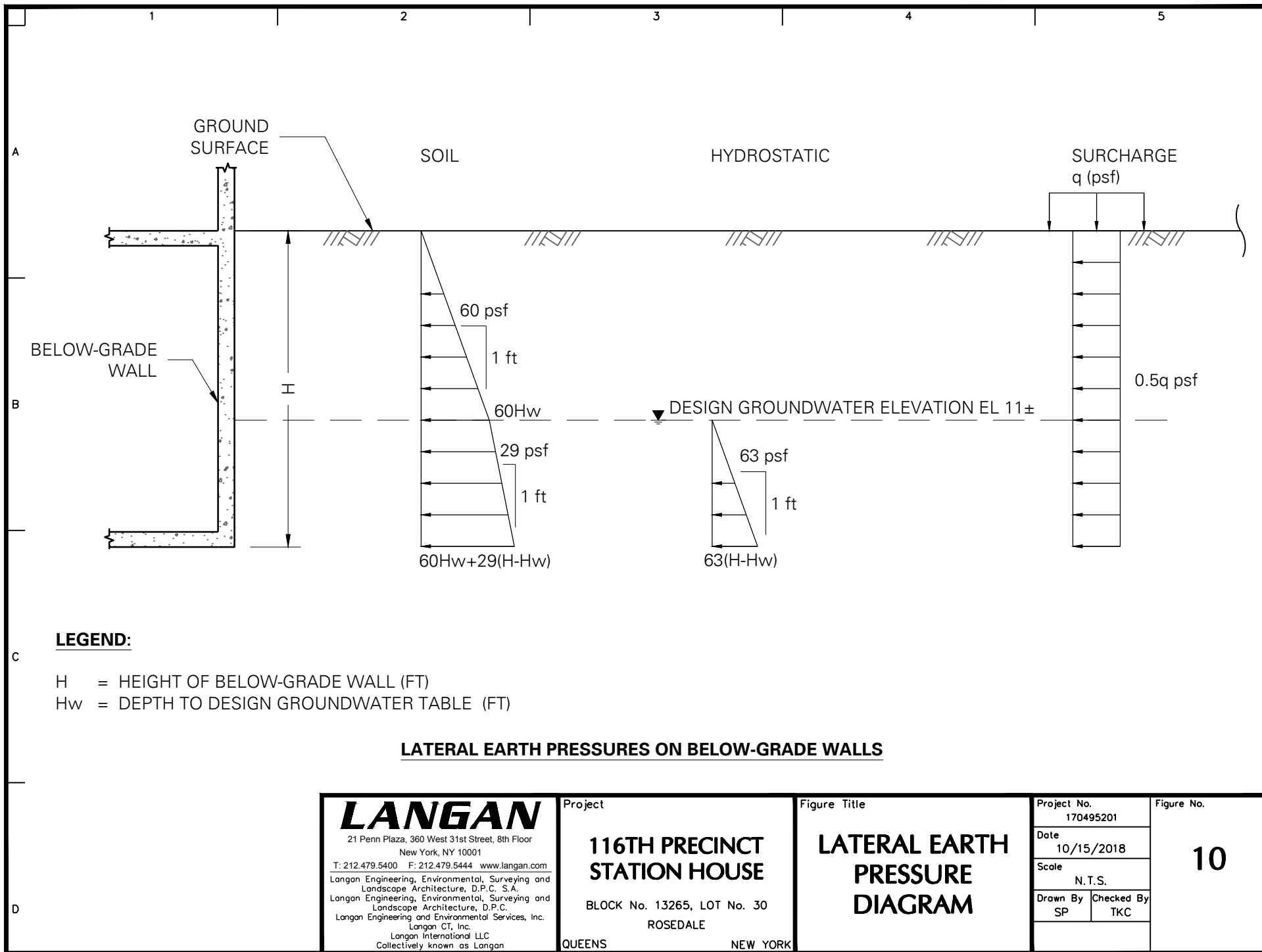
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Figure No.

**9**



## BORING KEY

<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">B(OW)</div> <div style="border: 1px solid black; width: 10px; height: 100px; position: relative;"> <div style="position: absolute; top: 0; left: 0; right: 0; text-align: center;">EL</div> <div style="position: absolute; bottom: 0; left: 0; right: 0; text-align: center;"> </div> </div> </div>	<b>B</b> BORING IDENTIFICATION  <b>EL</b> GROUND SURFACE ELEVATION AT TIME OF BORING  <b>N</b> STANDARD PENETRATION RESISTANCE; NUMBER OF BLOWS OF A 140 LB. HAMMER FREE FALLING 30 IN. TO DRIVE A 2 IN O.D. SPLIT SPOON SAMPLER 12 IN. AFTER 6 INCHES OF INITIAL PENETRATION  <b>REC</b> (LENGTH OF ROCK RETREIVED)/(LENGTH OF ROCK CORED)*100%  <b>RQD</b> ROCK QUALITY DESIGNATION (LENGTH OF ROCK PIECES 4 INCHES OR LONGER)/ (LENGTH OF ROCK CORED)*100%  <b>X</b> NEW YORK CITY BUILDING CODE CLASSIFICATION  <b>(OW)</b> GROUNDWATER OBSERVATION WELL <b>E</b> <b>MEASURED GROUNDWATER LEVEL</b>  <b>C-1</b> ROCK CORE RUN IDENTIFICATION AND LENGTH
---	---

### MATERIAL SYMBOLS

	UNCONTROLLED FILL
	SAND
	SANDY SILT/SILTY SAND
	SILT
	SOFT ROCK
	BEDROCK
	ORGANICS/PEAT

### NEW YORK CITY BUILDING CODE CLASSIFICATION NUMBER

1A	HARD SOUND ROCK
1B	MEDIUM ROCK
1C	INTERMEDIATE ROCK
1D	SOFT ROCK
2A	DENSE SANDY GRAVEL & GRAVEL
2B	MEDIUM SANDY GRAVEL & GRAVEL
3A	DENSE GRANULAR SOILS
3B	MEDIUM GRANULAR SOILS
4A	HARD CLAYS
4B	STIFF CLAYS
4C	MEDIUM CLAYS
5A	DENSE SILTS & SILTY SOILS
5B	MEDIUM SILTS & SILTY SOILS
6	ORGANIC SILTS & CLAYS, PEATS, SOFT CLAYS, LOOSE GRANULAR SOILS, AND VARVED SILTS
7	CONTROLLED & UNCONTROLLED FILLS

# LANGAN

21 Penn Plaza, 360 West 31st Street, 8th Floor  
New York, NY 10001

T: 212.479.5400 F: 212.479.5444 [www.langan.com](http://www.langan.com)  
 Langan Engineering, Environmental, Surveying and  
 Landscape Architecture, D.P.C. S.A.  
 Langan Engineering, Environmental, Surveying and  
 Landscape Architecture, D.P.C.  
 Langan Engineering and Environmental Services, Inc.  
 Langan CT, Inc.  
 Langan International LLC  
 Collectively known as Langan

Project

## 116TH PRECINCT STATION HOUSE

**BLOCK No. 13265, LOT No. 30  
ROSEDALE**

**QUEENS**

**NEW YORK**

Figure Title

## LANGAN STANDARDS

Project No.

170495201

Date

12/15/2017

Scale

N.T.S.

Drawn By  
SP

Checked By  
TKC

Figure No.

# LS-1

# **APPENDIX A**

## **GEOPHYSICAL ENGINEERING SURVEY REPORT**

# **GEOPHYSICAL ENGINEERING SURVEY REPORT**

**116<sup>th</sup> Precinct**

**244-04 North Conduit Avenue**

**Queens, New York 11422**

**NOVA PROJECT NUMBER**

**17-0339**

**DATED**

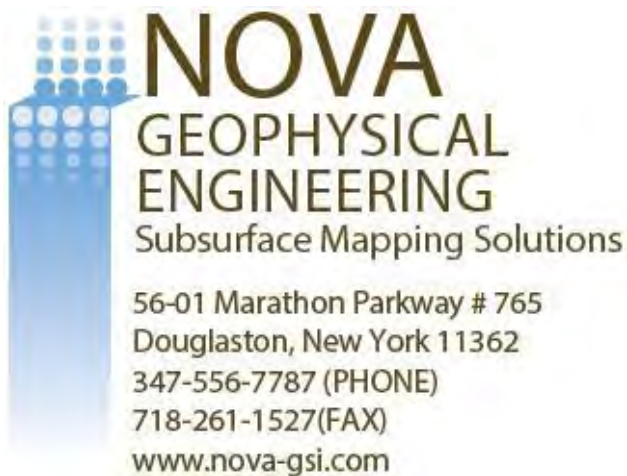
**August 21, 2017**

**PREPARED FOR:**

**NYC Department of Design and Construction**

**30-30 Thomson Avenue, Long Island City, NY 11101**

**PREPARED BY:**



# NOVA GEOPHYSICAL SERVICES

## SUBSURFACEMAPPINGSOLUTIONS

56-01 Marathon Parkway, # 765, Douglaston, New York 11362  
Ph. 347-556-7787 Fax. 718-261-1527  
www.nova-gsi.com

---

August 19, 2017

Jeffrey K. Au, P.E.

Deputy Director

Program Management Division

Office of Environmental and Geotechnical Services

**NYC Department of Design and Construction**

30-30 Thomson Avenue, Long Island City, NY 11101

O 718-391-1037

C 347-302-5130

E [auje@ddc.nyc.gov](mailto:auje@ddc.nyc.gov)

Re: Geophysical Engineering Survey (GES) Report

116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

Dear Mr. Au:

Nova Geophysical Services (NOVA) is pleased to provide findings of the geophysical engineering survey (GES) at the above referenced project site: 116<sup>th</sup> Precinct, 244-04 North Conduit Avenue, Queens, New York (the "Site"). Please see attached Site Location and Geophysical Survey maps for more details.

## INTRODUCTION TO GEOPHYSICAL ENGINEERING SURVEY (GES)

NOVA performed a Geophysical engineering surveys (GES) consisting of a Ground Penetrating Radar (GPR) survey at the site. The purpose of this survey is to locate and identify USTs, anomalies, utilities and other substructures and to clear and mark proposed boring areas on August 15, 2017.

The equipment selected for this investigation was Noggin's 250 MHz ground penetrating radar (GPR) shielded antenna and 3M DYNATL.

A GPR system consists of a radar control unit, control cable and a transducer (antenna). The control unit transmits a trigger pulse at a normal repetition rate of 250 MHz. The trigger pulse is sent to the transmitter electronics in the transducer via the control cable. The transmitter electronics amplify the trigger pulses into bipolar pulses that are radiated to the surface. The transformed pulses vary in shape and frequency according to the transducer used. In the subsurface, variations of the signal occur at boundaries where there is a dielectric contrast (void, steel, soil type, etc.). Signal reflections travel back to the control unit and are represented as color graphic images for interpolation.

GPR, Magnetics, Electromagnetics, Seismic, Resistivity, Utility Location, Borehole Logging & Camera





## GEOPHYSICAL METHODS

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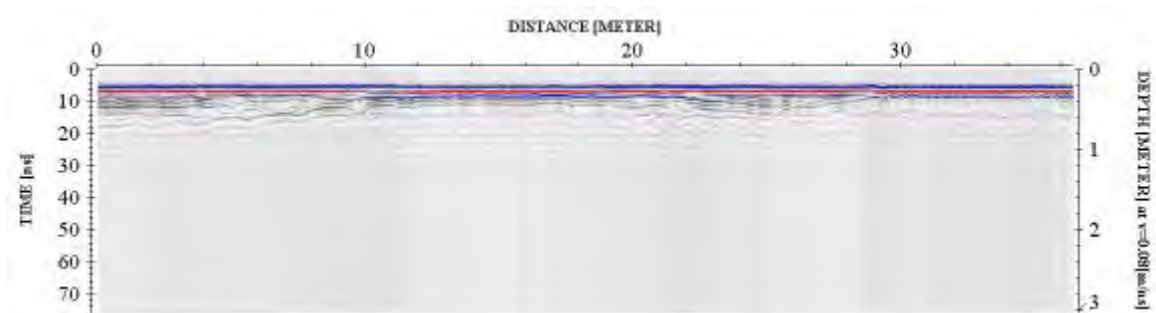
The project site was screened using the GPR to search the areas of interest and inspected for reflections, which could be indicative of major anomalies and substructures. Borehole locations were then individually cleared.

GPR data profiles were collected for the areas of the Site specified by the client. The surveyed areas consisted of grass, asphalt and concrete surfaces.

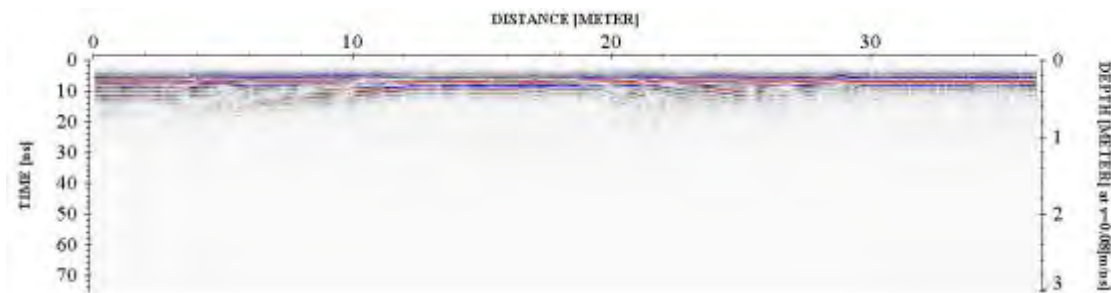
## DATA PROCESSING

In order to improve the quality of the results and to better identify subsurface anomalies NOVA processed the collected data. The processes flow is briefly described at this section.

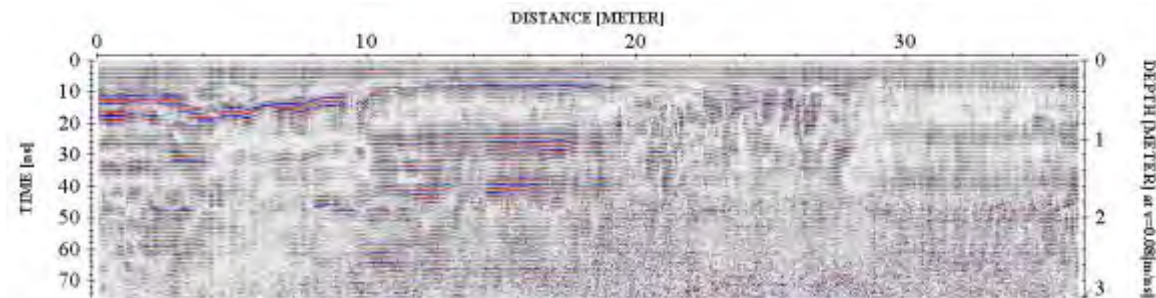
**Step 1.** Import raw RAMAC data to standard processing format



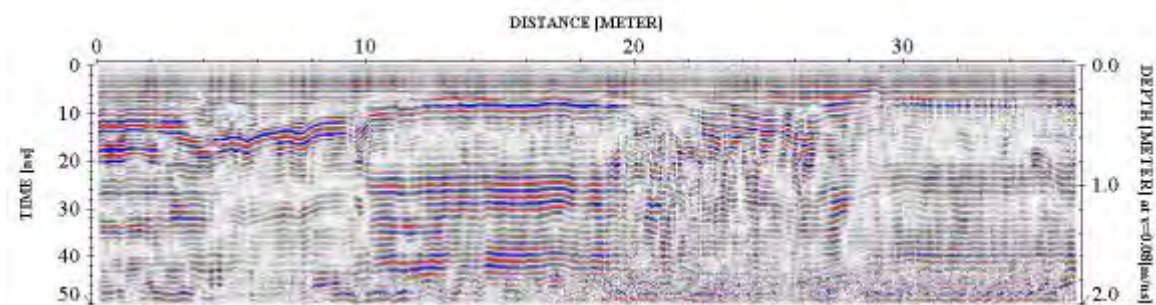
**Step 2.** Remove instrument noise (*dewow*)



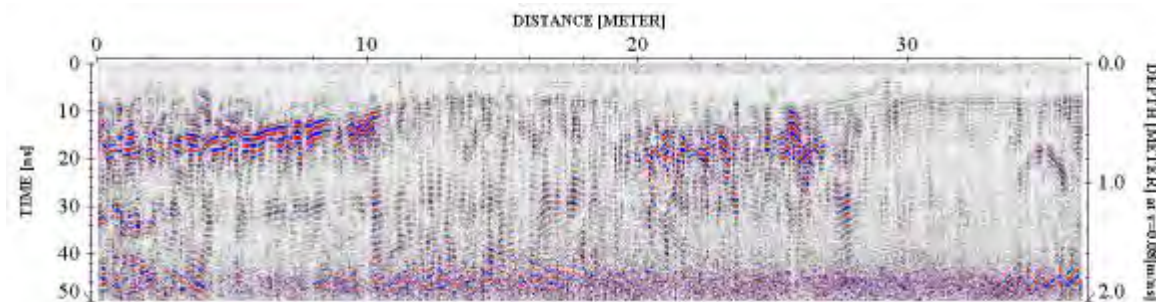
**Step 3.** Correct for attenuation losses (*energy decay function*)



**Step 4.** Remove static from bottom of profile (*time cut*)



**Step 5.** Mute horizontal ringing/noise (*subtracting average*)



The above example shows the significance of data processing. The last image (step 5) has higher resolution than the starting image (raw data – step 1) and describes the subsurface anomalies more accurately.

---

## PHYSICAL SETTINGS

---

Nova observed following physical conditions at the time of the survey:

**The weather:** Overcast/Light Rain

**Temp:** 80 Degrees (F).

**Surface:** Grass, asphalt and concrete surfaces

**Geophysical Noise Level (GNL):** Geophysical Noise Level (GNL) was very high at the site. The noise was a result of the site being located in an urban environment and close proximity to train tracks.

---

## RESULTS

---

The results of the geophysical engineering survey (GES) identified following at the project Site:

- GES survey identified scattered anomalies located throughout the project site. Based on their rates and proximity, these anomalies were inconsistent with any USTs. These areas were indicated on the on-site markout.
- Several utilities (sewer, water, gas, telecommunications and electrical) were located on the site. These utilities were indicated on the survey map.
- Two large, linear anomalies were located on the site located approximately 7 to 10 feet below ground surface at the project site. These are indicated both on-site and on the survey map.
- Geophysical Survey Plan portrays the areas investigated during the geophysical survey.

If you have any questions please do not hesitate to contact the undersigned.

Sincerely,

**NOVA Geophysical Services**



Levent Eskicakit, P.G., E.P.  
Project Engineer

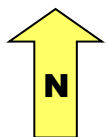
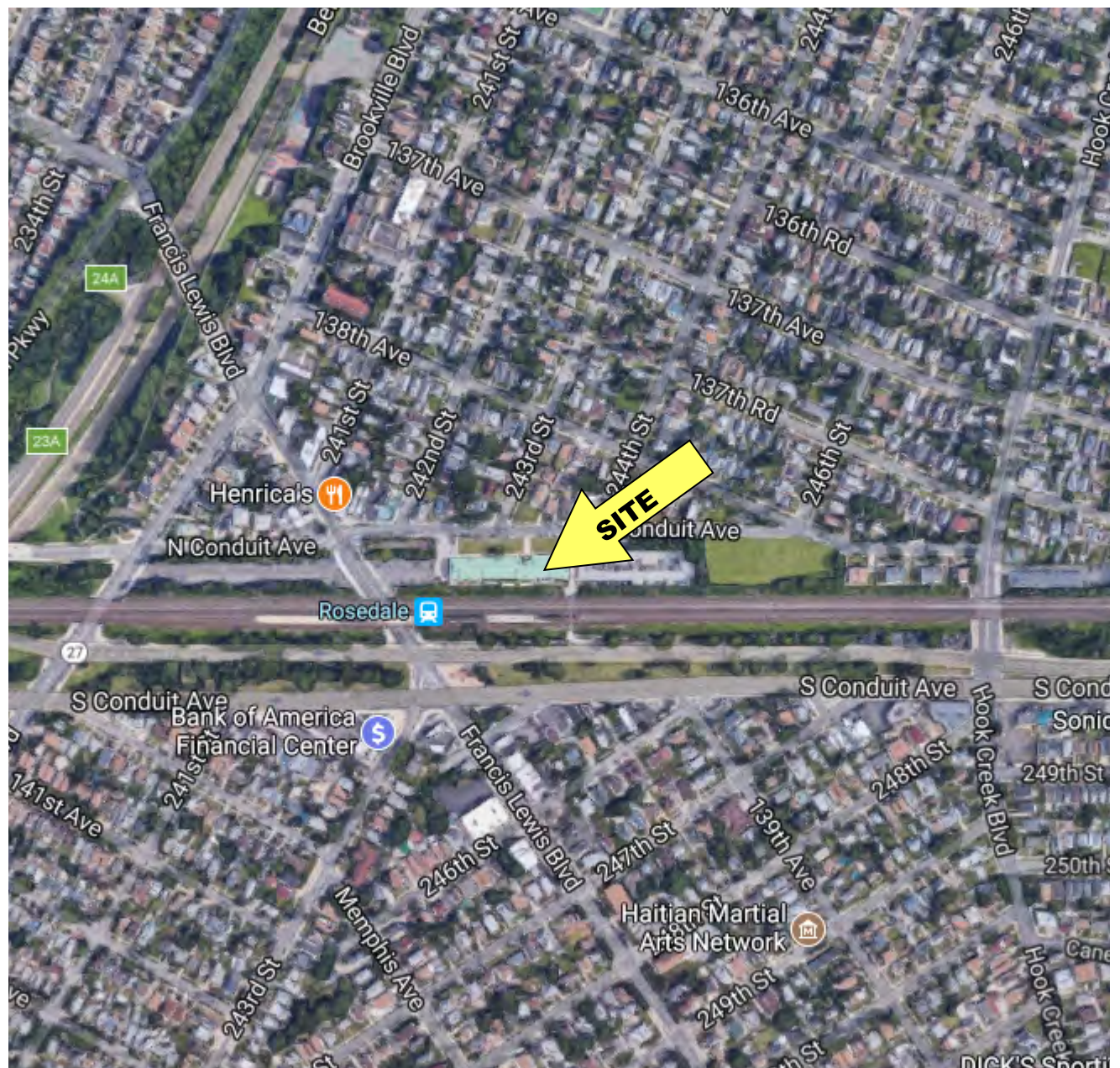
**Attachments:**

Figure 1 Site Location Map

Geophysical Survey Plan

Geophysical Images





500 ft.

**FIGURE 1**  
**SITE LOCATION MAP**

**NOVA**  
**GEOPHYSICAL**  
**ENGINEERING**  
Subsurface Mapping Solutions  
56-01 Marathon Parkway # 765  
Douglaston, New York 11362  
347-556-7787 (PHONE)  
718-261-1527 (FAX)  
www.nova-gsi.com

**SITE:** **116th Precinct**  
244-04 North Conduit Avenue  
Queens, New York 11422

**SCALE:** See Map





1- All anomalies were marked in the field.

**NOVA**  
**GEOPHYSICAL**  
**ENGINEERING**  
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 www.nova-gsi.com

### GEOPHYSICAL SURVEY PLAN

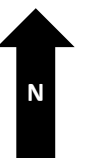
SITE : **116<sup>th</sup> Precinct**  
 244-04 North Conduit Avenue  
 Queens, New York 11422

CLIENT: **NYC DDC**  
 DATE: August 15, 2017  
 Scale See Map

- Survey Area
- Gas Line
- Water Line
- Storm Drain

### INFORMATION

- Sewer Line
- Electrical Line
- Dry Well
- Large Anomaly



**60 ft.**







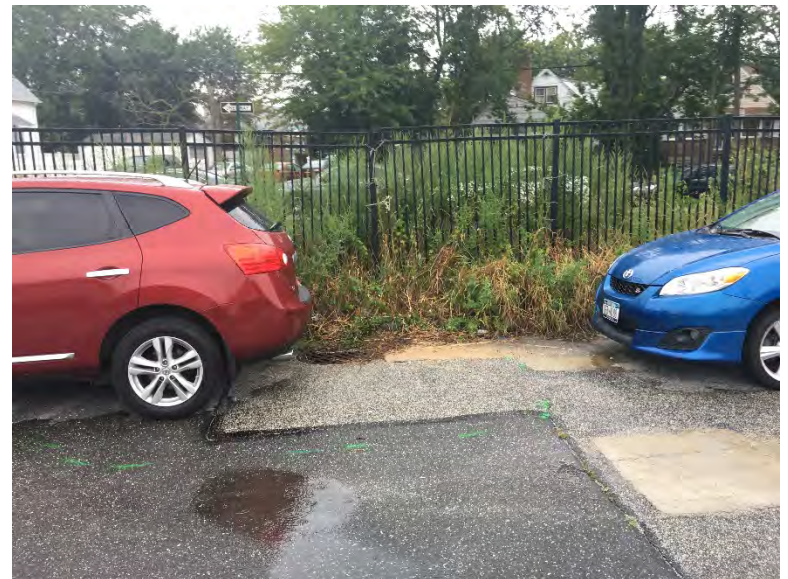
## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





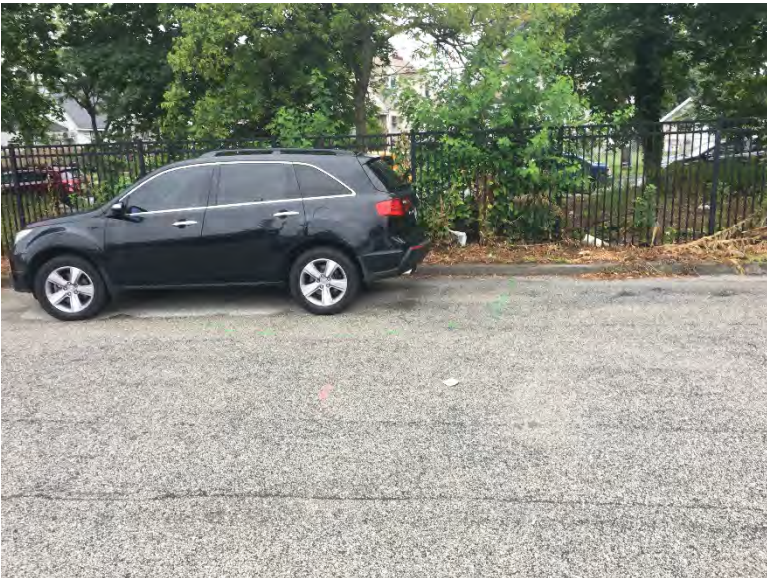
## GEOPHYSICAL IMAGES

### 116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017





## GEOPHYSICAL IMAGES

116<sup>th</sup> Precinct

244-04 North Conduit Avenue

Queens, New York 11422

August 15<sup>th</sup>, 2017



# **APPENDIX B**

## **GEOTECHNICAL DATA REPORT BY CDM SMITH**

# GEOTECHNICAL DATA REPORT

**DDC PROJECT: New NYPD 116<sup>th</sup> Precinct**  
**244-04 North Conduit**  
**Borough of Queens, New York**

**SES NO.: 4231**

**CONTRACT REG NO.: 20151402686**

**WORK ORDER NO.: 13195-CDM-1-11954**

*Prepared for:*



**Department of  
Design and  
Construction**

City of New York Department of Design and Construction  
Division of Program Management Safety and Site Support  
Office of Environmental and Geotechnical Services  
30-30 Thomson Avenue  
Long Island City, NY 11101

*Prepared by:*

CDM Smith  
14 Wall Street, Suite 1702  
New York, New York 10005

DDC Project No.: PO002-116  
October 20, 2017  
DRAFT





*To: Jeffrey K. Au, P.E., Geotechnical Engineer,  
Deputy Director, DDC OEGS  
Richard Meserole, Section Chief, DDC OEGS*

*From: Kapila Pathirage, Ph.D., P.E.*

*Date: October 20, 2017*

*RE: GEOTECHNICAL DATA REPORT  
DDC Project # P0002-116  
New NYPD 116<sup>th</sup> Precinct  
244-04 North Conduit  
Borough of Queens, New York*

<b>Contract Code CDM and Registration Number:</b>	20151402686
<b>Task ID #:</b>	13195 - Geotechnical II: Project Oversight
<b>CDM Smith WOL #:</b>	13195-CDM-1-11954
<b>Location and Details:</b>	244-04 North Conduit 19 borings @ 12' - 102'

This data report was developed as the final deliverable for the subsurface investigation at the New NYPD 116<sup>th</sup> Precinct, Borough of Queens project, performed from August 16, 2017 to September 8, 2017. This report contains the following data:

- Record of Borings for B-1 through B-11 and PB-1 through PB-8;
- Boring as-drilled location coordinates;
- Geotechnical Laboratory Test Results for samples collected at B-1 through B-11, and PB-1 through PB-8; and
- Typical observation well construction sketch.

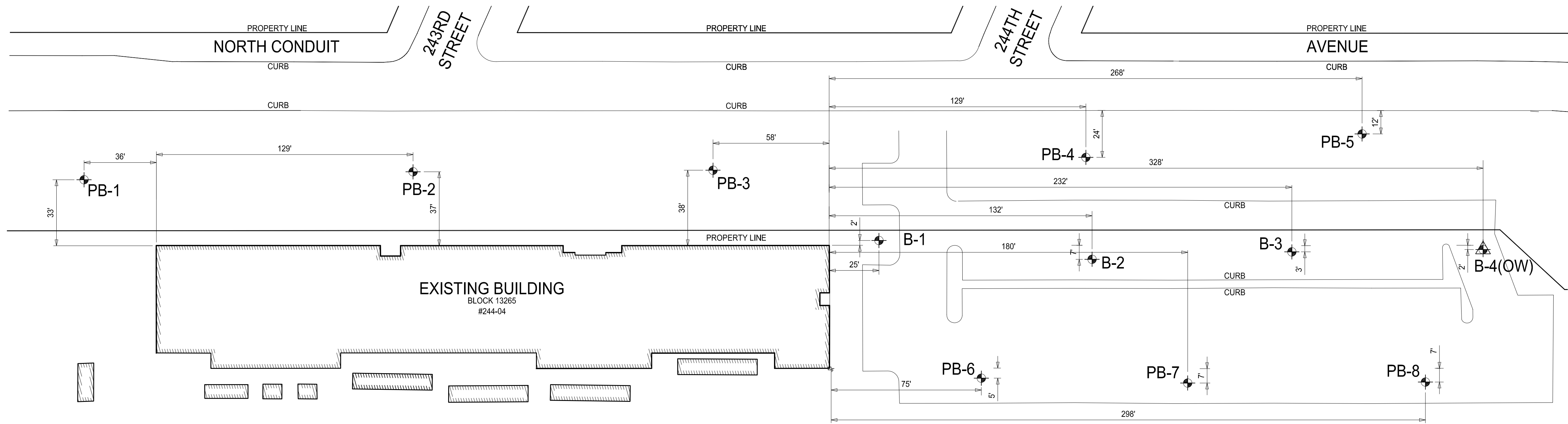
**RECORD OF BORINGS**

Boring	Geographic		NAD 27		NAD 83		QUEENS	
	Latitude	Longitude	N	E	N	E	W	S
B-1	40.666359	-73.734021	182160.97	1058037.98	160719.79	2073789.95	-819209.7127	-516102.6677
B-2	40.666361	-73.733650	182162.01	1058140.90	160720.83	2073892.87	-819120.1695	-516051.9089
B-3	40.666339	-73.733283	182154.31	1058242.74	160713.13	2073994.71	-819027.3375	-516009.3274
B-4 (OW)	40.666310	-73.732933	182144.04	1058339.87	160702.86	2074091.84	-818937.3829	-515971.2698
B-5	40.666297	-73.733857	182138.52	1058083.54	160697.34	2073835.52	-819158.9731	-516100.241
B-6 (OW)	40.666294	-73.733490	182137.74	1058185.36	160696.56	2073937.33	-819069.512	-516051.6135
B-7	40.666293	-73.732990	182137.80	1058324.07	160696.62	2074076.05	-818948.1784	-515984.3804
B-8 (OW)	40.666209	-73.734009	182106.33	1058041.47	160665.15	2073793.44	-819180.1915	-516148.7799
B-9	40.666233	-73.733727	182115.32	1058119.68	160674.13	2073871.65	-819116.1173	-516103.0441
B-10	40.666237	-73.733275	182117.15	1058245.07	160675.97	2073997.04	-819007.3015	-516040.7051
B-11	40.666232	-73.732865	182115.68	1058358.82	160674.50	2074110.80	-818907.0664	-515986.9039
PB-1	40.666453	-73.735468	182194.00	1057636.45	160752.82	2073388.41	-819577.019	-516268.2417
PB-2	40.666458	-73.734882	182196.32	1057799.01	160755.13	2073550.98	-819435.9096	-516187.4838
PB-3	40.666455	-73.734321	182195.70	1057954.65	160754.51	2073706.61	-819299.4393	-516112.6482
PB-4	40.666480	-73.733658	182205.36	1058138.55	160764.18	2073890.52	-819143.2215	-516015.1213
PB-5	40.666517	-73.733110	182219.30	1058290.53	160778.12	2074042.51	-819016.9994	-515929.3113
PB-6	40.666172	-73.733867	182092.97	1058080.91	160651.79	2073832.88	-819139.2183	-516141.3698
PB-7	40.666172	-73.733500	182093.28	1058182.72	160652.10	2073934.70	-819050.2893	-516091.7875
PB-8	40.666180	-73.733090	182096.54	1058296.46	160655.36	2074048.43	-818952.3604	-516033.8497



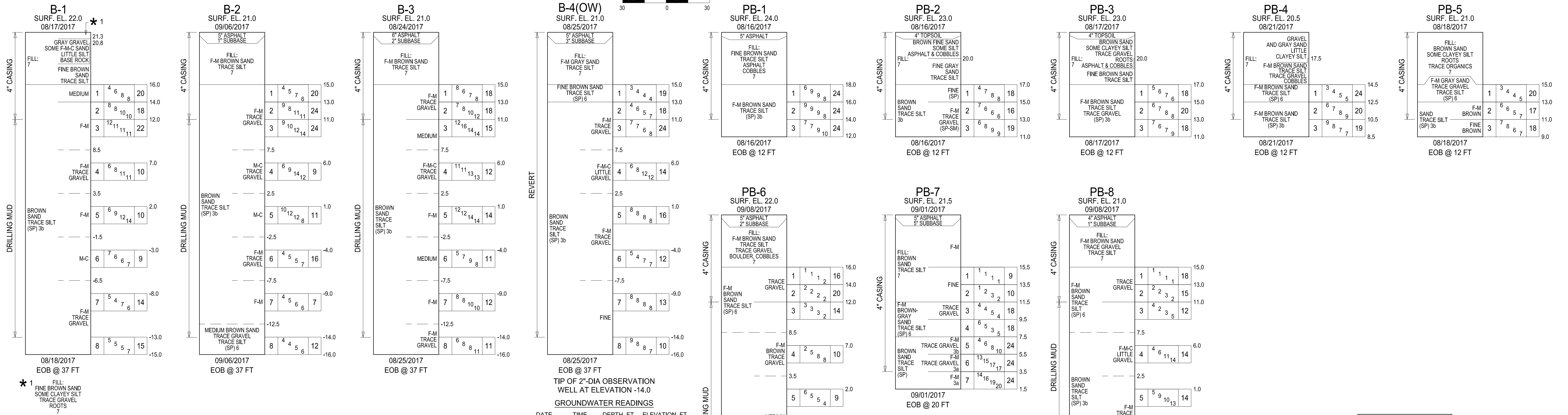






LOCATION PLAN

SCALE: 1" = 30'



LABORATORY ANALYSIS SUMMARY \*

Soil Sample Identification And Index Properties

BORING NO.	SAMPLE NO.	DEPTH, ft	D100, mm	D60, mm	D30, mm	D10, mm	% GRAVEL (> #4 SIEVE)	% SAND	% SILT OR CLAY (< #200 SIEVE)	WC %	Cc	Cu	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	pH	ORGANIC CONTENT (%)	USCS SYMBOL
B-1	4	15-17	-	0.38	0.26	0.15	0.3	95.6	4.1	-	1.13	2.50	-	-	-	-	-	SP
B-1	7	30-32	-	0.34	0.24	0.17	0.7	96.9	2.4	-	1.04	2.05	-	-	-	-	-	SP
B-2	3	10-12	-	0.34	0.25	0.16	0.1	96.8	3.1	-	1.16	2.16	-	-	-	-	-	SP
B-2	6	25-27	-	0.36	0.24	0.15	0.1	97.6	2.3	-	1.08	2.36	-	-	-	-	-	SP
B-3	1	6-8	-	0.38	0.29	0.22	0.2	98.0	1.8	-	1.01	1.78	-	-	-	-	-	SP
B-3	8	35-37	-	0.31	0.23	0.16	1.3	96.2	2.5	-	1.02	1.96	-	-	-	-	-	SP
B-4	3	10-12	-	0.40	0.28	0.20	0.8	98.2	1.0	-	1.01	2.05	-	-	-	-	-	SP
B-4	5	20-22	-	0.35	0.26	0.17	0.2	96.8	3.0	-	1.10	2.05	-	-	-	-	-	SP
PB-1	1	6-8	-	0.38	0.28	0.20	0.0	97.6	2.4	-	1.04	1.91	-	-	-	-	-	SP
PB-2	2	8-10	-	0.29	0.18	0.10	0.3	94.5	5.2	-	1.10	2.76	-	-	-	-	-	SP-SM
PB-3	3	10-12	-	0.38	0.28	0.19	0.4	97.5	2.1	-	1.05	1.99	-	-	-	-	-	SP
PB-4	2	8-10	-	0.37	0.26	0.18	0.0	97.7	2.3	-	1.07	2.10	-	-	-	-	-	SP
PB-5	1	6-8	-	0.37	0.27	0.19	0.1	98.8	1.1	-	1.04	1.93	-	-	-	-	-	SP
PB-6	4	15-17	-	0.46	0.30	0.20	4.7	92.2	3.1	-	0.99	2.32	-	-	-	-	-	SP
PB-7	5	14-16	-	0.36	0.25	0.18	0.2	98.7	1.1	-	1.02	2.07	-	-	-	-	-	SP
PB-8	5	20-22	-	0.37	0.26	0.15	0.4	95.5	4.1	-	1.22	2.49	-	-	-	-	-	SP

\* Refer to detailed laboratory analysis data for additional information regarding the results presented herein.

DATE	TIME	DEPTH, FT	ELEVATION, FT
09/01/17	11:00 AM	13.7	7.3
09/05/17	11:30 AM	13.7	7.3
09/06/17	11:30 AM	13.6	7.4
09/07/17	01:00 PM	13.6	7.4
09/08/17	07:00 AM	13.7	7.3
09/08/17	02:00 PM	13.7	7.3

GROUNDWATER READINGS

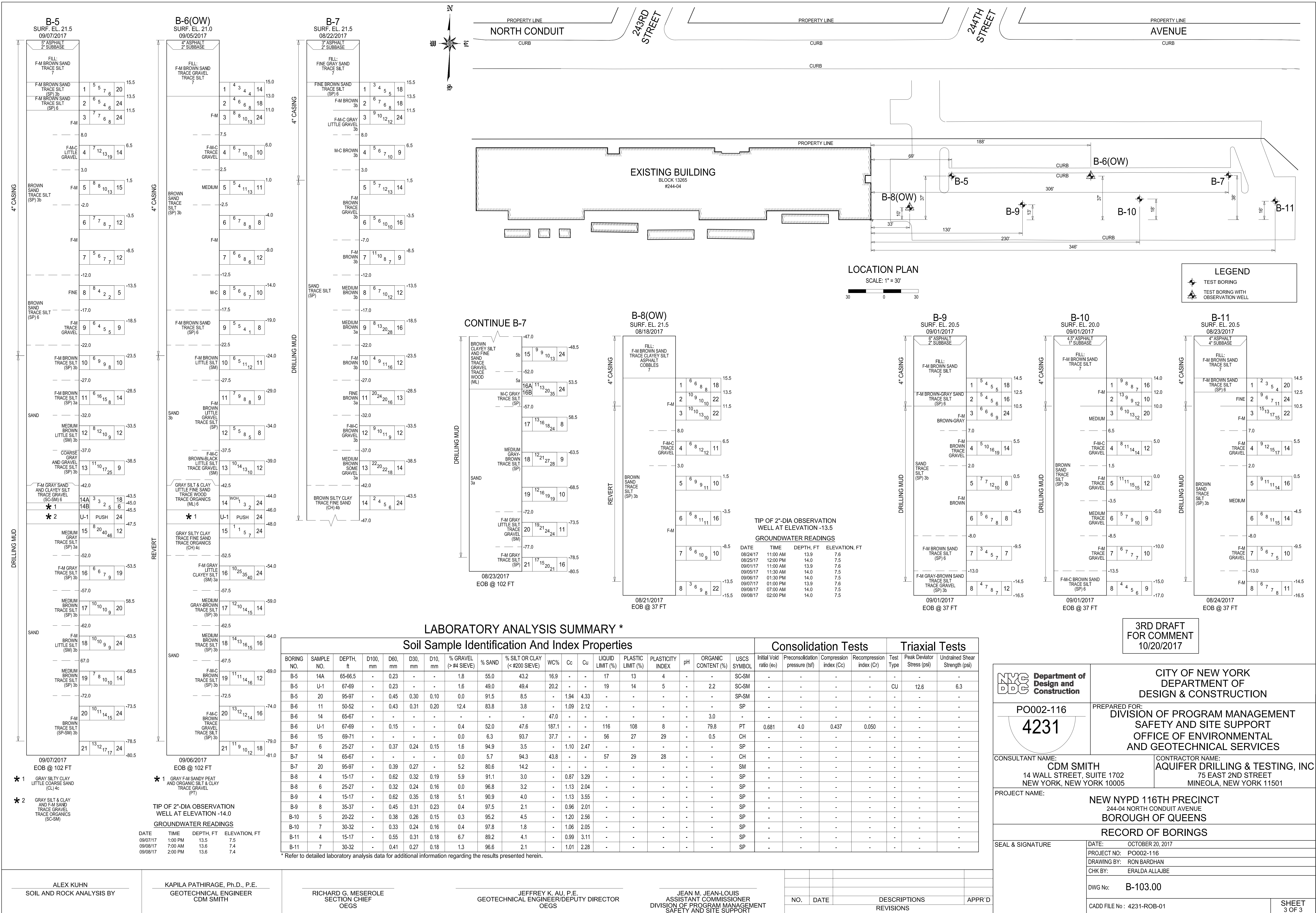
DATE	TIME	DEPTH, FT	ELEVATION, FT
09/01/17	11:00 AM	13.7	7.3
09/05/17	11:30 AM	13.7	7.3
09/06/17	11:30 AM	13.6	7.4
09/07/17	01:00 PM	13.6	7.4
09/08/17	07:00 AM	13.7	7.3
09/08/17	02:00 PM	13.7	7.3

3RD DRAFT  
FOR COMMENT  
10/20/2017

<b>NYC DDC</b> Department of Design and Construction	CITY OF NEW YORK DEPARTMENT OF DESIGN & CONSTRUCTION	
	PREPARED FOR: DIVISION OF PROGRAM MANAGEMENT SAFETY AND SITE SUPPORT OFFICE OF ENVIRONMENTAL AND GEOTECHNICAL SERVICES	
CONSULTANT NAME: CDM SMITH 14 WALL STREET, SUITE 1702 NEW YORK, NEW YORK 10005	CONTRACTOR NAME: AQUIFER DRILLING & TESTING, INC 75 EAST 2ND STREET MINEOLA, NEW YORK 11501	
PROJECT NAME: NEW NYPD 116TH PRECINCT 244-04 NORTH CONDUIT AVENUE BOROUGH OF QUEENS		
RECORD OF BORINGS		
SEAL & SIGNATURE	DATE: OCTOBER 20, 2017 PROJECT NO: PO002-116 DRAWING BY: RON BARDHAN CHK BY: ERLA ALAUBIE	
DWG No: B-102.00		SHEET 2 OF 3
CADD File No: 4231-ROB-01		

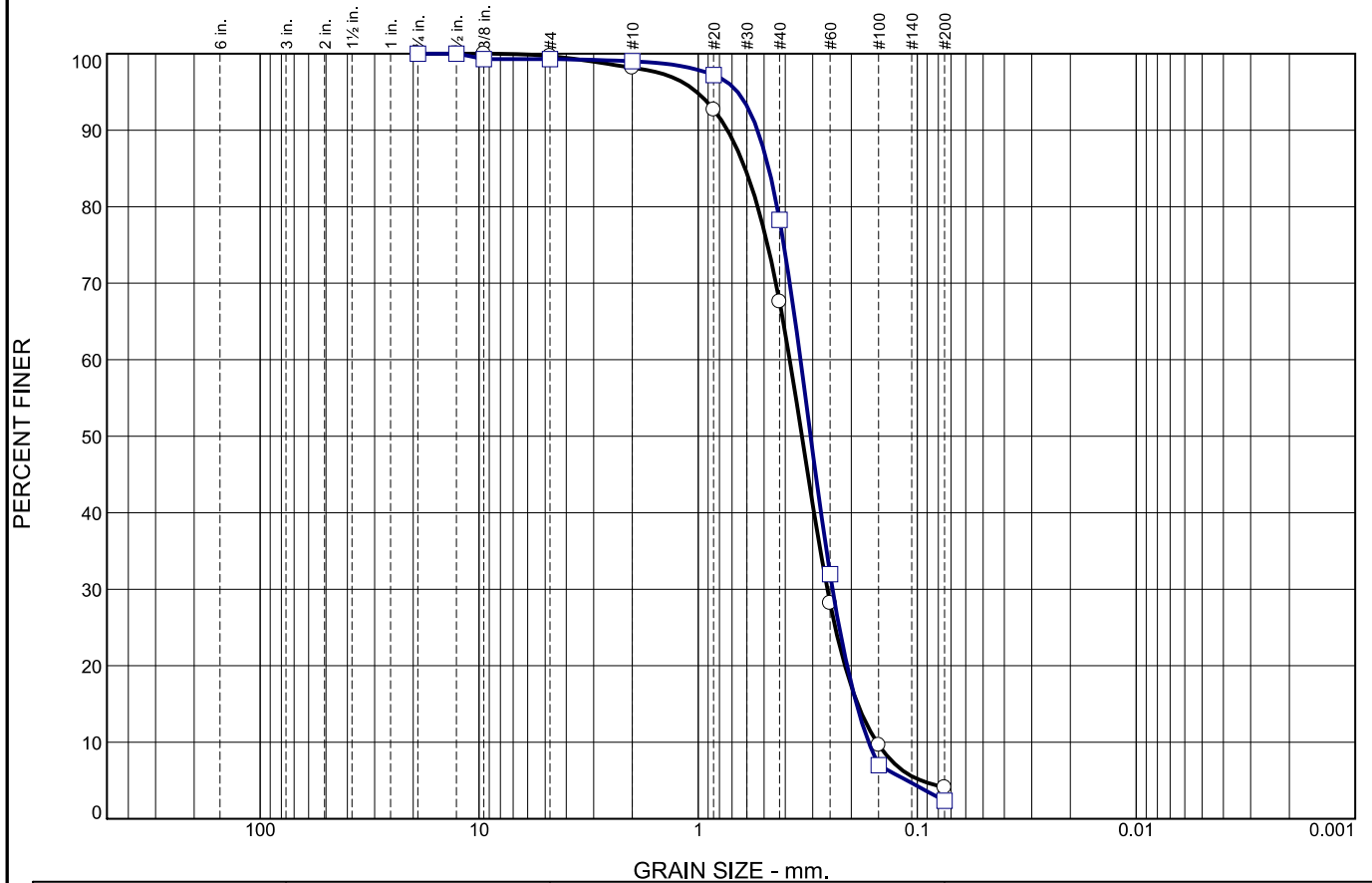
ALEX KUHN SOIL AND ROCK ANALYSIS BY	KAPILA PATHIRAGE, Ph.D., P.E. GEOTECHNICAL ENGINEER CDM SMITH	RICHARD G. MESEROLE SECTION CHIEF OEGS	JEFFREY K. AU, P.E. GEOTECHNICAL ENGINEER/DEPUTY DIRECTOR OEGS	JEAN M. JEAN-LOUIS ASSISTANT COMMISSIONER DIVISION OF PROGRAM MANAGEMENT SAFETY AND SITE SUPPORT	NO.	DATE	DESCRIPTIONS REVISIONS	APPR'D
--	---	--	--	---	-----	------	---------------------------	--------





**GEOTECHNICAL LABORATORY TEST RESULTS**

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.3	1.5	30.6	63.5	4.1	
□	0.0	0.0	0.7	0.3	20.7	75.9	2.4	

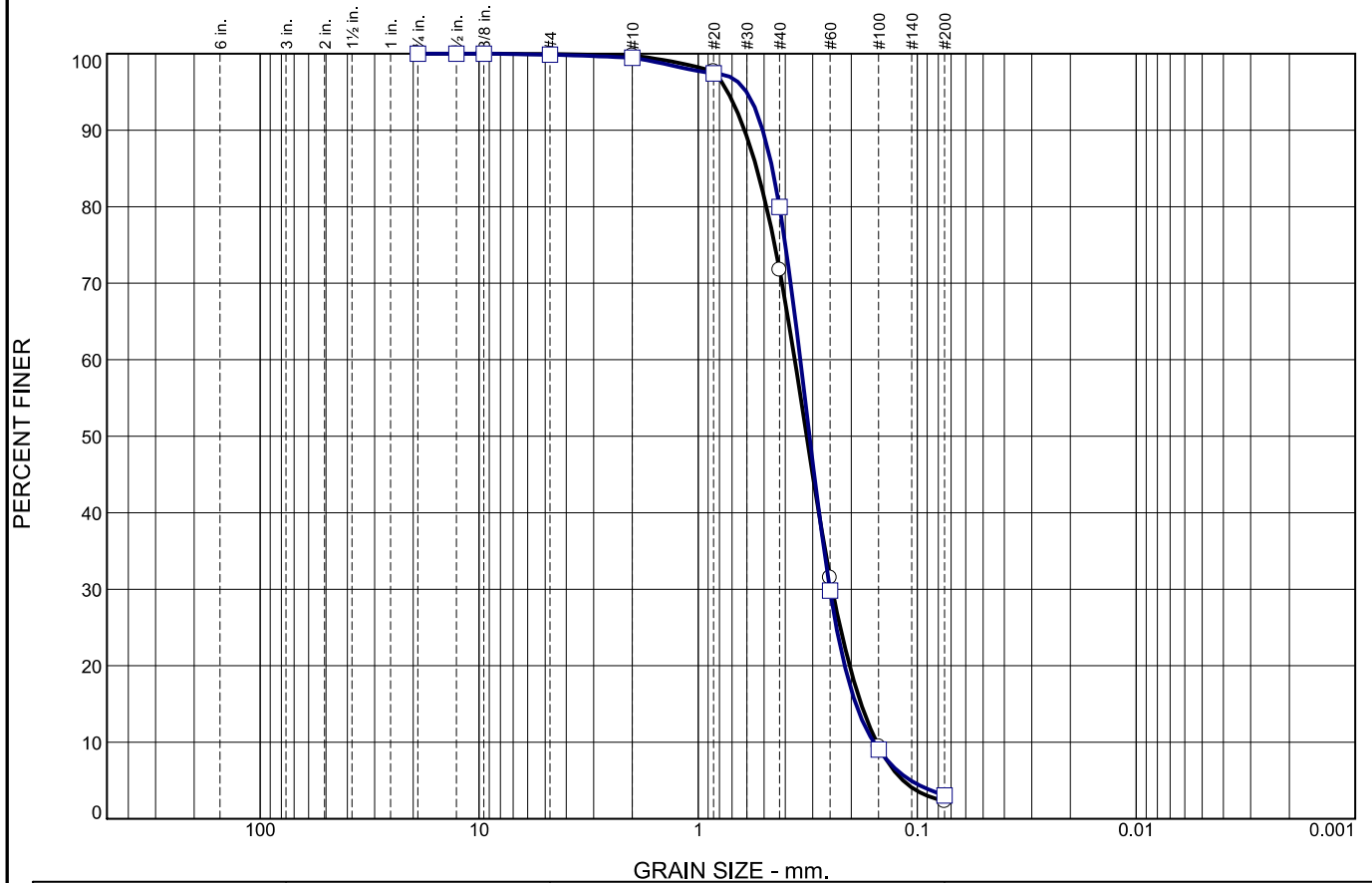
LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○		0.6105	0.3818	0.3358	0.2572	0.1871	0.1528	1.13	2.50
□		0.4760	0.3409	0.3065	0.2436	0.1894	0.1666	1.04	2.05

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							8/31/2017	SP	
□ Poorly graded sand							8/31/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC			<b>Remarks:</b>
<b>Project:</b> New NYPD 116th Precinct			
Queens, NY			
<input type="radio"/> <b>Source of Sample:</b> B-1	<b>Depth:</b> 15-17'	<b>Sample Number:</b> S-4	
<input type="checkbox"/> <b>Source of Sample:</b> B-1	<b>Depth:</b> 30-32'	<b>Sample Number:</b> S-7	
<b>CDM Smith</b>			
<b>Boston, Massachusetts</b>			<b>Figure</b>

Tested By: RZ      Checked By: MP

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.2	28.0	69.4	2.3	
□	0.0	0.0	0.1	0.4	19.5	76.9	3.1	

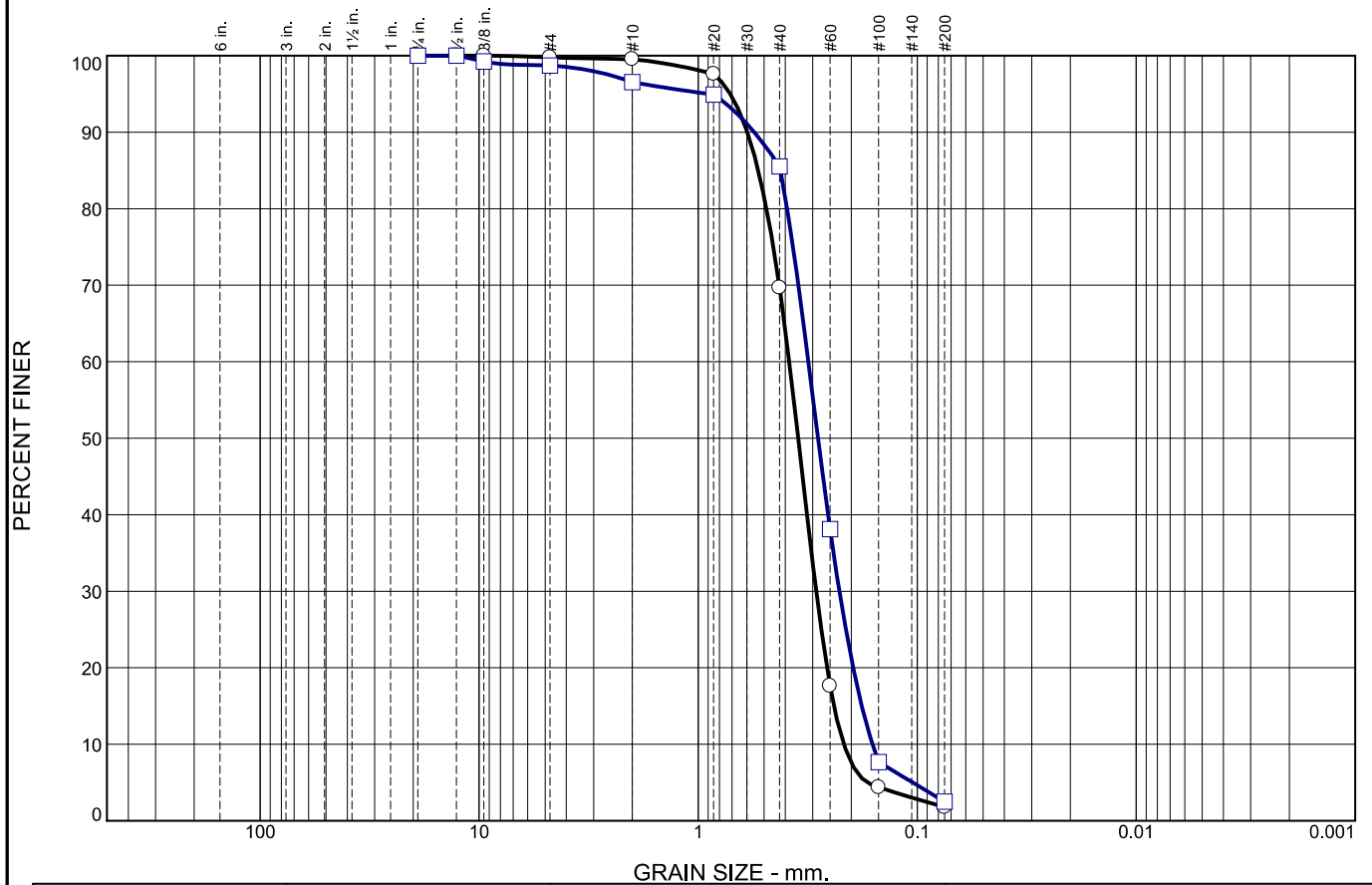
LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○		0.5404	0.3622	0.3196	0.2442	0.1803	0.1532	1.08	2.36
□		0.4584	0.3417	0.3102	0.2506	0.1907	0.1579	1.16	2.16

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							9/13/2017	SP	
□ Poorly graded sand							9/13/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY				<b>Remarks:</b>     <div>Figure</div>
○ <b>Source of Sample:</b> B-2	<b>Depth:</b> 25-27'	<b>Sample Number:</b> S-6		
□ <b>Source of Sample:</b> B-2	<b>Depth:</b> 10-12'	<b>Sample Number:</b> S-3		
<b>CDM Smith</b>  <b>Boston, Massachusetts</b>				

Tested By: RZ Checked By: MP

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.3	29.8	67.9	1.8	
□	0.0	0.0	1.3	2.2	11.0	83.0	2.5	

×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5318	0.3840	0.3494	0.2890	0.2399	0.2163	1.01	1.78
□			0.4214	0.3140	0.2837	0.2266	0.1791	0.1602	1.02	1.96

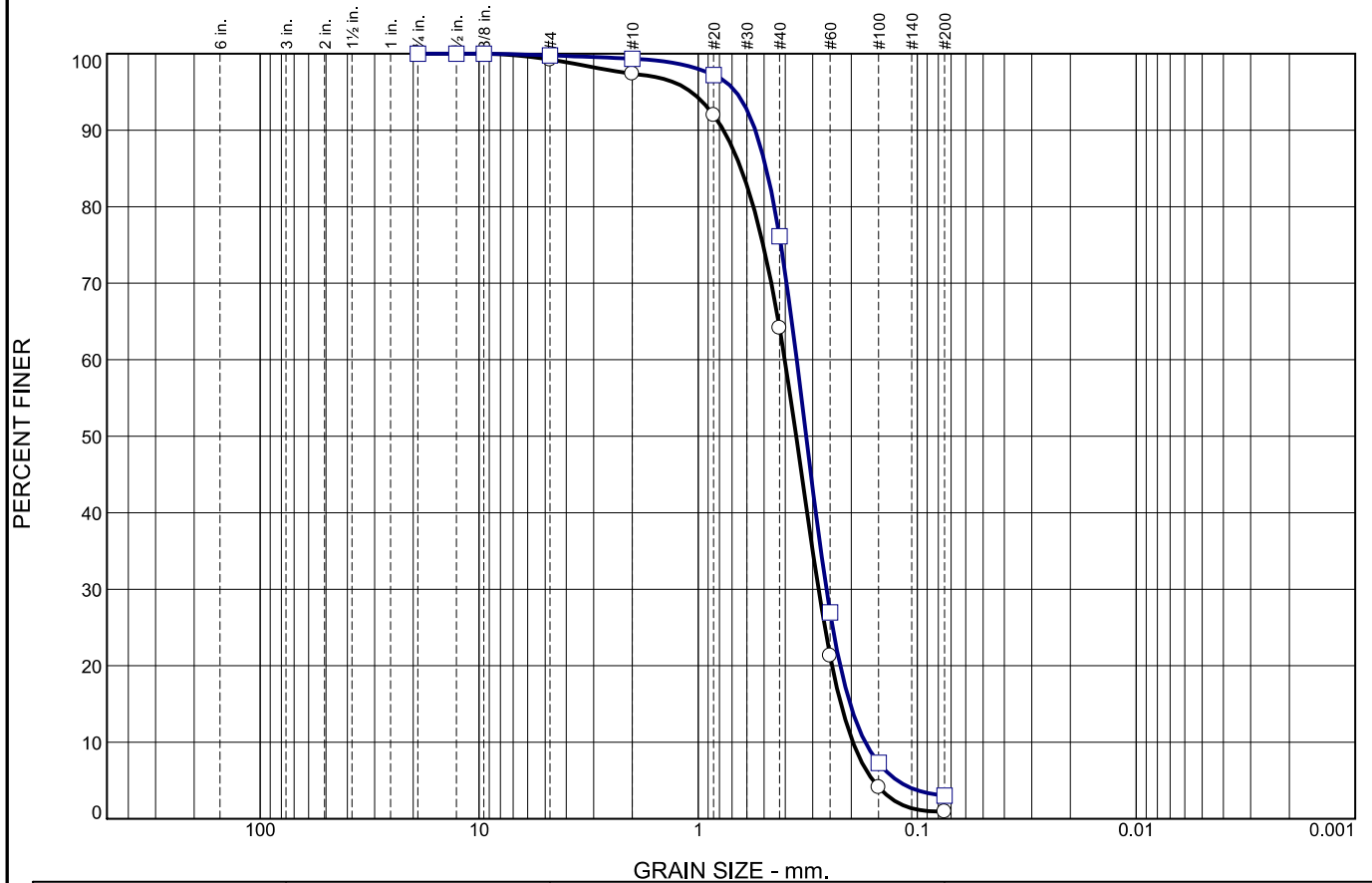
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							8/31/2017	SP	
□ Poorly graded sand							8/31/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY				<b>Remarks:</b>     <div>Figure</div>
○ <b>Source of Sample:</b> B-3	<b>Depth:</b> 6-8'	<b>Sample Number:</b> S-1		
□ <b>Source of Sample:</b> B-3	<b>Depth:</b> 35-37'	<b>Sample Number:</b> S-8		
<div>CDM Smith</div> <div>Boston, Massachusetts</div>				

Tested By: RZ Checked By: MP



# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.8	1.8	33.2	63.2	1.0	
□	0.0	0.0	0.2	0.5	23.2	73.1	3.0	

×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.6375	0.4023	0.3568	0.2821	0.2230	0.1966	1.01	2.05
□			0.4887	0.3548	0.3212	0.2598	0.2024	0.1728	1.10	2.05

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							8/31/2017	SP	
□ Poorly graded sand							8/31/2017	SP	

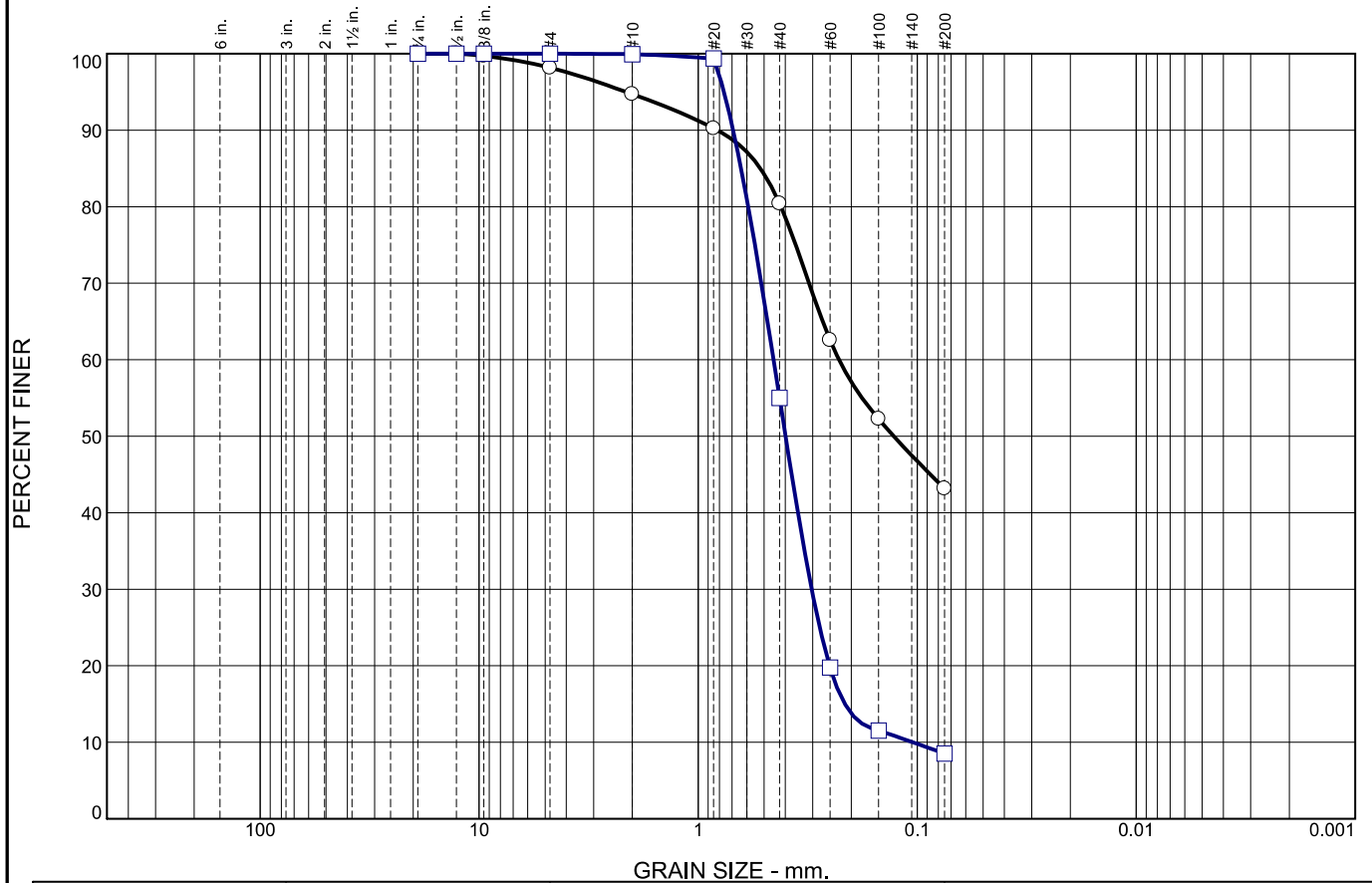
<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC			<b>Remarks:</b>
<b>Project:</b> New NYPD 116th Precinct			
Queens, NY			
<input type="radio"/> <b>Source of Sample:</b> B-4	<b>Depth:</b> 10-12'	<b>Sample Number:</b> S-3	
<input type="checkbox"/> <b>Source of Sample:</b> B-4	<b>Depth:</b> 20-22'	<b>Sample Number:</b> S-5	
<b>CDM Smith</b>			
<b>Boston, Massachusetts</b>			<b>Figure</b>

Tested By: RZ      Checked By: MP

Figure



# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.8	3.5	14.3	37.2	43.2	
□	0.0	0.0	0.0	0.1	44.9	46.5	8.5	

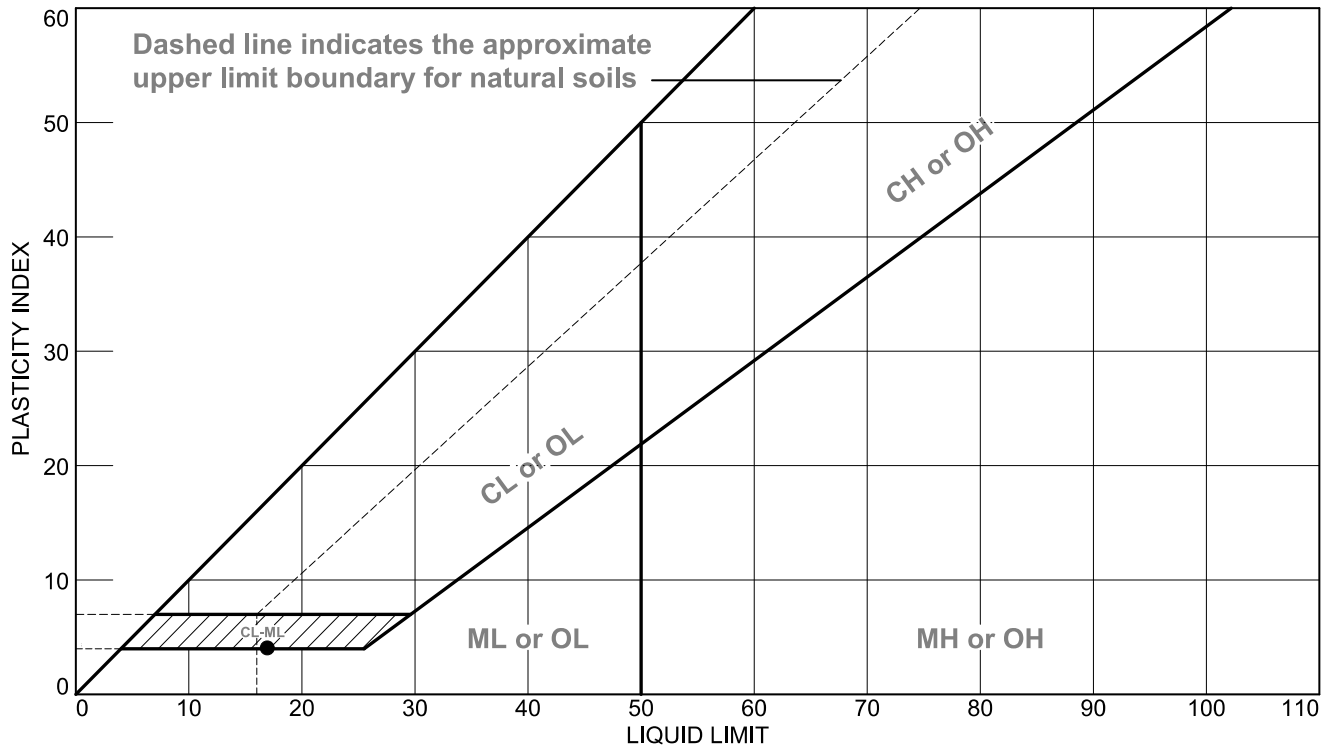
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○	17	13	0.5201	0.2275	0.1279					
□			0.6372	0.4526	0.3989	0.3032	0.2139	0.1045	1.94	4.33

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Silty, clayey sand							9/13/2017	SC-SM	16.9
□ Poorly graded sand with silt							9/13/2017	SP-SM	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC			<b>Remarks:</b>
<b>Project:</b> New NYPD 116th Precinct			
Queens, NY			
<input type="radio"/> <b>Source of Sample:</b> B-5	<b>Depth:</b> 65-66.5	<b>Sample Number:</b> S-14A	
<input type="checkbox"/> <b>Source of Sample:</b> B-5	<b>Depth:</b> 95-97'	<b>Sample Number:</b> S-20	
<b>CDM Smith</b>			
<b>Boston, Massachusetts</b>			<b>Figure</b>

Tested By: RZ      Checked By: MP

# LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-5	S-14	65-67'	16.9	13	17	4	SC-SM

**CDM Smith**

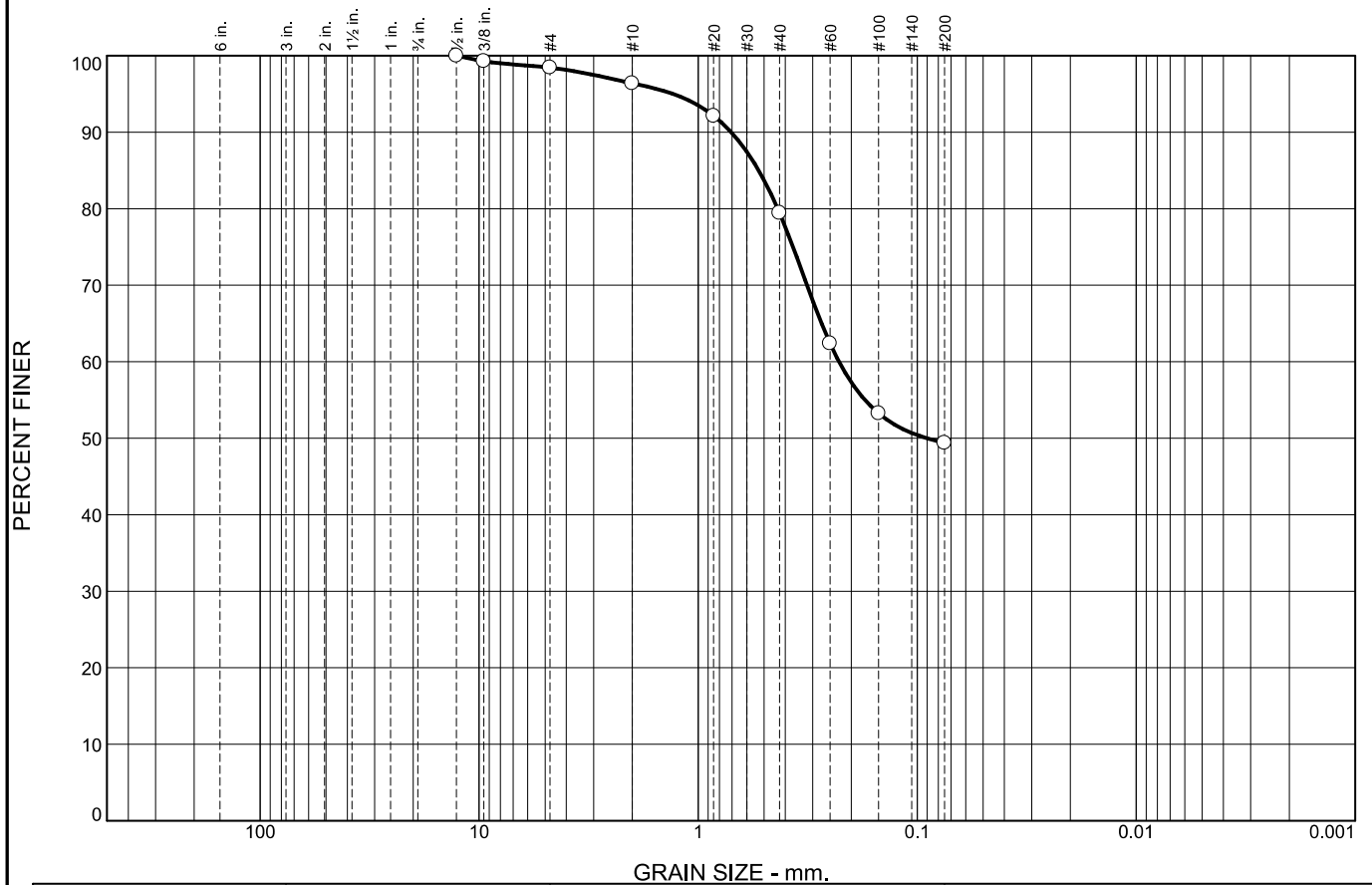
**Boston, Massachusetts**

**Client:** NYC DDC  
**Project:** New NYPD 116th Precinct  
 Queens, NY  
**Project No.:** 117520.221791

**Figure**

**Tested By:** RZ **Checked By:** MP

# Particle Size Distribution Report



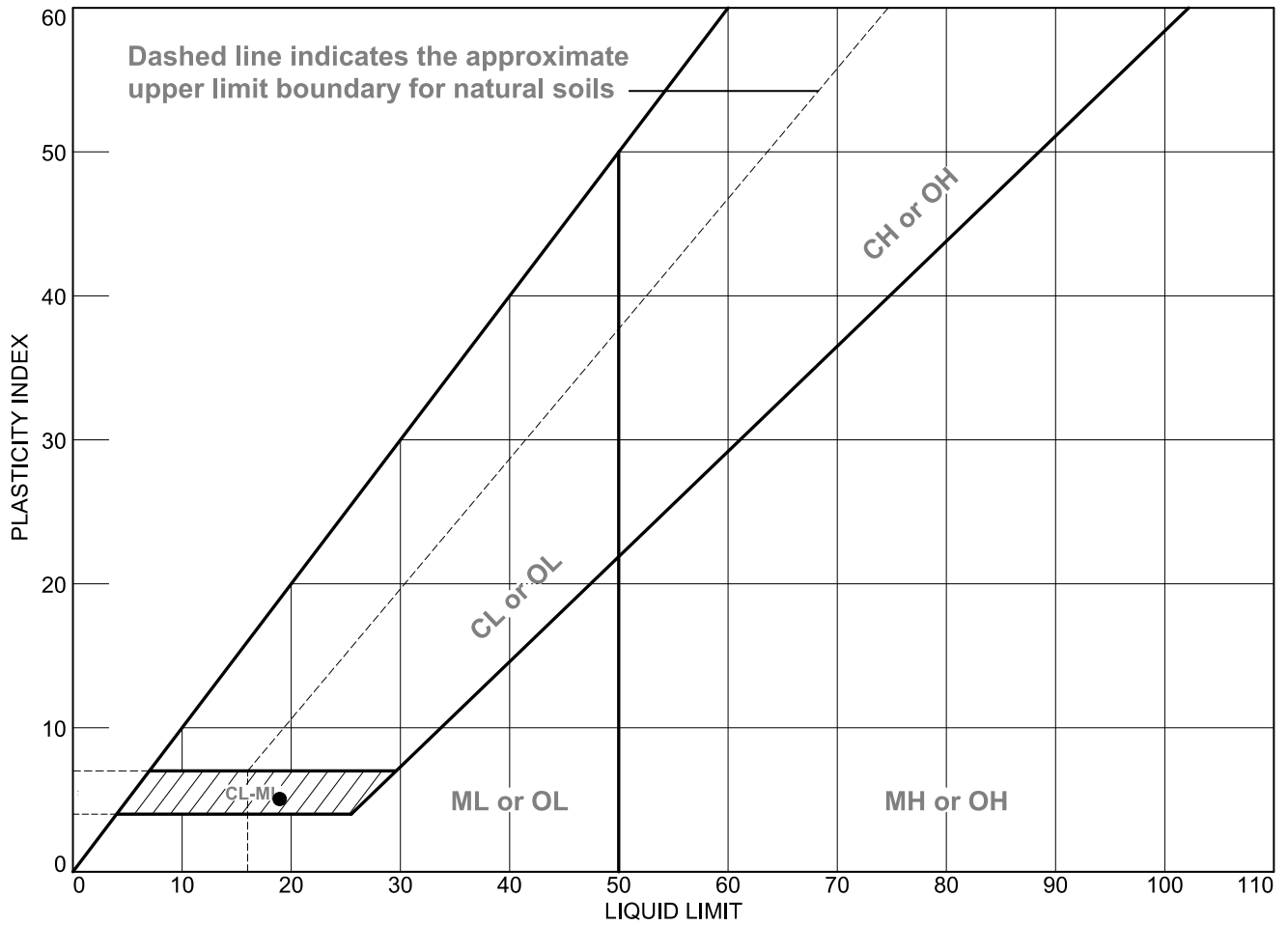
	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	1.6	2.0	17.0	30.0	49.4		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○	19	14	0.5294	0.2275	0.0901					

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Silty, clayey sand							9/20/2017	SC-SM	20.2

<div><div><div>Project No.117520.221791</div><div>Client:NYC DDC</div></div><div><div>Project:New NYPD 116th Precinct</div><div>Queens, NY</div></div><div><div>Source of Sample:B-5</div><div>Depth:67-69'</div><div>Sample Number:U-1</div></div></div>	<div>Remarks: ○As received MC = 20.2%</div>
<div><div>CDM Smith</div><div>Boston, Massachusetts</div></div>	<div>Figure</div>

Tested By: RZ Checked By: MP

# LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-5	U-1	67-69'	20.2	14	19	5	SC-SM

**CDM Smith**

**Boston, Massachusetts**

**Client:** NYC DDC  
**Project:** New NYPD 116th Precinct  
 Queens, NY  
**Project No.:** 117520.221791

**Figure**

**Tested By:** RZ **Checked By:** MP

# CDM Smith

## Geotechnical Engineering Laboratory

### Standard Test Method for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils (ASTM D2974)

Client: NYC DDC  
Project Name: New NYPD 116th Precinct  
Project Location: Queens, NY  
Project Number: 117520-221791  
Boring Number: B-5  
Sample Number: U-1  
Sample Depth (ft): 67-69'  
Sample Date: 9/7/2017

Tested By: MP  
Test Date: 9/18/2017

Procedure: C  
Temperature: 440° C

AS RECEIVED MOISTURE CONTENT	
Tin Mass (g)	126.66
Wet Mass of Sample & Tin (g)	190.44
Dry Mass of Sample & Tin (g)	178.92
Mass of Water (g)	11.52
Mass of Dry Soil (g)	52.26
<b>Moisture Content (%)</b>	<b>22.0</b>

ASH CONTENT	
Porcelain Dish Mass (g)	126.66
Porcelain Dish + Oven Dried Soil (g)	178.92
Mass of Oven Dried Soil (g)	52.26
Mass of Dish & Burned Soil (g)	177.77
Mass of Burned Soil (g)	51.11
Mass of Organic Material (g)	1.15
Ash Content (%)	97.8
<b>Organic Content (%)</b>	<b>2.2</b>



## Geotechnical Engineering Laboratory

### ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL TEST SUMMARY - ASTM D4767

**Client:** NYC DDC  
**Project:** New NYPD 116th Precinct  
**Location:** Queens, NY  
**Project No:** 117520-221791

**Test Date:** 9/20/2017  
**Exploration No:** B-5  
**Sample No:** U-1  
**Depth (ft):** 67-69

**LL :** 19  
**PL :** 14  
**PI :** 5  
**USCS:** SC-SM

#### Initial

Moisture Content (%):	20.2%
Dry Unit Weight (pcf):	111.4
Diameter (in):	2.867
Height (in):	5.604
Void Ratio (-):	0.54
Saturation (%):	102.8
Moisture Content (Trim.%):	20.2%
Cross Sectional Area (in <sup>2</sup> ):	6.456

#### Final

Moisture Content (%):	16.7%
Dry Unit Weight (pcf):	113.8
Height (in):	4.589
Void Ratio (-):	0.507
Saturation (%):	90.2
Cross Sectional Area (in <sup>2</sup> ):	7.883

#### End of Consolidation Data

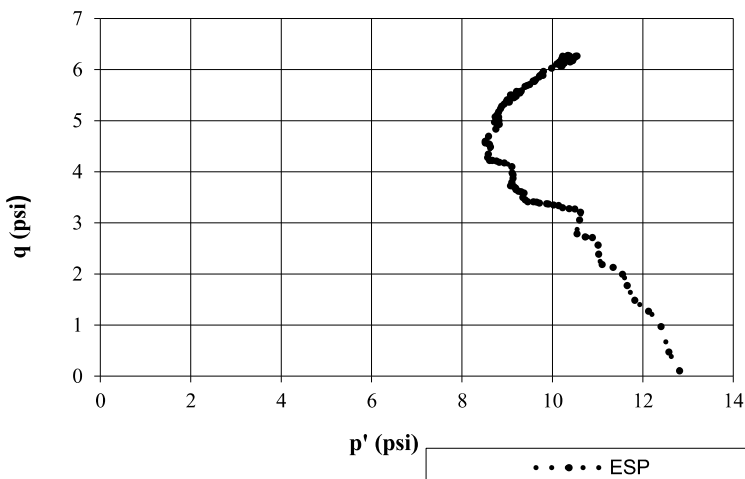
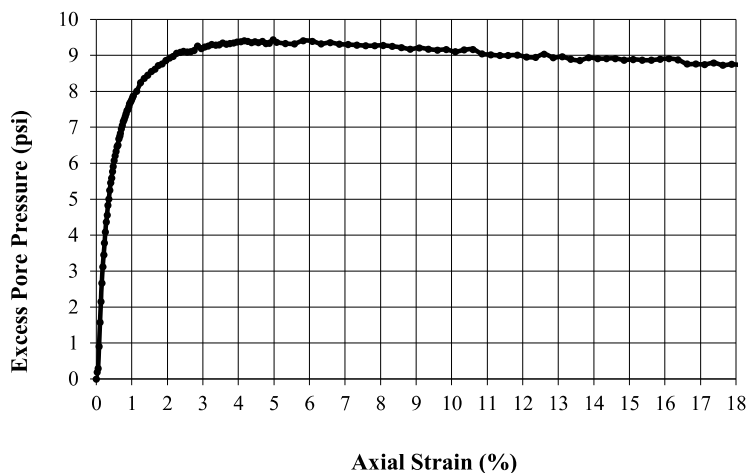
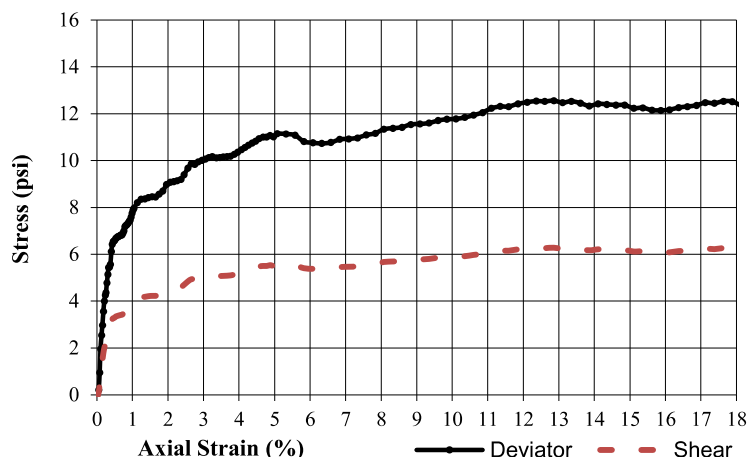
A <sub>c</sub> Evaluated using Method	B
Sample Saturated using Method	B
Moisture Content (%):	16.7%
Dry Unit Weight (pcf):	113.8
Height (in):	5.604
Void Ratio (-):	0.507
Saturation (%):	90.2
Cross Sectional Area (in <sup>2</sup> ):	6.456
Pore Pressure Parameter B (-):	1.00
Final Back Pressure (psi):	40
Consolidation Pressure (psi):	13.0

#### Shear Data

Shear Strain Rate (%/hr):	0.9
Max. Deviator Stress <sup>(*)</sup> (psi):	12.6
Strain at Failure (%):	12.9
Minor Eff. Pr. Stress <sup>(*)</sup> (psi):	4.1
Major Eff. Pr. Stress <sup>(*)</sup> (psi):	16.6
Undrained Strength Ratio (-):	0.48

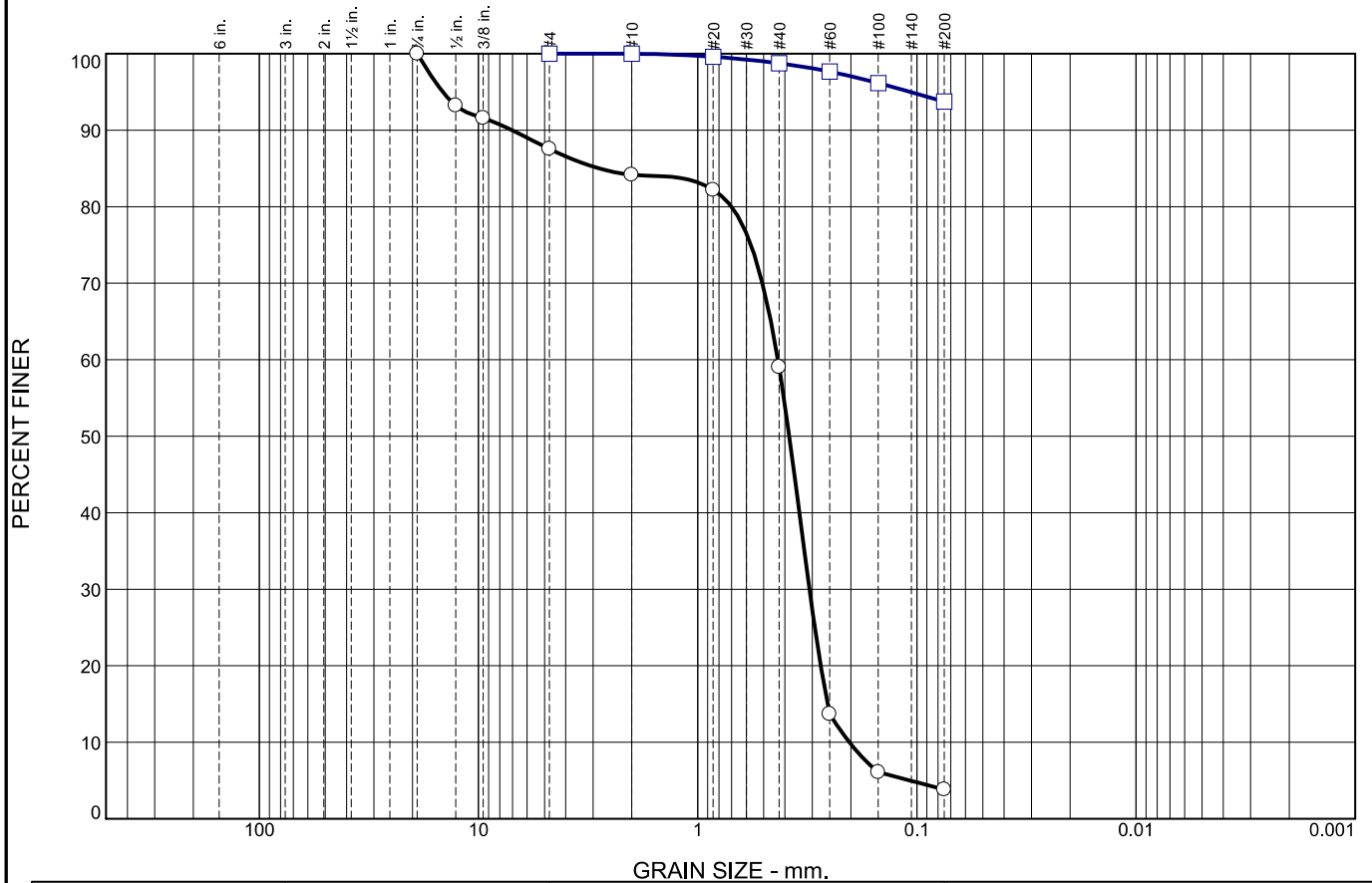
#### Notes:

(\*) Failure criterion: max. deviator stress or max deviator stress at strain = 15%, whichever is obtained first. No correction for membrane or filter paper applied



#### Remarks:

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	12.4	3.4	25.2	55.2	3.8	
□	0.0	0.0	0.0	0.0	1.3	5.0	93.7	

LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○		2.8143	0.4305	0.3820	0.3090	0.2556	0.2032	1.09	2.12
□	56	27							

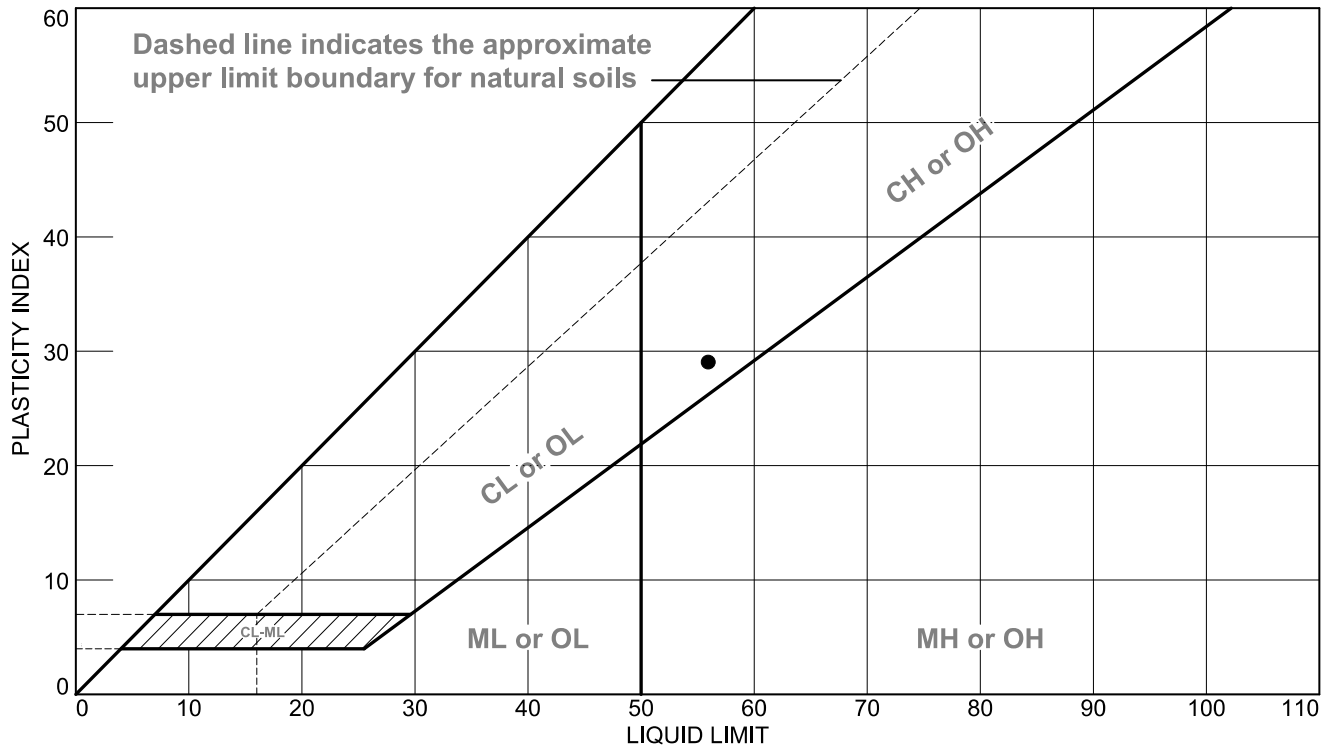
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							9/13/2017	SP	
□ Fat clay							9/13/2017	CH	37.7

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <input type="radio"/> <b>Source of Sample:</b> B-6 <b>Depth:</b> 50-52' <b>Sample Number:</b> S-11 <input type="checkbox"/> <b>Source of Sample:</b> B-6 <b>Depth:</b> 69-71' <b>Sample Number:</b> S-15	<b>Remarks:</b>
<b>CDM Smith</b>	
<b>Boston, Massachusetts</b>	

Figure

Tested By: RZ      Checked By: MP

# LIQUID AND PLASTIC LIMITS TEST REPORT



## SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-6	S-16	69-71'	37.7	27	56	29	CH

**CDM Smith**

**Boston, Massachusetts**

**Client:** NYC DDC

**Project:** New NYPD 116th Precinct  
Queens, NY

**Project No.:** 117520.221791

**Figure**

Tested By: RZ Checked By: MP



**CDM Smith**  
**Geotechnical Engineering Laboratory**

**Standard Test Method for Moisture, Ash, and Organic Matter of Peat and  
Other Organic Soils (ASTM D2974)**

Client:	NYC DDC	Tested By:	MP
Project Name:	New NYPD 116th Precinct	Test Date:	9/13/2017
Project Location:	Queens, NY		
Project Number:	117520-221791		
Sample Number:	B-6	Procedure:	C
Sample Location:	S-14	Temperature:	440° C
Sample Depth (ft):	65-67'		
Sample Date:	9/5/2017		
Lab ID Number:	453082251		

AS RECEIVED MOISTURE CONTENT	
Tin Mass (g)	96.88
Wet Mass of Sample & Tin (g)	168.59
Dry Mass of Sample & Tin (g)	145.65
Mass of Water (g)	22.9
Mass of Dry Soil (g)	48.8
<b>Moisture Content (%)</b>	<b>47.0</b>

ASH CONTENT	
Porcelain Dish Mass (g)	96.88
Porcelain Dish + Oven Dried Soil (g)	145.65
Mass of Oven Dried Soil (g)	48.8
Mass of Dish & Burned Soil (g)	144.17
Mass of Burned Soil (g)	47.3
Mass of Organic Material (g)	1.5
Ash Content (%)	97.0
<b>Organic Content (%)</b>	<b>3.0</b>

**CDM Smith**  
**Geotechnical Engineering Laboratory**

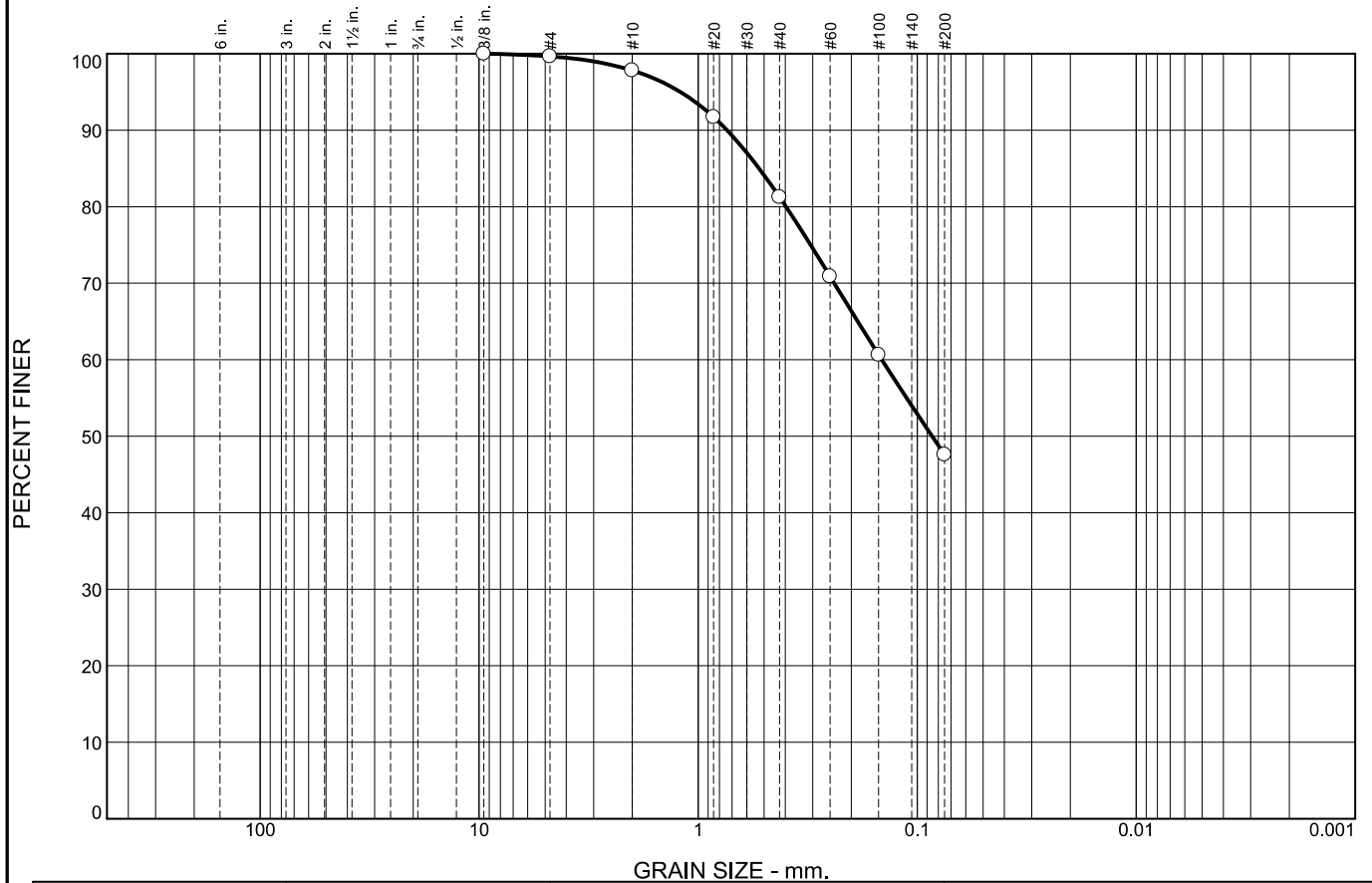
**Standard Test Method for Moisture, Ash, and Organic Matter of Peat and  
Other Organic Soils (ASTM D2974)**

Client:	NYC DDC	Tested By:	MP
Project Name:	New 116th Precinct	Test Date:	10/19/2017
Project Location:	Queens, NY		
Project Number:	117520-221791		
Sample Number:	B-6	Procedure:	C
Sample Location:	S-15	Temperature:	440° C
Sample Depth (ft):	69-71'		
Sample Date:	9/5/2017		
Lab ID Number:	453082251		

AS RECEIVED MOISTURE CONTENT	
Tin Mass (g)	126.64
Wet Mass of Sample & Tin (g)	173.21
Dry Mass of Sample & Tin (g)	157.55
Mass of Water (g)	15.7
Mass of Dry Soil (g)	30.9
<b>Moisture Content (%)</b>	<b>50.7</b>

ASH CONTENT	
Porcelain Dish Mass (g)	126.64
Porcelain Dish + Oven Dried Soil (g)	157.55
Mass of Oven Dried Soil (g)	30.9
Mass of Dish & Burned Soil (g)	157.38
Mass of Burned Soil (g)	30.7
Mass of Organic Material (g)	0.2
Ash Content (%)	99.5
<b>Organic Content (%)</b>	<b>0.5</b>

# Particle Size Distribution Report



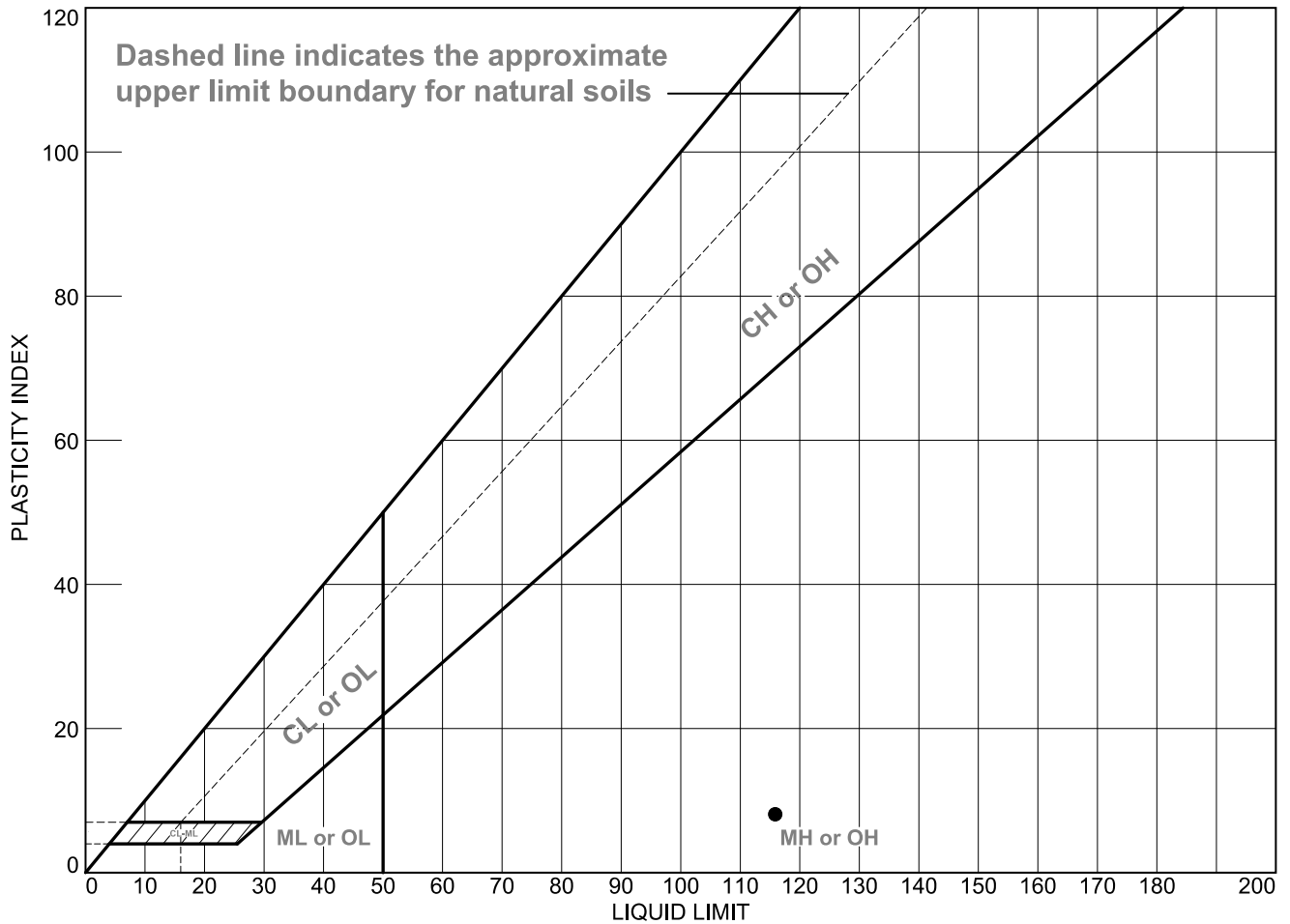
	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.4	1.8	16.5	33.7	47.6		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○	116	108	0.5274	0.1452	0.0854					

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Sandy peat							9/18/2017.	PT	187.1

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Tested By: GW      Checked By: MP

# LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-6	U-1	67-69'	187.1	108	116	8	PT

<b>CDM Smith</b>  <b>Boston, Massachusetts</b>		<b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <b>Project No.:</b> 117520.221791
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Figure

Tested By: RZ Checked By: MP

# CDM Smith

## Geotechnical Engineering Laboratory

### Standard Test Method for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils (ASTM D2974)

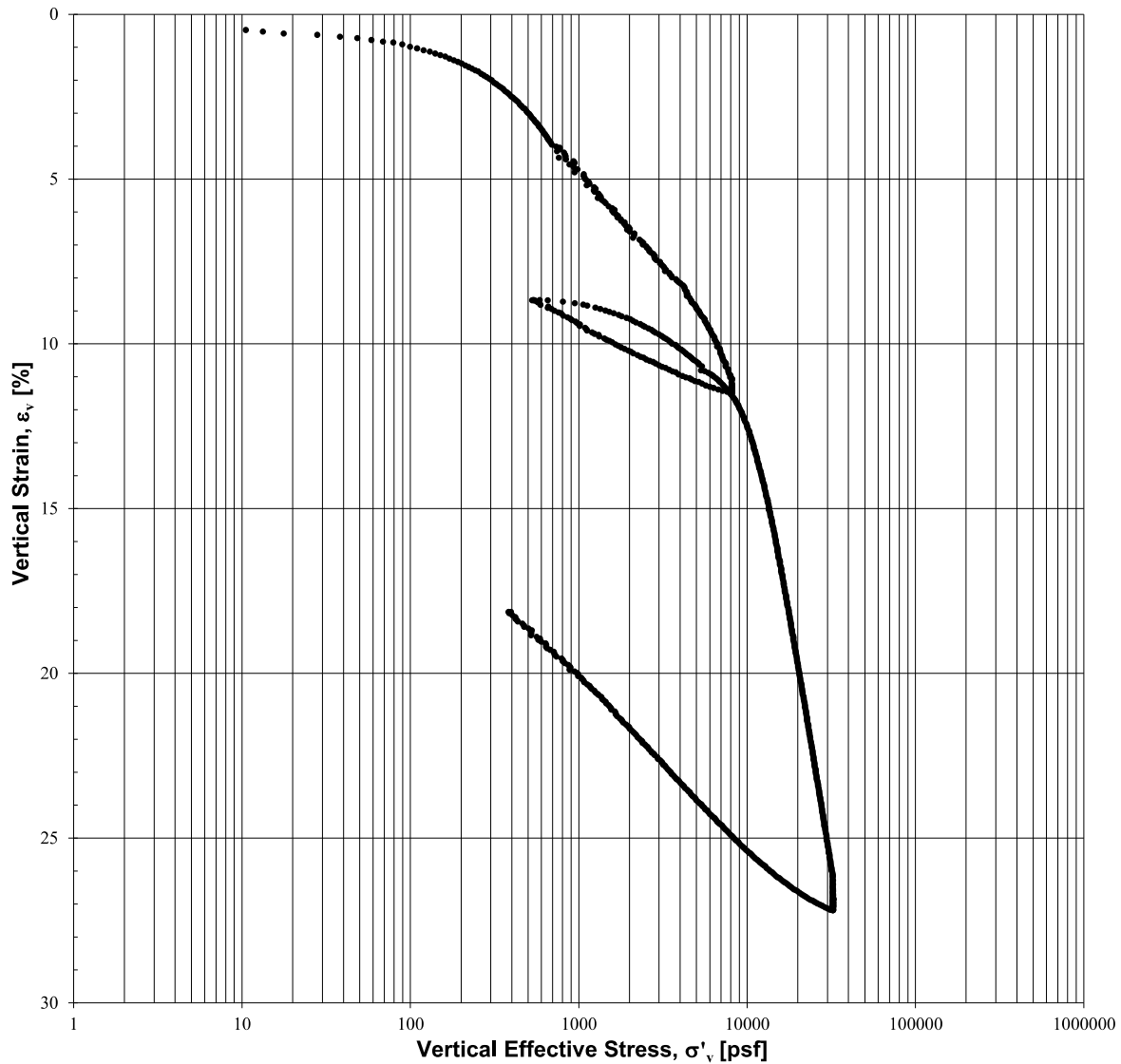
Client: NYC DDC  
Project Name: New NYPD 116th Precinct  
Project Location: Queens, NY  
Project Number: 117520-221791  
Boring Number: B-6  
Sample Number: U-1  
Sample Depth (ft): 67-69'  
Sample Date: 9/5/2017

Tested By: MP  
Test Date: 9/18/2017

Procedure: C  
Temperature: 440° C

AS RECEIVED MOISTURE CONTENT	
Tin Mass (g)	90.30
Wet Mass of Sample & Tin (g)	115.13
Dry Mass of Sample & Tin (g)	99.13
Mass of Water (g)	16.00
Mass of Dry Soil (g)	8.83
<b>Moisture Content (%)</b>	<b>181.2</b>

ASH CONTENT	
Porcelain Dish Mass (g)	90.30
Porcelain Dish + Oven Dried Soil (g)	99.13
Mass of Oven Dried Soil (g)	8.83
Mass of Dish & Burned Soil (g)	92.08
Mass of Burned Soil (g)	1.78
Mass of Organic Material (g)	7.05
Ash Content (%)	20.2
<b>Organic Content (%)</b>	<b>79.8</b>



**Exploration No:** B-6  
**Sample No:** U-1  
**Depth (ft):** 67-69  
**Sample Description:** Sandy peat

**Preconsolidation Pressure (psf):** 8,000  
**Estimated In Situ Pressure (psf):** --  
**OCR:** --  
**Compression Ratio, CR:** 0.260  
**Recompression Ratio, RR:** 0.030

**CDM Smith**  
 Geotechnical Engineering  
 Laboratory

**Client:** NYC DDC  
**Project:** New NYPD 116th Precinct  
**Location:** Queens, NY  
**Project No:** 117520-221791

**CONSTANT RATE OF STRAIN  
 CONSOLIDATION TEST  
 ASTM D4186**

# CDM Smith Geotechnical Engineering Laboratory

## CRS CONSOLIDATION TEST SUMMARY - ASTM D4186

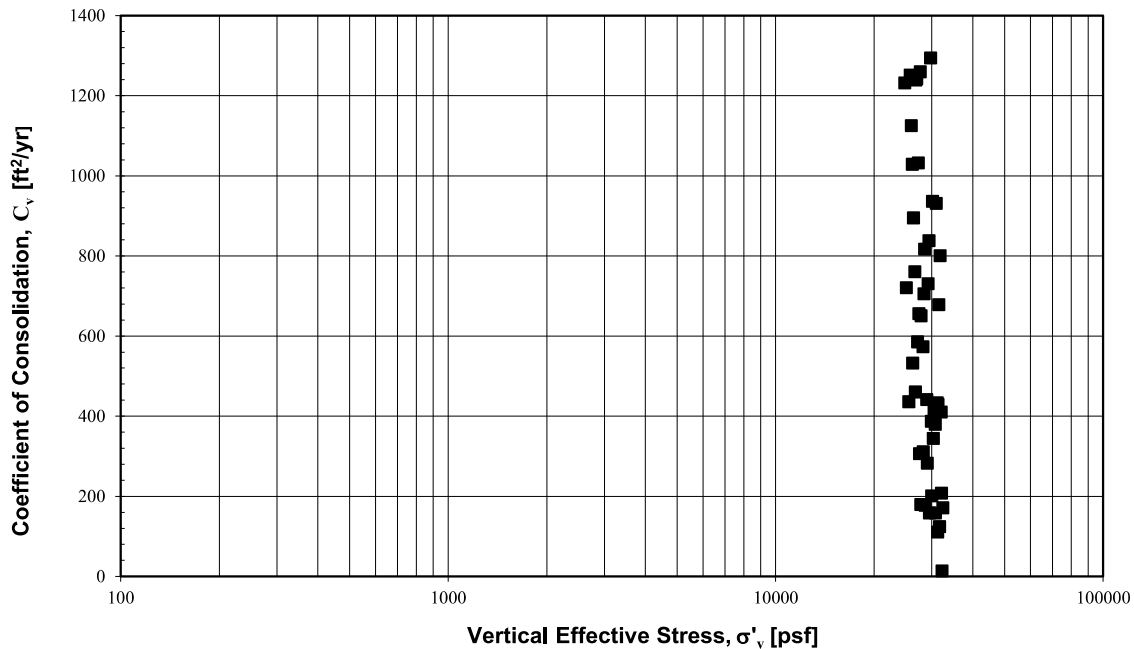
**Client:** NYC DDC  
**Project:** New NYPD 116th Precinct  
**Location:** Queens, NY  
**Project No:** 117520-221791

**Test Date:** 9/18/2017  
**Exploration No:** B-6  
**Sample No:** U1  
**Depth (ft):** 67-69  
**Sample Description:** Sandy peat

	<u>Initial</u>	<u>Final</u>
<b>Wet Mass (g)</b>	160.79	156.26
<b>Dry Mass (g)</b>	129.16	127.28
<b>Moisture Content (%):</b>	24.5	22.8
<b>Moist Unit Weight (pcf):</b>	124.8	136.3
<b>Dry Unit Weight (pcf):</b>	100.2	111.0
<b>Diameter (in):</b>	2.50	2.50
<b>Height (in)<sup>(*)</sup>:</b>	0.99	0.89
<b>Specific Gravity<sup>2</sup></b>	2.7	2.7
<b>Void Ratio (-)<sup>(*)</sup>: Saturation</b>	0.681	0.518
<b>(%):</b>	97.1	118.8

**Atterberg Limits:**  
**LL :** 116  
**PL :** 108  
**PI :** 8

**Consolidation Strain Rate (%/hr):** 1.0  
**Final Back Pressure (psi):** 40  
**Seating Pressure (psi):** 2



### Notes:

- Consolidation test performed in accordance with ASTM D4186.
  - Value of Specific gravity  $G_s$  is assumed
- (\*) Reported final data are taken at final deformation

### Test Remarks:

The graph displays the grain size distribution for three soil samples. The x-axis represents grain size in millimeters on a logarithmic scale, with major ticks at 100, 10, 1, 0.1, and 0.001. The y-axis represents the percent finer, ranging from 0 to 100. The three curves are as follows:

Grain Size (mm)	Blue Curve (Square Markers) % Finer	Black Curve (Circle Markers) % Finer	Red Curve (Triangle Markers) % Finer
6 in.	100	100	100
3 in.	100	100	100
2 in.	100	100	100
1½ in.	100	100	100
1 in.	100	100	100
¾ in.	100	100	100
½ in.	100	100	98
3/8 in.	100	100	97
#4	100	99	95
#10	100	97	93
#20	99	93	84
#30	99	80	78
#40	98	71	66
#60	97	32	27
#100	96	11	18
#140	95	3	16
#200	94	2	14

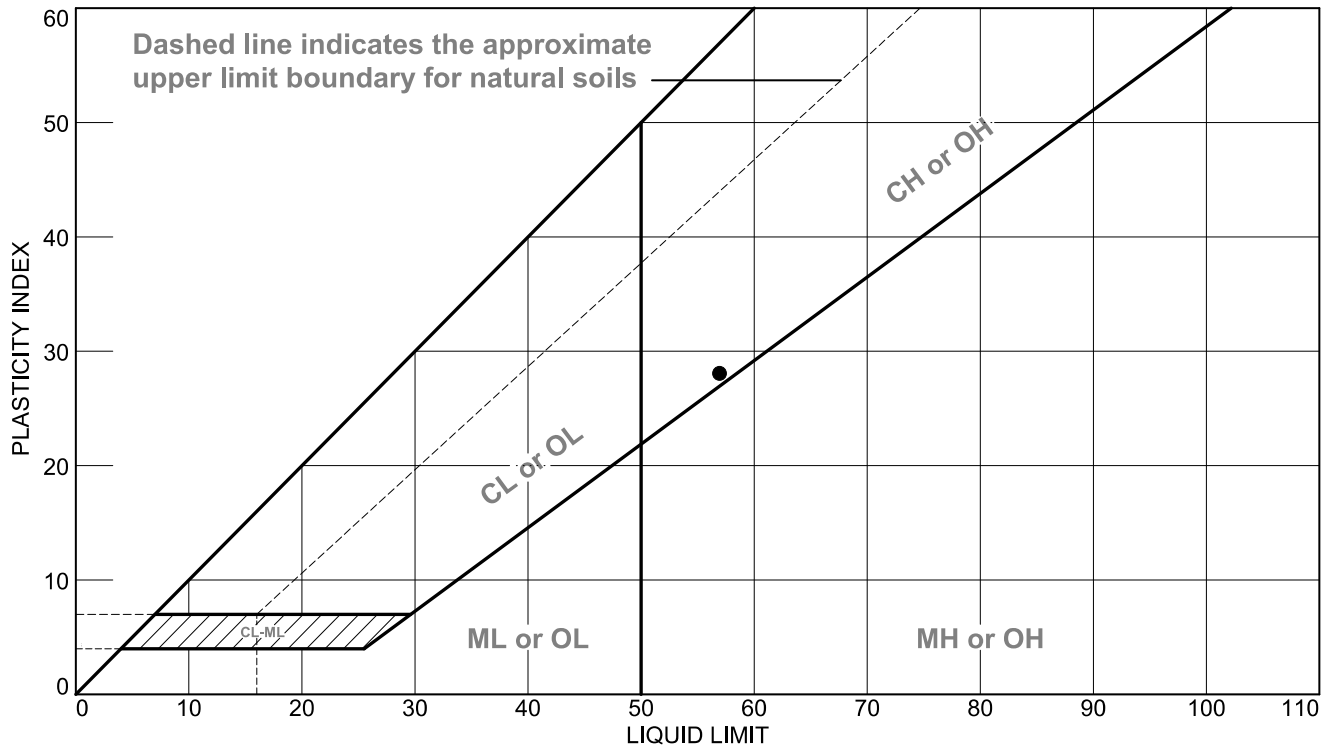
MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Poorly graded sand	8/31/2017	SP	43.8
□ Fat clay	8/31/2017	CH	
△ Silty sand	8/31/2017	SM	

<b>Project No.</b> 117520.221791	<b>Client:</b> NYC DDC	<b>Remarks:</b>	
<b>Project:</b> New NYPD 116th Precinct Queens, NY			
<input type="radio"/> <b>Source of Sample:</b> B-7	<b>Depth:</b> 25-27'		<b>Sample Number:</b> S-6
<input type="checkbox"/> <b>Source of Sample:</b> B-7	<b>Depth:</b> 65-67'		<b>Sample Number:</b> S-14
<input type="checkbox"/> <b>Source of Sample:</b> B-7	<b>Depth:</b> 95-97'		<b>Sample Number:</b> S-20
<b>CDM Smith</b>			
<b>Boston, Massachusetts</b>		<b>Figure</b>	

**Tested By:** RZ **Checked By:** MP



# LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-7	S-14	65-67'	43.8	29	57	28	CH

**CDM Smith**

**Boston, Massachusetts**

**Client:** NYC DDC

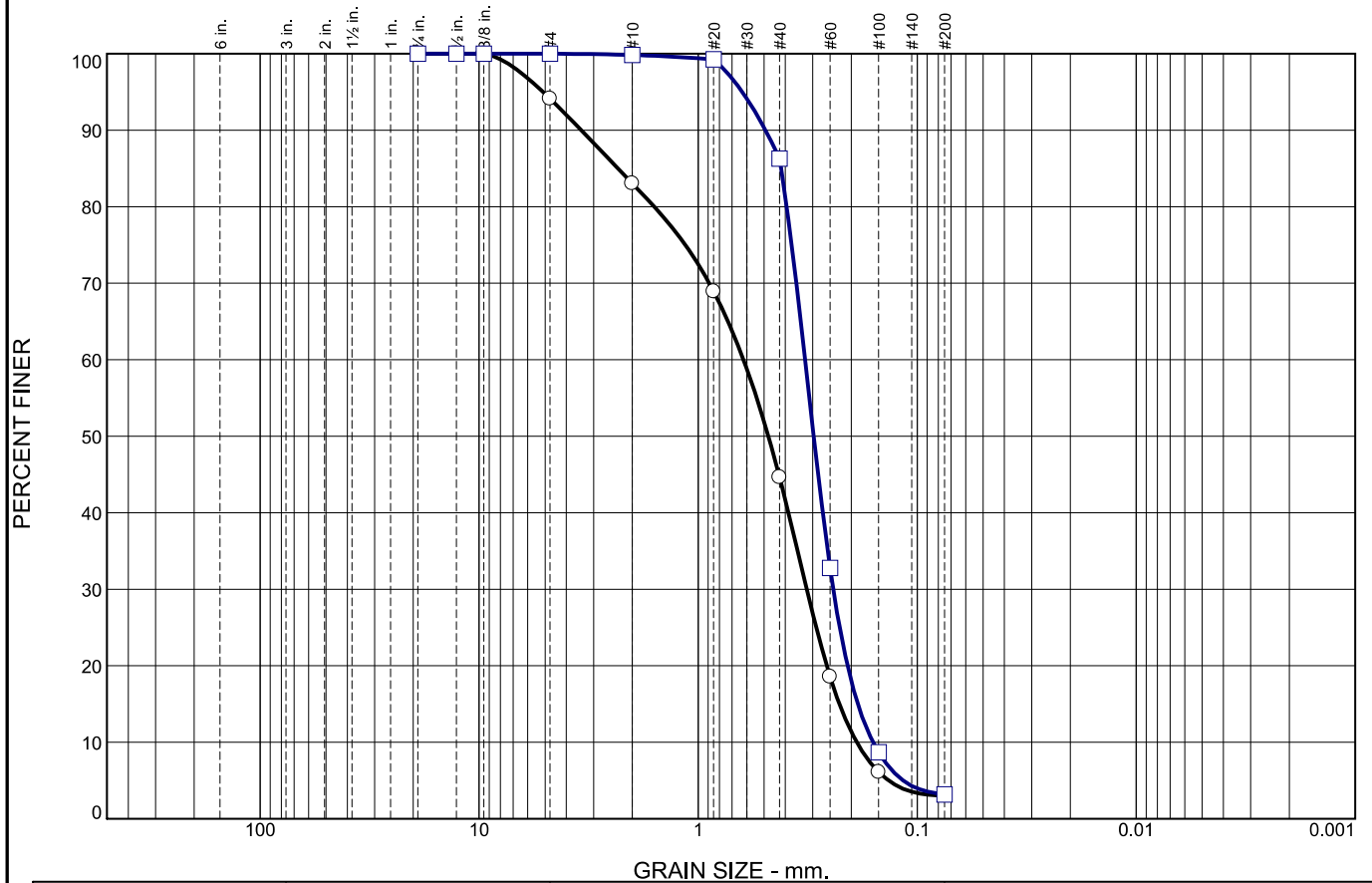
**Project:** New NYPD 116th Precinct  
Queens, NY

**Project No.:** 117520.221791

**Figure**

**Tested By:** RZ **Checked By:** MP

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	5.9	11.1	38.4	41.6	3.0	
□	0.0	0.0	0.0	0.2	13.5	83.1	3.2	

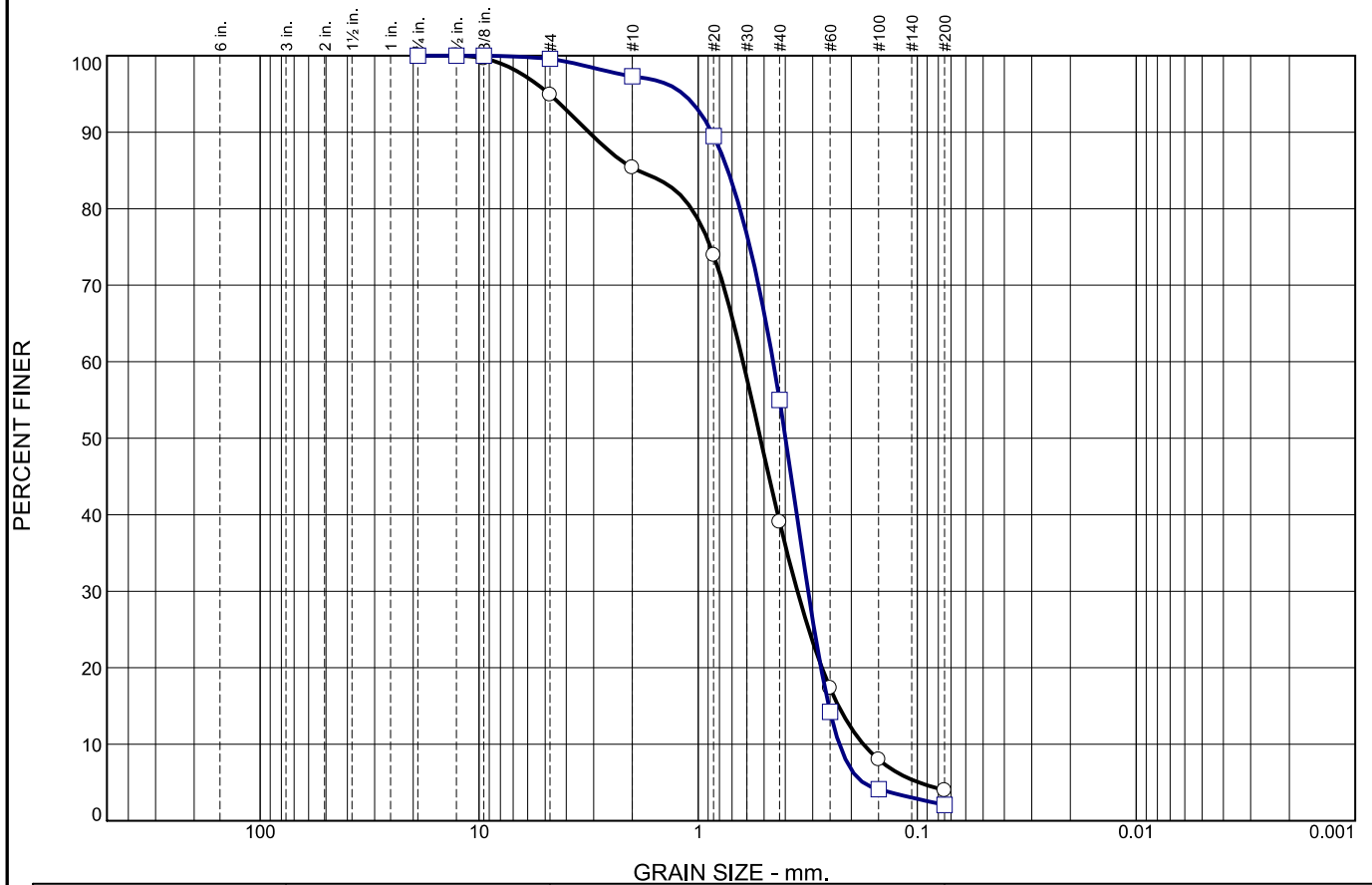
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			2.3254	0.6214	0.4780	0.3193	0.2266	0.1888	0.87	3.29
□			0.4179	0.3249	0.2969	0.2418	0.1868	0.1591	1.13	2.04

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							8/31/2017	SP	
□ Poorly graded sand							8/31/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY				<b>Remarks:</b>     <div>Figure</div>
○ <b>Source of Sample:</b> B-8	<b>Depth:</b> 15-17'	<b>Sample Number:</b> S-4		
□ <b>Source of Sample:</b> B-8	<b>Depth:</b> 25-27'	<b>Sample Number:</b> S-6		
<div>CDM Smith</div> <div>Boston, Massachusetts</div>				

Tested By: RZ Checked By: MP

# Particle Size Distribution Report

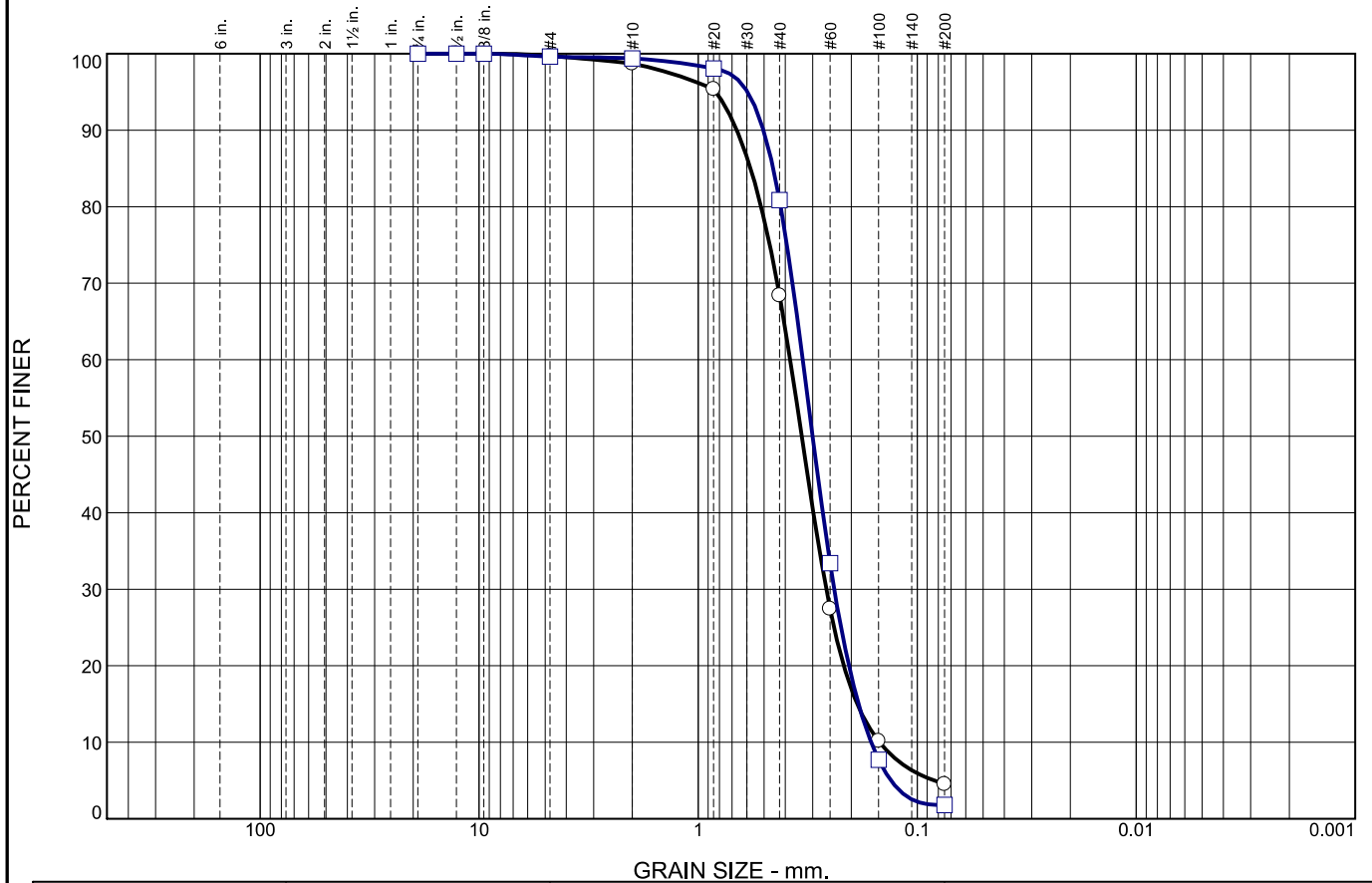


	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
<input type="radio"/>	0.0		0.0	5.1	9.5	46.3	35.1	4.0		
<input type="checkbox"/>	0.0		0.0	0.4	2.3	42.3	52.9	2.1		
<input checked="" type="checkbox"/>	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
<input type="radio"/>			1.8837	0.6244	0.5199	0.3522	0.2287	0.1761	1.13	3.55
<input type="checkbox"/>			0.7322	0.4544	0.3992	0.3145	0.2536	0.2266	0.96	2.01
MATERIAL DESCRIPTION								TEST DATE	USCS	NM
<input type="radio"/> Poorly graded sand								9/13/2017	SP	
<input type="checkbox"/> Poorly graded sand								9/13/2017	SP	
<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <input type="radio"/> <b>Source of Sample:</b> B-9 <b>Depth:</b> 15-17' <b>Sample Number:</b> S-4 <input type="checkbox"/> <b>Source of Sample:</b> B-9 <b>Depth:</b> 35-37' <b>Sample Number:</b> S-8								<b>Remarks:</b>		
CDM Smith										
Boston, Massachusetts								Figure		

Tested By: RZ

Checked By: MP

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.3	1.0	30.3	63.9	4.5	
□	0.0	0.0	0.4	0.2	18.5	79.1	1.8	

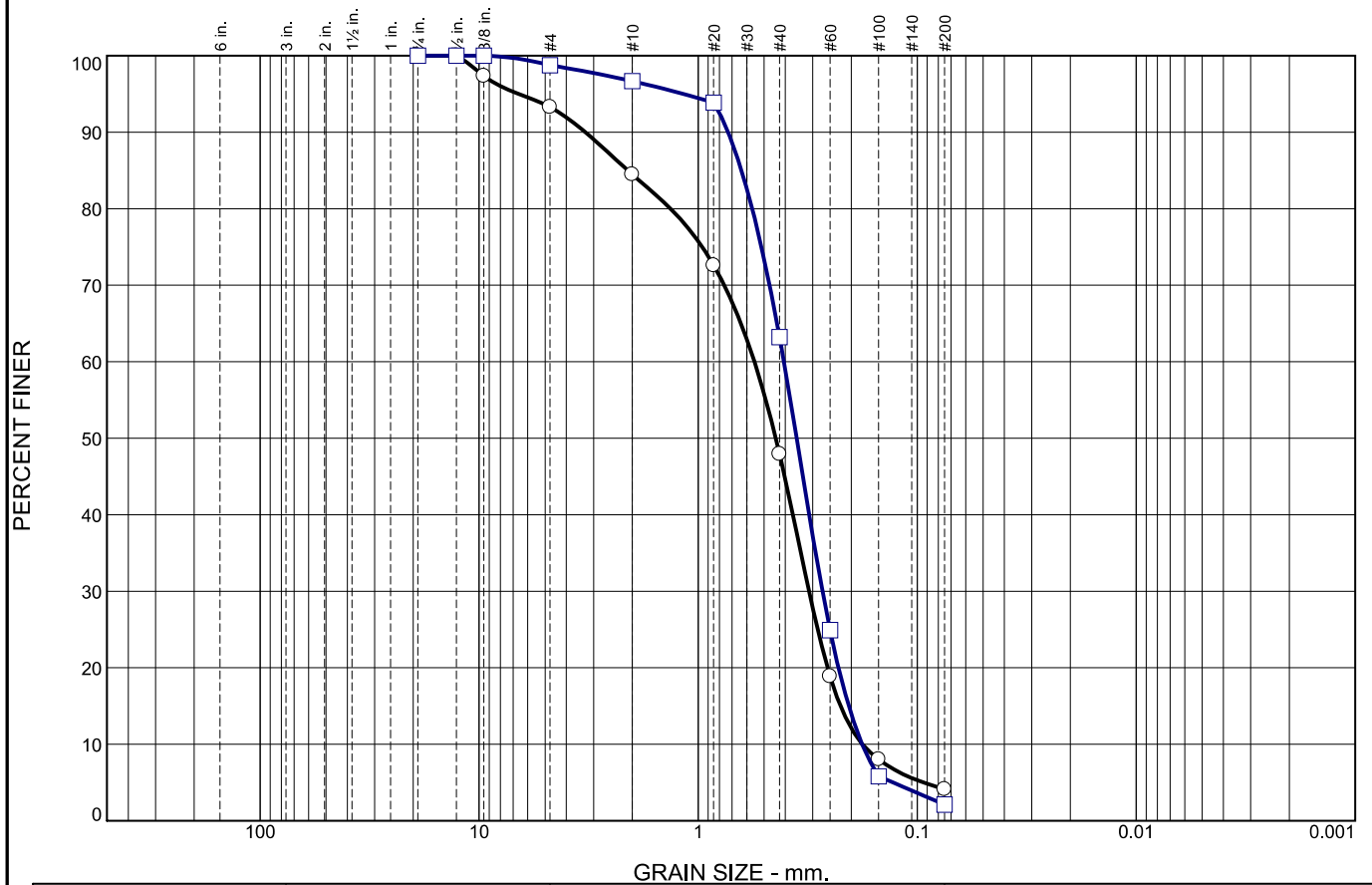
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5765	0.3802	0.3365	0.2601	0.1880	0.1484	1.20	2.56
□			0.4540	0.3330	0.3003	0.2393	0.1854	0.1624	1.06	2.05

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							9/13/2017	SP	
□ Poorly graded sand							9/13/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY ○ <b>Source of Sample:</b> B-10 <b>Depth:</b> 20-22' <b>Sample Number:</b> S-5 □ <b>Source of Sample:</b> B-10 <b>Depth:</b> 30-32' <b>Sample Number:</b> S-7			<b>Remarks:</b>          <div style="text-align: right;"><b>Figure</b></div>
<b>CDM Smith</b>			
<b>Boston, Massachusetts</b>			

Tested By: RZ      Checked By: MP

# Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.7	8.8	36.6	43.8	4.1	
□	0.0	0.0	1.3	2.0	33.5	61.1	2.1	

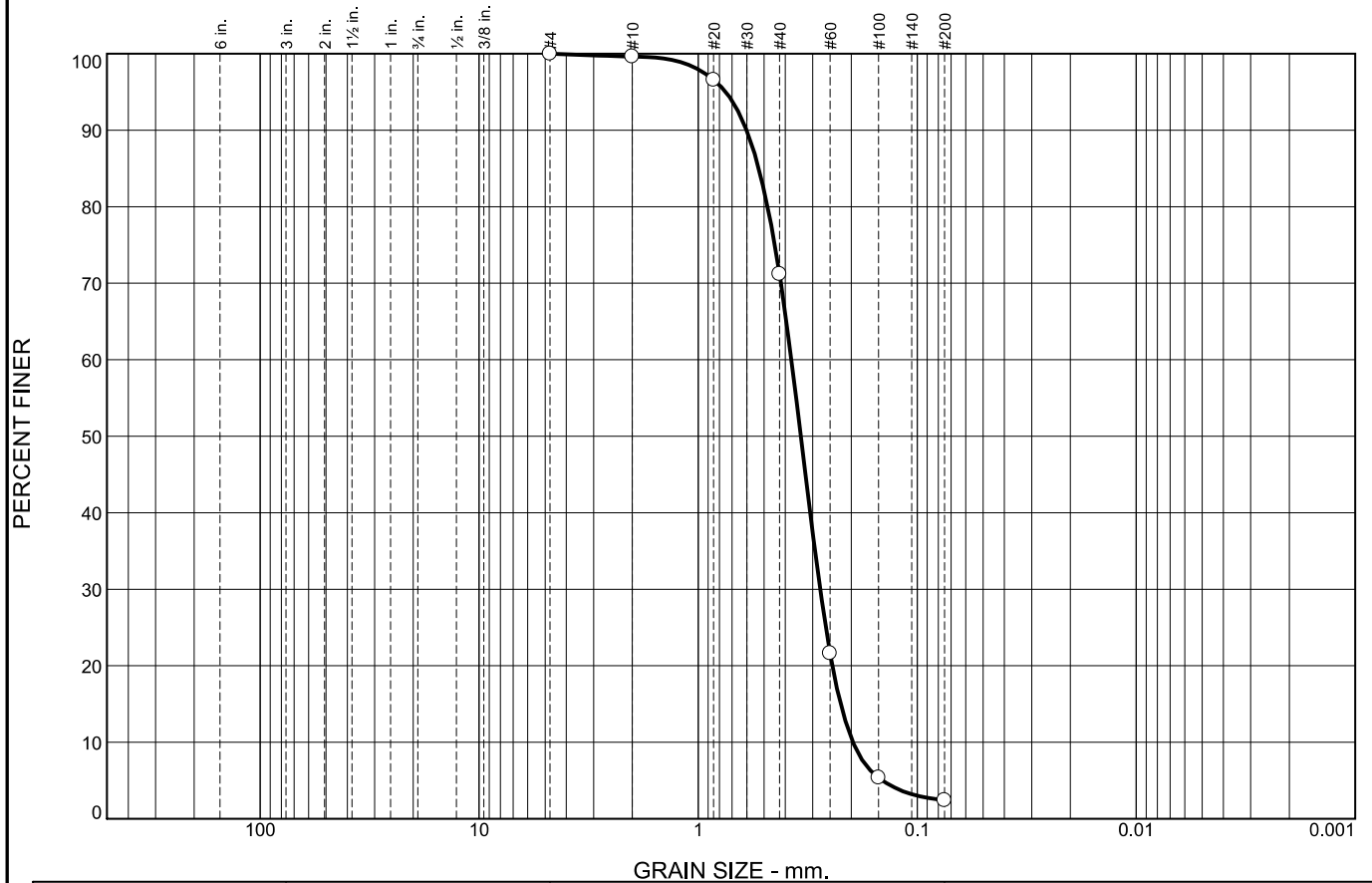
LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○		2.0952	0.5535	0.4421	0.3116	0.2241	0.1779	0.99	3.11
□		0.6343	0.4060	0.3549	0.2707	0.2053	0.1784	1.01	2.28

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							8/31/2017	SP	
□ Poorly graded sand							8/31/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY			<b>Remarks:</b>   
○ <b>Source of Sample:</b> B-11 □ <b>Source of Sample:</b> B-11	<b>Depth:</b> 15-17' <b>Depth:</b> 30-32'	<b>Sample Number:</b> S-4 <b>Sample Number:</b> S-7	
<b>CDM Smith</b>  <b>Boston, Massachusetts</b>			

Tested By: RZ Checked By: MP

# Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.0	0.4	28.4	68.8	2.4		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5291	0.3753	0.3398	0.2773	0.2236	0.1965	1.04	1.91

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Poorly graded sand							8/28/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <b>Source of Sample:</b> PB-1 <b>Depth:</b> 6-8' <b>Sample Number:</b> S-1	<b>Remarks:</b>   
<b>CDM Smith</b>  <b>Boston, Massachusetts</b>	<b>Figure</b>

Tested By: RZ      Checked By: MP

The graph illustrates the grain size distribution of a material. The y-axis represents the percentage of material finer than a given grain size, ranging from 0 to 100. The x-axis represents the grain size in millimeters on a logarithmic scale, ranging from 100 mm to 0.001 mm. The curve shows that the material is predominantly composed of particles larger than 1 mm, with a sharp drop in the percentage finer as the grain size decreases below 1 mm.

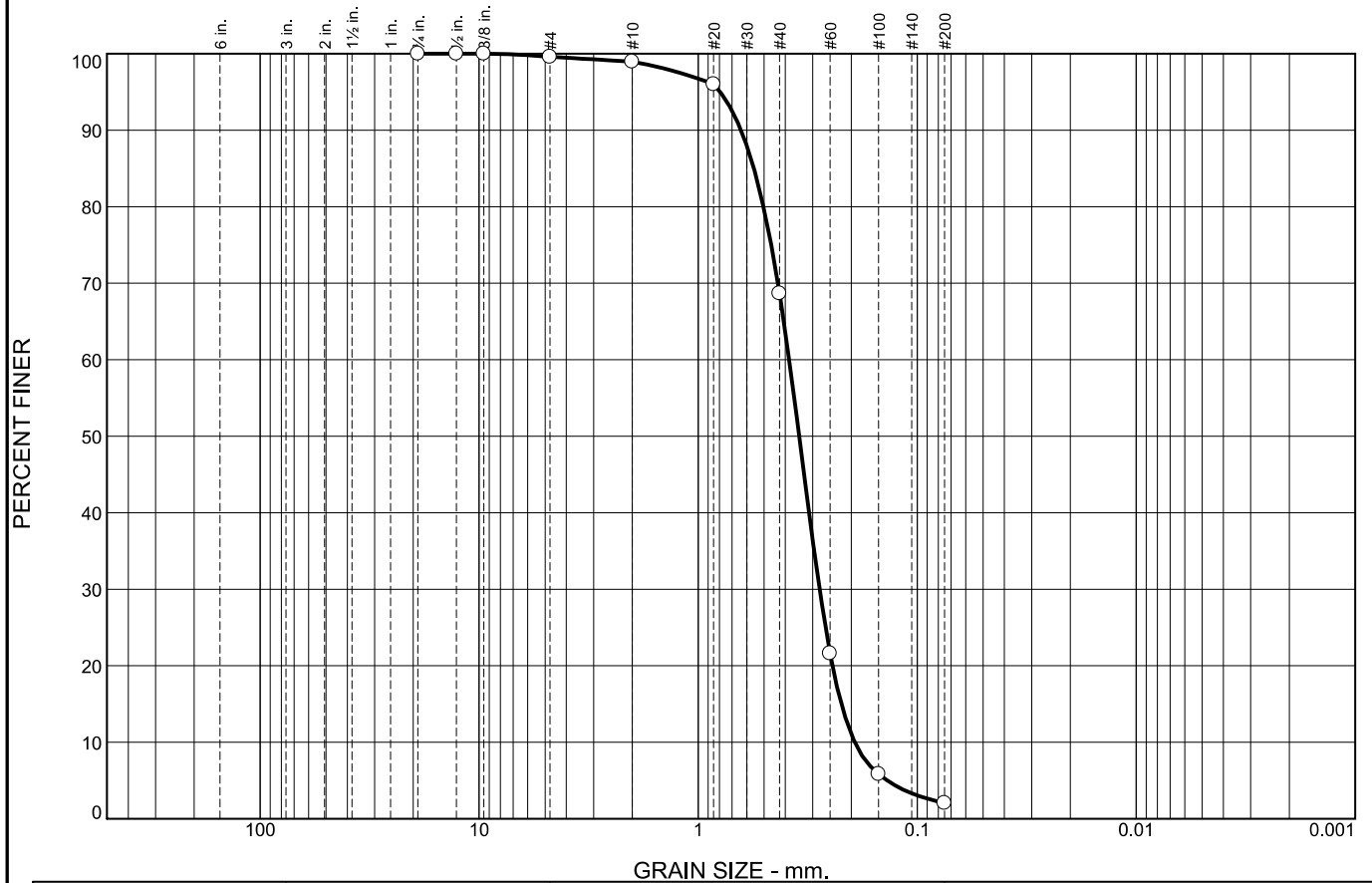
Grain Size (mm)	Percent Finer (%)
100	100
10	100
5	100
2.5	100
1.18	100
0.85	100
0.60	100
0.425	100
0.30	100
0.25	100
0.20	100
0.15	99
0.10	84
0.075	50
0.060	21
0.0425	5

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Poorly graded sand with silt	8/28/2017	SP-SM	

## Boston, Massachusetts

SP-SM

# Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.4	0.7	30.2	66.6	2.1		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5568	0.3842	0.3457	0.2790	0.2220	0.1928	1.05	1.99

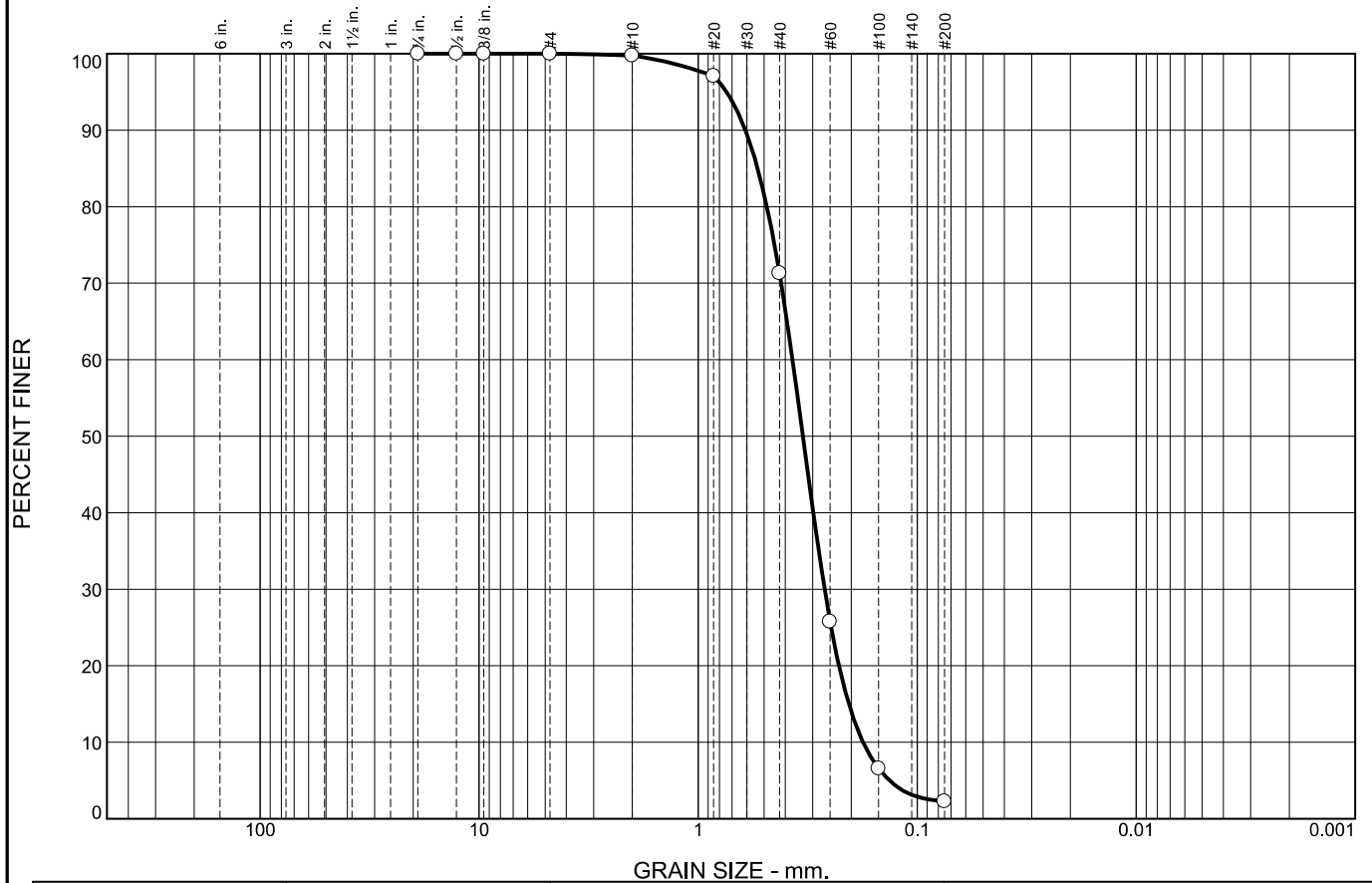
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Poorly graded sand							8/28/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <input type="radio"/> <b>Source of Sample:</b> PB-3 <b>Depth:</b> 10-12' <b>Sample Number:</b> S-3			<b>Remarks:</b>
<div>CDM Smith</div> <div>Boston, Massachusetts</div>			

Tested By: RZ Checked By: MP



# Particle Size Distribution Report



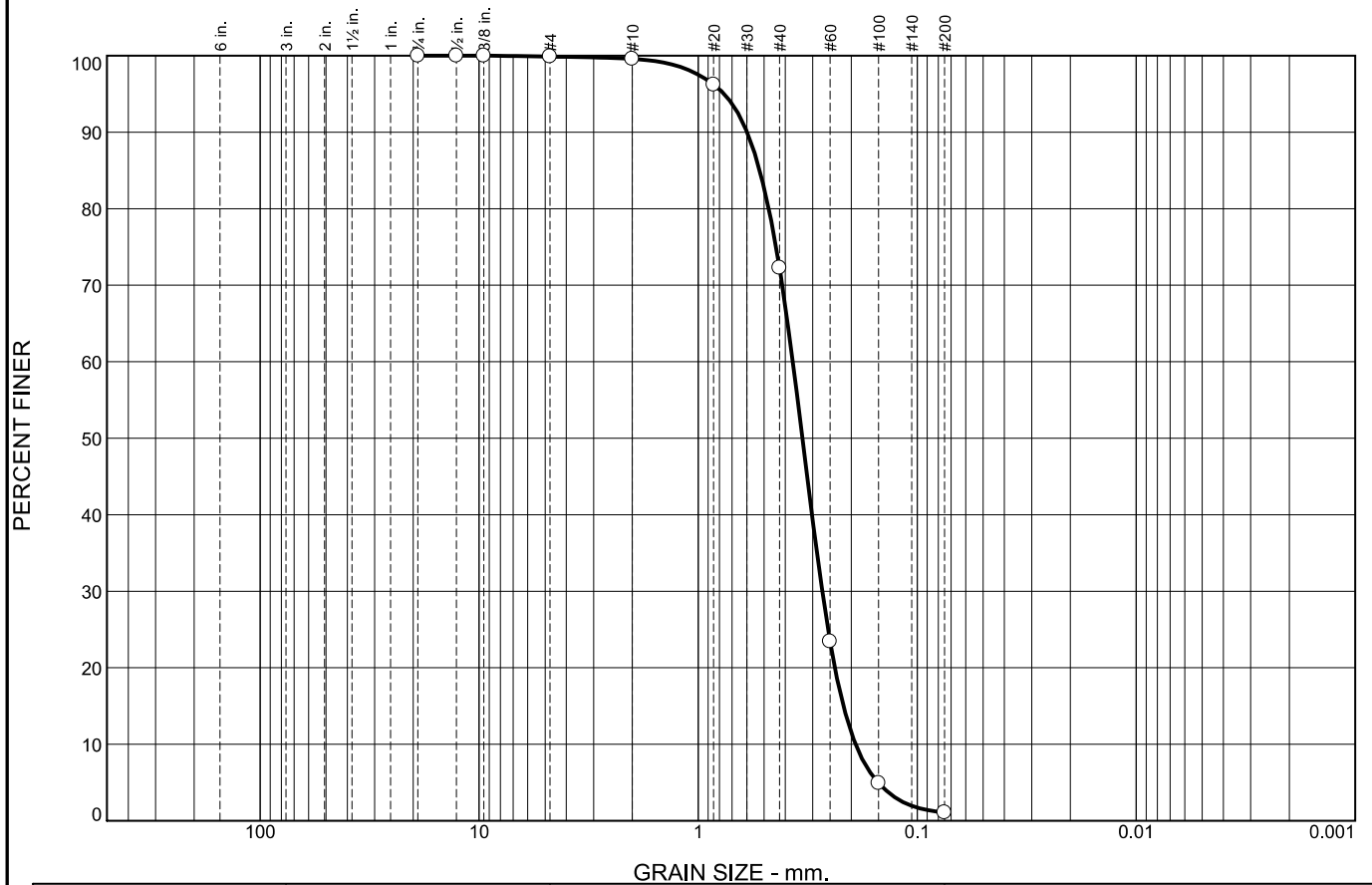
	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.0	0.2	28.5	69.0	2.3		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5352	0.3708	0.3324	0.2648	0.2053	0.1768	1.07	2.10

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Poorly graded sand							8/31/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <b>Source of Sample:</b> PB-4 <b>Depth:</b> 8-10' <b>Sample Number:</b> S-2		<b>Remarks:</b>          <div>Figure</div>
<div>CDM Smith</div> <div>Boston, Massachusetts</div>		

Tested By: RZ Checked By: MP

# Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.1	0.3	27.3	71.2	1.1		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5237	0.3697	0.3341	0.2713	0.2172	0.1913	1.04	1.93

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Poorly graded sand							8/31/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <b>Source of Sample:</b> PB-5 <b>Depth:</b> 6-8' <b>Sample Number:</b> S-1		<b>Remarks:</b>          <div>Figure</div>
<div>CDM Smith</div> <div>Boston, Massachusetts</div>		

Tested By: RZ                      Checked By: MP

The graph displays the grain size distribution of a soil sample. The y-axis represents the percentage of soil finer than a given grain size, ranging from 0 to 100. The x-axis represents the grain size in millimeters on a logarithmic scale, ranging from 0.001 to 100 mm. The curve shows that approximately 96% of the soil is finer than 2.0 mm, and about 3% is finer than 0.075 mm.

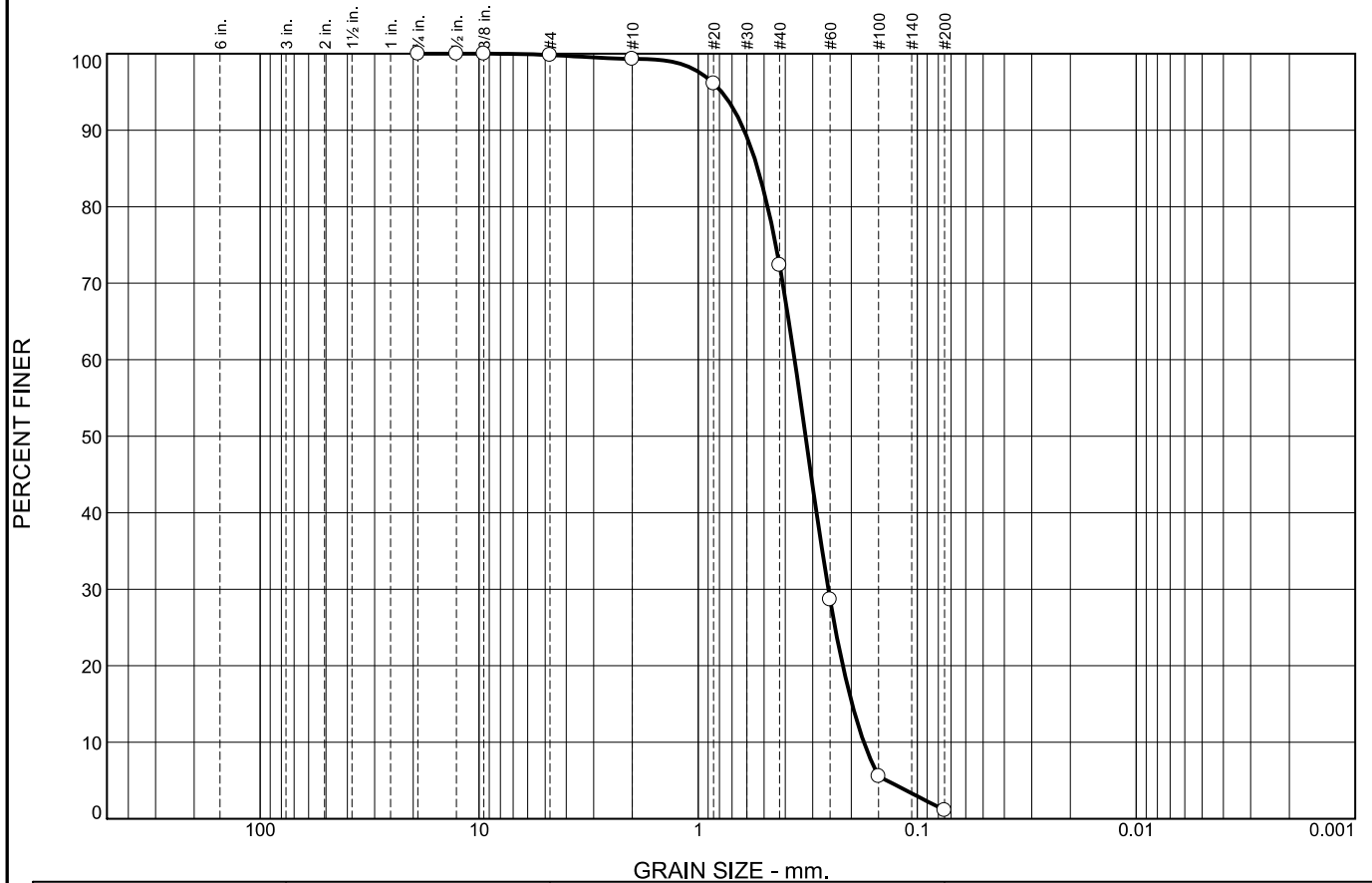
Grain Size (mm)	Percent Finer (%)
60	100
30	100
20	100
10	99
4.75	96
2.0	96
0.85	55
0.425	18
0.25	6
0.075	3

MATERIAL DESCRIPTION	TEST DATE	USCS	NM
○ Poorly graded sand	9/13/2017	SP	

	<b>USCS</b>	<b>NM</b>
	SP	

**Checked By:** MP

# Particle Size Distribution Report



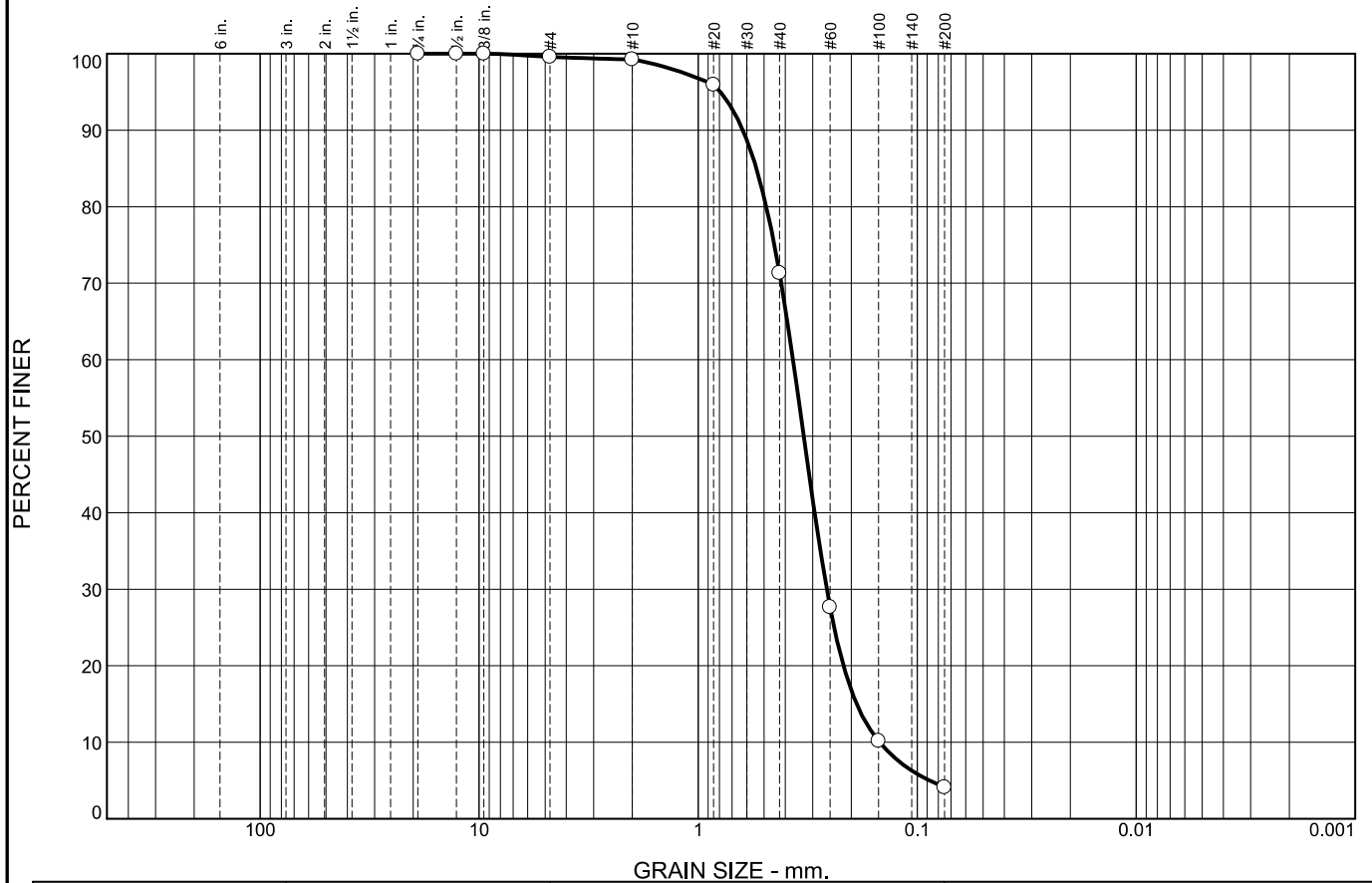
	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.2	0.5	26.9	71.3	1.1		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5351	0.3626	0.3233	0.2546	0.1983	0.1752	1.02	2.07

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Poorly graded sand							9/13/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <b>Source of Sample:</b> PB-7 <b>Depth:</b> 14-16' <b>Sample Number:</b> S-5			<b>Remarks:</b>     
<b>CDM Smith</b>  <b>Boston, Massachusetts</b>			

Tested By: RZ Checked By: MP

# Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.4	0.4	27.9	67.2	4.1		
⊗	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5423	0.3689	0.3295	0.2588	0.1891	0.1483	1.22	2.49

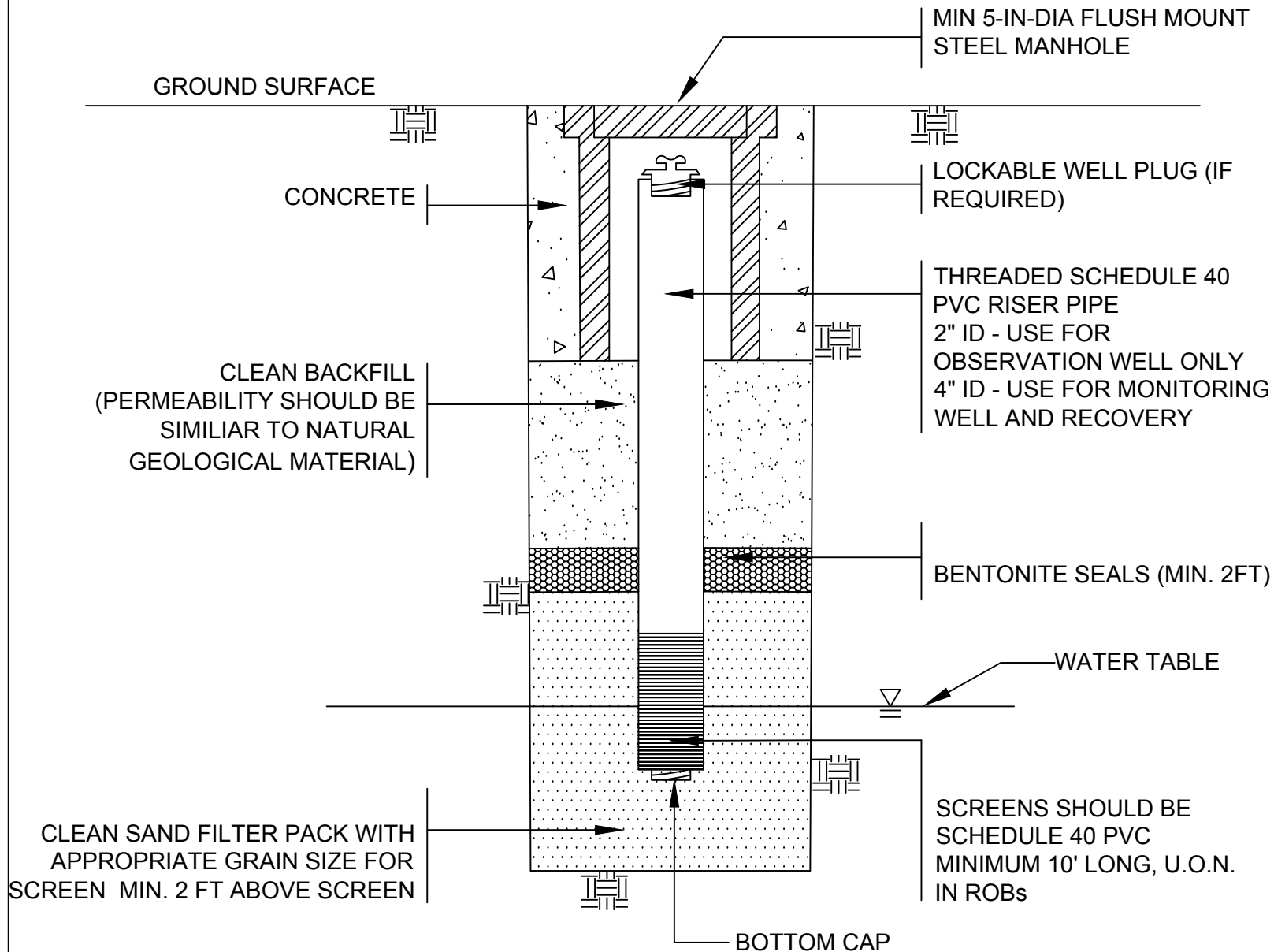
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
Poorly graded sand							9/13/2017	SP	

<b>Project No.</b> 117520.221791 <b>Client:</b> NYC DDC <b>Project:</b> New NYPD 116th Precinct Queens, NY <b>Source of Sample:</b> PB-8 <b>Depth:</b> 20-22' <b>Sample Number:</b> S-5		<b>Remarks:</b>          <div>Figure</div>
<div>CDM Smith</div> <div>Boston, Massachusetts</div>		

Tested By: RZ Checked By: MP

**TYPICAL OBSERVATION WELL CONSTRUCTION  
SKETCH**

# TYPICAL OBSERVATION WELL CONSTRUCTION



REVISIONS:

NUMBER	DESCRIPTION	DATE



CAPITAL PROJECT NUMBER:

PROJECT NAME:

FOR THE:

DRAWING TITLE:

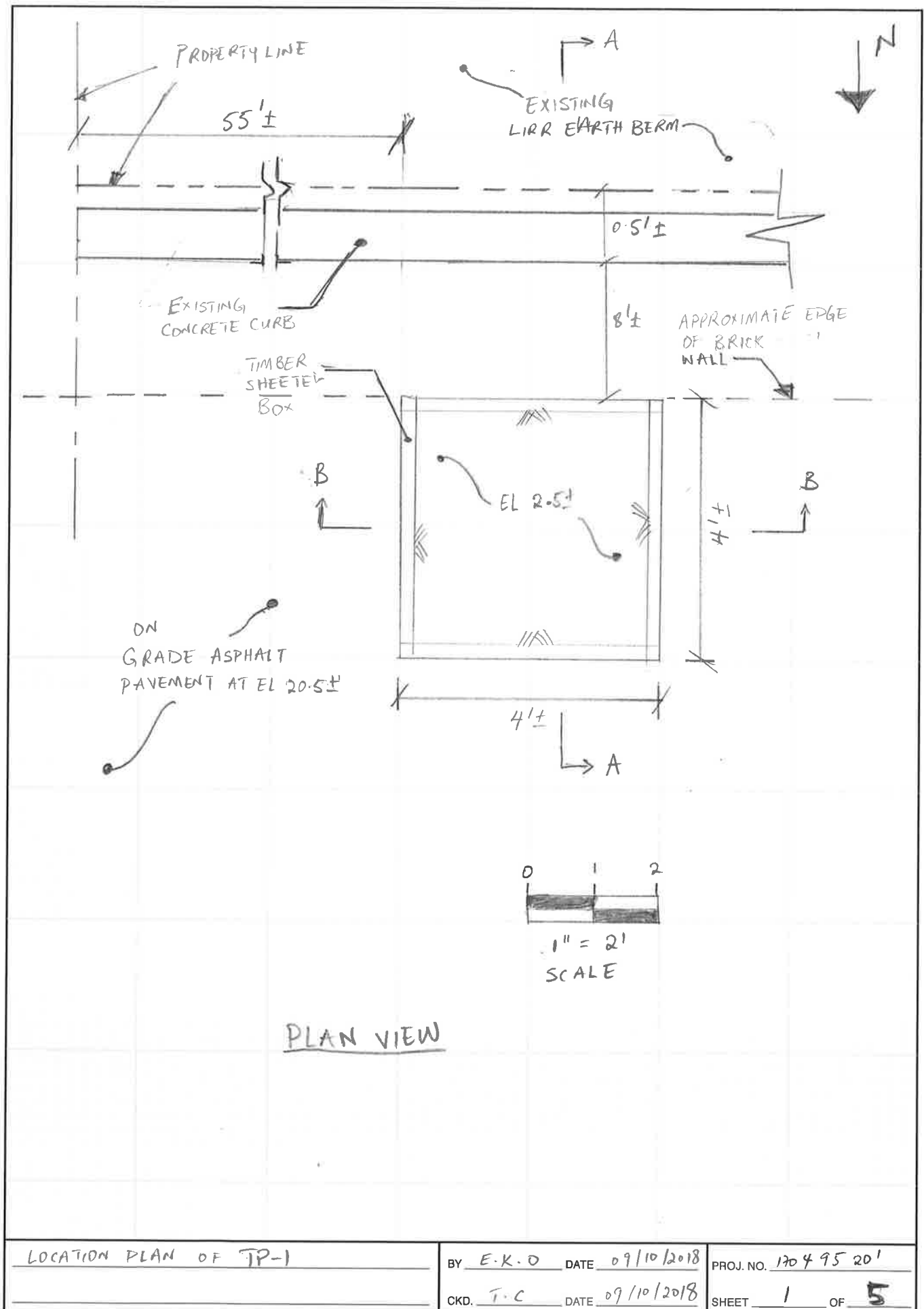
TYPICAL  
OBSERVATION WELL  
CONSTRUCTION

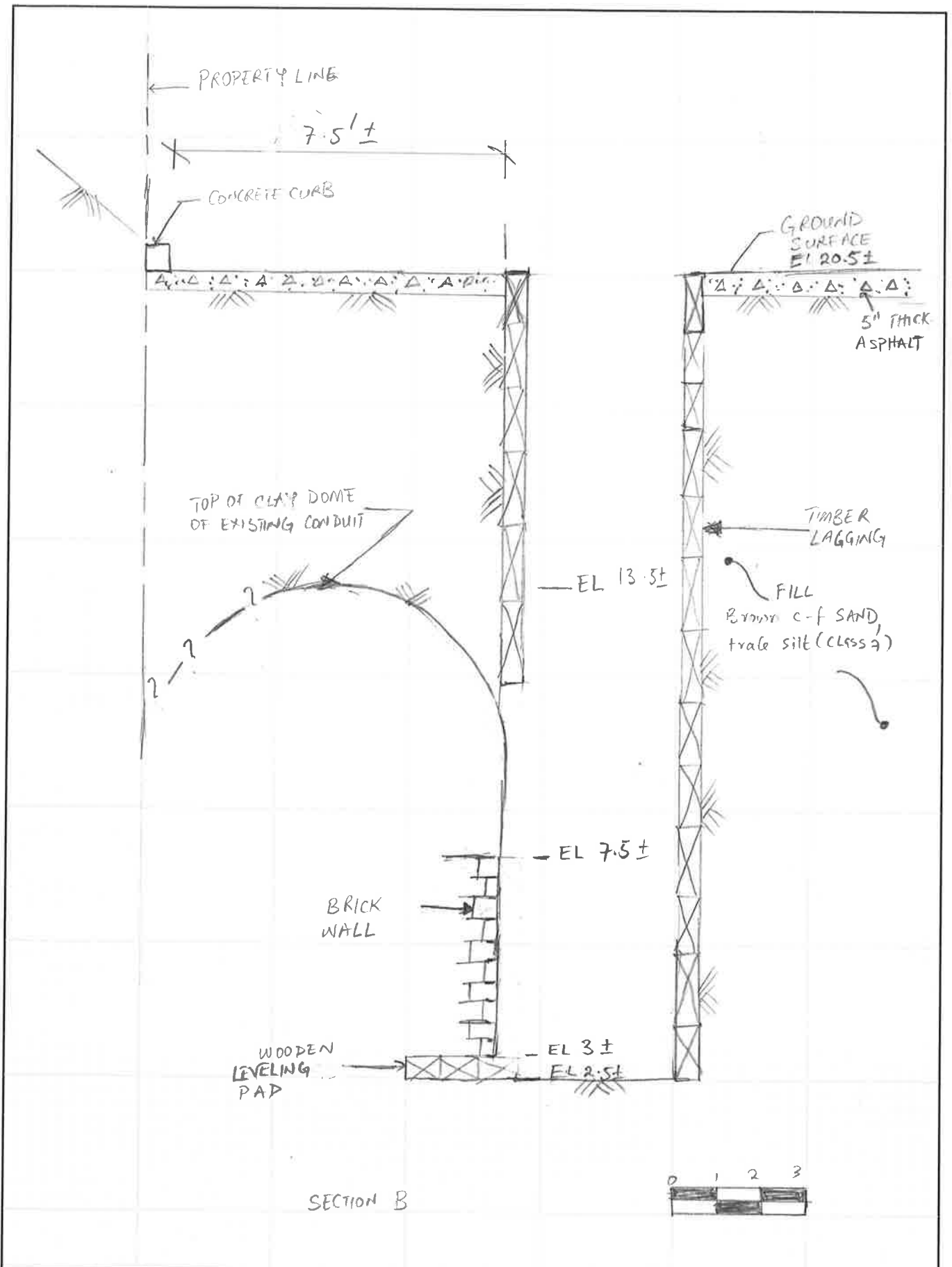
DATE:	SEPTEMBER 2017
PROJECT NO:	
DRAWN BY:	JR
CHECKED BY:	JA
DRAWING NUMBER:	SK-1
CADD FILE No:	
	OF

# **APPENDIX C**

## **TEST-PIT SKETCHES AND PHOTOGRAPHS**







SECTION B OF TP-1

FACING WEST

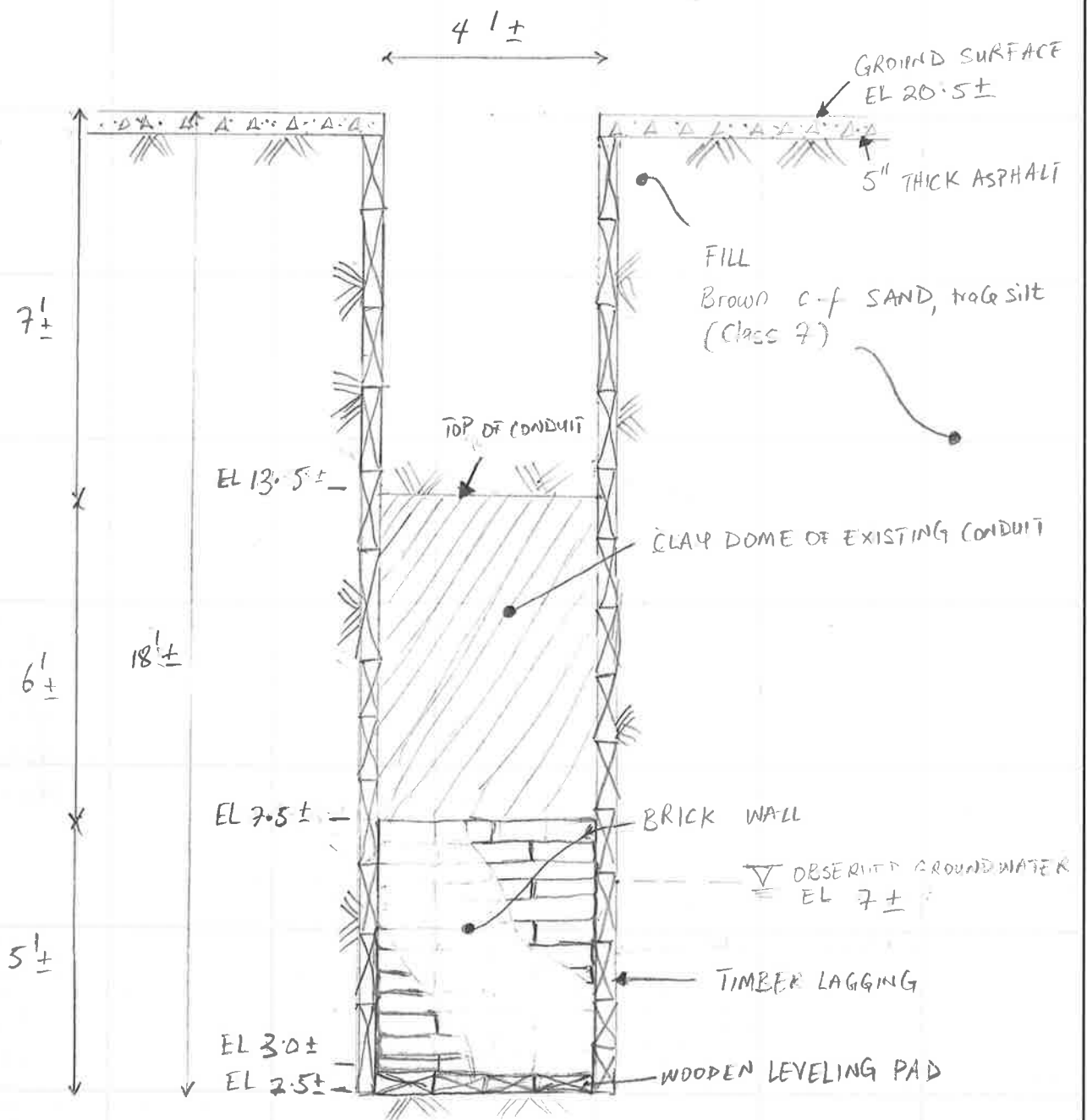
BY E.K.D. DATE 09/10/2018

CKD. T.C. DATE 09/10/2018

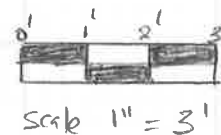
PROJ. NO. 170495201

SHEET 2 OF 5

**LANGAN**



ELEVATION B



ELEVATION B OF TP-1

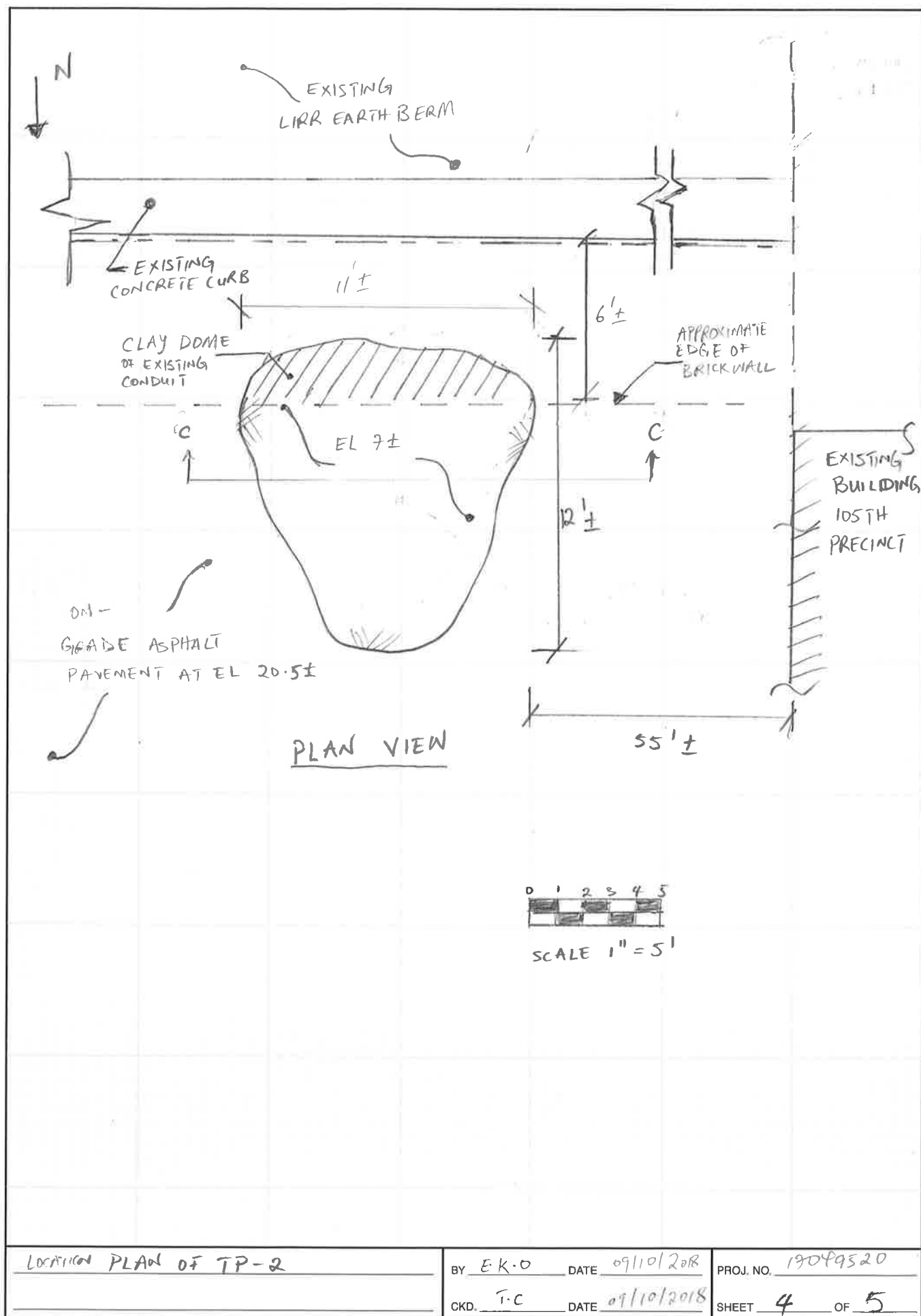
FACING SOUTH

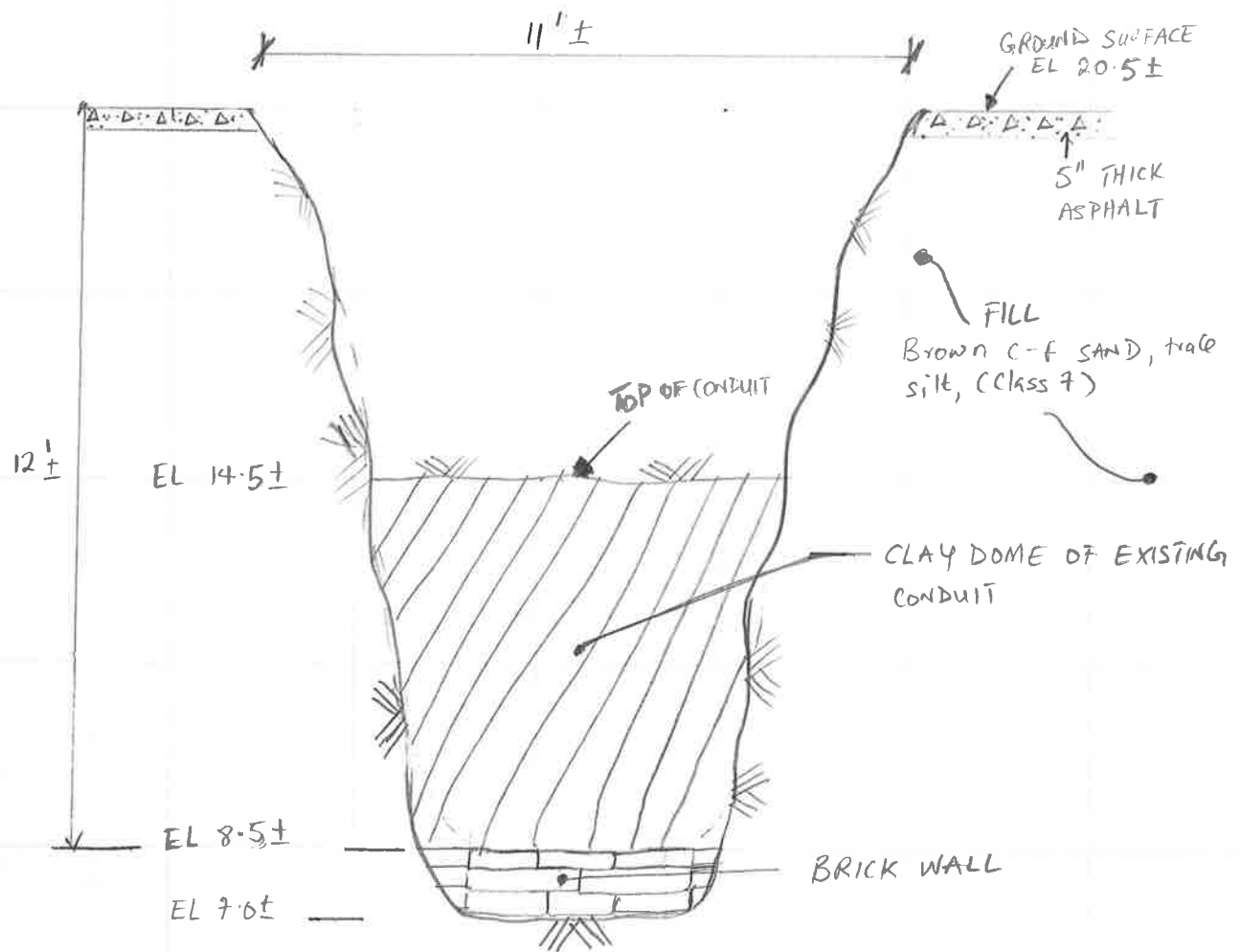
BY E.K.O. DATE 09/10/2018

CKD. T.C. DATE 09/10/2018

PROJ. NO. 1704 95201

SHEET 3 OF 5





SECTION C



1" = 3'  
SCALE

SECTION VIEW OF TP-2

FACING SOUTH

BY E.K.D. DATE 09/10/2018

CKD. T.C. DATE 09/10/2018

PROJ. NO. 170495201

SHEET 5 OF 5



Photo 1: General view of TP-1 (facing southwest)

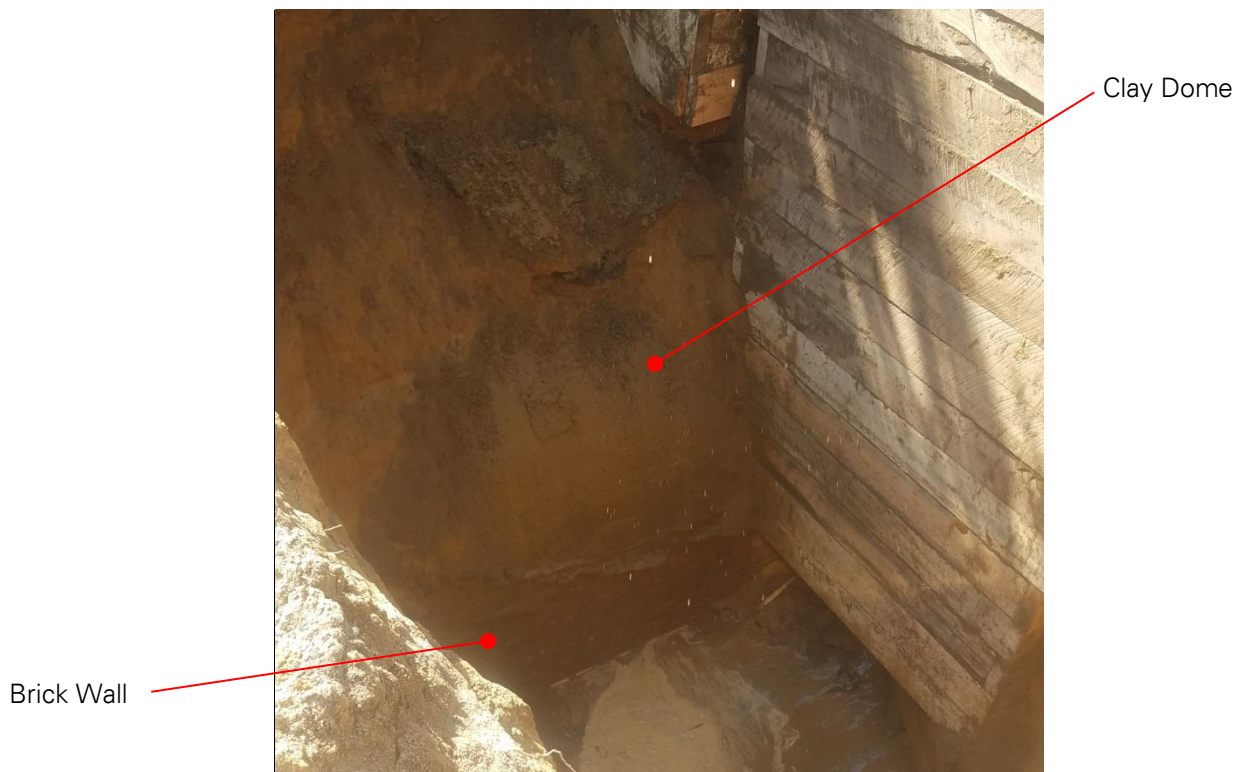


Photo 2: View of the clay dome and the brick wall at TP-1 (facing southwest)





Photo 3: View of the bottom of the existing conduit at TP-1 (facing south)



Photo 4: View of TP-1 after surface restoration (facing southeast)



Photo 5: General view of TP-2 (facing southeast)

Clay Dome



Photo 6: View of the clay dome at TP-2 (facing southwest)





Photo 7: General view of TP-2 after backfilling (facing south)



# Phase II Limited Site Investigation Results Report

Proposed 116<sup>th</sup> Police Precinct  
242-20 North Conduit Avenue  
Rosedale, Queens, New York

Block No. 13265, Lot No. 30  
CEQR No. 18NYPD02Q\*

**Prepared for:**

New York City Police Department  
Capital Construction Unit  
1 Police Plaza, Room 308  
New York, New York 10038

**Prepared by:**

AECOM  
125 Broad Street  
New York, NY 10281

AECOM Project No. 60540777

March 2018



# Phase II Limited Site Investigation Results Report

Proposed 116<sup>th</sup> Police Precinct  
242-20 North Conduit Avenue  
Rosedale, Queens, New York

Block No. 13265, Lot No. 30  
CEQR No. 18NYPD02Q\*

A handwritten signature in black ink, appearing to read 'Nelson J. Abrams', written over a horizontal line.

Prepared by Nelson J. Abrams, PG  
Senior Project Manager

A handwritten signature in black ink, appearing to read 'Cary Friedman', written over a horizontal line.

Reviewed by Cary Friedman  
Senior Geologist

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Table 2        Ground Water Analytical Results

Table 3        Soil Vapor Analytical Results

## **Figures**

Figure 1       Site Location Map

Figure 2       Site Plan

Figure 3       Location of Environmental Samples

Figure 4       Analytical Results – Surface and Subsurface Soil Samples

Figure 5       Analytical Results - Ground Water Samples

Figure 6       Analytical Results - Soil Vapor Samples

## **Appendices**

Appendix A    Boring Logs

Appendix B    Analytical Laboratory Results

## Executive Summary

The New York City Police Department's (NYPD) Capital Construction Unit contracted AECOM to conduct a Phase II Limited Site Investigation (LSI) on property adjacent to the 105<sup>th</sup> Satellite Police Precinct located at 242-20 North Conduit Avenue in Rosedale, Queens, New York. The subject property consists of a driveway, a parking lot, and vacant parcel of land along North Conduit Avenue. The subject property is used for employee parking for the 105<sup>th</sup> Satellite Police Precinct. The subject property is located within a predominately residential area within Rosedale, and is bounded to the south by the Long Island Rail Road (LIRR). The LSI was conducted as part of the proposed construction of the 116<sup>th</sup> Police Precinct.

This Phase II LSI Results Report presents the findings of an environmental subsurface site investigation to evaluate the following potential environmental concerns:

- Potential environmental impacts to the soil and groundwater from the subject property and from potential offsite sources.
- Evaluate whether any potential soil vapors resulting from environmental impacts on the subject parcel or from offsite sources could impact the future occupants at the subject parcel.

A geophysical survey was performed on December 29, 2017 to evaluate if subsurface structures or utilities were present in the proposed soil boring locations. The field investigation was conducted from January 9 to January 12, 2018 and consisted of the following activities:

- Advancement of eight soil borings for the collection of shallow and subsurface soil samples from each boring at depths of 0 to 2 feet below ground surface (bgs) and 15 to 17 feet bgs. An additional sample at a depth of 12 to 14 feet bgs was collected from SB-5 based upon visual discoloration of the soil.
- Collection of grab ground water samples from three of the eight soil borings to evaluate potential environmental impacts.
- Collection of subsurface soil vapor samples from four of the eight borings to evaluate potential soil vapors under the subject property.

The collection of soil and ground water samples were performed in general accordance with New York State Department of Environmental Conservation (NYSDEC) DER-10 Technical Guidance for Site Investigation and Remediation dated May 2010. The collection of the soil vapor samples was performed in general accordance with the New York State Department of Health (NYSDOH) October 2006 Final Guidance for Evaluating Soil Vapor Intrusion Matrices.

### **Results and Recommendations**

#### **Soils**

The majority of the compounds detected in the shallow soil samples (0 to 2 feet bgs), did not exceed the NYSDEC's unrestricted use SCO criterion at the eight soil boring locations. Pesticides consisting of chlordane, alpha-chlordane, gamma-chlordane, 4,4'-DDT exceeded only the unrestricted use SCOs in surface samples collected from SB-1, SB-2, and SB-3. Inorganic compounds consisting of lead and mercury were detected above the unrestricted use SCOs in the shallow samples collected from SB-1 and SB-3, respectively.

No organic or inorganic compounds were detected above the unrestricted use SCOs in any of the subsurface soil samples. Since the surface soil samples did not detect any compounds exceeding the residential use SCOs and the subsurface soils samples did not detect any compounds above the unrestricted use SCOs, no further investigative measures are warranted.

A Soils/Materials Management Plan will be developed in a Remedial Action Work Plan to outline the methods that will be conducted during excavation, sampling, transportation, and disposal for soils generated during the construction activities.

### **Ground Water**

Grab ground water samples and a duplicate sample were collected from three of the eight soil borings advanced at the subject parcel detected chloroform above the NYSDEC's Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards or guidance values (AWQSGV). Ground water samples were collected through the temporary installation of a one inch diameter PVC well casing and slotted screen. No VOCs, SVOCs, PCBs, metals, or total cyanide were detected above the AWQSGV criterion. Pesticides consisting of chlordane and dieldrin were the only compounds detected above the AWQSGV in two of the three ground water samples. The results of the samples did not detect any compounds above the AWQSGV criterion. Based upon the presence of only two pesticide compounds above the AWQSGV, it is likely their detection is associated with its historic use on the surrounding residential and former agricultural properties. Therefore, no further investigative or remedial measures are required.

### **Soil Vapor**

Elevated levels of acetone, chloromethane, 1,3-dichlorobenzene, cis-1,2-dichloroethene, methyl ethyl ketone, methylene chloride, methyl methacrylate, m,p xylene, tetrahydrofuran, and vinyl chloride, were detected in various concentrations in both the soil vapor and ambient air samples. Based upon several of these compounds detected in the ambient air samples, and the use of the proposed building as a police precinct, the following remedial measures will be performed as part of the construction activities:

- The installation of soil vapor barrier on the concrete slab in the basement of the building to assist in the mitigation of potential soil vapors.

The details of this remedial measure will be provided in a Remedial Action Work Plan that will be developed and submitted to the NYCDEP for review.



## 1.0 Introduction

The New York City Police Department's (NYPD) Capital Construction Unit contracted AECOM to conduct a Phase II Limited Site Investigation (LSI) on property adjacent to the 105th Satellite Police Precinct located at 242-20 North Conduit Avenue in Rosedale, Queens, New York. The subject property consists of a driveway, a parking lot, and vacant parcel of land along North Conduit Avenue. The subject property is used for employee parking for the 105th Satellite Police Precinct. The subject property is located within a predominately residential area within Rosedale, and is bounded to the south by the Long Island Rail Road (LIRR). The LSI was conducted as part of the proposed construction of the 116th Police Precinct.

This Phase II LSI Results Report presents the findings of an environmental subsurface site investigation to evaluate the following potential environmental concerns:

- Potential environmental impacts to the soil and groundwater from the subject parcel and from potential offsite sources.
- Evaluate whether any potential soil vapors resulting from environmental impacts on the subject parcel or from offsite sources could impact the future occupants at the subject parcel.

A geophysical survey was performed on June 29, 2017 to evaluate if subsurface structures or utilities were present in the proposed soil boring locations. The field investigation was conducted from January 9 to January 12, 2017 and consisted of the following activities:

- Advancement of eight soil borings for the collection of shallow and subsurface soil samples from each boring at depths of 0 to 2 feet below ground surface (bgs) and 15 to 17 feet bgs. An additional sample at a depth of 12 to 14 feet bgs was collected from SB-5 based upon visual discoloration of the soil.
- Collection of grab ground water samples from three of the eight soil borings to evaluate potential environmental impacts.
- Collection of subsurface soil vapor samples from four of the eight borings to evaluate potential soil vapors under the subject property.

A geophysical survey was performed on December 29, 2017 to evaluate if subsurface structures or utilities were present in the proposed soil boring locations. The field investigation was conducted from January 9 to January 12, 2018 and consisted of the following activities:

- Advancement of eight soil borings for the collection of shallow and subsurface soil samples from each boring at depths of 0 to 2 feet below ground surface (bgs) and 15 to 17 feet bgs. An additional sample at a depth of 12 to 14 feet bgs was collected from SB-5 based upon visual discoloration of the soil.
- Collection of grab ground water samples from three of the eight soil borings to evaluate potential environmental impacts.
- Collection of subsurface soil vapor samples from four of the eight borings to evaluate potential soil vapors under the subject property.

Sections 1.0 and 2.0 of this report provide an introduction and discussion of the background, historical information, area geology/hydrogeology and technical approach for the project. Section 3.0 and 4.0 provide the nature and extent of contamination, conclusions, and recommendations.

## **1.1 Site Investigation Objectives and Scope**

The objective of this investigation was to assess potential environmental impacts to soil, groundwater, and soil vapor from the former operations at the subject parcel and the potential for contamination from offsite sources.

## **1.2 Site Description**

The subject property is defined herein as a parking lot located at 242-20 North Conduit Avenue, Rosedale, Queens County, New York. The subject property consists of the eastern half of a 126,929 square-foot lot of land (subject parcel) that is developed with a parking lot for the NYPD's 105th Precinct Satellite Station. The 105th Precinct Satellite Station building is located (offsite) on the western portion of the subject parcel. The subject property is located adjacent to the south-southeast of the intersection of North Conduit Avenue and 244th Street.

According to the City of New York Department of Finance, the subject parcel in which the subject property is located consists of a single parcel of land designated as Block 13265, Lot 30. The location of the subject property is illustrated on Figure 1 - Site Location Map.

### **1.2.1 Current Use of Property**

The subject property is defined as the eastern half of a 126,929 square-foot lot used as automobile parking for the western-adjacent NYPD 105th Precinct Satellite Station. The perimeter of the subject property is surrounded by overgrown vegetation, landscaped areas, and sidewalks. During the site visit, no visual evidence of potable water wells, monitoring wells, dry wells, clarifiers, underground storage tanks, septic tanks, or leach fields were observed on the subject property. The subject property contained several storm sewer drains which discharge water into the combined sewer system along North Conduit Avenue that is maintained by the New York City Department of Environmental Protection (NYCDEP).

No visual evidence of discolored soil, water, or unusual vegetative conditions or odors was observed during the site visit. The general layout of the subject property is illustrated on Figure 2 - Site Plan.

### **1.2.2 Surrounding Property Use**

The properties located to the north of the subject property beyond North Conduit Avenue consist of residential dwellings, while vacant, vegetated land is located to the east. The 105th Precinct Satellite Station building is located to the west while the main line for the Long Island Rail Road (LIRR) and the Rosedale Station, which are elevated, are located to the south. On the southern side of the LIRR are South Conduit Avenue and Route 27 which run parallel to the LIRR. Beyond Route 27 are several commercial properties including three service stations and a tire repair shop. AECOM did not observe any dry cleaners in the immediate vicinity (500 feet) of the subject property. The three gasoline stations located on Route 27 are within 500 feet of the subject property. No sensitive receptors (i.e. day care centers, schools, hospitals, water bodies) are located adjacent to the subject property. Based on AECOM's site reconnaissance of the surrounding neighborhood, our review of the EDR database report, topographic location, and distance from the subject property, the three gasoline stations are not potential off-site sources of concern.

### **1.2.3 Site History**

Historical research indicates the subject property was vacant property until 1902 when the northern portion along North Conduit Avenue was occupied by the New York and Long Island Traction Company to operate a trolley line. This line remained active until 1926 when the trolley company went bankrupted. The subject property was utilized for automobile parking for individuals traveling on the LIRR from the Rosedale Station sometime around 1954. The subject property remained as commuter parking until sometime in the mid-2000s when the subject property was converted into a parking lot for the 105th Precinct Satellite Station.

## **1.3 Physical and Environmental Setting**

### **1.3.1 Geology**

Though the subject property has never been developed other than being used as a parking lot, published geologic documents indicate that the subject property is underlain with Urban Land, which is considered to be historic fill of unknown origin and is typically covered by streets, parking lots, buildings, and other structures of urban areas.

According to geologic information obtained from the United States Geological Survey, the soils underlying the surface soils at the subject site likely consists of unconsolidated strata of clay, silt, sand and gravel of late Cretaceous and Late Pleistocene ages. This consolidated material lies on crystalline bedrock of Ordovician age consisting of granitic gneiss of the Hartland Formation.

### **1.3.2 Hydrogeology**

Site-specific hydrologic information was not identified during the course of this assessment. Based on the topographic gradient in the area of the subject property, the groundwater flow beneath the subject property and in the surrounding area is anticipated to flow in a southerly direction. Based on a review of area review of the topographic map, groundwater is anticipated to be present at a depth between 10 to 20 feet below ground surface (bgs).

## 2.0 Site Investigation Scope of Work

The geophysical survey was performed on December 29, 2017 to evaluate if subsurface structures or utilities were present in the proposed soil boring locations, and the field investigation was conducted from January 9 to January 12, 2018. The information presented in the previous Phase I Environmental Site Assessment prepared by AECOM was utilized to determine the number of samples to be collected, the depth of sampling locations, and the analytical parameters to be evaluated. This information was presented in a Phase II LSI Work Plan dated November 2017 and submitted to NYCDEP for review and was conditional approval on December 6, 2017 by the NYCDEP with only minor comments. The work plan also included a Quality Assurance Project Plan describing the analytical laboratory methods to be performed and a Health and Safety Plan (HASP) to provide guidelines for their personnel health and safety during field operations.

The following sections describe the methods used for the sampling in accordance with the LSI Work Plan. Detailed field procedures are provided in the Work Plan. The following subcontractors were utilized to perform the field investigation activities:

- Utility Clearance – Dig Safely, East Syracuse, New York.
- Drilling – Cascade Technical Services, Lynbrook, New York.
- Analytical Laboratory Services – Eurofins Spectrum Analytical, North Kingstown, Rhode Island (soil and ground water) and TestAmerica, Burlington, Vermont (soil vapor).
- Geophysical Survey – Advanced Geological Services, Malvern, Pennsylvania.

### 2.1 Field Activities

The field activities consisted of the following tasks:

- Conducted a geophysical survey to clear the proposed boring locations of any underground utilities and/or structures.
- Advanced eight soil borings using direct push drilling techniques to depths between 17 and 30 feet below grade for the collection of subsurface soil samples at the depths of 0 to 2 and 15 to 17 feet bgs from each boring.
- Collected a grab ground water samples from three of the eight soil borings to evaluate potential environmental impacts.
- Collected four subsurface soil vapor samples to evaluate potential soil vapors under the subject parcel at the anticipated depth of the proposed building foundation.

### 2.2 Field Methods

The Phase II LSI consisted of the collection of soil, grab groundwater, and soil vapor samples obtained from soil borings advanced at the subject property. The locations of the soil borings are shown on Figure 3. All relevant field data were recorded in the field log and soil boring logs. The soil boring logs are provided in Appendix A.

### **2.2.1 Underground Utility Clearance / Geophysical Survey**

Prior to the start of intrusive fieldwork, clearance of underground utilities was performed. The drilling subcontractor contacted Dig Safely New York to arrange for the location and marking of underground utilities in the vicinity of the proposed soil boring locations.

In addition to these efforts, AECOM obtained the services of Advanced Geological Services to perform utility geophysical clearance in areas where suspected former or current USTs may have been located and areas suspected of containing other underground utilities such as sewer and water lines, along with obtaining any additional information associated with a concrete sump and sewer manway. In areas cleared for work, all subsurface sampling locations were initially hand or vacuum excavation to a depth of 5 feet before the direct drilling equipment was used.

The results of the survey did not identify any underground structures that would be indicative of former or current USTs. Borings SB-6, SB-7, and SB-8 were moved a few feet from their original location due to the presence of an underground storm sewer line and other underground utilities.

### **2.2.2 Soil Sampling**

An AECOM environmental professional was present to monitor the advancement of the eight soil borings and the collection of the soil samples (Figure 3). The samples collected from each boring were screened for organic vapors with a photo-ionization detector (PID), along with an examination of the soils for visual and olfactory impacts prior to collecting environmental samples. All field work was recorded in a field log. Direct push drilling techniques (i.e. Geoprobe) were used to advance the soil borings and collect the environmental samples. Five of the eight soil borings were advanced to a depth no greater than 17 feet bgs, while three of the soil borings were advanced to a greater depth in order to collect a grab ground water sample for analysis. Two soil samples were collected from each test boring for laboratory analysis. Samples included a shallow soil sample (0 to 2 feet bgs) and a subsurface soil sample from a two-foot interval beneath the anticipated depth of the basement floor (15 to 17 feet bgs). An additional sample at a depth of 12 to 14 feet bgs was collected from SB-5 based upon visual discoloration of the soil. Discrete (grab) samples were obtained from the aforementioned sampling intervals.

None of the soil cuttings exhibited any visual or olfactory signs of contamination and were returned back to the borehole, and the subject property was restored to prior conditions upon completion of the work.

### **2.2.3 Monitoring Well Installation and Ground Water Sampling**

Three soil borings (SB-2, SB-6, and SB-8) were advanced to a depth of 30 feet bgs using direct push drilling methods as the depth to groundwater was encountered between 13 and 16 feet bgs (Figure 3). Ground water samples (GW-1, GW-2, and GW-3) and a quality assurance duplicate sample from GW-1 (DUP-1) were collected from the boring through the temporary installation of a PVC well casing and screen.

Ground water samples were collected from the temporary well point by low-flow purge and sample methods using a peristaltic pump. A minimum of three well volumes were removed from each temporary well point. At the ground surface, the water passed through a sealed chamber containing probes which measured the water temperature, pH, specific conductivity, oxidation-reduction potential, and dissolved oxygen. Samples of water discharging from the pump were collected at regular intervals and analyzed for turbidity using a hand-held field meter. The purging of the well points was completed upon stable pH readings over three consecutive measurements. Purged water was placed into a 55-gallon drum and temporarily stored awaiting offsite disposal during the proposed construction activities. The temporary well point was gauged with a water level meter to record a depth to groundwater reading to within 1/100 foot. The height of the temporary

well point was measured from the ground surface, with the elevation to be obtained during the proposed construction activities by a NYS licensed surveyor. Samples collected for dissolved metals were filtered in the field prior to submission to the laboratory for analyses.

#### **2.2.4 Soil Vapor Sampling**

Soil vapor samples were collected over an eight-hour period in general accordance with the Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH October 2006). Four soil vapor samples were collected from the subject property (Figure 3). The direct push drill rig was used to advance the soil vapor probes. The soil vapor probes were installed between one and two feet below the proposed floor of the building's basement, which was determined to be approximately 15 to 17 feet bgs.

Temporary probes were constructed with inert polyethylene tubing. The annular space between the drilled hole and the sample tubing was filled and the sampling probe sealed with beeswax. Ambient air samples were also collected between 3 to 5 feet above the ground at each of the sampling points. The soil vapor and ambient air were sampled concurrently over an eight hour period.

The soil vapor and ambient air samples were collected in appropriately-sized Summa canisters that were certified clean by the laboratory. Flow rates for both purging and sampling did not exceed 0.2 L/min. Twenty-four hours following soil vapor probe installation, one to three implant volumes were purged prior to the collection of the soil-gas samples. A sample log sheet was maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of the soil vapor extracted, and vacuum of canisters before and after the samples were collected.

As part of the vapor intrusion evaluation, a tracer gas consisting of helium was used in accordance with NYSDOH protocols to serve as a QA/QC device to verify the integrity of the soil vapor probe seal. A container was used to keep the tracer gas in contact with the probe during testing. A portable monitoring device was used to analyze the sample of soil vapor for the tracer gas prior to sampling with each sampling point. If the tracer sample results show a significant presence of the tracer, the probe seals were adjusted to prevent infiltration. At the conclusion of the sampling round, tracer monitoring was performed a second time to confirm the integrity of the probe seals.

### **2.3 Quality Assurance**

Sample labeling, handling, and Chain of Custody (COC) requirements were consistent with the protocol as described in DER-10. Compliance with these procedures was monitored by the AECOM environmental professional. Samples were collected in laboratory supplied containers with the appropriate preservative for the analytical method requested. Typical requirements for analytical parameters utilized on the project with respect to the type of container, preservation method, and maximum holding time between collection and analysis were specified by the analytical method and the analytical laboratory.

QA/QC samples were collected as part of this investigation. One duplicate sample for each medium sampled (soil, ground water and soil gas) and one field blank sample for soil and ground water were collected during the field investigation activities. Internal laboratory QA/QC samples included method blanks, surrogate spikes, laboratory duplicates, and laboratory control spikes, and matrix spike/matrix spike duplicates. The laboratory selected matrix spike and matrix spike duplicate samples from among the field samples for QA/QC analysis.

## **2.4 Laboratory Analysis**

The soil and groundwater samples were submitted to Eurofins Spectrum Analytical, Inc. and the soil vapor samples were submitted to TestAmerica Laboratories, LLC. Both facilities are NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratories. Samples were analyzed for the following parameters:

### **Soil Samples**

- VOCs by EPA Method 8260;
- Semi-volatile organic compounds (SVOCs) by EPA Method 8270;
- Pesticides/Polychlorinated Biphenyls (PCBs) by EPA Method 8081/8082; and
- Target Analyte List (TAL) Metals by EPA Methods 6010 and 7471.

### **Groundwater Samples**

- VOCs by EPA Method 8260;
- SVOCs by EPA Method 8270;
- Pesticides/ PCBs by EPA Method 8081/8082;
- TAL Metals by EPA Methods 6010 and 7471 (filtered and unfiltered samples); and
- Total Cyanide by EPA Method 9010C.

### **Soil Vapor Samples**

- VOCs by EPA Method TO-15.

## **3.0 Field and Analytical Results**

### **3.1 Geology**

Based on the field observations made during the advancement of the soil borings, the soils to a depth of 30 feet bgs generally consists of a fine to medium sand with some gravel and pebbles. Groundwater was encountered at depths between 13 and 16 feet bgs.

### **3.2 Analytical Results – Soils**

The analytical results of the samples were compared to NYSDEC Part 375 unrestricted, residential and commercial SCOs. The analytical results are presented in Table 1 and are graphically shown on Figure 4. The full analytical data packages are provided in Appendix B for reference.

#### **3.2.1 Volatile Organic Compounds**

No VOCs were detected above the Unrestricted Use SCOs.

#### **3.2.2 Semi-Volatile Organic Compounds**

No SVOCs were detected above the Unrestricted Use SCOs

#### **3.2.3 Pesticides**

Pesticides consisting of chlordane, alpha-chlordane, gamma-chlordane, 4,4'-DDT exceeded only the unrestricted use SCOs in surface samples collected from SB-1, SB-2, and SB-3. No other pesticide compounds were detected above the unrestricted use SCOs in any of the other samples.

#### **3.2.4 Polychlorinated Biphenyls**

No PCBs were detected above the unrestricted use SCOs.

#### **3.2.5 Metals**

Lead and mercury were detected above the unrestricted use SCOs in the shallow samples collected from SB-1 and SB-3, respectively. All other results were below unrestricted use SCOs in the remaining samples.

### **3.3 Analytical Results – Ground Water**

The analytical results of the ground water sample collected from temporary well points are summarized on Table 2 and are graphically shown on Figure 5. The full analytical data packages are provided in Appendix B for reference. The analytical results were compared to NYSDEC's AWQSGVs.

#### **3.3.1 Volatile Organic Compounds**

No VOCs were detected above the AWQSGVs.

#### **3.3.2 Semi-Volatile Organic Compounds**

No SVOCs were detected above the AWQSGVs.



### 3.3.3 Pesticides

Dieldrin was detected above the AWQSGV in the samples collected from GW-1 and GW-3 while dieldrin was detected above the AWQSGV from the samples collected from GW-3. No other pesticide compounds were detected above the AWQSGV in any of the other samples.

### 3.3.4 Polychlorinated Biphenyls

No PCBs were detected above the AWQSGV.

### 3.3.5 Metals

Neither total nor dissolved metals were detected above the AWQSGVs.

## 3.4 Analytical Results – Soil Vapor Samples

Samples of soil vapor were collected from four locations at the subject property (Figure 3). These locations were chosen to assist in evaluating the potential for indoor impacts of VOCs from onsite and offsite sources.

The results of the soil vapor samples collected during the investigation are summarized in Table 3 and in Figure 6. Since New York State does not have any standards, criteria or guidance values for the concentrations of volatile chemicals in subsurface vapors, the NYSDOH recommends the results of the soil vapor samples be compared to the Upper Fence Background Indoor Air values from the NYSDOH's 2003 publication, Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes and the 90th Percentile Background Indoor Air values as identified the United States Environmental Protection Agency's (EPA) 2001 publication, Building Assessment and Survey Evaluation (BASE) Database for indoor air in office and commercial buildings. These values were used as initial benchmarks to evaluate the results of the soil vapor samples when evaluating what the potential compounds and concentrations might be for indoor air in residential, office, and commercial buildings.

Elevated levels of acetone, chloromethane, 1,3-dichlorobenzene, cis-1,2-dichloroethene, methyl ethyl ketone, methylene chloride, methyl methacrylate, m,p xylene, tetrahydrofuran, and vinyl chloride, were detected in various concentrations in both the soil vapor and ambient air samples. The presence of these compounds may be related to the current and/or former retail and commercial operations (including gasoline service stations, automobile repair shops) located along South Conduit Street as well as the operations of the LIRR.

## 4.0 Conclusions and Recommendations

The purpose of this Phase II SI was to assess potential environmental impacts to soil, groundwater, and soil vapor at the subject parcel prior to the proposed construction of the 116th Police Precinct. The investigation was performed based upon the Phase II Limited Site Investigation Work Plan for the subject property that was conditionally approved by the NYCDEP and subsequently modified per the NYCDEP's comments.

### 4.1 Soils

The majority of the compounds detected in the shallow soil samples (0 to 2 feet bgs), did not exceed the NYSDEC's unrestricted use SCO criterion at the eight soil boring locations. Pesticides consisting of chlordane, alpha-chlordane, gamma-chlordane, 4,4'-DDT exceeded only the unrestricted use in surface samples collected from SB-1, SB-2, and SB-3. Inorganic compounds consisting of lead and mercury were detected above the unrestricted use SCOs in the shallow samples collected from SB-1 and SB-3, respectively. No organic or inorganic compounds were detected above the unrestricted use SCOs in any of the subsurface soil samples.

Since the surface soil samples did not detect any compounds exceeding the residential use SCOs and the subsurface soils samples did not detect any compounds above the unrestricted use SCOs, no further investigative measures are warranted.

A Soils/Materials Management Plan will be developed a Remedial Action Work Plan to outline the methods that will be conducted during excavation, sampling, transportation, and disposal for soils generated during the construction activities.

### 4.2 Ground Water

Grab ground water samples and a duplicate sample were collected from three of the eight soil borings advanced at the subject parcel detected chloroform above the NYSDEC's Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards or guidance values (AWQSGV). Ground water samples were collected through the temporary installation of a one inch diameter PVC well casing and slotted screen. No VOCs, SVOCs, PCBs, metals, or total cyanide were detected above the AWQSGV criterion. Pesticides consisting of chlordane and dieldrin were the only compounds detected above the AWQSGV in two of the three ground water samples. Based upon the presence of only two pesticide compounds above the AWQSGV, it is likely their detection is associated with its historic use on the surrounding residential and former agricultural properties. Therefore, no further investigative or remedial measures are required.

### 4.3 Soil Vapor

Elevated levels of acetone, chloromethane, 1,3-dichlorobenzene, cis-1,2-dichloroethene, methyl ethyl ketone, methylene chloride, methyl methacrylate, m,p xylene, tetrahydrofuran, and vinyl chloride, were detected in various concentrations in both the soil vapor and ambient air samples. Based upon the presence of several of these compounds in the ambient air samples, and the use of the proposed building as a police precinct, the following remedial measures will be performed as part of the construction activities:

- The installation of soil vapor barrier on the concrete slab in the basement of the building to assist in the mitigation of potential soil vapors.

The details of this remedial measure will be provided in a Remedial Action Work Plan that will be developed and submitted to the NYCDEP for review.

## 5.0 References

AECOM, Phase I Environmental Site Assessment, Proposed 116<sup>th</sup> Precinct, 242-20 North Conduit Avenue, Rosedale, Queens, New York. September 2017

New York City Mayor's Office of Sustainability. City Environmental Quality Review (CEQR) Technical Manual. Chapter 12: Hazardous Materials. 2014.

New York State Department of Environmental Conservation. DER-10, Technical Guidance for Site Investigation and Remediation. May 2010.

New York State Department of Health, Final - Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October 2006.

## Tables

TABLE 1  
SHALLOW AND SUBSURFACE SOIL ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID	NYSDEC Part 375-6 Unrestricted Use	NYSDEC Part 375-6 Residential	NYSDEC Part 375-6 Commercial	SB-1 0-2' 1/10/2018	SB-1 15-17' 1/10/2018	SB-2 0-2' 1/11/2018	SB-2 15-17' 1/11/2018	SB-3 0-2' 1/10/2018	SB-3 15-17' 1/10/2018	SB-4 0-2' 1/11/2018	SB-4 15-17' 1/11/2018	SB-5 (0-2') 0-2' 1/11/2018	SB-5 (12-14') 12-14' 1/11/2018	SB-5 (15-17') 15-17' 1/11/2018	SB-5 DUPLICATE 0-2' 1/11/2018	SB-6 (0-2') 0-2' 1/9/2018	SB-6 (15-17') SC43071-04 1/9/2018	SB-7 (0-2') SC43071-05 1/10/2018	SB-7 (15-17') SC43071-06 1/10/2018	SB-8 (0-2') SC43071-01 1/9/2018	SB-8 (15-17') SC43071-02 1/9/2018
Volatile Organic Compounds (VOCs) - BTEX (mg/Kg)																					
Benzene	0.06	2.9	44	< 0.0146 U,D	< 0.0164 U,D	< 0.0161 U,D	< 0.0014 U	< 0.0154 U,D	< 0.0169 U,D	< 0.0014 U	< 0.0017 U	< 0.0013 U	< 0.0017 U	< 0.0016 U	< 0.0013 U	< 0.0156 U,D	< 0.0153 U,D	< 0.0148 U,D	< 0.0164 U,D	< 0.0151 U,D	< 0.0155 U,D
Ethylbenzene	1	30	390	< 0.0079 U,D	< 0.0089 U,D	< 0.0088 U,D	< 0.0008 U	< 0.0084 U,D	< 0.0092 U,D	< 0.0008 U	< 0.0009 U	< 0.0007 U	< 0.0009 U	< 0.0009 U	< 0.0007 U	< 0.0085 U,D	< 0.0083 U,D	< 0.0081 U,D	< 0.0089 U,D	< 0.0082 U,D	< 0.0084 U,D
m,p-Xylene	NL	NL	NL	< 0.0099 U,D	< 0.0111 U,D	< 0.0110 U,D	< 0.0010 U	< 0.0105 U,D	< 0.0115 U,D	< 0.0010 U	< 0.0011 U	< 0.0009 U	< 0.0011 U	< 0.0011 U	< 0.0009 U	< 0.0106 U,D	< 0.0104 U,D	< 0.0101 U,D	< 0.0111 U,D	< 0.0102 U,D	< 0.0105 U,D
o-Xylene	NL	NL	NL	< 0.0154 U,D	< 0.0173 U,D	< 0.0171 U,D	< 0.0015 U	< 0.0163 U,D	< 0.0178 U,D	< 0.0015 U	< 0.0018 U	< 0.0014 U	< 0.0018 U	< 0.0017 U	< 0.0014 U	< 0.0165 U,D	< 0.0162 U,D	< 0.0157 U,D	< 0.0173 U,D	< 0.0159 U,D	< 0.0164 U,D
Toluene	0.7	100	500	< 0.0178 U,D	< 0.0201 U,D	< 0.0197 U,D	< 0.0018 U	< 0.0189 U,D	< 0.0206 U,D	< 0.0017 U	< 0.0021 U	< 0.0016 U	< 0.0021 U	< 0.0020 U	< 0.0016 U	< 0.0191 U,D	< 0.0187 U,D	< 0.0181 U,D	< 0.0200 U,D	< 0.0184 U,D	< 0.0189 U,D
Xylene (Total)	0.26	100	500	< 0.0253	< 0.0284	< 0.0281	< 0.0025	< 0.0268	< 0.0293	< 0.0024	< 0.0029	< 0.0023	< 0.0029	< 0.0028	< 0.0023	< 0.0271	< 0.0266	< 0.0258	< 0.0284	< 0.0261	< 0.0269
Other Volatile Organic Compounds (VOCs) (mg/Kg)																					
1,1,1,2-Tetrachloroethane	NL	NL	NL	< 0.0468 U,D	< 0.0526 U,D	< 0.0518 U,D	< 0.0046 U	< 0.0495 U,D	< 0.0541 U,D	< 0.0045 U	< 0.0054 U	< 0.0042 U	< 0.0054 U	< 0.0051 U	< 0.0042 U	< 0.0501 U,D	< 0.0491 U,D	< 0.0475 U,D	< 0.0525 U,D	< 0.0483 U,D	< 0.0497 U,D
1,1,1-Trichloroethane	0.68	100	500	< 0.0183 U,D	< 0.0205 U,D	< 0.0202 U,D	< 0.0018 U	< 0.0193 U,D	< 0.0211 U,D	< 0.0018 U	< 0.0021 U	< 0.0017 U	< 0.0021 U	< 0.0020 U	< 0.0016 U	< 0.0196 U,D	< 0.0192 U,D	< 0.0186 U,D	< 0.0205 U,D	< 0.0189 U,D	< 0.0194 U,D
1,1,2,2-Tetrachloroethane	NL	NL	NL	< 0.0466 U,D	< 0.0524 U,D	< 0.0515 U,D	< 0.0046 U	< 0.0493 U,D	< 0.0538 U,D	< 0.0045 U	< 0.0053 U	< 0.0042 U	< 0.0054 U	< 0.0051 U	< 0.0042 U	< 0.0499 U,D	< 0.0488 U,D	< 0.0473 U,D	< 0.0522 U,D	< 0.0481 U,D	< 0.0494 U,D
1,1,2-Trichloroethane	NL	NL	NL	< 0.0399 U,D	< 0.0449 U,D	< 0.0442 U,D	< 0.0039 U	< 0.0422 U,D	< 0.0461 U,D	< 0.0038 U	< 0.0046 U	< 0.0036 U	< 0.0046 U	< 0.0044 U	< 0.0036 U	< 0.0427 U,D	< 0.0419 U,D	< 0.0405 U,D	< 0.0448 U,D	< 0.0412 U,D	< 0.0424 U,D
1,1,2-Trichlorotrifluoroethane	NL	NL	NL	< 0.0279 U,D	< 0.0314 U,D	< 0.0309 U,D	< 0.0028 U	< 0.0295 U,D	< 0.0323 U,D	< 0.0027 U	< 0.0032 U	< 0.0025 U	< 0.0032 U	< 0.0031 U	< 0.0025 U	< 0.0299 U,D	< 0.0293 U,D	< 0.0283 U,D	< 0.0313 U,D	< 0.0288 U,D	< 0.0296 U,D
1,1-Dichloroethane	0.27	19	240	< 0.0144 U,D	< 0.0162 U,D	< 0.0160 U,D	< 0.0014 U	< 0.0153 U,D	< 0.0167 U,D	< 0.0014 U	< 0.0017 U	< 0.0013 U	< 0.0017 U	< 0.0016 U	< 0.0013 U	< 0.0154 U,D	< 0.0151 U,D	< 0.0146 U,D	< 0.0162 U,D	< 0.0149 U,D	< 0.0153 U,D
1,1-Dichloroethene	0.33	100	500	< 0.0288 U,D	< 0.0324 U,D	< 0.0319 U,D	< 0.0028 U	< 0.0305 U,D	< 0.0333 U,D	< 0.0028 U	< 0.0033 U	< 0.0026 U	< 0.0033 U	< 0.0032 U	< 0.0026 U	< 0.0308 U,D	< 0.0302 U,D	< 0.0292 U,D	< 0.0323 U,D	< 0.0297 U,D	< 0.0306 U,D
1,1-Dichloropropene	NL	NL	NL	< 0.0177 U,D	< 0.0199 U,D	< 0.0196 U,D	< 0.0018 U	< 0.0188 U,D	< 0.0205 U,D	< 0.0017 U	< 0.0020 U	< 0.0016 U	< 0.0020 U	< 0.0020 U	< 0.0016 U	< 0.0190 U,D	< 0.0186 U,D	< 0.0180 U,D	< 0.0199 U,D	< 0.0183 U,D	< 0.0188 U,D
1,2,3-Trichlorobenzene	NL	NL	NL	< 0.0193 U,D	< 0.0217 U,D	< 0.0214 U,D	< 0.0019 U	< 0.0204 U,D	< 0.0223 U,D	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0022 U	< 0.0021 U	< 0.0017 U	< 0.0207 U,D	< 0.0203 U,D	< 0.0196 U,D	< 0.0217 U,D	< 0.0200 U,D	< 0.0205 U,D
1,2,3-Trichloropropane	NL	NL	NL	< 0.0413 U,D	< 0.0464 U,D	< 0.0457 U,D	< 0.0041 U	< 0.0437 U,D	< 0.0477 U,D	< 0.0040 U	< 0.0047 U	< 0.0037 U	< 0.0048 U	< 0.0045 U	< 0.0037 U	< 0.0442 U,D	< 0.0433 U,D	< 0.0419 U,D	< 0.0463 U,D	< 0.0426 U,D	< 0.0438 U,D
1,2,4-Trichlorobenzene	NL	NL	NL	< 0.0406 U,D	< 0.0456 U,D	< 0.0449 U,D	< 0.0040 U	< 0.0429 U,D	< 0.0469 U,D	< 0.0039 U	< 0.0047 U	< 0.0037 U	< 0.0047 U	< 0.0045 U	< 0.0037 U	< 0.0434 U,D	< 0.0426 U,D	< 0.0412 U,D	< 0.0455 U,D	< 0.0419 U,D	< 0.0431 U,D
1,2,4-Trimethylbenzene	3.6	47	190	< 0.0134 U,D	< 0.0150 U,D	< 0.0148 U,D	< 0.0013 U	< 0.0142 U,D	< 0.0155 U,D	< 0.0013 U	< 0.0015 U	< 0.0012 U	< 0.0015 U	< 0.0015 U	< 0.0012 U	< 0.0143 U,D	< 0.0140 U,D	< 0.0136 U,D	< 0.0150 U,D	< 0.0138 U,D	< 0.0142 U,D
1,2-Dibromo-3-chloropropane	NL	NL	NL	< 0.0796 U,D	< 0.0894 U,D	< 0.0880 U,D	< 0.0078 U	< 0.0842 U,D	< 0.0919 U,D	< 0.0076 U	< 0.0091 U	< 0.0072 U	< 0.0092 U	< 0.0087 U	< 0.0072 U	< 0.0852 U,D	< 0.0834 U,D	< 0.0808 U,D	< 0.0892 U,D	< 0.0822 U,D	< 0.0844 U,D
1,2-Dibromoethane	NL	NL	NL	< 0.0369 U,D	< 0.0415 U,D	< 0.0409 U,D	< 0.0036 U	< 0.0391 U,D	< 0.0427 U,D	< 0.0035 U	< 0.0042 U	< 0.0033 U	< 0.0043 U	< 0.0041 U	< 0.0033 U	< 0.0396 U,D	< 0.0387 U,D	< 0.0375 U,D	< 0.0414 U,D	< 0.0382 U,D	< 0.0392 U,D
1,2-Dichlorobenzene	1.1	100	500	< 0.0143 U,D	< 0.0161 U,D	< 0.0158 U,D	< 0.0014 U	< 0.0151 U,D	< 0.0165 U,D	< 0.0014 U	< 0.0016 U	< 0.0013 U	< 0.0017 U	< 0.0016 U	< 0.0013 U	< 0.0153 U,D	< 0.0150 U,D	< 0.0145 U,D	< 0.0161 U,D	< 0.0148 U,D	< 0.0152 U,D
1,2-Dichloroethane	0.02	2.3	30	< 0.0197 U,D	< 0.0222 U,D	< 0.0218 U,D	< 0.0019 U	< 0.0209 U,D	< 0.0228 U,D	< 0.0019 U	< 0.0023 U	< 0.0018 U	< 0.0023 U	< 0.0022 U	< 0.0018 U	< 0.0211 U,D	< 0.0207 U,D	< 0.0200 U,D	< 0.0221 U,D	< 0.0204 U,D	< 0.0209 U,D
1,2-Dichloropropane	NL	NL	NL	< 0.0289 U,D	< 0.0324 U,D	< 0.0319 U,D	< 0.0028 U	< 0.0305 U,D	< 0.0333 U,D	< 0.0028 U	< 0.0033 U	< 0.0026 U	< 0.0033 U	< 0.0032 U	< 0.0026 U	< 0.0309 U,D	< 0.0303 U,D	< 0.0293 U,D	< 0.0324 U,D	< 0.0298 U,D	< 0.0306 U,D
1,3,5-Trichlorobenzene	NL	NL	NL	< 0.0173 U,D	< 0.0194 U,D	< 0.0191 U,D	< 0.0017 U	< 0.0183 U,D	< 0.0200 U,D	< 0.0017 U	< 0.0020 U	< 0.0016 U	< 0.0020 U	< 0.0019 U	< 0.0016 U	< 0.0185 U,D	< 0.0181 U,D	< 0.0176 U,D	< 0.0194 U,D	< 0.0179 U,D	< 0.0183 U,D
1,3,5-Trimethylbenzene	8.4	47	190	< 0.0095 U,D	< 0.0106 U,D	< 0.0105 U,D	< 0.0009 U	< 0.0100 U,D	< 0.0109 U,D	< 0.0009 U	< 0.0011 U	< 0.0009 U	< 0.0011 U	< 0.0010 U	< 0.0009 U	< 0.0101 U,D	< 0.0099 U,D	< 0.0096 U,D	< 0.0106 U,D	< 0.0098 U,D	< 0.0100 U,D
1,3-Dichlorobenzene	2.4	17	280	< 0.0119 U,D	< 0.0134 U,D	< 0.0132 U,D	< 0.0012 U	< 0.0126 U,D	< 0.0138 U,D	< 0.0012 U	< 0.0014 U	< 0.0011 U	< 0.0014 U	< 0.0013 U	< 0.0011 U	< 0.0128 U,D	< 0.0125 U,D	< 0.0121 U,D	< 0.0134 U,D	< 0.0123 U,D	< 0.0127 U,D
1,3-Dichloropropane	NL	NL	NL	< 0.0285 U,D	< 0.0321 U,D	< 0.0315 U,D	< 0.0028 U	< 0.0302 U,D	< 0.0330 U,D	< 0.0027 U	< 0.0033 U	< 0.0026 U	< 0.0033 U	< 0.0031 U	< 0.0026 U	< 0.0305 U,D	< 0.0299 U,D	< 0.0290 U,D	< 0.0320 U,D	< 0.0295 U,D	< 0.0303 U,D
1,4-Dichlorobenzene	1.8	9.8	130	< 0.0163 U,D	< 0.0183 U,D	< 0.0180 U,D	< 0.0016 U	< 0.0172 U,D	< 0.0188 U,D	< 0.0016 U	< 0.0019 U	< 0.0015 U	< 0.0019 U	< 0.0018 U	< 0.0015 U	< 0.0174 U,D	< 0.0171 U,D	< 0.0165 U,D	< 0.0183 U,D	< 0.0168 U,D	< 0.0173 U,D
1,4-Dioxane	0.1	9.8	130	< 0.9560 U,D	< 1.0700 U,D	< 1.0600 U,D	< 0.0942 U	< 1.0100 U,D	< 1.1100 U,D	< 0.0917 U	< 0.1100 U	< 0.0865 U	< 0.1100 U	< 0.1050 U	< 0.0859 U	< 1.0200 U,D	< 1.0000 U,D	< 0.9710 U,D	< 1.0700 U,D	< 0.9880 U,D	< 1.0100 U,D
2,2-Dichloropropane	NL	NL	NL	< 0.0260 U,D	< 0.0292 U,D	< 0.0287 U,D	< 0.0026 U	< 0.0275 U,D	< 0.0300 U,D	< 0.0025 U	< 0.0030 U	< 0.0024 U	< 0.0030 U	< 0.0029 U	< 0.0023 U	< 0.0278 U,D	< 0.0273 U,D	< 0.0264 U,D	< 0.0291 U,D	< 0.0268 U,D	< 0.0276 U,D
2-Butanone	0.12	100	500	< 0.0984 U,D	< 0.1110 U,D	< 0.1090 U,D	< 0.0097 U	< 0.1040 U,D	< 0.1140 U,D	< 0.0094 U	< 0.0113 U	< 0.0089 U	< 0.0113 U	< 0.0108 U	< 0.0089 U	< 0.1050 U,D	< 0.1030 U,D	< 0.1000 U,D	< 0.1100 U,D	< 0.1020 U,D	< 0.1040 U,D
2-Chlorotoluene	NL	NL	NL	< 0.0137 U,D	< 0.0154 U,D	< 0.0152 U,D	< 0.0014 U	< 0.0145 U,D	< 0.0158 U,D	< 0.0013 U	< 0.0016 U	< 0.0012 U	< 0.0016 U	< 0.0015 U	< 0.0012 U	< 0.0147 U,D	< 0.0144 U,D	< 0.0139 U,D	< 0.0154 U,D	< 0.0142 U,D	< 0.0145 U,D
2-Hexanone	NL	NL	NL	< 0.0676 U,D	< 0.0759 U,D	< 0.0747 U,D	< 0.0067 U	< 0.0715 U,D	< 0.0781 U,D	< 0.0065 U	< 0.0078 U	< 0.0061 U	< 0.0078 U	< 0.0074 U	< 0.0061 U	< 0.0723 U,D	< 0.0708 U,D	< 0.0686 U,D	< 0.0758 U,D	< 0.0698 U,D	< 0.0717 U,D
4-Chlorotoluene	NL	NL	NL	< 0.0129 U,D	< 0.0145 U,D	< 0.0143 U,D	< 0.0013 U	< 0.0137 U,D	< 0.0150 U,D	< 0.0012 U	< 0.0015 U	< 0.0012 U	< 0.0015 U	< 0.0014 U	< 0.0012 U	< 0.0139 U,D	< 0.0136 U,D	< 0.0131 U,D	< 0.0145 U,D	< 0.0134 U,D	< 0.0137 U,D
4-Isopropyltoluene	NL	NL	NL	< 0.0118 U,D	< 0.0133 U,D	< 0.0131 U,D	< 0.0012 U	< 0.0125 U,D	< 0.0137 U,D	< 0.0011 U	< 0.0014 U	< 0.0011 U	< 0.0014 U	< 0.0013 U	< 0.0011 U	< 0.0127 U,D	< 0.0124 U,D	< 0.0120 U,D	< 0.0133 U,D	< 0.0122 U,D	< 0.0126 U,D
4-Methyl-2-pentanone	NL	NL	NL	< 0.0283 U,D	< 0.0318 U,D	< 0.0313 U,D	< 0.0028 U	< 0.0299 U,D	< 0.0327 U,D	< 0.											



TABLE 1  
SHALLOW AND SUBSURFACE SOIL ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Sample Depth Sample Date	NYSDEC Part 375-6 Unrestricted Use	NYSDEC Part 375-6 Residential	NYSDEC Part 375-6 Commercial	SB-1 0-2' 1/10/2018	SB-1 15-17' 1/10/2018	SB-2 0-2' 1/11/2018	SB-2 15-17' 1/11/2018	SB-3 0-2' 1/10/2018	SB-3 15-17' 1/10/2018	SB-4 0-2' 1/11/2018	SB-4 15-17' 1/11/2018	SB-5 (0-2') 0-2' 1/11/2018	SB-5 (12-14') 12-14' 1/11/2018	SB-5 (15-17') 15-17' 1/11/2018	SB-5 DUPLICATE 0-2' 1/11/2018	SB-6 (0-2') 0-2' 1/9/2018	SB-6 (15-17') SC43071-04 1/9/2018	SB-7 (0-2') SC43071-05 1/10/2018	SB-7 (15-17') SC43071-06 1/10/2018	SB-8 (0-2') SC43071-01 1/9/2018	SB-8 (15-17') SC43071-02 1/9/2018
SVOCs - Polynuclear Aromatic Hydrocarbons (PAHs) (mg/Kg)																					
2-Methylnaphthalene	NL	NL	NL	< 0.2150 U, D	< 0.0460 U	< 0.2220 U, D	< 0.0461 U	< 0.4460 U, D	< 0.0481 U	< 0.0434 U	< 0.0503 U	< 0.0843 U, D	< 0.0435 U	< 0.0485 U	< 0.0422 U	< 0.0428 U	< 0.2140 U, D	< 0.2100 U, D	< 0.0478 U	< 0.2110 U, D	< 0.0441 U
Acenaphthene	20	100	500	< 0.1770 U, D	< 0.0379 U	< 0.1830 U, D	< 0.0379 U	< 0.3670 U, D	< 0.0396 U	< 0.0358 U	< 0.0348 U	< 0.0694 U, D	< 0.0358 U	< 0.0400 U	< 0.0348 U	< 0.0352 U	< 0.1760 U, D	< 0.1730 U, D	< 0.0394 U	< 0.1740 U, D	< 0.0363 U
Acenaphthylene	100	100	500	< 0.1750 U, D	< 0.0375 U	< 0.1810 U, D	< 0.0376 U	< 0.3640 U, D	< 0.0393 U	< 0.0355 U	< 0.0410 U	< 0.0688 U, D	< 0.0355 U	< 0.0396 U	< 0.0345 U	< 0.0349 U	< 0.1750 U, D	< 0.1720 U, D	< 0.0390 U	< 0.1720 U, D	< 0.0360 U
Anthracene	100	100	500	< 0.1700 U, D	< 0.0364 U	< 0.1760 U, D	< 0.0365 U	< 0.3530 U, D	< 0.0381 U	< 0.0344 U	< 0.0398 U	< 0.0667 U, D	< 0.0344 U	< 0.0384 U	< 0.0334 U	< 0.0339 U	< 0.1690 U, D	< 0.1670 U, D	< 0.0378 U	< 0.1670 U, D	< 0.0349 U
Benzo(a)anthracene	1	1	5.6	< 0.1880 U, D	< 0.0401 U	< 0.1940 U, D	< 0.0402 U	<b>0.4900 J, D</b>	< 0.0420 U	< 0.0379 U	< 0.0439 U	< 0.0736 U, D	< 0.0380 U	< 0.0424 U	< 0.0369 U	< 0.0374 U	< 0.1870 U, D	< 0.1840 U, D	< 0.0418 U	< 0.1840 U, D	< 0.0385 U
Benzo(a)pyrene	1	1	1	< 0.1320 U, D	< 0.0283 U	<b>0.2500 J, D</b>	< 0.0284 U	<b>0.5200 J, D</b>	< 0.0297 U	< 0.0268 U	< 0.0310 U	< 0.0519 U, D	< 0.0268 U	< 0.0299 U	< 0.0260 U	<b>0.0453 J</b>	< 0.1320 U, D	< 0.1300 U, D	< 0.0295 U	< 0.1300 U, D	< 0.0271 U
Benzo(b)fluoranthene	1	1	5.6	< 0.1720 U, D	< 0.0368 U	<b>0.2570 J, D</b>	< 0.0369 U	<b>0.5270 J, D</b>	< 0.0386 U	< 0.0348 U	< 0.0403 U	< 0.0675 U, D	< 0.0348 U	< 0.0389 U	< 0.0338 U	<b>0.0555 J</b>	< 0.1720 U, D	< 0.1690 U, D	< 0.0383 U	< 0.1690 U, D	< 0.0353 U
Benzo(g,h,i)perylene	100	100	500	< 0.1430 U, D	< 0.0306 U	<b>0.3030 J, D</b>	< 0.0306 U	<b>0.3060 J, D</b>	< 0.0320 U	< 0.0289 U	< 0.0334 U	< 0.0560 U, D	< 0.0289 U	< 0.0323 U	< 0.0281 U	<b>0.0287 J</b>	< 0.1420 U, D	< 0.1400 U, D	< 0.0318 U	< 0.1400 U, D	< 0.0293 U
Benzo(k)fluoranthene	0.8	1	56	< 0.1390 U, D	< 0.0298 U	<b>0.1930 J, D</b>	< 0.0298 U	<b>0.4200 J, D</b>	< 0.0312 U	< 0.0281 U	< 0.0326 U	< 0.0546 U, D	< 0.0282 U	< 0.0314 U	< 0.0273 U	<b>0.0463 J</b>	< 0.1390 U, D	< 0.1360 U, D	< 0.0310 U	< 0.1370 U, D	< 0.0285 U
Chrysene	1	1	56	< 0.1780 U, D	< 0.0380 U	<b>0.1890 J, D</b>	< 0.0381 U	<b>0.4500 J, D</b>	< 0.0398 U	< 0.0359 U	< 0.0415 U	< 0.0696 U, D	< 0.0359 U	< 0.0401 U	< 0.0349 U	<b>0.0439 J</b>	< 0.1770 U, D	< 0.1740 U, D	< 0.0395 U	< 0.1740 U, D	< 0.0364 U
Dibenzo(a,h)anthracene	0.33	0.33	0.56	< 0.1370 U, D	< 0.0292 U	< 0.1410 U, D	< 0.0293 U	< 0.2830 U, D	< 0.0306 U	< 0.0276 U	< 0.0319 U	< 0.0535 U, D	< 0.0276 U	< 0.0308 U	< 0.0268 U	< 0.0272 U	< 0.1360 U, D	< 0.1340 U, D	< 0.0304 U	< 0.1340 U, D	< 0.0280 U
Fluoranthene	100	100	500	< 0.1880 U, D	< 0.0402 U	<b>0.2990 J, D</b>	< 0.0403 U	<b>1.0000 D</b>	< 0.0421 U	< 0.0380 U	< 0.0440 U	< 0.0737 U, D	< 0.0380 U	< 0.0425 U	< 0.0369 U	<b>0.0471 J</b>	< 0.1870 U, D	< 0.1840 U, D	< 0.0418 U	< 0.1850 U, D	< 0.0385 U
Fluorene	30	100	500	< 0.1810 U, D	< 0.0387 U	< 0.1870 U, D	< 0.0387 U	< 0.3750 U, D	< 0.0405 U	< 0.0365 U	< 0.0423 U	< 0.0709 U, D	< 0.0366 U	< 0.0408 U	< 0.0355 U	< 0.0360 U	< 0.1800 U, D	< 0.1770 U, D	< 0.0402 U	< 0.1780 U, D	< 0.0371 U
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	< 0.1280 U, D	< 0.0274 U	<b>0.2520 J, D</b>	< 0.0274 U	<b>0.2980 J, D</b>	< 0.0287 U	< 0.0259 U	< 0.0299 U	< 0.0502 U, D	< 0.0259 U	< 0.0289 U	< 0.0251 U	<b>0.0269 J</b>	< 0.1280 U, D	< 0.1250 U, D	< 0.0285 U	< 0.1260 U, D	< 0.0262 U
Naphthalene	12	100	500	< 0.1660 U, D	< 0.0355 U	< 0.1710 U, D	< 0.0355 U	< 0.3440 U, D	< 0.0371 U	< 0.0335 U	< 0.0388 U	< 0.0650 U, D	< 0.0336 U	< 0.0375 U	< 0.0326 U	< 0.0269 U	< 0.1650 U, D	< 0.1620 U, D	< 0.0369 U	< 0.1630 U, D	< 0.0340 U
Phenanthrene	100	100	500	< 0.1660 U, D	< 0.0354 U	< 0.1710 U, D	< 0.0355 U	<b>0.6150 J, D</b>	< 0.0371 U	< 0.0335 U	< 0.0387 U	< 0.0649 U, D	< 0.0335 U	< 0.0374 U	< 0.0325 U	< 0.0329 U	< 0.1650 U, D	< 0.1620 U, D	< 0.0368 U	< 0.1630 U, D	< 0.0339 U
Pyrene	100	100	500	< 0.1980 U, D	< 0.0424 U	<b>0.2590 J, D</b>	< 0.0425 U	<b>0.9250 D</b>	< 0.0444 U	< 0.0401 U	< 0.0464 U	< 0.0778 U, D	< 0.0401 U	< 0.0448 U	< 0.0390 U	<b>0.0538 J</b>	< 0.1980 U, D	< 0.1940 U, D	< 0.0441 U	< 0.1950 U, D	< 0.0407 U
Other Semivolatile Organic Compounds (SVOC) (mg/Kg)																					
1,2,4,5-Tetrachlorobenzene	NL	NL	NL	< 0.1710 U, D	< 0.0365 U	< 0.1760 U, D	< 0.0366 U	< 0.3540 U, D	< 0.0382 U	< 0.0345 U	< 0.0399 U	< 0.0669 U, D	< 0.0345 U	< 0.0385 U	< 0.0335 U	< 0.0340 U	< 0.1700 U, D	< 0.1670 U, D	< 0.0380 U	< 0.1680 U, D	< 0.0350 U
1,2,4-Trichlorobenzene	NL	NL	NL	< 0.1740 U, D	< 0.0373 U	< 0.1800 U, D	< 0.0374 U	< 0.3610 U, D	< 0.0390 U	< 0.0352 U	< 0.0408 U	< 0.0684 U, D	< 0.0353 U	< 0.0394 U	< 0.0342 U	< 0.0347 U	< 0.1740 U, D	< 0.1710 U, D	< 0.0388 U	< 0.1710 U, D	< 0.0357 U
1,2-Dichlorobenzene	NL	NL	NL	< 0.1540 U, D	< 0.0328 U	< 0.1590 U, D	< 0.0329 U	< 0.3180 U, D	< 0.0344 U	< 0.0310 U	< 0.0359 U	< 0.0602 U, D	< 0.0311 U	< 0.0347 U	< 0.0302 U	< 0.0306 U	< 0.1530 U, D	< 0.1500 U, D	< 0.0342 U	< 0.1510 U, D	< 0.0315 U
1,3-Dichlorobenzene	NL	NL	NL	< 0.1540 U, D	< 0.0328 U	< 0.1590 U, D	< 0.0329 U	< 0.3180 U, D	< 0.0344 U	< 0.0310 U	< 0.0359 U	< 0.0602 U, D	< 0.0311 U	< 0.0347 U	< 0.0302 U	< 0.0306 U	< 0.1530 U, D	< 0.1500 U, D	< 0.0342 U	< 0.1510 U, D	< 0.0315 U
1,4-Dichlorobenzene	NL	NL	NL	< 0.1630 U, D	< 0.0349 U	< 0.1690 U, D	< 0.0350 U	< 0.3380 U, D	< 0.0365 U	< 0.0330 U	< 0.0382 U	< 0.0640 U, D	< 0.0330 U	< 0.0369 U	< 0.0320 U	< 0.0325 U	< 0.1630 U, D	< 0.1600 U, D	< 0.0363 U	< 0.1600 U, D	< 0.0334 U
1-Methylnaphthalene	NL	NL	NL	< 0.1750 U, D	< 0.0374 U	< 0.1810 U, D	< 0.0375 U	< 0.3630 U, D	< 0.0392 U	< 0.0354 U	< 0.0409 U	< 0.0686 U, D	< 0.0354 U	< 0.0395 U	< 0.0344 U	< 0.0348 U	< 0.1740 U, D	< 0.1710 U, D	< 0.0389 U	< 0.1720 U, D	< 0.0359 U
2,4,5-Trichlorophenol	NL	NL	NL	< 0.1580 U, D	< 0.0339 U	< 0.1640 U, D	< 0.0339 U	< 0.3280 U, D	< 0.0355 U	< 0.0320 U	< 0.0370 U	< 0.0621 U, D	< 0.0320 U	< 0.0358 U	< 0.0311 U	< 0.0315 U	< 0.1580 U, D	< 0.1550 U, D	< 0.0352 U	< 0.1560 U, D	< 0.0325 U
2,4,6-Trichlorophenol	NL	NL	NL	< 0.1590 U, D	< 0.0340 U	< 0.1640 U, D	< 0.0340 U	< 0.3290 U, D	< 0.0356 U	< 0.0321 U	< 0.0372 U	< 0.0623 U, D	< 0.0321 U	< 0.0359 U	< 0.0312 U	< 0.0316 U	< 0.1580 U, D	< 0.1560 U, D	< 0.0353 U	< 0.1560 U, D	< 0.0326 U
2,4-Dichlorophenol	NL	NL	NL	< 0.1660 U, D	< 0.0356 U	< 0.1720 U, D	< 0.0357 U	< 0.3450 U, D	< 0.0373 U	< 0.0336 U	< 0.0389 U	< 0.0653 U, D	< 0.0337 U	< 0.0376 U	< 0.0327 U	< 0.0331 U	< 0.1660 U, D	< 0.1630 U, D	< 0.0370 U	< 0.1640 U, D	< 0.0341 U
2,4-Dimethylphenol	NL	NL	NL	< 0.1260 U, D	< 0.0269 U	< 0.1300 U, D	< 0.0270 U	< 0.2610 U, D	< 0.0282 U	< 0.0254 U	< 0.0294 U	< 0.0493 U, D	< 0.0255 U	< 0.0284 U	< 0.0247 U	< 0.0250 U	< 0.1250 U, D	< 0.1230 U, D	< 0.0280 U	< 0.1240 U, D	< 0.0258 U
2,4-Dinitrophenol	NL	NL	NL	< 0.1790 U, D	< 0.0383 U	< 0.1850 U, D	< 0.0384 U	< 0.3710 U, D	< 0.0401 U	< 0.0362 U	< 0.0419 U	< 0.0703 U, D	< 0.0362 U	< 0.0405 U	< 0.0352 U	< 0.0357 U	< 0.1790 U, D	< 0.1750 U, D	< 0.0399 U	< 0.1760 U, D	< 0.0367 U
2,4-Dinitrotoluene	NL	NL	NL	< 0.3440 U, D	< 0.0737 U	< 0.3560 U, D	< 0.0738 U	< 0.7140 U, D	< 0.0771 U	< 0.0696 U	< 0.0806 U	< 0.1350 U, D	< 0.0697 U	< 0.0778 U	< 0.0676 U	< 0.0686 U	< 0.3430 U, D	< 0.3370 U, D	< 0.0766 U	< 0.3380 U, D	< 0.0706 U
2,6-Dinitrotoluene	NL	NL	NL	< 0.2010 U, D	< 0.0429 U	< 0.2070 U, D	< 0.0430 U	< 0.4160 U, D	< 0.0449 U	< 0.0405 U	< 0.0469 U	< 0.0786 U, D	< 0.0406 U	< 0.0453 U	< 0.0394 U	< 0.0399 U	< 0.2000 U, D	< 0.1960 U, D	< 0.0446 U	< 0.1970 U, D	< 0.0411 U
2-Chloronaphthalene	NL	NL	NL	< 0.1630 U, D	< 0.0348 U	< 0.1680 U, D	< 0.0349 U	< 0.3370 U, D	< 0.0364 U	< 0.0329 U	< 0.0380 U	< 0.0638 U, D	< 0.0329 U	< 0.0367 U	< 0.0319 U	< 0.0324 U	< 0.1620 U, D	< 0.1590 U, D	< 0.0362 U	< 0.1600 U, D	< 0.0333 U
2-Chlorophenol	NL	NL	NL	< 0.1580 U, D	< 0.0339 U	< 0.1640 U, D	< 0.0339 U	< 0.3280 U, D	< 0.0355 U	< 0.0320 U	< 0.0370 U	< 0.0621 U, D	< 0.0320 U	< 0.0358 U	< 0.0311 U	< 0.0315 U	< 0.1580 U, D	< 0.1550 U, D	< 0.0352 U	< 0.1560 U, D	< 0.0325 U
2-Methylphenol	0.33	100	500	< 0.1500 U, D	< 0.0320 U	< 0.1550 U, D	< 0.0321 U	< 0.3100 U, D	< 0.0335 U	< 0.0302 U	< 0.0350 U	< 0.0587 U, D	< 0.0303 U	< 0.0338 U	< 0.0294 U	< 0.0298 U	< 0.1490 U, D	< 0.1460 U, D	< 0.0333 U	< 0.1470 U, D	< 0.0307 U
2-Nitroaniline	NL	NL	NL	< 0.1490 U, D	< 0.0319 U	< 0.1540 U, D	< 0.0320 U	< 0.3100 U, D	< 0.0334 U	< 0.0302 U	< 0.0349 U	< 0.0585 U, D	< 0.0302 U	< 0.0337 U	< 0.0293 U	< 0.0297 U	< 0.1490 U, D	< 0.1460 U, D	< 0.0332 U	< 0.1470 U, D	< 0.0306 U
2-Nitrophenol	NL	NL	NL	< 0.1480 U, D	< 0.0316 U	< 0.1530 U, D	< 0.0317 U	< 0.3060 U, D	< 0.0331 U	< 0.0299 U	< 0.0346 U	< 0.0579 U, D	< 0.0299 U	< 0.0334 U	< 0.0290 U	< 0.0294 U	< 0.1470 U, D	< 0.1450 U, D	< 0.0329 U	< 0.1450 U, D	< 0.0303 U
3 &																					

TABLE 1  
SHALLOW AND SUBSURFACE SOIL ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Sample Depth Sample Date	NYSDEC Part 375-6 Unrestricted Use	NYSDEC Part 375-6 Residential	NYSDEC Part 375-6 Commercial	SB-1 0-2' 1/10/2018	SB-1 15-17' 1/10/2018	SB-2 0-2' 1/11/2018	SB-2 15-17' 1/11/2018	SB-3 0-2' 1/10/2018	SB-3 15-17' 1/10/2018	SB-4 0-2' 1/11/2018	SB-4 15-17' 1/11/2018	SB-5 (0-2') 0-2' 1/11/2018	SB-5 (12-14') 12-14' 1/11/2018	SB-5 (15-17') 15-17' 1/11/2018	SB-5 DUPLICATE 0-2' 1/11/2018	SB-6 (0-2') 0-2' 1/9/2018	SB-6 (15-17') SC43071-04 1/9/2018	SB-7 (0-2') SC43071-05 1/10/2018	SB-7 (15-17') SC43071-06 1/10/2018	SB-8 (0-2') SC43071-01 1/9/2018	SB-8 (15-17') SC43071-02 1/9/2018
PCBs (mg/Kg)																					
Aroclor-1016	NL	NL	NL	< 0.0095 U	< 0.0102 U	< 0.0098 U	< 0.0102 U	< 0.0099 U	< 0.0106 U	< 0.0096 U	< 0.0111 U	< 0.0093 U	< 0.0096 U	< 0.0108 U	< 0.0093 U	< 0.0095 U	< 0.0095 U	< 0.0094 U	< 0.0106 U	< 0.0093 U	< 0.0098 U
Aroclor-1221	NL	NL	NL	< 0.0113 U	< 0.0121 U	< 0.0117 U	< 0.0121 U	< 0.0117 U	< 0.0126 U	< 0.0114 U	< 0.0132 U	< 0.0111 U	< 0.0114 U	< 0.0129 U	< 0.0111 U	< 0.0113 U	< 0.0112 U	< 0.0111 U	< 0.0126 U	< 0.0111 U	< 0.0116 U
Aroclor-1232	NL	NL	NL	< 0.0106 U	< 0.0114 U	< 0.0110 U	< 0.0114 U	< 0.0110 U	< 0.0119 U	< 0.0107 U	< 0.0124 U	< 0.0104 U	< 0.0108 U	< 0.0121 U	< 0.0104 U	< 0.0106 U	< 0.0106 U	< 0.0105 U	< 0.0118 U	< 0.0104 U	< 0.0109 U
Aroclor-1242	NL	NL	NL	< 0.0209 U	< 0.0224 U	< 0.0217 U	< 0.0225 U	< 0.0217 U	< 0.0234 U	< 0.0211 U	< 0.0245 U	< 0.0206 U	< 0.0212 U	< 0.0239 U	< 0.0205 U	< 0.0209 U	< 0.0209 U	< 0.0206 U	< 0.0233 U	< 0.0206 U	< 0.0215 U
Aroclor-1248	NL	NL	NL	< 0.0194 U	< 0.0208 U	< 0.0201 U	< 0.0208 U	< 0.0201 U	< 0.0217 U	< 0.0196 U	< 0.0227 U	< 0.0191 U	< 0.0196 U	< 0.0221 U	< 0.0190 U	< 0.0193 U	< 0.0193 U	< 0.0191 U	< 0.0216 U	< 0.0191 U	< 0.0199 U
Aroclor-1254	NL	NL	NL	< 0.0139 U	< 0.0149 U	< 0.0144 U	< 0.0149 U	< 0.0144 U	< 0.0155 U	< 0.0140 U	< 0.0162 U	< 0.0136 U	< 0.0141 U	< 0.0158 U	< 0.0136 U	< 0.0138 U	< 0.0138 U	< 0.0137 U	< 0.0155 U	< 0.0136 U	< 0.0142 U
Aroclor-1260	NL	NL	NL	< 0.0114 U	< 0.0122 U	< 0.0118 U	< 0.0122 U	< 0.0118 U	< 0.0127 U	< 0.0115 U	< 0.0133 U	< 0.0112 U	< 0.0115 U	< 0.0130 U	< 0.0111 U	< 0.0113 U	< 0.0113 U	< 0.0112 U	< 0.0127 U	< 0.0112 U	< 0.0117 U
Aroclor-1262	NL	NL	NL	< <b>0.0323</b>	0.0198 U	<b>0.0126</b>	< 0.0199 U	<b>0.0105</b> J	< 0.0207 U	< 0.0187 U	< 0.0217 U	< 0.0182 U	< 0.0187 U	< 0.0211 U	< 0.0181 U	< 0.0185 U	< 0.0184 U	< 0.0182 U	< 0.0206 U	< 0.0182 U	< 0.0190 U
Aroclor-1268	NL	NL	NL	< 0.0096 U	< 0.0102 U	< 0.0099 U	< 0.0103 U	< 0.0099 U	< 0.0107 U	< 0.0097 U	< 0.0112 U	< 0.0094 U	< 0.0097 U	< 0.0109 U	< 0.0094 U	< 0.0096 U	< 0.0095 U	< 0.0094 U	< 0.0107 U	< 0.0094 U	< 0.0098 U
Total PCBs	1	1	1	<b>0.0323</b>	ND	<b>0.0126</b>	ND	<b>0.0105</b>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides (mg/Kg)																					
4,4'-DDD	0.0033	2.6	92	< 0.0092 U, D	< 0.0020 U	< 0.0095 U, D	< 0.0020 U	< 0.0096 U, D	< 0.0020 U	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0019 U	< 0.0021 U	< 0.0018 U	< 0.0037 U, D	< 0.0092 U, D	< 0.0090 U, D	< 0.0021 U	< 0.0091 U, D	< 0.0019 U
4,4'-DDE	0.0033	1.8	62	< 0.0083 U, D	< 0.0018 U	< 0.0087 U, D	< 0.0018 U	< 0.0087 U, D	< 0.0019 U	< 0.0017 U	< 0.0020 U	< 0.0017 U	< 0.0019 U	< 0.0017 U	< 0.0017 U	< 0.0033 U, D	< 0.0083 U, D	< 0.0082 U, D	< 0.0019 U	< 0.0082 U, D	< 0.0017 U
4,4'-DDT	0.0033	1.7	47	< 0.0081 U, D	< 0.0017 U	<b>0.0143</b> J, D	< 0.0018 U	< 0.0085 U, D	< 0.0018 U	< 0.0017 U	< 0.0019 U	<b>0.0107</b>	< 0.0017 U	< 0.0019 U	< 0.0016 U	< 0.0033 U, D	< 0.0081 U, D	< 0.0080 U, D	< 0.0018 U	< 0.0080 U, D	< 0.0017 U
Alachlor	NL	NL	NL	< 0.0129 U, D	< 0.0028 U	< 0.0134 U, D	< 0.0028 U	< 0.0135 U, D	< 0.0029 U	< 0.0026 U	< 0.0031 U	< 0.0025 U	< 0.0027 U	< 0.0029 U	< 0.0026 U	< 0.0052 U, D	< 0.0129 U, D	< 0.0127 U, D	< 0.0029 U	< 0.0127 U, D	< 0.0026 U
Aldrin	0.005	0.019	0.68	< 0.0081 U, D	< 0.0017 U	< 0.0084 U, D	< 0.0018 U	< 0.0085 U, D	< 0.0018 U	< 0.0017 U	< 0.0019 U	< 0.0016 U	< 0.0017 U	< 0.0019 U	< 0.0016 U	< 0.0033 U, D	< 0.0081 U, D	< 0.0080 U, D	< 0.0018 U	< 0.0080 U, D	< 0.0017 U
alpha-BHC	0.02	0.097	3.4	< 0.0071 U, D	< 0.0015 U	< 0.0073 U, D	< 0.0015 U	< 0.0074 U, D	< 0.0016 U	< 0.0014 U	< 0.0017 U	< 0.0014 U	< 0.0017 U	< 0.0015 U	< 0.0016 U	< 0.0028 U, D	< 0.0071 U, D	< 0.0069 U, D	< 0.0016 U	< 0.0070 U, D	< 0.0015 U
alpha-Chlordane	0.094	0.91	24	<b>0.1250</b> D	< 0.0019 U	<b>0.0136</b> P, J, D	< 0.0020 U	<b>0.0109</b> J, D	< 0.0020 U	< 0.0018 U	< 0.0021 U	<b>0.0022</b> P, J	< 0.0019 U	< 0.0021 U	< 0.0018 U	< 0.0036 U, D	< 0.0090 U, D	< 0.0089 U, D	< 0.0020 U	< 0.0089 U, D	< 0.0019 U
beta-BHC	0.036	0.072	3	< 0.0104 U, D	< 0.0022 U	< 0.0108 U, D	< 0.0023 U	< 0.0109 U, D	< 0.0023 U	< 0.0021 U	< 0.0025 U	< 0.0021 U	< 0.0022 U	< 0.0024 U	< 0.0021 U	< 0.0042 U, D	< 0.0104 U, D	< 0.0103 U, D	< 0.0023 U	< 0.0103 U, D	< 0.0021 U
Chlordane	NL	NL	NL	<b>0.0954</b>	< 0.0224 U	< 0.0216 U	< 0.0225 U	< 0.0216 U	< 0.0232 U	< 0.0211 U	< 0.0247 U	< 0.0203 U	< 0.0214 U	< 0.0237 U	< 0.0205 U	< 0.0417 U, D	< 0.1040 U, D	< 0.1020 U, D	< 0.0234 U	< 0.1030 U, D	< 0.0214 U
delta-BHC	0.04	100	500	< 0.0076 U, D	< 0.0016 U	< 0.0079 U, D	< 0.0016 U	< 0.0079 U, D	< 0.0017 U	< 0.0015 U	< 0.0018 U	< 0.0015 U	< 0.0016 U	< 0.0017 U	< 0.0015 U	< 0.0030 U, D	< 0.0076 U, D	< 0.0075 U, D	< 0.0017 U	< 0.0075 U, D	< 0.0016 U
Dieldrin	0.005	0.039	1.4	< 0.0093 U, D	< 0.0020 U	< 0.0096 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0021 U	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0019 U	< 0.0021 U	< 0.0018 U	< 0.0037 U, D	< 0.0093 U, D	< 0.0091 U, D	< 0.0021 U	< 0.0092 U, D	< 0.0019 U
Endosulfan I	2.4	4.8	200	< 0.0093 U, D	< 0.0020 U	< 0.0096 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0021 U	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0019 U	< 0.0021 U	< 0.0018 U	< 0.0037 U, D	< 0.0093 U, D	< 0.0091 U, D	< 0.0021 U	< 0.0092 U, D	< 0.0019 U
Endosulfan II	2.4	4.8	200	< 0.0099 U, D	< 0.0021 U	< 0.0103 U, D	< 0.0021 U	< 0.0103 U, D	< 0.0022 U	< 0.0020 U	< 0.0024 U	< 0.0019 U	< 0.0020 U	< 0.0023 U	< 0.0020 U	< 0.0040 U, D	< 0.0099 U, D	< 0.0097 U, D	< 0.0022 U	< 0.0098 U, D	< 0.0020 U
Endosulfan sulfate	2.4	4.8	200	< 0.0088 U, D	< 0.0019 U	< 0.0091 U, D	< 0.0019 U	< 0.0092 U, D	< 0.0020 U	< 0.0018 U	< 0.0021 U	< 0.0017 U	< 0.0018 U	< 0.0020 U	< 0.0017 U	< 0.0035 U, D	< 0.0088 U, D	< 0.0087 U, D	< 0.0020 U	< 0.0087 U, D	< 0.0018 U
Endrin	0.014	2.2	89	< 0.0093 U, D	< 0.0020 U	< 0.0096 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0021 U	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0019 U	< 0.0021 U	< 0.0018 U	< 0.0037 U, D	< 0.0093 U, D	< 0.0091 U, D	< 0.0021 U	< 0.0092 U, D	< 0.0019 U
Endrin aldehyde	NL	NL	NL	< 0.0088 U, D	< 0.0019 U	< 0.0091 U, D	< 0.0019 U	< 0.0092 U, D	< 0.0020 U	< 0.0018 U	< 0.0021 U	< 0.0017 U	< 0.0018 U	< 0.0020 U	< 0.0017 U	< 0.0035 U, D	< 0.0088 U, D	< 0.0087 U, D	< 0.0020 U	< 0.0087 U, D	< 0.0018 U
Endrin ketone	NL	NL	NL	< 0.0095 U, D	< 0.0020 U	< 0.0098 U, D	< 0.0021 U	< 0.0099 U, D	< 0.0021 U	< 0.0019 U	< 0.0023 U	< 0.0019 U	< 0.0020 U	< 0.0022 U	< 0.0019 U	< 0.0038 U, D	< 0.0095 U, D	< 0.0093 U, D	< 0.0021 U	< 0.0094 U, D	< 0.0019 U
gamma-BHC (Lindane)	0.1	0.28	9.2	< 0.0076 U, D	< 0.0016 U	< 0.0079 U, D	< 0.0016 U	< 0.0079 U, D	< 0.0017 U	< 0.0015 U	< 0.0018 U	< 0.0015 U	< 0.0016 U	< 0.0017 U	< 0.0015 U	< 0.0030 U, D	< 0.0076 U, D	< 0.0075 U, D	< 0.0017 U	< 0.0075 U, D	< 0.0016 U
gamma-Chlordane	NL	NL	NL	<b>0.1250</b> D	< 0.0020 U	< 0.0107 J, D	< 0.0021 U	< 0.0099 U, D	< 0.0021 U	< 0.0019 U	< 0.0023 U	< 0.0019 U	< 0.0020 U	< 0.0022 U	< 0.0019 U	< 0.0038 U, D	< 0.0095 U, D	< 0.0093 U, D	< 0.0021 U	< 0.0094 U, D	< 0.0019 U
Heptachlor	0.042	0.42	15	< 0.0088 U, D	< 0.0019 U	< 0.0091 U, D	< 0.0019 U	< 0.0092 U, D	< 0.0020 U	< 0.0018 U	< 0.0021 U	< 0.0017 U	< 0.0018 U	< 0.0020 U	< 0.0017 U	< 0.0035 U, D	< 0.0088 U, D	< 0.0087 U, D	< 0.0020 U	< 0.0087 U, D	< 0.0018 U
Heptachlor epoxide	NL	NL	NL	< 0.0093 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0021 U	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0019 U	< 0.0021 U	< 0.0019 U	< 0.0037 U, D	< 0.0093 U, D	< 0.0092 U, D	< 0.0021 U	< 0.0092 U, D	< 0.0019 U
Methoxychlor	NL	NL	NL	< 0.0093 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0020 U	< 0.0097 U, D	< 0.0021 U	< 0.0019 U	< 0.0022 U	< 0.0018 U	< 0.0019 U	< 0.0021 U	< 0.0019 U	< 0.0037 U, D	< 0.0093 U, D	< 0.0092 U, D	< 0.0021 U	< 0.0092 U, D	< 0.0019 U
Toxaphene	NL	NL	NL	< 0.1140 U, D	< 0.0245 U	< 0.1180 U, D	< 0.0246 U	< 0.1190 U, D	< 0.0254 U	< 0.0231 U	< 0.0271 U	< 0.0224 U	< 0.0234 U	< 0.0259 U	< 0.0225 U	< 0.0456 U, D	< 0.1140 U, D	< 0.1120 U, D	< 0.0256 U	< 0.1130 U, D	< 0.0234 U
Metals (mg/Kg)																					
Aluminum	NL	NL	NL	<b>5710</b>	<b>1990</b>	<b>4850</b>	<b>2350</b>	<b>5510</b>	<b>2410</b>	<b>4150</b>	<b>1880</b>	<b>5190</b>	<b>2940</b>	<b>2450</b>	<b>4700</b>	<b>5300</b>	<b>2600</b>	<b>5840</b>	<b>2010</b>	<b>5700</b>	<b>3080</b>
Antimony	NL	NL	NL	< 0.401 U	< 0.423 U	< 0.416 U	< 0.426 U	< 0.41 U	< 0.445 U	< 0.399 U	< 0.466 U	< 0.389 U	< 0.406 U	< 0.452 U	< 0.387 U	< 0.396 U	< 0.395 U	< 0.394 U	< 0.446 U	< 0.393 U	< 0.412 U
Arsenic	13	16	16	<b>3.12</b>	<b>0.325</b> J	<b>2.45</b>	<b>0.613</b> J	<b>2.25</b>	<b>0.348</b> J	<b>0.975</b> J	<b>0.415</b> J	<b>1.53</b> J	<b>0.323</b> J	<b>0.526</b> J	<b>0.996</b> J	<b>2.32</b>	<b>0.609</b> J	<b>1.81</b>			



TABLE 2  
GROUND WATER ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Sample Date Type of Sample	NYSDEC AWQSGV	GW-1 1/12/2018 Ground Water	GW-1(DUP) 1/12/2018 Ground Water	GW-2 1/10/2018 Ground Water	GW-3 1/10/2018 Ground Water	GW-3* 1/10/2018 Ground Water
<b>Volatile Organic Compounds (VOCs) - BTEX (ug/L)</b>						
Benzene	1	<0.28 U	<0.28 U	<0.28 U	<0.28 U	NA
Ethylbenzene	5	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
m,p-Xylene	NL	<0.38 U	<0.38 U	<0.38 U	<0.38 U	NA
o-Xylene	NL	<0.28 U	<0.28 U	<0.28 U	<0.28 U	NA
Toluene	5	<0.30 U	<0.30 U	<0.30 U	<0.30 U	NA
Xylene (Total)	5	<0.66	<0.66	<0.66	<0.66	NA
<b>Other Volatile Organic Compounds (VOCs) (ug/L)</b>						
1,1,1,2-Tetrachloroethane	5	<0.38 U	<0.38 U	<0.38 U	<0.38 U	NA
1,1,1-Trichloroethane	5	<0.51 U	<0.51 U	<0.51 U	<0.51 U	NA
1,1,2,2-Tetrachloroethane	5	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
1,1,2-Trichloroethane	1	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
1,1,2-Trichlorotrifluoroethane	5	<0.53 U	<0.53 U	<0.53 U	<0.53 U	NA
1,1-Dichloroethane	5	<0.32 U	<0.32 U	<0.32 U	<0.32 U	NA
1,1-Dichloroethene	5	<0.69 U	<0.69 U	<0.69 U	<0.69 U	NA
1,1-Dichloropropene	5	<0.58 U	<0.58 U	<0.58 U	<0.58 U	NA
1,2,3-Trichlorobenzene	5	<0.38 U	<0.38 U	<0.38 U	<0.38 U	NA
1,2,3-Trichloropropane	0.04	<0.29 U	<0.29 U	<0.29 U	<0.29 U	NA
1,2,4-Trichlorobenzene	5	<0.38 U	<0.38 U	<0.38 U	<0.38 U	NA
1,2,4-Trimethylbenzene	5	<0.36 U	<0.36 U	<0.36 U	<0.36 U	NA
1,2-Dibromo-3-chloropropane	0.04	<0.86 U	<0.86 U	<0.86 U	<0.86 U	NA
1,2-Dibromoethane	0.0006	<0.20 U	<0.20 U	<0.20 U	<0.20 U	NA
1,2-Dichlorobenzene	3	<0.28 U	<0.28 U	<0.28 U	<0.28 U	NA
1,2-Dichloroethane	0.6	<0.28 U	<0.28 U	<0.28 U	<0.28 U	NA
1,2-Dichloropropane	1	<0.29 U	<0.29 U	<0.29 U	<0.29 U	NA
1,3,5-Trichlorobenzene	5	<0.30 U	<0.30 U	<0.30 U	<0.30 U	NA
1,3,5-Trimethylbenzene	5	<0.43 U	<0.43 U	<0.43 U	<0.43 U	NA
1,3-Dichlorobenzene	3	<0.31 U	<0.31 U	<0.31 U	<0.31 U	NA
1,3-Dichloropropane	5	<0.21 U	<0.21 U	<0.21 U	<0.21 U	NA
1,4-Dichlorobenzene	3	<0.27 U	<0.27 U	<0.27 U	<0.27 U	NA
1,4-Dioxane	NL	<11.4 U	<11.4 U	<11.4 U	<11.4 U	NA
2,2-Dichloropropane	5	<0.42 U	<0.42 U	<0.42 U	<0.42 U	NA
2-Butanone	50	<1.07 U	<1.07 U	<1.07 U	<1.07 U	NA
2-Chlorotoluene	5	<0.32 U	<0.32 U	<0.32 U	<0.32 U	NA
2-Hexanone	50	<0.53 U	<0.53 U	<0.53 U	<0.53 U	NA
4-Chlorotoluene	5	<0.32 U	<0.32 U	<0.32 U	<0.32 U	NA
4-Isopropyltoluene	5	<0.28 U	<0.28 U	<0.28 U	<0.28 U	NA
4-Methyl-2-pentanone	NL	<0.52 U	<0.52 U	<0.52 U	<0.52 U	NA
Acetone	50	<b>1.82 J</b>	<b>1.90 J</b>	<b>3.51 J</b>	<b>1.46 J</b>	NA
Acrylonitrile	5	<0.47 U	<0.47 U	<0.47 U	<0.47 U	NA
Bromobenzene	5	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
Bromochloromethane	5	<0.34 U	<0.34 U	<0.34 U	<0.34 U	NA
Bromodichloromethane	50	<0.42 U	<0.42 U	<0.42 U	<0.42 U	NA
Bromoform	50	<0.42 U	<0.42 U	<0.42 U	<0.42 U	NA
Bromomethane	5	<0.90 U	<0.90 U	<0.90 U	<0.90 U	NA
Carbon disulfide	NL	<0.41 U	<0.41 U	<0.41 U	<0.41 U	NA
Carbon tetrachloride	5	<0.44 U	<0.44 U	<0.44 U	<0.44 U	NA
Chlorobenzene	5	<0.25 U	<0.25 U	<0.25 U	<0.25 U	NA
Chloroethane	5	<0.59 U	<0.59 U	<0.59 U	<0.59 U	NA
Chloroform	7	<0.33 U	<0.33 U	<b>1.29</b>	<b>0.48 J</b>	NA
Chloromethane	5	<0.37 U	<0.37 U	<0.37 U	<0.37 U	NA
cis-1,2-Dichloroethene	5	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
cis-1,3-Dichloropropene	0.4	<0.36 U	<0.36 U	<0.36 U	<0.36 U	NA
Dibromochloromethane	50	<0.32 U	<0.32 U	<0.32 U	<0.32 U	NA
Dibromomethane	5	<0.31 U	<0.31 U	<0.31 U	<0.31 U	NA
Dichlorodifluoromethane	5	<0.58 U	<0.58 U	<0.58 U	<0.58 U	NA
Di-isopropyl ether	NL	<0.29 U	<0.29 U	<0.29 U	<0.29 U	NA
Ethanol	NL	<30.9 U	<30.9 U	<30.9 U	<30.9 U	NA
Ethyl ether	NL	<0.37 U	<0.37 U	<0.37 U	<0.37 U	NA
Ethyl tert-butyl ether	NL	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
Hexachlorobutadiene	0.5	<0.47 U	<0.47 U	<0.47 U	<0.47 U	NA
Isopropylbenzene	5	<0.36 U	<0.36 U	<0.36 U	<0.36 U	NA
Methyl tert-butyl ether	NL	<0.24 U	<0.24 U	<0.24 U	<0.24 U	NA
Methylene chloride	5	<0.66 U	<0.66 U	<0.66 U	<0.66 U	NA
Naphthalene	10	<0.35 U	<0.35 U	<0.35 U	<0.35 U	NA
n-Butylbenzene	5	<0.41 U	<0.41 U	<0.41 U	<0.41 U	NA
n-Propylbenzene	5	<0.34 U	<0.34 U	<0.34 U	<0.34 U	NA
sec-Butylbenzene	5	<0.33 U	<0.33 U	<0.33 U	<0.33 U	NA
Styrene	5	<0.40 U	<0.40 U	<0.40 U	<0.40 U	NA
Tert-amyl methyl ether	NL	<0.49 U	<0.49 U	<0.49 U	<0.49 U	NA
Tert butyl alcohol	NL	<5.90 U	<5.90 U	<5.90 U	<5.90 U	NA
tert-Butylbenzene	5	<0.32 U	<0.32 U	<0.32 U	<0.32 U	NA
Tetrachloroethene	5	<0.57 U	<0.57 U	<0.57 U	<0.57 U	NA
Tetrahydrofuran	NL	<1.06 U	<1.06 U	<1.06 U	<1.06 U	NA
trans-1,2-Dichloroethene	5	<0.38 U	<0.38 U	<0.38 U	<0.38 U	NA
trans-1,3-Dichloropropene	0.4	<0.35 U	<0.35 U	<0.35 U	<0.35 U	NA
trans-1,4-Dichloro-2-butene	5	<0.82 U	<0.82 U	<0.82 U	<0.82 U	NA
Trichloroethene	5	<0.50 U	<0.50 U	<0.50 U	<0.50 U	NA
Trichlorofluoromethane	5	<0.49 U	<0.49 U	<0.49 U	<0.49 U	NA
Vinyl chloride	2	<0.47 U	<0.47 U	<0.47 U	<0.47 U	NA

TABLE 2  
GROUND WATER ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Sample Date Type of Sample	NYSDEC AWQSGV	GW-1 1/12/2018 Ground Water	GW-1(DUP) 1/12/2018 Ground Water	GW-2 1/10/2018 Ground Water	GW-3 1/10/2018 Ground Water	GW-3* 1/10/2018 Ground Water
<b>SVOCs - Polynuclear Aromatic Hydrocarbons (PAHs) (ug/L)</b>						
2-Methylnaphthalene	NL	<0.542 U	<0.542 U	<0.552 U	<0.557 U	NA
Acenaphthene	20	<0.652 U	<0.652 U	<0.664 U	<0.671 U	NA
Acenaphthylene	NL	<0.644 U	<0.644 U	<0.657 U	<0.663 U	NA
Anthracene	50	<0.574 U	<0.574 U	<0.585 U	<0.590 U	NA
Benzo(a)anthracene	0.002	<0.506 U	<0.506 U	<0.515 U	<0.520 U	NA
Benzo(a)pyrene	0	<0.530 U	<0.530 U	<0.540 U	<0.546 U	NA
Benzo(b)fluoranthene	0.002	<0.412 U	<0.412 U	<0.420 U	<0.424 U	NA
Benzo(g,h,i)perylene	NL	<0.500 U	<0.500 U	<0.510 U	<0.515 U	NA
Benzo(k)fluoranthene	0.002	<0.453 U	<0.453 U	<0.462 U	<0.466 U	NA
Chrysene	0.002	<0.502 U	<0.502 U	<0.512 U	<0.517 U	NA
Dibenzo(a,h)anthracene	NL	<0.425 U	<0.425 U	<0.433 U	<0.437 U	NA
Fluoranthene	50	<0.602 U	<0.602 U	<0.613 U	<0.619 U	NA
Fluorene	50	<0.577 U	<0.577 U	<0.588 U	<0.594 U	NA
Indeno(1,2,3-cd)pyrene	0.002	<0.547 U	<0.547 U	<0.558 U	<0.563 U	NA
Naphthalene	10	<0.646 U	<0.646 U	<0.659 U	<0.665 U	NA
Phenanthrene	50	<0.553 U	<0.553 U	<0.563 U	<0.569 U	NA
Pyrene	50	<0.575 U	<0.575 U	<0.587 U	<0.592 U	NA
<b>Other Semivolatile Organic Compounds (SVOC) (ug/L)</b>						
1,2,4,5-Tetrachlorobenzene	NL	<0.684 U	<0.684 U	<0.697 U	<0.704 U	NA
1,2,4-Trichlorobenzene	5	<0.648 U	<0.648 U	<0.661 U	<0.667 U	NA
1,2-Dichlorobenzene	3	<0.530 U	<0.530 U	<0.540 U	<0.546 U	NA
1,3-Dichlorobenzene	3	<0.610 U	<0.610 U	<0.622 U	<0.628 U	NA
1,4-Dichlorobenzene	3	<0.579 U	<0.579 U	<0.590 U	<0.596 U	NA
1-Methylnaphthalene	NL	<0.692 U	<0.692 U	<0.705 U	<0.712 U	NA
2,4,5-Trichlorophenol	NL	<0.491 U	<0.491 U	<0.500 U	<0.505 U	NA
2,4,6-Trichlorophenol	NL	<0.489 U	<0.489 U	<0.498 U	<0.503 U	NA
2,4-Dichlorophenol	1	<0.500 U	<0.500 U	<0.510 U	<0.515 U	NA
2,4-Dimethylphenol	1	<0.616 U	<0.616 U	<0.628 U	<0.634 U	NA
2,4-Dinitrophenol	1	<0.529 U	<0.529 U	<0.539 U	<0.545 U	NA
2,4-Dinitrotoluene	5	<0.635 U	<0.635 U	<0.647 U	<0.653 U	NA
2,6-Dinitrotoluene	5	<0.559 U	<0.559 U	<0.570 U	<0.576 U	NA
2-Chloronaphthalene	10	<0.557 U	<0.557 U	<0.567 U	<0.573 U	NA
2-Chlorophenol	NL	<0.706 U	<0.706 U	<0.719 U	<0.726 U	NA
2-Methylphenol	NL	<0.627 U	<0.627 U	<0.639 U	<0.646 U	NA
2-Nitroaniline	5	<0.572 U	<0.572 U	<0.583 U	<0.588 U	NA
2-Nitrophenol	NL	<0.439 U	<0.439 U	<0.447 U	<0.451 U	NA
3 & 4-Methylphenol	NL	<0.580 U	<0.580 U	<0.591 U	<0.597 U	NA
3,3'-Dichlorobenzidine	5	<1.88 U	<1.88 U	<1.91 U	<1.93 U	NA
3-Nitroaniline	5	<0.512 U	<0.512 U	<0.522 U	<0.527 U	NA
4,6-Dinitro-2-methylphenol	NL	<0.301 U	<0.301 U	<0.307 U	<0.310 U	NA
4-Bromophenyl-phenylether	NL	<0.568 U	<0.568 U	<0.579 U	<0.584 U	NA
4-Chloro-3-methylphenol	NL	<0.473 U	<0.473 U	<0.482 U	<0.486 U	NA
4-Chloroaniline	5	<1.06 U	<1.06 U	<1.08 U	<1.09 U	NA
4-Chlorophenyl-phenylether	NL	<0.569 U	<0.569 U	<0.580 U	<0.585 U	NA
4-Nitroaniline	5	<0.353 U	<0.353 U	<0.360 U	<0.363 U	NA
4-Nitrophenol	NL	<0.791 U	<0.791 U	<0.806 U	<0.814 U	NA
Aniline	5	<1.67 U	<1.67 U	<1.70 U	<1.72 U	NA
Azobenzene/Diphenyldiazene	5	<0.706 U	<0.706 U	<0.719 U	<0.726 U	NA
Benzidine	0.02	<1.08 U	<1.08 U	<1.10 U	<1.11 U	NA
Benzoic acid	NL	<0.497 U	<0.497 U	<0.507 U	<0.512 U	NA
Benzyl alcohol	NL	<0.736 U	<0.736 U	<0.750 U	<0.757 U	NA
Bis(2-chloroethoxy)methane	5	<0.628 U	<0.628 U	<0.640 U	<0.647 U	NA
Bis(2-chloroethyl)ether	1	<0.692 U	<0.692 U	<0.706 U	<0.713 U	NA
Bis(2-chloroisopropyl)ether	5	<0.734 U	<0.734 U	<0.748 U	<0.755 U	NA
Bis(2-ethylhexyl)phthalate	5	<0.602 U	<0.602 U	1.17 J	0.835 J	NA
Butylbenzylphthalate	50	<0.413 U	<0.413 U	<0.421 U	<0.425 U	NA
Carbazole	NL	<1.47 U	<1.47 U	<1.50 U	<1.51 U	NA
Dibenzofuran	NL	<0.698 U	<0.698 U	<0.712 U	<0.718 U	NA
Diethylphthalate	50	<0.588 U	<0.588 U	<0.599 U	<0.605 U	NA
Dimethylphthalate	50	<0.715 U	<0.715 U	<0.729 U	<0.736 U	NA
Di-n-butylphthalate	50	<0.431 U	<0.431 U	<0.439 U	<0.444 U	NA
Di-n-octylphthalate	NL	<0.383 U	<0.383 U	2.88 J	<0.394 U	NA
Hexachlorobenzene	0.04	<0.539 U	<0.539 U	<0.549 U	<0.554 U	NA
Hexachlorobutadiene	0.5	<0.366 U	<0.366 U	<0.373 U	<0.377 U	NA
Hexachlorocyclopentadiene	5	<0.977 U	<0.977 U	<0.996 U	<1.01 U	NA
Hexachloroethane	5	<0.603 U	<0.603 U	<0.614 U	<0.620 U	NA
Isophorone	50	<0.553 U	<0.553 U	<0.563 U	<0.569 U	NA
Nitrobenzene	0.4	<0.651 U	<0.651 U	<0.663 U	<0.670 U	NA
N-Nitrosodimethylamine	NL	<0.635 U	<0.635 U	<0.647 U	<0.653 U	NA
N-Nitroso-di-n-propylamine	NL	<0.545 U	<0.545 U	<0.556 U	<0.561 U	NA
N-Nitrosodiphenylamine	50	<0.614 U	<0.614 U	<0.626 U	<0.632 U	NA
Pentachloronitrobenzene	NL	<0.657 U	<0.657 U	<0.669 U	<0.676 U	NA
Pentachlorophenol	1	<0.352 U	<0.352 U	<0.359 U	<0.362 U	NA
Phenol	1	<0.608 U	<0.608 U	<0.620 U	<0.626 U	NA
Pyridine	NL	<0.773 U	<0.773 U	<0.788 U	<0.795 U	NA

TABLE 2  
GROUND WATER ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Sample Date Type of Sample	NYSDEC AWQSGV	GW-1 1/12/2018 Ground Water	GW-1(DUP) 1/12/2018 Ground Water	GW-2 1/10/2018 Ground Water	GW-3 1/10/2018 Ground Water	GW-3* 1/10/2018 Ground Water
<b>PCBs (ug/L)</b>						
Aroclor-1016	NL	<0.0972 U	<0.0981 U	<0.0981 U	<0.100 U	<0.0990 U
Aroclor-1221	NL	<0.107 U	<0.108 U	<0.108 U	<0.111 U	<0.110 U
Aroclor-1232	NL	<0.104 U	<0.105 U	<0.105 U	<0.107 U	<0.106 U
Aroclor-1242	NL	<0.100 U	<0.101 U	<0.101 U	<0.103 U	<0.102 U
Aroclor-1248	NL	<0.127 U	<0.128 U	<0.128 U	<0.131 U	<0.130 U
Aroclor-1254	NL	<0.108 U	<0.109 U	<0.109 U	<0.112 U	<0.110 U
Aroclor-1260	NL	<0.0795 U	<0.0803 U	<0.0803 U	<0.0818 U	<0.0810 U
Aroclor-1262	NL	<0.0837 U	<0.0845 U	<0.0845 U	<0.0862 U	<0.0853 U
Aroclor-1268	NL	<0.0855 U	<0.0863 U	<0.0863 U	<0.0880 U	<0.0871 U
<b>Pesticides (ug/L)</b>						
4,4-DDD	0.3	<0.017 U	<0.018 U	<0.018 U	<0.018 U	<0.018 U
4,4-DDE	0.2	<0.017 U	<0.017 U	<0.017 U	<0.017 U	<0.017 U
4,4-DDT	0.2	<0.017 U	<0.017 U	<0.017 U	<0.017 U	<0.017 U
Alachlor	0.5	<0.018 U	<0.018 U	<0.018 U	<0.018 U	<0.018 U
Aldrin	NL	<0.015 U	<0.015 U	<0.015 U	<0.015 U	<0.015 U
alpha-BHC	NL	<0.011 U	<0.011 U	<0.011 U	<0.011 U	<0.011 U
alpha-Chlordane	NL	<b>0.085 P</b>	<b>0.082 P</b>	<0.015 U	<0.015 U	<0.015 U
beta-BHC	0.05	<0.014 U	<0.014 U	<0.014 U	<0.014 U	<0.014 U
Chlordane	0.05	<b>0.692</b>	<b>0.575</b>	<0.048 U	<0.049 U	<0.049 U
delta-BHC	NL	<0.014 U	<0.015 U	<0.015 U	<0.015 U	<0.015 U
Dieldrin	0.004	<b>0.129</b>	<b>0.105</b>	<0.016 U	<b>0.060</b>	<b>0.019</b>
Endosulfan I	NL	<0.015 U	<0.015 U	<0.015 U	<0.016 U	<0.016 U
Endosulfan II	NL	<0.019 U	<0.019 U	<0.019 U	<0.019 U	<0.019 U
Endosulfan Sulfate	NL	<0.019 U	<0.019 U	<0.019 U	<0.019 U	<0.019 U
Endrin	NL	<0.018 U	<0.018 U	<0.018 U	<0.018 U	<0.018 U
Endrin aldehyde	NL	<0.018 U	<0.018 U	<0.018 U	<0.018 U	<0.018 U
Endrin ketone	NL	<0.016 U	<0.016 U	<0.016 U	<0.017 U	<0.016 U
gamma-BHC (Lindane)	NL	<0.016 U	<0.016 U	<0.016 U	<0.017 U	<0.016 U
gamma-Chlordane	NL	<b>0.073</b>	<b>0.072</b>	<0.015 U	<0.015 U	<0.015 U
Heptachlor	0.4	<0.018 U	<0.018 U	<0.018 U	<0.019 U	<0.019 U
Heptachlor epoxide	0.03	<0.014 U	<0.014 U	<0.014 U	<0.015 U	<0.014 U
Methoxychlor	35	<0.017 U	<0.017 U	<0.017 U	<0.018 U	<0.017 U
Toxaphene	0.06	<0.307 U	<0.309 U	<0.309 U	<0.315 U	<0.312 U
<b>Total Metals (mg/L)</b>						
Aluminum	100	<b>0.0113 J</b>	<0.0250 U	<b>0.364</b>	<b>0.241</b>	NA
Antimony	3	<0.0060 U	<0.0060 U	<0.0060 U	<0.0060 U	NA
Arsenic	50	<b>0.0016 J</b>	<b>0.0022 J</b>	<b>0.0022 J</b>	<b>0.0014 J</b>	NA
Barium	1,000	<b>0.0394</b>	<b>0.0393</b>	<b>0.0817</b>	<b>0.0277</b>	NA
Beryllium	11	<0.0020 U	<0.0020 U	<0.0020 U	<0.0020 U	NA
Cadmium	5	<0.0025 U	<0.0025 U	<0.0025 U	<0.0025 U	NA
Calcium	NL	<b>25.5</b>	<b>25.5</b>	<b>36.6</b>	<b>17.9</b>	NA
Chromium	50	<0.0050 U	<0.0050 U	<b>0.0012 J</b>	<0.0050 U	NA
Cobalt	5	<b>0.0041 J</b>	<b>0.0038 J</b>	<b>0.0046 J</b>	<b>0.0028 J</b>	NA
Copper	200	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	NA
Iron	300	<b>0.296</b>	<b>0.303</b>	<b>1.13</b>	<b>0.649</b>	NA
Lead	50	<0.0075 U	<0.0075 U	<0.0075 U	<0.0075 U	NA
Magnesium	35,000	<b>4.58</b>	<b>4.56</b>	<b>6.70</b>	<b>2.74</b>	NA
Manganese	300	<b>2.11</b>	<b>2.05</b>	<b>4.08</b>	<b>1.75</b>	NA
Mercury	0.7	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	NA
Nickel	100	<b>0.0038 J</b>	<b>0.0036 J</b>	<b>0.0070</b>	<b>0.0049 J</b>	NA
Potassium	NL	<b>3.52</b>	<b>3.55</b>	<b>6.60</b>	<b>3.40</b>	NA
Selenium	10	<0.0150 U	<0.0150 U	<0.0150 U	<0.0150 U	NA
Silver	50	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	NA
Sodium	20,000	<b>94.6</b>	<b>94.2</b>	<b>182</b>	<b>67.5</b>	NA
Thallium	8	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	NA
Vanadium	14	<0.0050 U	<0.0050 U	<b>0.0019 J</b>	<b>0.0012 J</b>	NA
Zinc	NL	<b>0.0016 J</b>	<b>0.0076</b>	<b>0.0125</b>	<b>0.0040 J</b>	NA

TABLE 2  
GROUND WATER ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Sample Date Type of Sample	NYSDEC AWQSGV	GW-1 1/12/2018 Ground Water	GW-1(DUP) 1/12/2018 Ground Water	GW-2 1/10/2018 Ground Water	GW-3 1/10/2018 Ground Water	GW-3* 1/10/2018 Ground Water
Dissolved Metals (mg/L)						
Aluminum (dissolved)	100	<0.0250 U	<0.0250 U	<0.0250 U	<0.0250 U	NA
Antimony (dissolved)	3	<0.0060 U	<0.0060 U	<0.0060 U	<0.0060 U	NA
Arsenic (dissolved)	50	<0.0040 U	<0.0040 U	<b>0.0022</b> J	<0.0014 U	NA
Barium (dissolved)	1,000	<b>0.0423</b>	<b>0.0409</b>	<b>0.0908</b>	<b>0.0270</b>	NA
Beryllium (dissolved)	11	<0.0020 U	<0.0020 U	<0.0020 U	<0.0020 U	NA
Cadmium (dissolved)	5	<0.0025 U	<0.0025 U	<0.0025 U	<0.0025 U	NA
Calcium (dissolved)	NL	<b>26.7</b>	<b>25.8</b>	<b>40.8</b>	<b>18.3</b>	NA
Chromium (dissolved)	50	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	NA
Cobalt (dissolved)	5	<b>0.0040</b> J	<b>0.0046</b> J	<b>0.0051</b>	<b>0.0032</b> J	NA
Copper (dissolved)	200	<b>0.0026</b> J	<0.0050 U	<0.0023 U	<0.0023 U	NA
Iron (dissolved)	300	<b>0.331</b>	<b>0.275</b>	<b>0.150</b>	<b>0.228</b>	NA
Lead (dissolved)	50	<0.0075 U	<0.0075 U	<0.0075 U	<0.0075 U	NA
Magnesium (dissolved)	35,000	<b>4.84</b>	<b>4.62</b>	<b>7.10</b>	<b>2.74</b>	NA
Manganese (dissolved)	300	<b>2.06</b>	<b>2.24</b>	<b>4.70</b>	<b>1.93</b>	NA
Mercury (dissolved)	0.7	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	NA
Nickel (dissolved)	100	<b>0.0040</b> J	<b>0.0038</b> J	<b>0.0066</b>	<b>0.0050</b>	NA
Potassium (dissolved)	NL	<b>3.83</b>	<b>3.73</b>	<b>7.30</b>	<b>3.55</b>	NA
Selenium (dissolved)	10	<0.0150 U	<0.0150 U	<0.0150 U	<0.0150 U	NA
Silver (dissolved)	50	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	NA
Sodium (dissolved)	20,000	<b>100</b>	<b>97.0</b>	<b>187</b>	<b>73.7</b>	NA
Thallium (dissolved)	8	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	NA
Vanadium (dissolved)	14	<0.0050 U	<0.0050 U	<b>0.0012</b> J	<0.0050 U	NA
Zinc (dissolved)	NL	<b>0.0039</b> J	<b>0.0022</b> J	<b>0.0114</b>	<b>0.0035</b> J	NA
Cyanide (mg/L)						
Cyanide	NL	<0.00500 U	<0.00500 U	<0.00500 U	<0.00500 U	NA

**Notes:**  
mg/Kg - milligrams per kilogram  
ug/Kg - micrograms per kilogram  
NA = Not Analyzed  
NL = Not Listed  
< = The material was analyzed for but not detected at, or above, the reporting limit.  
The associated numerical value is the sample quantitation limit.  
**Bold indicates compound detected at a concentration greater than the reporting limit.**  
**Yellow Highlighted values exceed NYSDEC Groundwater Guidance or Standard Value**  
U - The compound was not detected at the indicated concentration.  
J - Data indicates the presence of a compound that meets the identification criteria. The result is less than the quantitation limit but greater than MDL. The concentration given is an approximate value.  
D - The reported value is from a secondary analysis with a dilution factor. The original analysis exceeded the calibration range.  
P - Difference between the two GC columns is greater than 40%.  
\* - Sample was originally analyzed within the recommended method holding time; however, QC materials for the sample run were out of control. As a result, the sample was immediately re-analyzed (outside the holding time).



TABLE 3  
SUBSURFACE SOIL VAPOR ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Lab Sample ID Date Sample Type	NYSDOH Background Indoor Air Values3		SV-1 200-41898-1	DUP-1 (SV-1) 200-41898-9	SV-2 200-41898-2	SV-3 200-41898-3	SV-4 200-41898-4	AMB-1 200-41898-5	AMB-2 200-41898-6	AMB-3 200-41898-7	AMB-4 200-41898-8
	90th Percentile	Upper Fence	1/11/2018 Soil Vapor	1/11/2018 Ambient Air	1/11/2018 Soil Vapor	1/11/2018 Soil Vapor	1/11/2018 Soil Vapor	1/11/2018 Ambient Air	1/11/2018 Ambient Air	1/11/2018 Ambient Air	1/11/2018 Ambient Air
	TO-15 (µg/m³)										
1,1,1-Trichloroethane	3.1	2.5	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
1,1,2,2-Tetrachloroethane	<0.25	0.38	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
1,1,2-Trichloroethane	<0.25	0.38	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
1,1-Dichloroethane	<0.25	0.38	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U
1,1-Dichloroethene	<0.25	0.4	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
1,2,4-Trichlorobenzene	3.4	0.47	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U
1,2,4-Trimethylbenzene	9.5	9.8	0.98 U	0.98 U	3.7	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	1.2
1,2-Dibromoethane	<0.25	0.38	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
1,2-Dichlorobenzene	0.72	0.48	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
1,2-Dichloroethane	<0.25	0.37	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U	0.81 U
1,2-Dichloroethene, Total	NL	NL	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
1,2-Dichloropropane	<0.25	0.39	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U
1,2-Dichlorotetrafluoroethane	0.52	0.42	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
1,3,5-Trimethylbenzene	3.6	3.9	0.98 U	0.98 U	1.1	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
1,3-Butadiene	NL	NL	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U	0.44 U
1,3-Dichlorobenzene	0.6	0.46	1.3	2.7	1.8	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
1,4-Dichlorobenzene	1.3	1.2	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
1,4-Dioxane	NL	NL	18 U	18 U	18 U	18 U	18 U	18 U	18 U	18 U	18 U
2,2,4-Trimethylpentane	NL	NL	1.1	1.6	5.9	1.4	1.9	0.99	2.3	0.93 U	0.93
2-Chlorotoluene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
3-Chloropropene	NL	NL	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
4-Ethyltoluene	NL	NL	0.98 U	0.98 U	1.1	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
4-Isopropyltoluene	NL	NL	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Acetone	110	115	100 D	140 D	140 D	120 D	340 D	23	12 U	16	160 D
Benzene	15	13	1.0	1.5	2.7	1.2	2.8	1.0	2.4	0.90	1.4
Benzyl chloride	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	NL	NL	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
Bromoethene(Vinyl Bromide)	NL	NL	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U
Bromoform	NL	NL	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U
Bromomethane	0.6	0.48	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U	0.78 U
Carbon disulfide	NL	NL	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	2.5	1.6 U	1.6 U
Carbon tetrachloride	0.81	1.3	0.38	0.43	0.39	0.36	0.36	0.39	0.40	0.38	0.37
Chlorobenzene	<0.25	0.41	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U	0.92 U
Chloroethane	<0.25	0.39	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U
Chloroform	1.4	1.2	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
Chloromethane	3.3	4.2	1.9	2.9	3.8	3.0	1.0 U	1.0 U	1.1	1.0	1.1
cis-1,2-Dichloroethene	<0.25	0.41	0.50	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
cis-1,3-Dichloropropene	<0.25	0.38	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U
Cumene	NL	NL	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
Cyclohexane	8.1	6.3	0.69 U	0.86	2.4	1.1	0.69 U	0.69 U	1.2	0.68	0.69 U
Dibromochloromethane	NL	NL	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Dichlorodifluoromethane	15	10	2.5 U	2.9	2.5 U	2.6	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Ethylbenzene	7.4	6.4	0.87 U	0.87 U	5.2	0.87 U	0.87 U	0.87 U	1.3	0.87 U	0.87 U
Freon 22	NL	NL	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
Freon TF	NL	NL	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Hexachlorobutadiene	4.6	0.49	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U
Isopropyl alcohol	NL	NL	270 D	320 D	110 D	360 D	12 U	12 U	12 U	12 U	12 U
m,p-Xylene	12	11	2.2 U	2.3	12	2.2 U	2.6	2.2 U	2.6	2.2 U	2.2 U
Methyl Butyl Ketone (2-Hexanone)	NL	NL	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methyl Ethyl Ketone	16	16	8.1	25	12	6.3	170 D	6.8	1.7	3.1	60
Methyl isobutyl ketone	2.2	1.9	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

TABLE 3  
SUBSURFACE SOIL VAPOR ANALYTICAL RESULTS  
PROPOSED 166TH POLICE PRECINCT, ROSEDALE, QUEENS, NEW YORK

Sample ID Lab Sample ID Date Sample Type	NYSDOH Background Indoor Air Values3		SV-1 200-41898-1 1/11/2018 Soil Vapor	DUP-1 (SV-1) 200-41898-9 1/11/2018 Ambient Air	SV-2 200-41898-2 1/11/2018 Soil Vapor	SV-3 200-41898-3 1/11/2018 Soil Vapor	SV-4 200-41898-4 1/11/2018 Soil Vapor	AMB-1 200-41898-5 1/11/2018 Ambient Air	AMB-2 200-41898-6 1/11/2018 Ambient Air	AMB-3 200-41898-7 1/11/2018 Ambient Air	AMB-4 200-41898-8 1/11/2018 Ambient Air
	90th Percentile	Upper Fence									
	TO-15 (µg/m³)										
Methyl methacrylate	0.45	0.43	2.0 U	2.0 U	16	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methyl tert-butyl ether	27	14	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U
Methylene Chloride	22	16	33	34	3.4	39	1.7 U	36	1.7 U	40	21
Naphthalene	NL	NL	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U	2.6 U
n-Butane	NL	NL	12	21	10	10	8.5	10	86	12	24
n-Butylbenzene	1.2	1.1	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
n-Heptane	19	18	0.88	1.4	3.7	1.3	1.5	0.82 U	0.99	0.82 U	1.1
n-Hexane	18	14	3.1	4.1	6.3	3.7	2.7	3.5	4.2	3.0	4.4
n-Propylbenzene	1.7	1.5	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U
sec-Butylbenzene	1.2	1.2	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Styrene	1.3	1.4	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U
tert-Butyl alcohol	NL	NL	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
tert-Butylbenzene	1.6	1.3	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Tetrachloroethene	2.9	2.5	2.3	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
Tetrahydrofuran	3.3	0.78	15 U	15 U	15 U	15 U	150 D	15 U	15 U	15 U	43
Toluene	58	57	2.1	3.0	12	3.2	4.0	1.7	4.1	1.7	2.5
trans-1,2-Dichloroethene	NL	NL	0.79 U	0.79 U	0.79 U	0.79 U	0.79 U	0.79 U	0.79 U	0.79 U	0.79 U
trans-1,3-Dichloropropene	<0.25	0.4	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U	0.91 U
Trichloroethene	0.48	0.46	0.64	0.19 U	0.19 U	0.19	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
Trichlorofluoromethane	17	12	1.1 U	1.3	1.2	1.1	1.1 U	1.1	1.1 U	1.1 U	1.1 U
Vinyl chloride	<0.25	0.37	0.099	0.18	0.28	0.16	0.089 U	0.089 U	0.089 U	0.089 U	0.089 U
Xylene (total)	NL	NL	3.0 U	3.3	17	3.0 U	3.5	3.0 U	3.6	3.0 U	3.0 U
Xylene, o-	7.6	7.1	0.87 U	0.93	5.3	0.87 U	0.87	0.87 U	1.0	0.87 U	0.87 U

Notes:

Exceeds USEPA 2001 Background Indoor Air Values 90th Percentile

Exceeds NYSDOH 2003 Background Indoor Air Values Upper Fence

Exceeds both USEPA 2001 Background Indoor Air Values 90th Percentile and NYSDOH 2003 Background Indoor Air Values Upper Fence

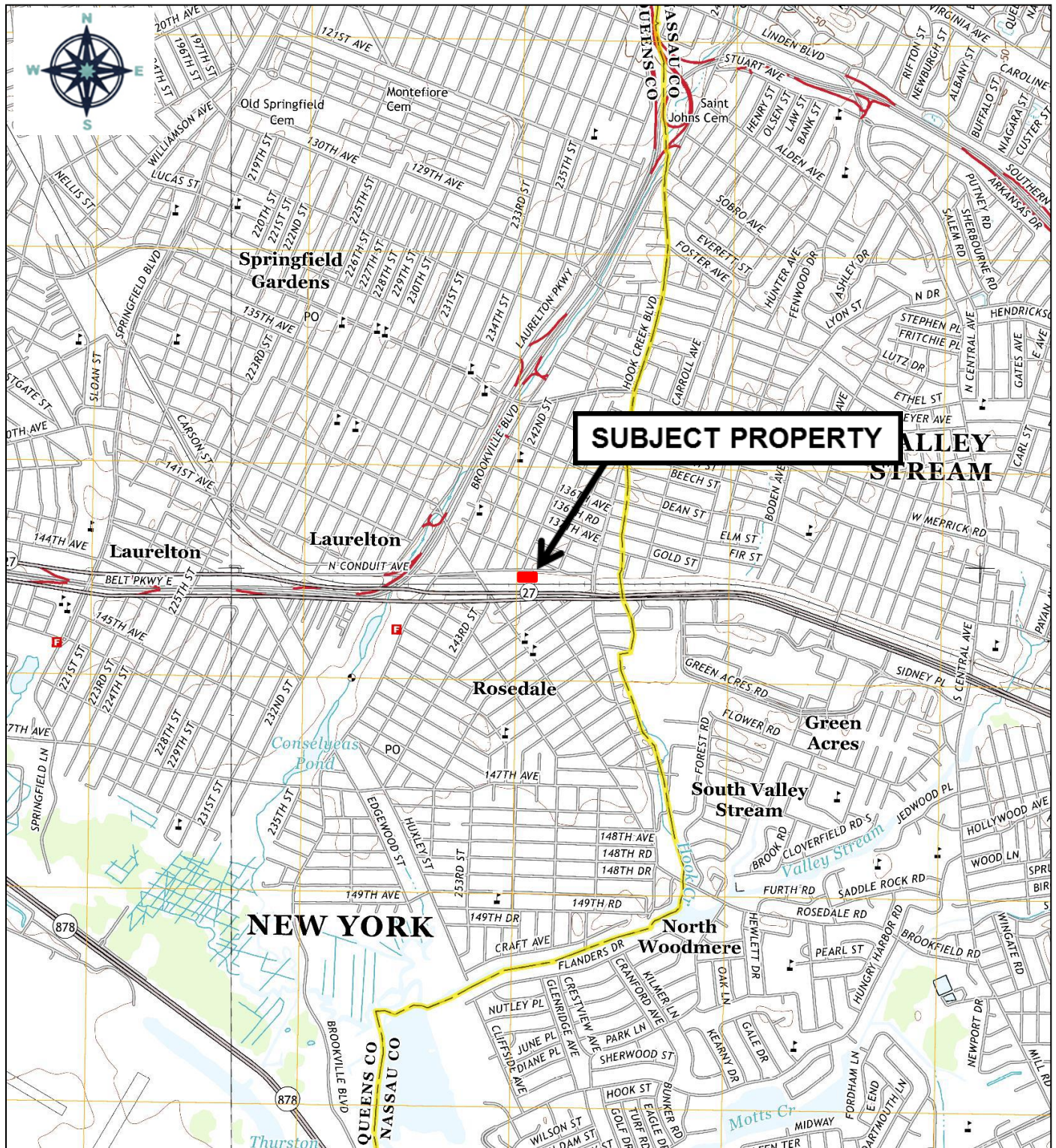
NL = Not Listed

U - The compound was not detected at the indicated concentration.

D - Data reported from a dilution.

## Figures





Scale 1:24,000

LYNBROOK/JAMAICA, NY  
7.5 Minute U.S.G.S. Quadrangles – 2013



**Figure 1**  
**Site Location Map**  
**Proposed 116th Police Precinct**  
**242-20 North Conduit Avenue**  
**Rosedale, New York**



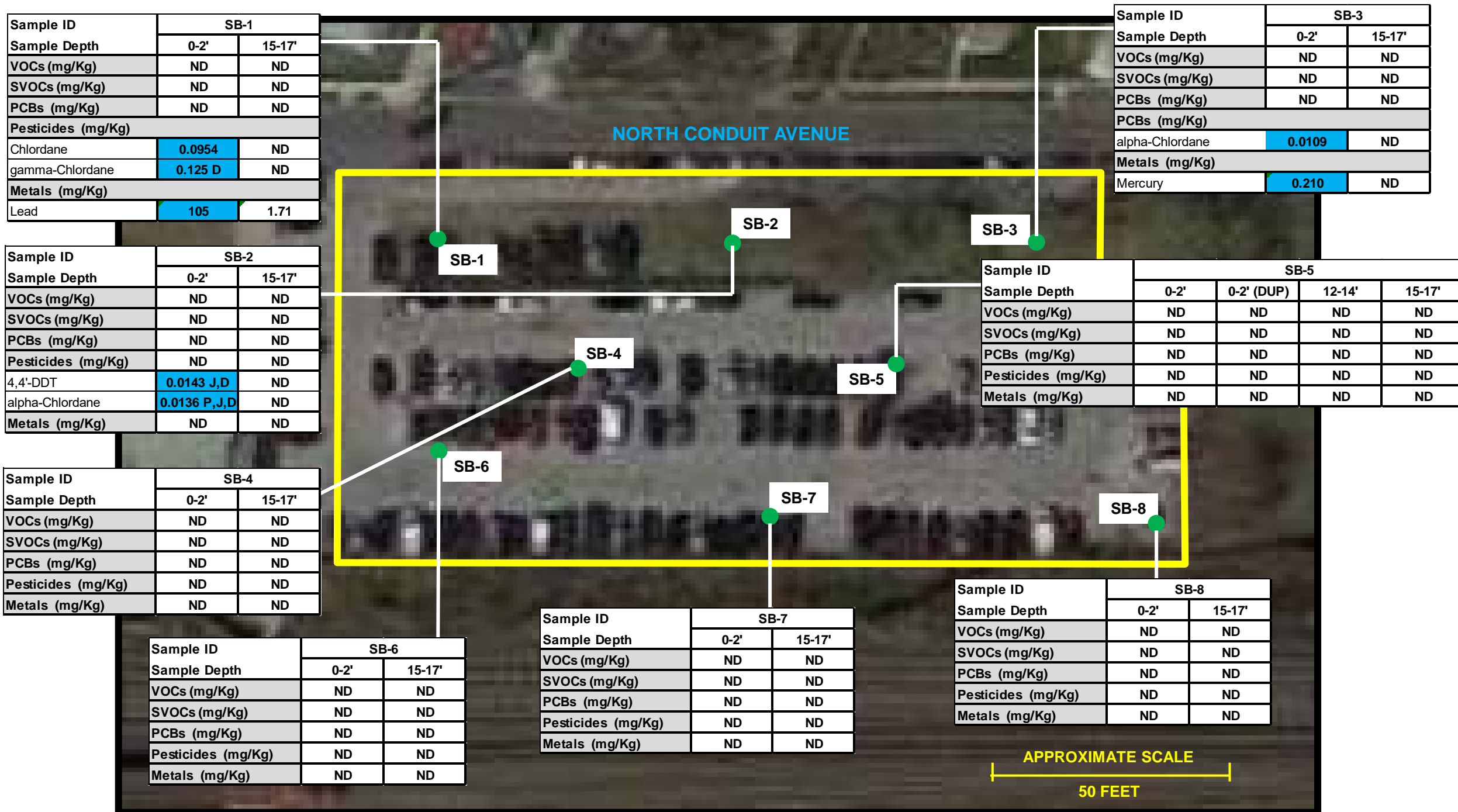


**Figure 2**  
**Site Plan**  
**Proposed 116th Precinct**  
**242-20 North Conduit Avenue**  
**Rosedale, New York**



- SB-4  
PROPOSED SOIL BORING
- SB-2/GW-1  
PROPOSED SOIL BORING / GRAB GROUND WATER SAMPLE
- SB-1/SV-1  
PROPOSED SOIL BORING / SOIL VAPOR SAMPLE
- SB-6/GW-2/SV-3  
PROPOSED SOIL BORING / GRAB GROUND WATER SAMPLE / SOIL VAPOR SAMPLE

**Figure 3**  
**Proposed Sample Locations**  
**Proposed 116th Police Precinct**  
**242-20 North Conduit Avenue**  
**Rosedale, New York**



#### NOTES

● Location of soil boring  
mg/kg milligrams per kilogram

ND – Not detected above NYSDEC Unrestricted Use Soil Cleanup Objectives

J - Data indicates the presence of a compound that meets the identification criteria.  
The result is less than the quantitation limit but greater than MDL.  
The concentration given is an approximate value.

D - The reported value is from a secondary analysis with a dilution factor.  
The original analysis exceeded the calibration range.

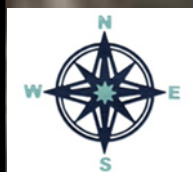
P - Difference between the two GC columns is greater than 40%.

Blue shaded value: Exceedance of the NYSDEC Part 375-6.8(b)  
Unrestricted Use SCO value.



**Figure 4**  
**Analytical Results - Surface and**  
**Subsurface Soil Sample Results**  
**Proposed 116th Police Precinct**  
**242-20 North Conduit Avenue**  
**Rosedale, New York**





NORTH CONDUIT AVENUE

Sample ID	GW-1	GW-1(DUP)
Sample Date	1/12/2018	1/12/2018
VOCs (ug/L)	ND	ND
SVOCs (ug/L)	ND	ND
PCBs (ug/L)	ND	ND
Pesticides (ug/L)	ND	ND
Chlordane	0.692	0.575
Dieldrin	0.129	0.105
Total Metals (mg/L)	ND	ND
Dissolved Metals (mg/L)	ND	ND
Total Cyanide (mg/L)	ND	ND

GW-1

Sample ID	GW-3	GW-3*
Sample Date	1/10/2018	1/10/2018
VOCs (ug/L)	ND	NA
SVOCs (ug/L)	ND	NA
PCBs (ug/L)	ND	NA
Pesticides (ug/L)	ND	ND
Dieldrin	0.060	0.019
Total Metals (mg/L)	ND	NA
Dissolved Metals (mg/L)	ND	NA
Total Cyanide (mg/L)	ND	NA

GW-2

Sample ID	GW-2
Sample Date	1/12/2018
VOCs (ug/L)	ND
SVOCs (ug/L)	ND
PCBs (ug/L)	ND
Pesticides (ug/L)	ND
Total Metals (mg/L)	ND
Dissolved Metals (mg/L)	ND
Total Cyanide (mg/L)	ND

GW-3

LONG ISLAND RAILROAD

APPROXIMATE SCALE

50 FEET

#### NOTES

● Location of Ground Water Sample

ug/L - micrograms per liter

mg/L - milligrams per liter

ND - Compounds did not exceed the NYSDEC Groundwater Guidance or Standard Values

Yellow Highlighted values exceed NYSDEC Groundwater Guidance or Standard Value

\* - Sample was originally analyzed within the recommended method holding time; however, QC materials for the sample run were out of control. As a result, the sample was immediately re-analyzed (outside the holding time).



Figure 5  
Analytical Results –  
Ground Water Samples  
Proposed 116th Police Precinct  
242-20 North Conduit Avenue  
Rosedale, New York



NORTH CONDUIT AVENUE

Sample ID	SV-1	DUP-1	AMB-1
Sample Date	1/11/2018		
TO-15 ( $\mu\text{g}/\text{m}^3$ )			
1,3-Dichlorobenzene	1.3	2.7	ND
Acetone	100 D	140 D	23
cis-1,2-Dichloroethene	0.50	ND	ND
Methyl Ethyl Ketone	8.1	25	6.8
Methylene Chloride	33	34	36
Trichloroethene	0.64	ND	ND

SV-1

Sample ID	SV-2	AMB-2
Sample Date	1/11/2018	
TO-15 ( $\mu\text{g}/\text{m}^3$ )		
1,3-Dichlorobenzene	1.8	ND
Acetone	140 D	ND
Chloromethane	3.8	1.1
m,p-Xylene	12	2.6
Methyl methacrylate	16	ND
Vinyl chloride	0.28	ND

SV-2

SV-3

Sample ID	SV-3	AMB-3
Sample Date	1/11/2018	
TO-15 ( $\mu\text{g}/\text{m}^3$ )		
Acetone	120 D	16
Methylene Chloride	39	40

SV-4

Sample ID	SV-4	AMB-4
Sample Date	1/11/2018	
TO-15 ( $\mu\text{g}/\text{m}^3$ )		
Acetone	340 D	160 D
Methyl Ethyl Ketone	170 D	60
Methylene Chloride	ND	21
Tetrahydrofuran	150 D	43

LONG ISLAND RAILROAD

APPROXIMATE SCALE

50 FEET

## NOTES

● Location of Soil Vapor and Ambient Air Samples

$\mu\text{g}/\text{m}^3$  - micrograms per cubic meters

Exceeds USEPA 2001 Background Indoor Air Values 90th Percentile

Exceeds NYSDOH 2003 Background Indoor Air Values Upper Fence

Exceeds both USEPA 2001 Background Indoor Air Values 90th Percentile and NYSDOH 2003 Background Indoor Air Values Upper Fence

ND - Not Detected above minimum laboratory detection limits



D - Data reported from a dilution.


AECOM

**Figure 6**  
**Analytical Results – Soil Vapor Samples**  
**Proposed 116th Police Precinct**  
**242-20 North Conduit Avenue**  
**Rosedale, New York**

## **Appendix A**


### **Boring Logs**

										TEST BORING LOG																																		
PROJECT: 116th Precinct. Rosedale Phase II										BORING/WELL NO: SB - 1																																		
CLIENT: NYPD										SHEET: 1 of 1																																		
BORING CONTRACTOR: Cascade Environmental										JOB NO.:																																		
GROUNDWATER (BTOC):										BORING LOCATION:																																		
<table border="1"> <tr> <th>DATE</th> <th>TIME</th> <th>LEVEL</th> <th>TYPE</th> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td>DIA.</td> <td></td> <td>2"</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>WT.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>FALL</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										DATE	TIME	LEVEL	TYPE	CAS.	SAMPLER	CORE	TUBE				DIA.		2"						WT.								FALL					GROUND ELEVATION:		
DATE	TIME	LEVEL	TYPE	CAS.	SAMPLER	CORE	TUBE																																					
			DIA.		2"																																							
			WT.																																									
			FALL																																									
DATE STARTED: 01/10/18										DATE FINISHED: 01/10/18																																		
DRILLER: Quincy Brandt										GEOLOGIST: John Crespo																																		
REVIEWED BY:																																												
DEPTH FEET	SAMPLE			DESCRIPTION				REMARKS																																				
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION	USCS CLASS	PID	Moist.																																			
			Hand Clear	black	dense	RCA, med-large sand, med to large gravel	GM ↓ SW SP	0.0	Moist.																																			
				dark brown	med dense	fine med sand, fine med large gravel		0.0																																				
				↓	↓	fine med sand, fine gravel imbeded		0.0																																				
				brown	medium	↓		0.0																																				
				light brown	↓	0.0																																						
5		1	52%	brown	↓	fine med sand, interlayer color dark brown	0.0	↓																																				
				↓		↓	0.0																																					
				light brown		fine med sand	0.0																																					
				↓		↓	0.0																																					
				10		2	67%		dark brown	Same as above with a layer of dark brown sand at 13-14' only 3" thick. No odor	0.0																																	
		↓	↓	0.0																																								
		15	3	100%	brown	Same as above with a 1/2" band of dark color sand	0.0	wet ↓																																				
		↓	↓	0.0																																								
20																																												
25																																												
30																																												
<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT										PROJECT NO. 60540777																																		
The following soil samples were collected, sent to Eurofins and analyzed for VOC's,										BORING/WELL NO. SB - 1																																		
SVOC's, cyanide, pesticides and metals:																																												
SB- (0 - 2') @ 14:30 and SB-1 (15 - 17') @ 15 :00																																												


										TEST BORING LOG										
PROJECT: 116th Precinct. Rosedale Phase II										BORING/WELL NO: SB - 2										
CLIENT: NYPD										SHEET: 1 of 1										
BORING CONTRACTOR: Cascade Environmental										JOB NO.:										
GROUNDWATER (BTOC):										BORING LOCATION:										
<table border="1"> <tr> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>										CAS.	SAMPLER	CORE	TUBE					GROUND ELEVATION:		
CAS.	SAMPLER	CORE	TUBE																	
DATE	TIME	LEVEL	TYPE	TYPE					DATE STARTED:	01/11/18										
				DIA.		2"			DATE FINISHED:	01/11/18										
				WT.					DRILLER:	Quincy Brandt										
				FALL					GEOLOGIST:	John Crespo										
										REVIEWED BY:										
DEPTH FEET	SAMPLE			DESCRIPTION					REMARKS											
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION			USCS CLASS	PID	Moist.									
			Hand Clear	brown	dense	Fine, medium sand, roots, fine med large gravel			SW	0.0	Moist.									
				↓	↓	Fine to med sand, fine pebbles imbeded			↓	0.0	↓									
				↓	medium	↓			SP	0.0	↓									
				↓		↓				0.0	↓									
5		1	52%	light brown		fine to med sand				0.0	dry									
				↓		↓				0.0	↓									
				↓		same with interlayered dark brown, light brown sand at 8'				0.0	↓									
				↓		↓				0.0	↓									
10		2	80%	brown/green		fine to med sand				0.0	↓									
				↓		↓				0.0	↓									
				↓		↓				0.0	Moist.									
				↓		↓				0.0	↓									
15		3	92%			fine to med sand, fine to med pebbles				0.0	wet									
				↓		↓				0.0	↓									
				↓		↓				0.0	↓									
20		4	85%	brown		fine to med sand				0.0	↓									
				↓		↓				0.0	↓									
				↓		fine med large sand, fine med pebbles imbeded				0.0	↓									
				↓		↓				0.0	↓									
				↓		fine med large sand				0.0	↓									
25		5	90%			fine med sand with darker bands of brown/gray at 26' - 26 1/2'				0.0	↓									
				↓		↓				0.0	↓									
				↓		fine med large sand				0.0	↓									
30						End of boring at 30'														
						Install temporary well. DTB 30', Diameter 1" and 15' screen														

<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT The following soil samples were collected, sent to Eurofins and analyzed for VOC's, SVOC's, cyanide, pesticides and metals: SB-2 (0 - 2') @ 10:10 and SB-2 (15 - 17') @ 10:40						<b>PROJECT NO.</b> 60540777  <b>BORING/WELL NO.</b> SB - 2	
--	--	--	--	--	--	--	--





										TEST BORING LOG										
PROJECT: 116th Precinct. Rosedale Phase II										BORING/WELL NO: <b>SB - 3</b>										
CLIENT: NYCPD										SHEET: 1 of 1										
BORING CONTRACTOR: Cascade Environmental										JOB NO.:										
GROUNDWATER (BTOC):										BORING LOCATION:										
<table border="1"> <tr> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>										CAS.	SAMPLER	CORE	TUBE					GROUND ELEVATION:		
CAS.	SAMPLER	CORE	TUBE																	
DATE	TIME	LEVEL	TYPE	TYPE					DATE STARTED: 01/11/18											
				DIA.		2"			DATE FINISHED: 01/11/18											
				WT.					DRILLER: Quincy Brandt											
				FALL					GEOLOGIST: John Crespo											
										REVIEWED BY:										
DEPTH FEET	SAMPLE			DESCRIPTION				REMARKS												
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION	USCS CLASS	PID	Moist.											
			Hand Clear	dark brown	medium	Fine to med sand, roots, fine med large gravel, fine to med charcoal, med to large gravel	SW	0.0	Moist.											
				↓		↓	↓	0.0												
				↓		↓	↓	0.0												
				↓		↓	↓	0.0												
5			53%			fine to med sand	SP	0.0												
						↓		0.0												
						same as above with interlayered dark brown sand		0.0												
						↓		0.0												
10			75%			fine to med sand		0.0												
						↓		0.0												
						interlayered brown, grey sand. No odor		0.0	↓											
						fine, med and large sand		0.0	wet											
15		100%			↓		0.0													
					medium sand, fine pebbles		0.0	↓												
20						End of boring at 17'														
25																				
30																				

<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT The following soil samples were collected, sent to Eurofins and analyzed for VOC's, SVOC's, cyanide, pesticides and metals: SB- 3 (0 - 2') @ 16:05 and SB- 3 (15 - 17') @ 16:30	PROJECT NO. <b>60540777</b>
	BORING/WELL NO. <b>SB - 3</b>


										TEST BORING LOG																																						
PROJECT: 116th Precinct. Rosedale Phase II										BORING/WELL NO: SB - 4																																						
CLIENT: NYPD										SHEET: 1 of 1																																						
BORING CONTRACTOR: Cascade Environmental										JOB NO.:																																						
GROUNDWATER (BTOC):										BORING LOCATION:																																						
<table border="1"> <tr> <th>DATE</th> <th>TIME</th> <th>LEVEL</th> <th>TYPE</th> <th>TYPE</th> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>DIA.</td> <td></td> <td>2"</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>WT.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>FALL</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										DATE	TIME	LEVEL	TYPE	TYPE	CAS.	SAMPLER	CORE	TUBE					DIA.		2"							WT.									FALL					GROUND ELEVATION:		
DATE	TIME	LEVEL	TYPE	TYPE	CAS.	SAMPLER	CORE	TUBE																																								
				DIA.		2"																																										
				WT.																																												
				FALL																																												
DATE STARTED:										DATE FINISHED: 01/00/00																																						
DRILLER: Quincy Brandt										GEOLOGIST: John Crespo																																						
REVIEWED BY:																																																
DEPTH FEET	SAMPLE			DESCRIPTION					REMARKS																																							
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION			USCS CLASS	PID	Moist.																																					
			Hand Clear	black	very dense	Asphalt 6"				0.0	dry																																					
				grey	↓	Fine to med gravel, RCA, fine to med pebbles			SW	0.0	Moist.																																					
				brown	medium	fine to med sand, fine and med pebbles			SP	0.0																																						
						↓				0.0																																						
5		1	53%			Fine to med sand				0.0																																						
						↓				0.0																																						
						↓				0.0																																						
10		2	76%			Same as above with two 1/4" thick darker color bands at 12'				0.0																																						
						↓				0.0																																						
				brown/orange		↓				0.0																																						
				brown		↓				0.0	wet																																					
15		3	100%			Fine to med sand				0.0																																						
						fine to med sand, fine and med pebbles				0.0																																						
						End of boring at 17'																																										
20																																																
25																																																
30																																																

<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT The following soil samples were collected, sent to Eurofins and analyzed for VOC's, SVOC's, cyanide, pesticides and metals: DUP 011118 @ 8:00 from 0 - 2' , SB-4 (0 - 2') @ 13:17 and SB- 4 (15 - 17' ) @ 13:40	PROJECT NO. 60540777
	BORING/WELL NO. SB - 4


										TEST BORING LOG										
PROJECT: 116th Precinct, Rosedale Phase II										BORING/WELL NO: SB - 5										
CLIENT: NYPD										SHEET: 1 of 1										
BORING CONTRACTOR: Cascade Environmental										JOB NO.:										
GROUNDWATER (BTOC):										BORING LOCATION:										
<table border="1"> <tr> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>										CAS.	SAMPLER	CORE	TUBE					GROUND ELEVATION:		
CAS.	SAMPLER	CORE	TUBE																	
DATE	TIME	LEVEL	TYPE	TYPE					DATE STARTED:	01/11/18										
				DIA.		2"			DATE FINISHED:	01/11/18										
				WT.					DRILLER:	Quincy Brandt										
				FALL					GEOLOGIST:	John Crespo										
										REVIEWED BY:										
DEPTH FEET	SAMPLE			DESCRIPTION				REMARKS												
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION	USCS CLASS	PID	Moist.											
			Hand Clear	black	very dense	Asphalt 7"			dry											
				grey	dense	Fine to med sand, fine med gravel, fine charcoal	SW	0.0												
				brown	medium	Fine to med sand	SP	0.0												
								0.0												
5								0.0												
		1	58%					0.0												
								0.0												
10								0.0												
		2	72%			same as above with band of grey color sand over thin band of brown and 5" wide beige sand		0.0	Moist.											
				beige		fine to medium sand		0.0												
				brown				0.0												
15								0.0												
		3	100%			fine to med sand, fine and medium pebbles		0.0	wet											
								0.0												
						End of boring at 17'														
20						Collected extra sample at 12 - 14' interval														
25																				
30																				
<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT The following soil samples were collected, sent to Eurofins and analyzed for VOC's, SVOC's, cyanide, pesticides and metals: SB - 5 (0 - 2') @ 14:30, SB- (12 - 14') @ 15:05 and SB- 5 (15 - 17') @ 15:15										<b>PROJECT NO.</b> 60540777  <b>BORING/WELL NO.</b> SB - 5										

										TEST BORING LOG																																		
PROJECT: 116th Precinct. Rosedale Phase II										BORING/WELL NO: SB - 6																																		
CLIENT: NYPD										SHEET: 1 of 1																																		
BORING CONTRACTOR: Cascade Environmental										JOB NO.:																																		
GROUNDWATER (BTOC):										BORING LOCATION:																																		
<table border="1"> <tr> <th>DATE</th> <th>TIME</th> <th>LEVEL</th> <th>TYPE</th> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td>DIA.</td> <td></td> <td>2"</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>WT.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>FALL</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										DATE	TIME	LEVEL	TYPE	CAS.	SAMPLER	CORE	TUBE				DIA.		2"						WT.								FALL					GROUND ELEVATION:		
DATE	TIME	LEVEL	TYPE	CAS.	SAMPLER	CORE	TUBE																																					
			DIA.		2"																																							
			WT.																																									
			FALL																																									
DATE STARTED: 01/09/18										DATE FINISHED: 01/09/18																																		
DRILLER: Quincy Brandt										GEOLOGIST: John Crespo																																		
REVIEWED BY:																																												
DEPTH FEET	SAMPLE			DESCRIPTION				REMARKS																																				
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION	USCS CLASS	PID	Moist.																																			
			Hand Clear	black	very dense	Asphalt 6"			dry																																			
				grey	dense	med sand, fine and medium gravel	SW	0.0	↓																																			
				brown	medium	fine and med sand, fine med pebbles, med large gravel imbeded	↓	0.0																																				
						fine and med sand	SP	0.0																																				
								0.0																																				
								0.0																																				
5		1	76%	light brown		fine and med sand, med to large charcoal imbeded.		0.0	↓																																			
						fine and med sand		0.0																																				
						thin layer of light brown and brown sand		0.0																																				
								0.0																																				
								0.0																																				
10		2	67%	dark brown		Fine and med sand, black rock imbeded		0.0	↓																																			
				brown				0.0																																				
						Fine to med sand, interlayer light brown, brown and beige color sand		0.0																																				
								0.0																																				
								0.0																																				
15		3	65%			fine to med sand		0.0	↓																																			
								0.0																																				
						fine to med sand, fine and med pebbles, large pebble imbeded		0.0																																				
								0.0																																				
								0.0																																				
20		4	96%			Fine to med sand		0.0	↓																																			
								0.0																																				
								0.0																																				
								0.0																																				
								0.0																																				
25		5	88%	light brown		Fine to med sand, fine pebbles imbeded		0.0	↓																																			
								0.0																																				
								0.0																																				
								0.0																																				
								0.0																																				
30						End of boring at 30'																																						
						Install temporary well. Diameter 1", DTB ~ 30'																																						
						screen 15'																																						

<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT The following soil samples were collected, sent to Eurofins and analyzed for VOC's, SVOC's, cyanide, pesticides and metals: SB- 6 (0 - 2') @ 14:20 and SB- 6 (15 - 17') @ 15:15						<b>PROJECT NO.</b> 60540777  <b>BORING/WELL NO.</b> SB - 6	
--	--	--	--	--	--	--	--

										TEST BORING LOG																																						
PROJECT: 116th Precinct. Rosedale Phase II										BORING/WELL NO: SB - 7																																						
CLIENT: NYPD										SHEET: 1 of 1																																						
BORING CONTRACTOR: Cascade Environmental										JOB NO.:																																						
GROUNDWATER (BTOC):										BORING LOCATION:																																						
<table border="1"> <tr> <th>DATE</th> <th>TIME</th> <th>LEVEL</th> <th>TYPE</th> <th>TYPE</th> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>DIA.</td> <td></td> <td>2"</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>WT.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>FALL</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										DATE	TIME	LEVEL	TYPE	TYPE	CAS.	SAMPLER	CORE	TUBE					DIA.		2"							WT.									FALL					GROUND ELEVATION:		
DATE	TIME	LEVEL	TYPE	TYPE	CAS.	SAMPLER	CORE	TUBE																																								
				DIA.		2"																																										
				WT.																																												
				FALL																																												
DATE STARTED: 01/10/18										DATE FINISHED: 01/10/18																																						
DRILLER: Quincy Brandt										GEOLOGIST: John Crespo																																						
REVIEWED BY:																																																
DEPTH FEET	SAMPLE			DESCRIPTION					REMARKS																																							
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION			USCS CLASS	PID	Moist.																																					
			Hand Clear	black	very dense	Asphalt 5"				0.0	dry																																					
				grey	dense	Fine to med sand, fine med gravel, fine med pebbles			SW	0.0																																						
				brown	medium	Fine to med sand, fine to med pebbles			SP	0.0																																						
										0.0																																						
5		1	70%			Fine to med sand, fine charcoal imbedded				0.0																																						
										0.0																																						
										0.0																																						
10		2	55%			Fine to med sand, band of darker sand at 11'				0.0																																						
										0.0																																						
						same with interlayered color light brown and brown sand				0.0	Moist																																					
										0.0																																						
15		3	100%			Fine to med sand				0.0																																						
						fine to med sand, fine and medium pebbles				0.0																																						
						End of boring at 17'																																										
20																																																
25																																																
30																																																

<b>COMMENTS:</b> Borings were advanced using a geoprobe model 6620 DT The following soil samples were collected, sent to Eurofins and analyzed for VOC's, SVOC's, cyanide, pesticides and metals: SB -7 ( 0 - 2') @ 10:15 and SB- 7 (15 - 17') @ 11:20	<b>PROJECT NO.</b> 60540777
	<b>BORING/WELL NO.</b> SB - 7

										TEST BORING LOG																																										
PROJECT: 116th Precinct, Rosedale Phase II										BORING/WELL NO: SB - 8																																										
CLIENT: NYPD										SHEET: 1 of 1																																										
BORING CONTRACTOR: Cascade Environmental										JOB NO.:																																										
GROUNDWATER (BTOC):										BORING LOCATION:																																										
<table border="1"> <tr> <th>DATE</th> <th>TIME</th> <th>LEVEL</th> <th>TYPE</th> <th>CAS.</th> <th>SAMPLER</th> <th>CORE</th> <th>TUBE</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										DATE	TIME	LEVEL	TYPE	CAS.	SAMPLER	CORE	TUBE																																	GROUND ELEVATION:		
DATE	TIME	LEVEL	TYPE	CAS.	SAMPLER	CORE	TUBE																																													
DATE STARTED: 01/09/18										DATE FINISHED: 01/09/18																																										
DRILLER: Quincy Brandt										GEOLOGIST: John Crespo																																										
REVIEWED BY:																																																				
DEPTH FEET	SAMPLE			DESCRIPTION				REMARKS																																												
	STRAT. SYMBOL	NO.	RECOV. RQD.	COLOR	HARDNESS	MATERIAL DESCRIPTION	USCS CLASS	PID	Moist.																																											
			Hand Clear	black	very dense	Asphalt 6"			dry																																											
				brown	medium	Fine med sand, fine med pebbles, med gravel	SW	0.0																																												
				light brown			↓	0.0																																												
				↓		fine and med sand, fine pebbles	SP	0.0																																												
				↓				0.0																																												
5		1	53%	brown				0.0																																												
				↓				0.0																																												
				light brown				0.0																																												
				↓				0.0																																												
10		2	55%	dark brown		same as above with a 3" thick layer of dark color sand. No odor.		0.0																																												
				brown				0.0	Moist.																																											
				↓				0.0																																												
				↓				0.0																																												
15		3	80%					0.0	wet																																											
								0.0																																												
						fine to med sand, layer of fine to large pebbles		0.0																																												
				↓				0.0																																												
20		4	97%	dark brown		same with band of darker color sand		0.0																																												
				brown		Fine to med sand		0.0																																												
				↓				0.0																																												
25		5	95%	light brown	med/loose	6" layer of light brown sand over brown sand		0.0																																												
				brown		fine to med sand, fine pebbles		0.0																																												
				↓				0.0																																												
30						End of boring at 30'																																														
						Install temporary well. Diameter 1", DTB ~ 30'																																														
						screen 15'																																														
COMMENTS: Borings were advanced using a geoprobe model 6620 DT							PROJECT NO. 60540777																																													
The following soil samples were collected, sent to Eurofins and analyzed for VOC's,							BORING/WELL NO. SB - 8																																													
SVOC's, cyanide, pesticides and metals:																																																				
SB- 8 (0 - 2') @ 11:15 and SB- 8 (15 - 17') @ 12:05																																																				

## **Appendix B**

### **Analytical Laboratory Results**

Report Date:  
30-Jan-18 15:59

## Laboratory Report SC43071

AECOM Environment  
125 Broad St  
, 15th Floor  
New York, NY 10005

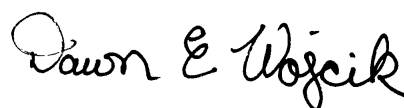
Project: 116th Police Precinct, Rosedale, NY  
Project #: [none]

I attest that the information contained within the report has been reviewed for accuracy and checked against the quality control requirements for each method. These results relate only to the sample(s) as received.  
All applicable NELAC requirements have been met.

Massachusetts # M-MA138/MA1110  
Connecticut # PH-0777  
Florida # E87936  
Maine # MA138  
New Hampshire # 2972/2538  
New Jersey # MA011  
New York # 11393  
Pennsylvania # 68-04426/68-02924  
Rhode Island # LAO00348  
USDA # P330-15-00375  
Vermont # VT-11393



Authorized by:  
Dawn Wojcik  
Laboratory Director



Eurofins Spectrum Analytical holds primary NELAC certification in the State of New York for the analytes as indicated with an X in the "Cert." column within this report. Please note that the State of New York does not offer certification for all analytes. Please refer to our website for specific certification holdings in each state.

Please note that this report contains 193 pages of analytical data plus Chain of Custody document(s). When the Laboratory Report is indicated as revised, this report supersedes any previously dated reports for the laboratory ID(s) referenced above. Where this report identifies subcontracted analyses, copies of the subcontractor's test report are available upon request. This report may not be reproduced, except in full, without written approval from Eurofins Spectrum Analytical, Inc.

*Eurofins Spectrum Analytical, Inc. is a NELAC accredited laboratory organization and meets NELAC testing standards. Use of the NELAC logo however does not insure that Eurofins Spectrum Analytical, Inc. is currently accredited for the specific method or analyte indicated. Please refer to our Quality web page at [www.spectrum-analytical.com](http://www.spectrum-analytical.com) for a full listing of our current certifications and fields of accreditation. States in which Eurofins Spectrum Analytical, Inc. holds NELAC certification are New York, New Hampshire, New Jersey, Pennsylvania and Florida. All analytical work for Volatile Organic and Air analysis are transferred to and conducted at our 830 Silver Street location (PA-68-04426).*

*Please contact the Laboratory or Technical Director at 800-789-9115 with any questions regarding the data contained in this laboratory report.*



## Sample Summary

**Work Order:** SC43071  
**Project:** 116th Police Precinct, Rosedale, NY  
**Project Number:** [none]

<u>Laboratory ID</u>	<u>Client Sample ID</u>	<u>Matrix</u>	<u>Date Sampled</u>	<u>Date Received</u>
SC43071-01	SB-8 (0-2')	Soil	09-Jan-18 11:15	12-Jan-18 11:05
SC43071-02	SB-8 (15-17')	Soil	09-Jan-18 12:05	12-Jan-18 11:05
SC43071-03	SB-6 (0-2')	Soil	09-Jan-18 14:20	12-Jan-18 11:05
SC43071-04	SB-6 (15-17')	Soil	09-Jan-18 15:15	12-Jan-18 11:05
SC43071-05	SB-7 (0-2')	Soil	10-Jan-18 10:15	12-Jan-18 11:05
SC43071-06	SB-7 (15-17')	Soil	10-Jan-18 11:20	12-Jan-18 11:05
SC43071-07	SB-1 (0-2')	Soil	10-Jan-18 14:30	12-Jan-18 11:05
SC43071-08	SB-1 (15-17')	Soil	10-Jan-18 15:00	12-Jan-18 11:05
SC43071-09	SB-3 (0-2')	Soil	10-Jan-18 16:05	12-Jan-18 11:05
SC43071-10	SB-3 (15-17')	Soil	10-Jan-18 16:30	12-Jan-18 11:05
SC43071-11	SB-2 (0-2')	Soil	11-Jan-18 10:10	12-Jan-18 11:05
SC43071-12	SB-2 (15-17')	Soil	11-Jan-18 10:40	12-Jan-18 11:05
SC43071-13	SB-4 (0-2')	Soil	11-Jan-18 13:17	12-Jan-18 11:05
SC43071-14	SB-4 (15-17')	Soil	11-Jan-18 13:40	12-Jan-18 11:05
SC43071-15	TB	Methanol/Deionized Water	11-Jan-18 16:00	12-Jan-18 11:05
SC43071-16	SB-5 (0-2')	Soil	11-Jan-18 14:30	12-Jan-18 11:05
SC43071-17	SB-5 (12-14')	Soil	11-Jan-18 15:05	12-Jan-18 11:05
SC43071-18	SB-5 (15-17')	Soil	11-Jan-18 15:15	12-Jan-18 11:05
SC43071-19	DUP-011118	Soil	11-Jan-18 08:00	12-Jan-18 11:05

## CASE NARRATIVE:

Data has been reported to the RDL. This report includes estimated concentrations detected below the RDL and above the MDL (J-Flag).

All non-detects and all results below the detection limit are reported as "<" (less than) the detection limit in this report.

The samples were received 1.0 degrees Celsius, please refer to the Chain of Custody for details specific to temperature upon receipt. An infrared thermometer with a tolerance of +/- 1.0 degrees Celsius was used immediately upon receipt of the samples.

If a Matrix Spike (MS), Matrix Spike Duplicate (MSD) or Duplicate (DUP) was not requested on the Chain of Custody, method criteria may have been fulfilled with a source sample not of this Sample Delivery Group. If method or program required MS/MSD/Dup were not performed, sufficient sample was not provided to the laboratory.

All VOC soils samples submitted and analyzed in methanol will have a minimum dilution factor of 50. This is the minimum amount of solvent allowed on the instrumentation without causing interference. Soils are run on a manual load instrument. 100ug of sample (MEOH) is spiked into 5ml DI water along with the surrogate and added directly onto the instrument. Additional dilution factors may be required to keep analyte concentration within instrument calibration range.

Method SW846 5035A is designed to use on samples containing low levels of VOCs, ranging from 0.5 to 200 ug/Kg. Target analytes that are less responsive to purge and trap may be present at concentrations over 200ug/Kg but may not be reportable in the methanol preserved vial (SW846 5030). This is the result of the inherent dilution factor required for the methanol preservation.

**See below for any non-conformances and issues relating to quality control samples and/or sample analysis/matrix.**

### SW846 6010C

#### Spikes:

1800473-MS1      *Source: SC43071-01*

---

The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.

Iron  
Magnesium

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Aluminum

The spike recovery was outside of QC acceptance limits for the MS, MSD and/or PS due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

Calcium

1800473-MSD1      *Source: SC43071-01*

---

The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.

Iron  
Magnesium

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Aluminum

The spike recovery was outside of QC acceptance limits for the MS, MSD and/or PS due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

Calcium

## **SW846 6010C**

### **Duplicates:**

1800473-DUP1      *Source: SC43071-01*

---

MRL raised to correlate to batch QC reporting limits.

Iron

The RPD exceeded the QC control limits; however precision is demonstrated with acceptable RPD values for MS/MSD.

Barium

Calcium

Chromium

Lead

Magnesium

1801087-DUP1      *Source: SC43071-01*

---

Analyses are not controlled on RPD values from sample concentrations that are less than 5 times the reporting level. The batch is accepted based upon the difference between the sample and duplicate is less than or equal to the reporting limit.

Cobalt

The RPD exceeded the QC control limits; however precision is demonstrated with acceptable RPD values for MS/MSD.

Potassium

### **Samples:**

SC43071-01      *SB-8 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-02      *SB-8 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-03      *SB-6 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-04      *SB-6 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-05      *SB-7 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-06      *SB-7 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-07      *SB-1 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-08      *SB-1 (15-17')*

---

**SW846 6010C****Samples:**

SC43071-08                      *SB-1 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-09                      *SB-3 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-10                      *SB-3 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-11                      *SB-2 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-12                      *SB-2 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-13                      *SB-4 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-14                      *SB-4 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-16                      *SB-5 (0-2')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-17                      *SB-5 (12-14')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-18                      *SB-5 (15-17')*

---

MRL raised to correlate to batch QC reporting limits.

Iron

SC43071-19                      *DUP-011118*

---

MRL raised to correlate to batch QC reporting limits.

Iron

**SW846 7471B****Duplicates:**

1800474-DUP1                      *Source: SC43071-01*

---

## **SW846 7471B**

### **Duplicates:**

1800474-DUP1      *Source: SC43071-01*

---

Analyses are not controlled on RPD values from sample concentrations that are less than 5 times the reporting level. The batch is accepted based upon the difference between the sample and duplicate is less than or equal to the reporting limit.

Mercury

## **SW846 8081B**

### **Spikes:**

1800576-MS1      *Source: SC43071-19*

---

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Alachlor [2C]

1800576-MSD1      *Source: SC43071-19*

---

The RPD result exceeded the QC control limits; however, both percent recoveries were acceptable. Sample results for the QC batch were accepted based on percent recoveries and completeness of QC data.

4,4'-DDD (p,p')

4,4'-DDE (p,p')

4,4'-DDT (p,p')

Aldrin

alpha-Chlordane

Chlordane (gamma)(trans)

Dieldrin

Endrin

Heptachlor

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Alachlor [2C]

### **Samples:**

SC43071-01      *SB-8 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-03      *SB-6 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-04      *SB-6 (15-17')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-05      *SB-7 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-07      *SB-1 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-09      *SB-3 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

## **SW846 8081B**

### **Samples:**

SC43071-11                      *SB-2 (0-2')*

---

Difference between the two GC columns is greater than 40%.

alpha-Chlordane

The Reporting Limit has been raised to account for matrix interference.

The surrogate recovery for this sample is outside of established control limits due to a sample matrix effect.

Decachlorobiphenyl (Sr) [2C]

SC43071-12                      *SB-2 (15-17')*

---

The surrogate recovery for this sample is outside of established control limits due to a sample matrix effect.

Decachlorobiphenyl (Sr)

SC43071-16                      *SB-5 (0-2')*

---

Difference between the two GC columns is greater than 40%.

alpha-Chlordane

## **SW846 8260C**

### **Calibration:**

1801061

---

Analyte quantified by quadratic equation type calibration.

1,4-Dioxane  
2-Hexanone (MBK)  
4-Isopropyltoluene  
4-Methyl-2-pentanone (MIBK)  
Bromomethane  
cis-1,3-Dichloropropene  
Di-isopropyl ether  
Naphthalene  
sec-Butylbenzene  
trans-1,3-Dichloropropene  
Vinyl chloride

This affected the following samples:

S815994-ICV1

1801068

---

Analyte quantified by quadratic equation type calibration.

1,2-Dibromo-3-chloropropane  
Acetone  
Bromoform  
trans-1,4-Dichloro-2-butene  
Vinyl chloride

## **SW846 8260C**

### **Calibration:**

1801068

---

This affected the following samples:

1800741-BLK1  
1800741-BS1  
1800741-BSD1  
1800813-BLK1  
1800813-BS1  
1800813-BSD1  
DUP-011118  
S816046-CCV1  
S816061-ICV1  
S816080-CCV1  
SB-2 (15-17")  
SB-4 (0-2")  
SB-4 (15-17")  
SB-5 (0-2")  
SB-5 (12-14")  
SB-5 (15-17")  
TB

S815994-ICV1

---

Analyte percent recovery is outside individual acceptance criteria (80-120).

Carbon disulfide (78%)

This affected the following samples:

1800822-BLK1  
1800822-BS1  
1800822-BSD1  
S816085-CCV1  
SB-1 (0-2")  
SB-1 (15-17")  
SB-2 (0-2")  
SB-3 (0-2")  
SB-3 (15-17")  
SB-6 (0-2")  
SB-6 (15-17")  
SB-7 (0-2")  
SB-7 (15-17")  
SB-8 (0-2")  
SB-8 (15-17")

S816061-ICV1

---

Analyte percent recovery is outside individual acceptance criteria (80-120).

Naphthalene (128%)

## **SW846 8260C**

### **Calibration:**

S816061-ICV1

---

This affected the following samples:

1800741-BLK1  
1800741-BS1  
1800741-BSD1  
1800813-BLK1  
1800813-BS1  
1800813-BSD1  
DUP-011118  
S816046-CCV1  
S816080-CCV1  
SB-2 (15-17")  
SB-4 (0-2")  
SB-4 (15-17")  
SB-5 (0-2")  
SB-5 (12-14")  
SB-5 (15-17")  
TB

### **Laboratory Control Samples:**

1800741 BS/BSD

---

2-Hexanone (MBK) percent recoveries (135/122) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially high bias:

SB-2 (15-17")  
SB-4 (0-2")  
SB-4 (15-17")

Acetone percent recoveries (158/123) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially high bias:

SB-2 (15-17")  
SB-4 (0-2")  
SB-4 (15-17")

1800822 BS/BSD

---

1,1,2-Trichlorotrifluoroethane (Freon 113) percent recoveries (66/62) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2")  
SB-1 (15-17")  
SB-2 (0-2")  
SB-3 (0-2")  
SB-3 (15-17")  
SB-6 (0-2")  
SB-6 (15-17")  
SB-7 (0-2")  
SB-7 (15-17")  
SB-8 (0-2")  
SB-8 (15-17")



**Laboratory Control Samples:**1800822 BS/BSD

---

Carbon disulfide percent recoveries (62/80) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

Chloromethane percent recoveries (66/60) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

Dichlorodifluoromethane (Freon12) percent recoveries (67/63) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

Vinyl chloride percent recoveries (78/68) are outside individual acceptance criteria (70-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

## **SW846 8260C**

### **Samples:**

#### S816046-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

2-Hexanone (MBK) (21.7%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Acetone (23.2%)

This affected the following samples:

1800741-BLK1  
1800741-BS1  
1800741-BSD1  
SB-2 (15-17')  
SB-4 (0-2')  
SB-4 (15-17')

#### S816080-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

2-Hexanone (MBK) (-27.8%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Acetone (-29.8%)

This affected the following samples:

1800813-BLK1  
1800813-BS1  
1800813-BSD1  
DUP-011118  
SB-5 (0-2')  
SB-5 (12-14')  
SB-5 (15-17')  
TB

#### S816085-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

1,1,2-Trichlorotrifluoroethane (Freon 113) (-36.1%)  
1,1-Dichloroethene (-23.2%)  
Carbon disulfide (-39.2%)  
Chloroethane (-24.3%)  
Chloromethane (-33.9%)  
Dichlorodifluoromethane (Freon12) (-34.7%)  
Methyl tert-butyl ether (21.0%)  
Methylene chloride (-23.0%)  
Trichlorofluoromethane (Freon 11) (-21.6%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

1,4-Dioxane (21.9%)  
Vinyl chloride (-21.1%)

## **SW846 8260C**

### **Samples:**

S816085-CCV1

---

This affected the following samples:

1800822-BLK1  
1800822-BS1  
1800822-BSD1  
SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

SC43071-01                      *SB-8 (0-2')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-02                      *SB-8 (15-17')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-03                      *SB-6 (0-2')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-04                      *SB-6 (15-17')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-05                      *SB-7 (0-2')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-06                      *SB-7 (15-17')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-07                      *SB-1 (0-2')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-08                      *SB-1 (15-17')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-09                      *SB-3 (0-2')*

---

## **SW846 8260C**

### **Samples:**

SC43071-09                      *SB-3 (0-2')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-10                      *SB-3 (15-17')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

SC43071-11                      *SB-2 (0-2')*

---

Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.

## **SW846 8270D**

### **Calibration:**

1712056

---

Analyte quantified by quadratic equation type calibration.

2,4-Dinitrophenol  
4,6-Dinitro-2-methylphenol  
Benzidine  
Benzoic acid  
Carbazole  
Pentachlorophenol

This affected the following samples:

S711008-ICV1

### **Laboratory Control Samples:**

1800478 BS/BSD

---

Aniline percent recoveries (38/41) are outside individual acceptance criteria (40-140), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-2 (15-17')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-4 (0-2')  
SB-4 (15-17')  
SB-5 (0-2')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

## **SW846 8270D**

### **Laboratory Control Samples:**

1800478 BS/BSD

---

Benzoic acid percent recoveries (24/23) are outside individual acceptance criteria (30-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

SB-1 (0-2')  
SB-1 (15-17')  
SB-2 (0-2')  
SB-2 (15-17')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-4 (0-2')  
SB-4 (15-17')  
SB-5 (0-2')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

1800478 BSD

---

Benzidine RPD 35% (30%) is outside individual acceptance criteria.

1800643 BS/BSD

---

4-Chloroaniline percent recoveries (38/50) are outside individual acceptance criteria (40-140), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

DUP-011118  
SB-5 (12-14')  
SB-5 (15-17')

Aniline percent recoveries (36/39) are outside individual acceptance criteria (40-140), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

DUP-011118  
SB-5 (12-14')  
SB-5 (15-17')

Benzoic acid percent recoveries (27/24) are outside individual acceptance criteria (30-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

DUP-011118  
SB-5 (12-14')  
SB-5 (15-17')

1800643 BSD

---

Benzidine RPD 39% (30%) is outside individual acceptance criteria.

### **Spikes:**

1800478-MS1      *Source: SC43071-01*

---

Analyte out of acceptance range in QC spike but no reportable concentration present in sample.

Aniline

## **SW846 8270D**

### **Spikes:**

1800478-MS1      *Source: SC43071-01*

---

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

2,4-Dinitrophenol  
2-Nitrophenol  
4,6-Dinitro-2-methylphenol  
4-Chloroaniline  
Bis(2-chloroethoxy)methane  
Hexachlorocyclopentadiene

1800478-MSD1      *Source: SC43071-01*

---

Analyte out of acceptance range in QC spike but no reportable concentration present in sample.

2,4-Dinitrophenol  
2-Nitrophenol  
4,6-Dinitro-2-methylphenol  
4-Chloroaniline  
Aniline  
Bis(2-chloroethoxy)methane  
Bis(2-chloroisopropyl)ether  
Hexachlorocyclopentadiene

1800643-MS1      *Source: SC43071-17*

---

Analyte out of acceptance range in QC spike but no reportable concentration present in sample.

Aniline

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

2,4-Dinitrophenol

1800643-MSD1      *Source: SC43071-17*

---

Analyte out of acceptance range in QC spike but no reportable concentration present in sample.

Aniline

RPD out of acceptance range. The batch is accepted based upon LCS and/or LCSD recovery.

2,4-Dinitrophenol

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

2,4-Dinitrophenol  
4-Chloroaniline

### **Samples:**

S815988-CCV1

---

## **SW846 8270D**

### **Samples:**

S815988-CCV1

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Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

3,3'-Dichlorobenzidine (-29.6%)  
4-Chloroaniline (-32.3%)  
4-Chlorophenyl phenyl ether (23.8%)  
4-Nitroaniline (-28.4%)  
Aniline (-35.7%)  
Diethyl phthalate (24.8%)  
Dimethyl phthalate (22.4%)  
Hexachlorobutadiene (28.0%)  
Hexachlorocyclopentadiene (27.9%)  
Hexachloroethane (22.5%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Benzidine (-86.2%)

This affected the following samples:

1800478-BLK1  
1800478-BS1  
1800478-BSD1

S815997-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

2-Methylphenol (-22.5%)  
4-Chloroaniline (-25.6%)  
4-Chlorophenyl phenyl ether (29.0%)  
4-Nitroaniline (-25.5%)  
Aniline (-46.8%)  
Bis(2-chloroisopropyl)ether (-21.4%)  
Diethyl phthalate (32.2%)  
Dimethyl phthalate (24.7%)  
Di-n-octyl phthalate (20.3%)  
Hexachlorobutadiene (37.8%)  
Hexachlorocyclopentadiene (24.4%)  
Pyridine (-25.1%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Benzidine (-73.5%)

This affected the following samples:

1800478-DUP1  
1800478-MS1  
1800478-MSD1  
SB-1 (0-2')  
SB-1 (15-17')  
SB-3 (0-2')  
SB-3 (15-17')  
SB-6 (0-2')  
SB-6 (15-17')  
SB-7 (0-2')  
SB-7 (15-17')  
SB-8 (0-2')  
SB-8 (15-17')

S816015-CCV1

---

## **SW846 8270D**

### **Samples:**

S816015-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

2-Methylnaphthalene (22.6%)  
4-Chlorophenyl phenyl ether (27.3%)  
4-Nitroaniline (-27.6%)  
Aniline (-28.4%)  
Diethyl phthalate (28.8%)  
Dimethyl phthalate (23.9%)  
Hexachlorobutadiene (33.8%)  
Hexachlorocyclopentadiene (26.1%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Benzidine (-67.0%)

This affected the following samples:

SB-2 (0-2')  
SB-2 (15-17')  
SB-4 (0-2')  
SB-4 (15-17')  
SB-5 (0-2')

S816022-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

3,3'-Dichlorobenzidine (-27.0%)  
4-Chloroaniline (-28.9%)  
4-Chlorophenyl phenyl ether (26.9%)  
4-Nitroaniline (-34.8%)  
Aniline (-47.2%)  
Diethyl phthalate (21.8%)  
Hexachlorobutadiene (35.2%)  
Hexachlorocyclopentadiene (27.3%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Benzidine (-83.2%)

This affected the following samples:

1800643-BLK1  
1800643-BS1  
1800643-BSD1  
1800643-DUP1  
1800643-MS1  
1800643-MSD1  
DUP-011118  
SB-5 (12-14')  
SB-5 (15-17')

SC43071-01                      *SB-8 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-04                      *SB-6 (15-17')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-05                      *SB-7 (0-2')*

---



## **SW846 8270D**

### **Samples:**

SC43071-05                      *SB-7 (0-2')*

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The Reporting Limit has been raised to account for matrix interference.

SC43071-07                      *SB-1 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-09                      *SB-3 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-11                      *SB-2 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

SC43071-16                      *SB-5 (0-2')*

---

The Reporting Limit has been raised to account for matrix interference.

## **SW846 9012B**

### **Spikes:**

1800670-MSD1                      *Source: SC43071-10*

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The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Cyanide (total)

## Sample Acceptance Check Form

Client: AECOM Environment - NY, NY  
Project: 116th Police Precinct, Rosedale, NY / [none]  
Work Order: SC43071  
Sample(s) received on: 1/12/2018

*The following outlines the condition of samples for the attached Chain of Custody upon receipt.*

	<u>Yes</u>	<u>No</u>	<u>N/A</u>
Were custody seals present?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were custody seals intact?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples received at a temperature of $\leq 6^{\circ}\text{C}$ ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples cooled on ice upon transfer to laboratory representative?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were sample containers received intact?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples properly labeled (labels affixed to sample containers and include sample ID, site location, and/or project number and the collection date)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples accompanied by a Chain of Custody document?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does Chain of Custody document include proper, full, and complete documentation, which shall include sample ID, site location, and/or project number, date and time of collection, collector's name, preservation type, sample matrix and any special remarks concerning the sample?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Did sample container labels agree with Chain of Custody document?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples received within method-specific holding times?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Summary of Hits

**Lab ID:** SC43071-01

**Client ID:** SB-8 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	5700		5.17	mg/kg	SW846 6010C
Arsenic	1.91		1.55	mg/kg	SW846 6010C
Barium	27.9		1.03	mg/kg	SW846 6010C
Beryllium	0.277	J	0.517	mg/kg	SW846 6010C
Cadmium	0.708		0.517	mg/kg	SW846 6010C
Calcium	2820		25.8	mg/kg	SW846 6010C
Chromium	8.99		1.03	mg/kg	SW846 6010C
Cobalt	2.49		1.05	mg/kg	SW846 6010C
Copper	11.9		1.03	mg/kg	SW846 6010C
Iron	9080	R06	517	mg/kg	SW846 6010C
Lead	21.2		1.55	mg/kg	SW846 6010C
Magnesium	2050		5.17	mg/kg	SW846 6010C
Manganese	157		1.03	mg/kg	SW846 6010C
Nickel	7.36		1.03	mg/kg	SW846 6010C
Potassium	278		52.3	mg/kg	SW846 6010C
Sodium	101		25.8	mg/kg	SW846 6010C
Vanadium	15.1		1.55	mg/kg	SW846 6010C
Zinc	22.5		1.03	mg/kg	SW846 6010C
Mercury	0.0232	J	0.0290	mg/kg	SW846 7471B

**Lab ID:** SC43071-02

**Client ID:** SB-8 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	3080		5.43	mg/kg	SW846 6010C
Arsenic	0.646	J	1.63	mg/kg	SW846 6010C
Barium	13.9		1.09	mg/kg	SW846 6010C
Beryllium	0.187	J	0.543	mg/kg	SW846 6010C
Cadmium	0.494	J	0.543	mg/kg	SW846 6010C
Calcium	294		27.1	mg/kg	SW846 6010C
Chromium	10.9		1.09	mg/kg	SW846 6010C
Cobalt	2.05		1.10	mg/kg	SW846 6010C
Copper	5.97		1.09	mg/kg	SW846 6010C
Iron	6290	R06	543	mg/kg	SW846 6010C
Lead	3.28		1.63	mg/kg	SW846 6010C
Magnesium	848		5.43	mg/kg	SW846 6010C
Manganese	91.5		1.09	mg/kg	SW846 6010C
Nickel	5.80		1.09	mg/kg	SW846 6010C
Potassium	443		54.8	mg/kg	SW846 6010C
Sodium	55.3		27.1	mg/kg	SW846 6010C
Vanadium	8.08		1.63	mg/kg	SW846 6010C
Zinc	8.75		1.09	mg/kg	SW846 6010C
Bis(2-ethylhexyl)phthalate	47.7	J	183	µg/kg	SW846 8270D
Cyanide (total)	0.298	J	0.326	mg/kg	SW846 9012B

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Lab ID: SC43071-03

Client ID: SB-6 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	5300		5.26	mg/kg	SW846 6010C
Arsenic	2.32		1.58	mg/kg	SW846 6010C
Barium	26.0		1.05	mg/kg	SW846 6010C
Beryllium	0.304	J	0.526	mg/kg	SW846 6010C
Cadmium	0.582		0.526	mg/kg	SW846 6010C
Calcium	708		26.3	mg/kg	SW846 6010C
Chromium	8.52		1.05	mg/kg	SW846 6010C
Cobalt	3.15		1.05	mg/kg	SW846 6010C
Copper	10.4		1.05	mg/kg	SW846 6010C
Iron	7370	R06	526	mg/kg	SW846 6010C
Lead	20.3		1.58	mg/kg	SW846 6010C
Magnesium	883		5.26	mg/kg	SW846 6010C
Manganese	112		1.05	mg/kg	SW846 6010C
Nickel	8.34		1.05	mg/kg	SW846 6010C
Potassium	214		52.6	mg/kg	SW846 6010C
Sodium	449		26.3	mg/kg	SW846 6010C
Vanadium	13.4		1.58	mg/kg	SW846 6010C
Zinc	21.8		1.05	mg/kg	SW846 6010C
Mercury	0.0413		0.0311	mg/kg	SW846 7471B
Benzo (a) pyrene	45.3	J	70.8	µg/kg	SW846 8270D
Benzo (b) fluoranthene	55.5	J	70.8	µg/kg	SW846 8270D
Benzo (g,h,i) perylene	28.7	J	70.8	µg/kg	SW846 8270D
Benzo (k) fluoranthene	46.3	J	70.8	µg/kg	SW846 8270D
Chrysene	43.9	J	70.8	µg/kg	SW846 8270D
Fluoranthene	47.1	J	70.8	µg/kg	SW846 8270D
Indeno (1,2,3-cd) pyrene	26.9	J	70.8	µg/kg	SW846 8270D
Pyrene	53.8	J	70.8	µg/kg	SW846 8270D

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Lab ID: SC43071-04

Client ID: SB-6 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	2600		5.30	mg/kg	SW846 6010C
Arsenic	0.609	J	1.59	mg/kg	SW846 6010C
Barium	17.6		1.06	mg/kg	SW846 6010C
Beryllium	0.139	J	0.530	mg/kg	SW846 6010C
Cadmium	0.584		0.530	mg/kg	SW846 6010C
Calcium	893		26.5	mg/kg	SW846 6010C
Chromium	17.2		1.06	mg/kg	SW846 6010C
Cobalt	4.38		1.05	mg/kg	SW846 6010C
Copper	14.4		1.06	mg/kg	SW846 6010C
Iron	7540	R06	530	mg/kg	SW846 6010C
Lead	2.60		1.59	mg/kg	SW846 6010C
Magnesium	1170		5.30	mg/kg	SW846 6010C
Manganese	206		1.06	mg/kg	SW846 6010C
Nickel	8.61		1.06	mg/kg	SW846 6010C
Potassium	590		52.6	mg/kg	SW846 6010C
Sodium	222		26.5	mg/kg	SW846 6010C
Vanadium	10.4		1.59	mg/kg	SW846 6010C
Zinc	9.76		1.06	mg/kg	SW846 6010C

Lab ID: SC43071-05

Client ID: SB-7 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	5840		5.17	mg/kg	SW846 6010C
Arsenic	1.81		1.55	mg/kg	SW846 6010C
Barium	21.8		1.03	mg/kg	SW846 6010C
Beryllium	0.249	J	0.517	mg/kg	SW846 6010C
Cadmium	0.641		0.517	mg/kg	SW846 6010C
Calcium	5660		25.8	mg/kg	SW846 6010C
Chromium	9.53		1.03	mg/kg	SW846 6010C
Cobalt	3.03		1.05	mg/kg	SW846 6010C
Copper	12.5		1.03	mg/kg	SW846 6010C
Iron	7950	R06	517	mg/kg	SW846 6010C
Lead	10.5		1.55	mg/kg	SW846 6010C
Magnesium	3470		5.17	mg/kg	SW846 6010C
Manganese	125		1.03	mg/kg	SW846 6010C
Nickel	7.72		1.03	mg/kg	SW846 6010C
Potassium	328		52.4	mg/kg	SW846 6010C
Sodium	73.3		25.8	mg/kg	SW846 6010C
Vanadium	13.1		1.55	mg/kg	SW846 6010C
Zinc	16.8		1.03	mg/kg	SW846 6010C
Mercury	0.0214	J	0.0293	mg/kg	SW846 7471B
Ethanol	5340	J, D	11200	µg/kg	SW846 8260C

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Lab ID: SC43071-06

Client ID: SB-7 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	2010		5.90	mg/kg	SW846 6010C
Arsenic	0.713	J	1.77	mg/kg	SW846 6010C
Barium	10.2		1.18	mg/kg	SW846 6010C
Beryllium	0.117	J	0.590	mg/kg	SW846 6010C
Cadmium	0.439	J	0.590	mg/kg	SW846 6010C
Calcium	316		29.5	mg/kg	SW846 6010C
Chromium	7.26		1.18	mg/kg	SW846 6010C
Cobalt	2.32		1.18	mg/kg	SW846 6010C
Copper	5.46		1.18	mg/kg	SW846 6010C
Iron	5920	R06	590	mg/kg	SW846 6010C
Lead	2.28		1.77	mg/kg	SW846 6010C
Magnesium	666		5.90	mg/kg	SW846 6010C
Manganese	102		1.18	mg/kg	SW846 6010C
Nickel	5.08		1.18	mg/kg	SW846 6010C
Potassium	525		59.2	mg/kg	SW846 6010C
Sodium	51.1		29.5	mg/kg	SW846 6010C
Vanadium	6.28		1.77	mg/kg	SW846 6010C
Zinc	7.72		1.18	mg/kg	SW846 6010C
Ethanol	5220	J, D	12300	µg/kg	SW846 8260C

Lab ID: SC43071-07

Client ID: SB-1 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	5710		5.30	mg/kg	SW846 6010C
Arsenic	3.12		1.59	mg/kg	SW846 6010C
Barium	41.2		1.06	mg/kg	SW846 6010C
Beryllium	0.263	J	0.530	mg/kg	SW846 6010C
Cadmium	1.10		0.530	mg/kg	SW846 6010C
Calcium	6050		26.5	mg/kg	SW846 6010C
Chromium	9.94		1.06	mg/kg	SW846 6010C
Cobalt	5.59		1.07	mg/kg	SW846 6010C
Copper	45.2		1.06	mg/kg	SW846 6010C
Iron	12100	R06	530	mg/kg	SW846 6010C
Lead	105		1.59	mg/kg	SW846 6010C
Magnesium	3360		5.30	mg/kg	SW846 6010C
Manganese	225		1.06	mg/kg	SW846 6010C
Nickel	10.3		1.06	mg/kg	SW846 6010C
Potassium	587		53.3	mg/kg	SW846 6010C
Sodium	272		26.5	mg/kg	SW846 6010C
Vanadium	30.5		1.59	mg/kg	SW846 6010C
Zinc	53.6		1.06	mg/kg	SW846 6010C
Mercury	0.0582		0.0302	mg/kg	SW846 7471B
alpha-Chlordane	125	D	26.3	µg/kg	SW846 8081B
Chlordane (gamma)(trans) [2C]	125	D	26.3	µg/kg	SW846 8081B
Chlordane [2C]	95.4		21.1	µg/kg	SW846 8081B
Aroclor-1262	32.3		21.2	µg/kg	SW846 8082A

Lab ID: SC43071-08

Client ID: SB-1 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	1990		5.69	mg/kg	SW846 6010C
Arsenic	0.325	J	1.71	mg/kg	SW846 6010C
Barium	11.2		1.14	mg/kg	SW846 6010C
Beryllium	0.112	J	0.569	mg/kg	SW846 6010C
Cadmium	0.440	J	0.569	mg/kg	SW846 6010C
Calcium	290		28.5	mg/kg	SW846 6010C
Chromium	7.50		1.14	mg/kg	SW846 6010C
Cobalt	1.64		1.12	mg/kg	SW846 6010C
Copper	5.88		1.14	mg/kg	SW846 6010C
Iron	5820	R06	569	mg/kg	SW846 6010C
Lead	1.71		1.71	mg/kg	SW846 6010C
Magnesium	725		5.69	mg/kg	SW846 6010C
Manganese	118		1.14	mg/kg	SW846 6010C
Nickel	5.64		1.14	mg/kg	SW846 6010C
Potassium	420		56.2	mg/kg	SW846 6010C
Sodium	54.2		28.5	mg/kg	SW846 6010C
Vanadium	6.92		1.71	mg/kg	SW846 6010C
Zinc	8.31		1.14	mg/kg	SW846 6010C

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Lab ID: SC43071-09

Client ID: SB-3 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	5510		5.43	mg/kg	SW846 6010C
Arsenic	2.25		1.63	mg/kg	SW846 6010C
Barium	42.1		1.09	mg/kg	SW846 6010C
Beryllium	0.258	J	0.543	mg/kg	SW846 6010C
Cadmium	0.877		0.543	mg/kg	SW846 6010C
Calcium	4100		27.2	mg/kg	SW846 6010C
Chromium	11.1		1.09	mg/kg	SW846 6010C
Cobalt	4.75		1.09	mg/kg	SW846 6010C
Copper	28.0		1.09	mg/kg	SW846 6010C
Iron	9220	R06	543	mg/kg	SW846 6010C
Lead	50.1		1.63	mg/kg	SW846 6010C
Magnesium	2140		5.43	mg/kg	SW846 6010C
Manganese	161		1.09	mg/kg	SW846 6010C
Nickel	9.91		1.09	mg/kg	SW846 6010C
Potassium	499		54.5	mg/kg	SW846 6010C
Sodium	54.6		27.2	mg/kg	SW846 6010C
Vanadium	16.9		1.63	mg/kg	SW846 6010C
Zinc	57.2		1.09	mg/kg	SW846 6010C
Mercury	0.210		0.0324	mg/kg	SW846 7471B
alpha-Chlordane	10.9	J, D	27.5	µg/kg	SW846 8081B
Aroclor-1262 [2C]	10.5	J	11.0	µg/kg	SW846 8082A
Naphthalene	117	D	58.3	µg/kg	SW846 8260C
Benzo (a) anthracene	490	J, D	737	µg/kg	SW846 8270D
Benzo (a) pyrene	520	J, D	737	µg/kg	SW846 8270D
Benzo (b) fluoranthene	527	J, D	737	µg/kg	SW846 8270D
Benzo (g,h,i) perylene	306	J, D	737	µg/kg	SW846 8270D
Benzo (k) fluoranthene	420	J, D	737	µg/kg	SW846 8270D
Chrysene	450	J, D	737	µg/kg	SW846 8270D
Fluoranthene	1000	D	737	µg/kg	SW846 8270D
Indeno (1,2,3-cd) pyrene	298	J, D	737	µg/kg	SW846 8270D
Phenanthrene	615	J, D	737	µg/kg	SW846 8270D
Pyrene	925	D	737	µg/kg	SW846 8270D

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**Lab ID:** SC43071-10**Client ID:** SB-3 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	2410		5.90	mg/kg	SW846 6010C
Arsenic	0.348	J	1.77	mg/kg	SW846 6010C
Barium	15.2		1.18	mg/kg	SW846 6010C
Beryllium	0.0902	J	0.590	mg/kg	SW846 6010C
Cadmium	0.337	J	0.590	mg/kg	SW846 6010C
Calcium	122		29.5	mg/kg	SW846 6010C
Chromium	7.56		1.18	mg/kg	SW846 6010C
Cobalt	2.12		1.18	mg/kg	SW846 6010C
Copper	4.69		1.18	mg/kg	SW846 6010C
Iron	4420	R06	590	mg/kg	SW846 6010C
Lead	1.38	J	1.77	mg/kg	SW846 6010C
Magnesium	918		5.90	mg/kg	SW846 6010C
Manganese	126		1.18	mg/kg	SW846 6010C
Nickel	7.08		1.18	mg/kg	SW846 6010C
Potassium	619		59.2	mg/kg	SW846 6010C
Sodium	54.7		29.5	mg/kg	SW846 6010C
Vanadium	6.73		1.77	mg/kg	SW846 6010C
Zinc	9.46		1.18	mg/kg	SW846 6010C

Lab ID: SC43071-11

Client ID: SB-2 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	4850		5.48	mg/kg	SW846 6010C
Arsenic	2.45		1.65	mg/kg	SW846 6010C
Barium	30.1		1.10	mg/kg	SW846 6010C
Beryllium	0.252	J	0.548	mg/kg	SW846 6010C
Cadmium	0.893		0.548	mg/kg	SW846 6010C
Calcium	5160		27.4	mg/kg	SW846 6010C
Chromium	8.98		1.10	mg/kg	SW846 6010C
Cobalt	3.29		1.11	mg/kg	SW846 6010C
Copper	25.8		1.10	mg/kg	SW846 6010C
Iron	8960	R06	548	mg/kg	SW846 6010C
Lead	44.6		1.65	mg/kg	SW846 6010C
Magnesium	2810		5.48	mg/kg	SW846 6010C
Manganese	163		1.10	mg/kg	SW846 6010C
Nickel	8.58		1.10	mg/kg	SW846 6010C
Potassium	281		55.3	mg/kg	SW846 6010C
Sodium	59.9		27.4	mg/kg	SW846 6010C
Vanadium	13.9		1.65	mg/kg	SW846 6010C
Zinc	44.9		1.10	mg/kg	SW846 6010C
Mercury	0.0557		0.0287	mg/kg	SW846 7471B
4,4'-DDT (p,p') [2C]	14.3	J, D	43.8	µg/kg	SW846 8081B
alpha-Chlordane	13.6	P, J, D	27.3	µg/kg	SW846 8081B
Chlordane (gamma)(trans)	10.7	J, D	27.3	µg/kg	SW846 8081B
Aroclor-1262	12.6		11.0	µg/kg	SW846 8082A
Benzo (a) pyrene	250	J, D	368	µg/kg	SW846 8270D
Benzo (b) fluoranthene	257	J, D	368	µg/kg	SW846 8270D
Benzo (g,h,i) perylene	303	J, D	368	µg/kg	SW846 8270D
Benzo (k) fluoranthene	193	J, D	368	µg/kg	SW846 8270D
Chrysene	189	J, D	368	µg/kg	SW846 8270D
Fluoranthene	299	J, D	368	µg/kg	SW846 8270D
Indeno (1,2,3-cd) pyrene	252	J, D	368	µg/kg	SW846 8270D
Pyrene	259	J, D	368	µg/kg	SW846 8270D

Lab ID: SC43071-12

Client ID: SB-2 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	2350		5.67	mg/kg	SW846 6010C
Arsenic	0.613	J	1.70	mg/kg	SW846 6010C
Barium	16.6		1.13	mg/kg	SW846 6010C
Beryllium	0.153	J	0.567	mg/kg	SW846 6010C
Cadmium	0.567		0.567	mg/kg	SW846 6010C
Calcium	350		28.4	mg/kg	SW846 6010C
Chromium	11.2		1.13	mg/kg	SW846 6010C
Cobalt	2.10		1.13	mg/kg	SW846 6010C
Copper	7.16		1.13	mg/kg	SW846 6010C
Iron	7220	R06	567	mg/kg	SW846 6010C
Lead	2.10		1.70	mg/kg	SW846 6010C
Magnesium	835		5.67	mg/kg	SW846 6010C
Manganese	111		1.13	mg/kg	SW846 6010C
Nickel	6.98		1.13	mg/kg	SW846 6010C
Potassium	617		56.7	mg/kg	SW846 6010C
Sodium	57.3		28.4	mg/kg	SW846 6010C
Vanadium	8.28		1.70	mg/kg	SW846 6010C
Zinc	9.82		1.13	mg/kg	SW846 6010C

Lab ID: SC43071-13

Client ID: SB-4 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	4150		5.39	mg/kg	SW846 6010C
Arsenic	0.975	J	1.62	mg/kg	SW846 6010C
Barium	13.8		1.08	mg/kg	SW846 6010C
Beryllium	0.223	J	0.539	mg/kg	SW846 6010C
Cadmium	0.519	J	0.539	mg/kg	SW846 6010C
Calcium	415		26.9	mg/kg	SW846 6010C
Chromium	6.94		1.08	mg/kg	SW846 6010C
Cobalt	3.13		1.06	mg/kg	SW846 6010C
Copper	4.78		1.08	mg/kg	SW846 6010C
Iron	6970	R06	539	mg/kg	SW846 6010C
Lead	2.68		1.62	mg/kg	SW846 6010C
Magnesium	900		5.39	mg/kg	SW846 6010C
Manganese	107		1.08	mg/kg	SW846 6010C
Nickel	7.51		1.08	mg/kg	SW846 6010C
Potassium	244		53.1	mg/kg	SW846 6010C
Sodium	52.1		26.9	mg/kg	SW846 6010C
Vanadium	9.41		1.62	mg/kg	SW846 6010C
Zinc	9.69		1.08	mg/kg	SW846 6010C

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Lab ID: SC43071-14

Client ID: SB-4 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	1880		6.20	mg/kg	SW846 6010C
Arsenic	0.415	J	1.86	mg/kg	SW846 6010C
Barium	10.9		1.24	mg/kg	SW846 6010C
Beryllium	0.0905	J	0.620	mg/kg	SW846 6010C
Cadmium	0.341	J	0.620	mg/kg	SW846 6010C
Calcium	189		31.0	mg/kg	SW846 6010C
Chromium	4.72		1.24	mg/kg	SW846 6010C
Cobalt	1.19	J	1.24	mg/kg	SW846 6010C
Copper	3.81		1.24	mg/kg	SW846 6010C
Iron	4680	R06	620	mg/kg	SW846 6010C
Lead	1.33	J	1.86	mg/kg	SW846 6010C
Magnesium	636		6.20	mg/kg	SW846 6010C
Manganese	87.3		1.24	mg/kg	SW846 6010C
Nickel	3.31		1.24	mg/kg	SW846 6010C
Potassium	323		61.9	mg/kg	SW846 6010C
Sodium	78.7		31.0	mg/kg	SW846 6010C
Vanadium	5.51		1.86	mg/kg	SW846 6010C
Zinc	6.30		1.24	mg/kg	SW846 6010C

Lab ID: SC43071-16

Client ID: SB-5 (0-2')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	5190		5.16	mg/kg	SW846 6010C
Arsenic	1.53	J	1.55	mg/kg	SW846 6010C
Barium	24.2		1.03	mg/kg	SW846 6010C
Beryllium	0.261	J	0.516	mg/kg	SW846 6010C
Cadmium	0.657		0.516	mg/kg	SW846 6010C
Calcium	7780		25.8	mg/kg	SW846 6010C
Chromium	8.18		1.03	mg/kg	SW846 6010C
Cobalt	2.75		1.03	mg/kg	SW846 6010C
Copper	31.0		1.03	mg/kg	SW846 6010C
Iron	7980	R06	516	mg/kg	SW846 6010C
Lead	28.9		1.55	mg/kg	SW846 6010C
Magnesium	4360		5.16	mg/kg	SW846 6010C
Manganese	137		1.03	mg/kg	SW846 6010C
Nickel	7.97		1.03	mg/kg	SW846 6010C
Potassium	214		51.7	mg/kg	SW846 6010C
Sodium	79.6		25.8	mg/kg	SW846 6010C
Vanadium	13.9		1.55	mg/kg	SW846 6010C
Zinc	22.4		1.03	mg/kg	SW846 6010C
Mercury	0.0156	J	0.0300	mg/kg	SW846 7471B
4,4'-DDE (p,p')	13.2		5.17	µg/kg	SW846 8081B
4,4'-DDT (p,p')	10.7		8.27	µg/kg	SW846 8081B
alpha-Chlordane	2.20	P, J	5.17	µg/kg	SW846 8081B

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Lab ID: SC43071-17

Client ID: SB-5 (12-14')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	2940		5.39	mg/kg	SW846 6010C
Arsenic	0.323	J	1.62	mg/kg	SW846 6010C
Barium	18.4		1.08	mg/kg	SW846 6010C
Beryllium	0.117	J	0.539	mg/kg	SW846 6010C
Cadmium	0.418	J	0.539	mg/kg	SW846 6010C
Calcium	251		26.9	mg/kg	SW846 6010C
Chromium	8.77		1.08	mg/kg	SW846 6010C
Cobalt	1.41		1.08	mg/kg	SW846 6010C
Copper	5.29		1.08	mg/kg	SW846 6010C
Iron	5780	R06	539	mg/kg	SW846 6010C
Lead	1.68		1.62	mg/kg	SW846 6010C
Magnesium	1130		5.39	mg/kg	SW846 6010C
Manganese	82.8		1.08	mg/kg	SW846 6010C
Nickel	6.88		1.08	mg/kg	SW846 6010C
Potassium	597		54.0	mg/kg	SW846 6010C
Sodium	59.3		26.9	mg/kg	SW846 6010C
Vanadium	9.11		1.62	mg/kg	SW846 6010C
Zinc	9.65		1.08	mg/kg	SW846 6010C
Cyanide (total)	0.256	J	0.296	mg/kg	SW846 9012B

Lab ID: SC43071-18

Client ID: SB-5 (15-17')

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	2450		5.98	mg/kg	SW846 6010C
Arsenic	0.526	J	1.79	mg/kg	SW846 6010C
Barium	14.7		1.20	mg/kg	SW846 6010C
Beryllium	0.121	J	0.598	mg/kg	SW846 6010C
Cadmium	0.480	J	0.598	mg/kg	SW846 6010C
Calcium	217		29.9	mg/kg	SW846 6010C
Chromium	7.18		1.20	mg/kg	SW846 6010C
Cobalt	1.73		1.20	mg/kg	SW846 6010C
Copper	5.71		1.20	mg/kg	SW846 6010C
Iron	6510	R06	598	mg/kg	SW846 6010C
Lead	1.83		1.79	mg/kg	SW846 6010C
Magnesium	838		5.98	mg/kg	SW846 6010C
Manganese	209		1.20	mg/kg	SW846 6010C
Nickel	5.23		1.20	mg/kg	SW846 6010C
Potassium	504		60.1	mg/kg	SW846 6010C
Sodium	48.4		29.9	mg/kg	SW846 6010C
Vanadium	8.23		1.79	mg/kg	SW846 6010C
Zinc	8.54		1.20	mg/kg	SW846 6010C
Cyanide (total)	0.264	J	0.310	mg/kg	SW846 9012B

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Lab ID: SC43071-19

Client ID: DUP-011118

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	4700		5.19	mg/kg	SW846 6010C
Arsenic	0.996	J	1.56	mg/kg	SW846 6010C
Barium	16.5		1.04	mg/kg	SW846 6010C
Beryllium	0.236	J	0.519	mg/kg	SW846 6010C
Cadmium	0.550		0.519	mg/kg	SW846 6010C
Calcium	430		25.9	mg/kg	SW846 6010C
Chromium	7.96		1.04	mg/kg	SW846 6010C
Cobalt	2.58		1.03	mg/kg	SW846 6010C
Copper	4.97		1.04	mg/kg	SW846 6010C
Iron	7490	R06	519	mg/kg	SW846 6010C
Lead	2.94		1.56	mg/kg	SW846 6010C
Magnesium	962		5.19	mg/kg	SW846 6010C
Manganese	112		1.04	mg/kg	SW846 6010C
Nickel	8.31		1.04	mg/kg	SW846 6010C
Potassium	193		51.5	mg/kg	SW846 6010C
Sodium	61.4		25.9	mg/kg	SW846 6010C
Vanadium	10.4		1.56	mg/kg	SW846 6010C
Zinc	10.2		1.04	mg/kg	SW846 6010C
Mercury	0.0087	J	0.0304	mg/kg	SW846 7471B

*Please note that because there are no reporting limits associated with hazardous waste characterizations or micro analyses, this summary does not include hits from these analyses if included in this work order.*

SC43071-01

[none]

Soil

09-Jan-18 11:15

12-Jan-18

Initial weight: 14.53 g

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Sample Identification

SB-8 (0-2')

SC43071-01

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 11:15

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 14.53 g													
100-41-4	Ethylbenzene	< 56.9	U, D	µg/kg dry	56.9	8.19	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 56.9	U, D	µg/kg dry	56.9	28.5	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 114	U, D	µg/kg dry	114	69.8	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 56.9	U, D	µg/kg dry	56.9	11.2	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 56.9	U, D	µg/kg dry	56.9	12.2	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 56.9	U, D	µg/kg dry	56.9	20.9	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 114	U, D	µg/kg dry	114	29.2	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 114	U, D	µg/kg dry	114	22.6	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 56.9	U, D	µg/kg dry	56.9	33.8	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 56.9	U, D	µg/kg dry	56.9	9.21	50	"	"	"	"	"	X
100-42-5	Styrene	< 56.9	U, D	µg/kg dry	56.9	11.4	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 56.9	U, D	µg/kg dry	56.9	48.3	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 56.9	U, D	µg/kg dry	56.9	48.1	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 56.9	U, D	µg/kg dry	56.9	19.4	50	"	"	"	"	"	X
108-88-3	Toluene	< 56.9	U, D	µg/kg dry	56.9	18.4	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 56.9	U, D	µg/kg dry	56.9	20.0	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 56.9	U, D	µg/kg dry	56.9	41.9	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 56.9	U, D	µg/kg dry	56.9	17.9	50	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 56.9	U, D	µg/kg dry	56.9	18.9	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 56.9	U, D	µg/kg dry	56.9	41.2	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 56.9	U, D	µg/kg dry	56.9	15.5	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 56.9	U, D	µg/kg dry	56.9	30.6	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 56.9	U, D	µg/kg dry	56.9	42.6	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 56.9	U, D	µg/kg dry	56.9	13.8	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 56.9	U, D	µg/kg dry	56.9	9.78	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 56.9	U, D	µg/kg dry	56.9	19.2	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 114	U, D	µg/kg dry	114	10.2	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 56.9	U, D	µg/kg dry	56.9	15.9	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 114	U, D	µg/kg dry	114	89.6	50	"	"	"	"	"	
60-29-7	Ethyl ether	< 56.9	U, D	µg/kg dry	56.9	51.5	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 56.9	U, D	µg/kg dry	56.9	19.0	50	"	"	"	"	"	
637-92-3	Ethyl tert-butyl ether	< 56.9	U, D	µg/kg dry	56.9	30.6	50	"	"	"	"	"	
108-20-3	Di-isopropyl ether	< 56.9	U, D	µg/kg dry	56.9	10.6	50	"	"	"	"	"	
75-65-0	Tert-Butanol / butyl alcohol	< 569	U, D	µg/kg dry	569	372	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1140	U, D	µg/kg dry	1140	988	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 284	U, D	µg/kg dry	284	130	50	"	"	"	"	"	X
64-17-5	Ethanol	< 11400	U, D	µg/kg dry	11400	2120	50	"	"	"	"	"	
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	104			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	99			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	96			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	94			70-130 %			"	"	"	"	"	

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Sample Identification

SB-8 (0-2')

SC43071-01

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 11:15

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 349	U, D	µg/kg dry	349	174	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 349	U, D	µg/kg dry	349	172	5	"	"	"	"	"	X
62-53-3	Aniline	< 1730	U, D	µg/kg dry	1730	124	5	"	"	"	"	"	X
120-12-7	Anthracene	< 349	U, D	µg/kg dry	349	167	5	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 1730	U, D	µg/kg dry	1730	170	5	"	"	"	"	"	
92-87-5	Benzidine	< 1730	U, D	µg/kg dry	1730	348	5	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 349	U, D	µg/kg dry	349	184	5	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 349	U, D	µg/kg dry	349	130	5	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 349	U, D	µg/kg dry	349	169	5	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 349	U, D	µg/kg dry	349	140	5	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 349	U, D	µg/kg dry	349	137	5	"	"	"	"	"	X
65-85-0	Benzoic acid	< 1730	U, D	µg/kg dry	1730	363	5	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 1730	U, D	µg/kg dry	1730	142	5	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 1730	U, D	µg/kg dry	1730	154	5	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 875	U, D	µg/kg dry	875	125	5	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 875	U, D	µg/kg dry	875	135	5	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 875	U, D	µg/kg dry	875	216	5	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 1730	U, D	µg/kg dry	1730	162	5	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 1730	U, D	µg/kg dry	1730	202	5	"	"	"	"	"	X
86-74-8	Carbazole	< 875	U, D	µg/kg dry	875	488	5	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 1730	U, D	µg/kg dry	1730	165	5	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 875	U, D	µg/kg dry	875	189	5	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 1730	U, D	µg/kg dry	1730	160	5	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 875	U, D	µg/kg dry	875	156	5	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 1730	U, D	µg/kg dry	1730	205	5	"	"	"	"	"	X
218-01-9	Chrysene	< 349	U, D	µg/kg dry	349	174	5	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 349	U, D	µg/kg dry	349	134	5	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 875	U, D	µg/kg dry	875	133	5	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1730	U, D	µg/kg dry	1730	151	5	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1730	U, D	µg/kg dry	1730	151	5	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1730	U, D	µg/kg dry	1730	160	5	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 1730	U, D	µg/kg dry	1730	263	5	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 875	U, D	µg/kg dry	875	164	5	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 1730	U, D	µg/kg dry	1730	214	5	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 1730	U, D	µg/kg dry	1730	189	5	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 1730	U, D	µg/kg dry	1730	124	5	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 1730	U, D	µg/kg dry	1730	183	5	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 1730	U, D	µg/kg dry	1730	222	5	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 1730	U, D	µg/kg dry	1730	176	5	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 875	U, D	µg/kg dry	875	338	5	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 875	U, D	µg/kg dry	875	197	5	"	"	"	"	"	X

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Sample Identification

SB-8 (0-2')

SC43071-01

Client Project #

[none]

Matrix

Soil

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12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

R01

117-84-0	Di-n-octyl phthalate	< 1730	U, D	µg/kg dry	1730	195	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 349	U, D	µg/kg dry	349	185	5	"	"	"	"	"	X
86-73-7	Fluorene	< 349	U, D	µg/kg dry	349	178	5	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 875	U, D	µg/kg dry	875	172	5	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 875	U, D	µg/kg dry	875	209	5	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 875	U, D	µg/kg dry	875	119	5	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 875	U, D	µg/kg dry	875	189	5	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 349	U, D	µg/kg dry	349	126	5	"	"	"	"	"	X
78-59-1	Isophorone	< 875	U, D	µg/kg dry	875	164	5	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 349	U, D	µg/kg dry	349	211	5	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 1730	U, D	µg/kg dry	1730	147	5	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 1730	U, D	µg/kg dry	1730	167	5	"	"	"	"	"	X
91-20-3	Naphthalene	< 349	U, D	µg/kg dry	349	163	5	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 1730	U, D	µg/kg dry	1730	147	5	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 1730	U, D	µg/kg dry	1730	236	5	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 875	U, D	µg/kg dry	875	269	5	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 875	U, D	µg/kg dry	875	159	5	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 875	U, D	µg/kg dry	875	145	5	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 6920	U, D	µg/kg dry	6920	279	5	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 875	U, D	µg/kg dry	875	162	5	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 875	U, D	µg/kg dry	875	170	5	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 1730	U, D	µg/kg dry	1730	188	5	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 1730	U, D	µg/kg dry	1730	185	5	"	"	"	"	"	X
85-01-8	Phenanthrene	< 349	U, D	µg/kg dry	349	163	5	"	"	"	"	"	X
108-95-2	Phenol	< 1730	U, D	µg/kg dry	1730	114	5	"	"	"	"	"	X
129-00-0	Pyrene	< 349	U, D	µg/kg dry	349	195	5	"	"	"	"	"	X
110-86-1	Pyridine	< 1730	U, D	µg/kg dry	1730	258	5	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1730	U, D	µg/kg dry	1730	171	5	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 349	U, D	µg/kg dry	349	172	5	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 1730	U, D	µg/kg dry	1730	156	5	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 875	U, D	µg/kg dry	875	156	5	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 1730	U, D	µg/kg dry	1730	273	5	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 1730	U, D	µg/kg dry	1730	168	5	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	53			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	49			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	52			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	45			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	61			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	58			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 20.9	U	µg/kg dry	20.9	9.34	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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Sample Identification

SB-8 (0-2')

SC43071-01

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 20.9	U	µg/kg dry	20.9	11.1	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 20.9	U	µg/kg dry	20.9	10.4	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 20.9	U	µg/kg dry	20.9	20.6	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 20.9	U	µg/kg dry	20.9	19.1	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 20.9	U	µg/kg dry	20.9	13.6	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 20.9	U	µg/kg dry	20.9	11.2	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 20.9	U	µg/kg dry	20.9	18.2	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 20.9	U	µg/kg dry	20.9	9.41	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	35			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	35			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	60			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 26.0	U, D	µg/kg dry	26.0	6.97	5	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 26.0	U, D	µg/kg dry	26.0	10.3	5	"	"	"	"	"	X
319-86-8	delta-BHC	< 26.0	U, D	µg/kg dry	26.0	7.49	5	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 15.6	U, D	µg/kg dry	15.6	7.49	5	"	"	"	"	"	X
76-44-8	Heptachlor	< 26.0	U, D	µg/kg dry	26.0	8.69	5	"	"	"	"	"	X
309-00-2	Aldrin	< 26.0	U, D	µg/kg dry	26.0	8.01	5	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 26.0	U, D	µg/kg dry	26.0	9.21	5	"	"	"	"	"	X
959-98-8	Endosulfan I	< 26.0	U, D	µg/kg dry	26.0	9.15	5	"	"	"	"	"	X
60-57-1	Dieldrin	< 26.0	U, D	µg/kg dry	26.0	9.15	5	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 26.0	U, D	µg/kg dry	26.0	8.22	5	"	"	"	"	"	X
72-20-8	Endrin	< 41.6	U, D	µg/kg dry	41.6	9.15	5	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 41.6	U, D	µg/kg dry	41.6	9.78	5	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 41.6	U, D	µg/kg dry	41.6	9.05	5	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 41.6	U, D	µg/kg dry	41.6	8.69	5	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 41.6	U, D	µg/kg dry	41.6	8.01	5	"	"	"	"	"	X
72-43-5	Methoxychlor	< 41.6	U, D	µg/kg dry	41.6	9.21	5	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 41.6	U, D	µg/kg dry	41.6	9.36	5	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 41.6	U, D	µg/kg dry	41.6	8.69	5	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 26.0	U, D	µg/kg dry	26.0	8.89	5	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 26.0	U, D	µg/kg dry	26.0	9.36	5	"	"	"	"	"	X
8001-35-2	Toxaphene	< 520	U, D	µg/kg dry	520	113	5	"	"	"	"	"	X
57-74-9	Chlordane	< 104	U, D	µg/kg dry	104	103	5	"	"	"	"	"	X
15972-60-8	Alachlor	< 26.0	U, D	µg/kg dry	26.0	12.7	5	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	86			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	92			30-150 %			"	"	"	"	"	

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**Pesticides**Organochlorine Pesticides

R01

2051-24-3	Decachlorobiphenyl (Sr)	114			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	126			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.55	U	mg/kg dry	1.55	0.167	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	5,700		mg/kg dry	5.17	1.17	1	"	"	"	"	"	X
7440-38-2	Arsenic	1.91		mg/kg dry	1.55	0.196	1	"	"	"	"	"	X
7440-39-3	Barium	27.9		mg/kg dry	1.03	0.122	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.277	J	mg/kg dry	0.517	0.0259	1	"	"	"	"	"	X
7440-70-2	Calcium	2,820		mg/kg dry	25.8	5.29	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.708		mg/kg dry	0.517	0.0268	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.49		mg/kg dry	1.05	0.0606	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	8.99		mg/kg dry	1.03	0.137	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	11.9		mg/kg dry	1.03	0.248	1	"	"	"	"	"	X
7439-89-6	Iron	9,080	R06	mg/kg dry	517	2.13	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0232	J	mg/kg dry	0.0290	0.0081	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X
<u>Prepared by method SW846 3050B</u>													
7440-09-7	Potassium	278		mg/kg dry	52.3	3.65	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	2,050		mg/kg dry	5.17	1.49	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	157		mg/kg dry	1.03	0.263	1	"	"	"	"	"	X
7440-23-5	Sodium	101		mg/kg dry	25.8	11.1	1	"	"	"	"	"	X
7440-02-0	Nickel	7.36		mg/kg dry	1.03	0.119	1	"	"	"	"	"	X
7439-92-1	Lead	21.2		mg/kg dry	1.55	0.219	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.23	U	mg/kg dry	5.23	0.393	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.57	U	mg/kg dry	1.57	0.299	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.10	U	mg/kg dry	3.10	1.14	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	15.1		mg/kg dry	1.55	0.275	1	"	"	"	"	"	X
7440-66-6	Zinc	22.5		mg/kg dry	1.03	0.800	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	95.1		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.264	U	mg/kg dry	0.264	0.223	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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SC43071-02

[none]

Soil

09-Jan-18 12:05

12-Jan-18

1800494

VOC8

Initial weight: 15.37 g

76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 58.4	U, D	µg/kg dry	58.4	29.6	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 584	U, D	µg/kg dry	584	234	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 58.4	U, D	µg/kg dry	58.4	56.1	50	"	"	"	"	"	X
71-43-2	Benzene	< 58.4	U, D	µg/kg dry	58.4	15.5	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 58.4	U, D	µg/kg dry	58.4	15.6	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 58.4	U, D	µg/kg dry	58.4	29.5	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 58.4	U, D	µg/kg dry	58.4	39.0	50	"	"	"	"	"	X
75-25-2	Bromoform	< 58.4	U, D	µg/kg dry	58.4	55.7	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 117	U, D	µg/kg dry	117	52.8	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 117	U, D	µg/kg dry	117	104	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 58.4	U, D	µg/kg dry	58.4	16.7	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 58.4	U, D	µg/kg dry	58.4	10.6	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 58.4	U, D	µg/kg dry	58.4	13.1	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 117	U, D	µg/kg dry	117	37.4	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 58.4	U, D	µg/kg dry	58.4	47.8	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 58.4	U, D	µg/kg dry	58.4	18.3	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 117	U, D	µg/kg dry	117	32.4	50	"	"	"	"	"	X
67-66-3	Chloroform	< 58.4	U, D	µg/kg dry	58.4	31.4	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 117	U, D	µg/kg dry	117	24.1	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 58.4	U, D	µg/kg dry	58.4	14.5	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 58.4	U, D	µg/kg dry	58.4	13.7	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 117	U, D	µg/kg dry	117	84.4	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 58.4	U, D	µg/kg dry	58.4	39.6	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 58.4	U, D	µg/kg dry	58.4	39.2	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 58.4	U, D	µg/kg dry	58.4	30.4	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 58.4	U, D	µg/kg dry	58.4	15.2	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 58.4	U, D	µg/kg dry	58.4	12.7	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 58.4	U, D	µg/kg dry	58.4	17.3	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 117	U, D	µg/kg dry	117	22.1	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 58.4	U, D	µg/kg dry	58.4	15.3	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 58.4	U, D	µg/kg dry	58.4	20.9	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 58.4	U, D	µg/kg dry	58.4	30.6	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 58.4	U, D	µg/kg dry	58.4	21.7	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 58.4	U, D	µg/kg dry	58.4	31.0	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 58.4	U, D	µg/kg dry	58.4	30.6	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 58.4	U, D	µg/kg dry	58.4	30.3	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 58.4	U, D	µg/kg dry	58.4	27.6	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 58.4	U, D	µg/kg dry	58.4	18.8	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 58.4	U, D	µg/kg dry	58.4	35.2	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 58.4	U, D	µg/kg dry	58.4	30.7	50	"	"	"	"	"	X

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Sample Identification

SB-8 (15-17')

SC43071-02

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 12:05

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 15.37 g													
100-41-4	Ethylbenzene	< 58.4	U, D	µg/kg dry	58.4	8.41	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 58.4	U, D	µg/kg dry	58.4	29.3	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 117	U, D	µg/kg dry	117	71.7	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 58.4	U, D	µg/kg dry	58.4	11.5	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 58.4	U, D	µg/kg dry	58.4	12.6	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 58.4	U, D	µg/kg dry	58.4	21.5	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 117	U, D	µg/kg dry	117	30.0	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 117	U, D	µg/kg dry	117	23.2	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 58.4	U, D	µg/kg dry	58.4	34.8	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 58.4	U, D	µg/kg dry	58.4	9.46	50	"	"	"	"	"	X
100-42-5	Styrene	< 58.4	U, D	µg/kg dry	58.4	11.7	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 58.4	U, D	µg/kg dry	58.4	49.7	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 58.4	U, D	µg/kg dry	58.4	49.4	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 58.4	U, D	µg/kg dry	58.4	20.0	50	"	"	"	"	"	X
108-88-3	Toluene	< 58.4	U, D	µg/kg dry	58.4	18.9	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 58.4	U, D	µg/kg dry	58.4	20.5	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 58.4	U, D	µg/kg dry	58.4	43.1	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 58.4	U, D	µg/kg dry	58.4	18.3	50	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 58.4	U, D	µg/kg dry	58.4	19.4	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 58.4	U, D	µg/kg dry	58.4	42.4	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 58.4	U, D	µg/kg dry	58.4	15.9	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 58.4	U, D	µg/kg dry	58.4	31.5	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 58.4	U, D	µg/kg dry	58.4	43.8	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 58.4	U, D	µg/kg dry	58.4	14.2	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 58.4	U, D	µg/kg dry	58.4	10.0	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 58.4	U, D	µg/kg dry	58.4	19.7	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 117	U, D	µg/kg dry	117	10.5	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 58.4	U, D	µg/kg dry	58.4	16.4	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 117	U, D	µg/kg dry	117	92.1	50	"	"	"	"	"	
60-29-7	Ethyl ether	< 58.4	U, D	µg/kg dry	58.4	52.9	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 58.4	U, D	µg/kg dry	58.4	19.5	50	"	"	"	"	"	
637-92-3	Ethyl tert-butyl ether	< 58.4	U, D	µg/kg dry	58.4	31.5	50	"	"	"	"	"	
108-20-3	Di-isopropyl ether	< 58.4	U, D	µg/kg dry	58.4	10.9	50	"	"	"	"	"	
75-65-0	Tert-Butanol / butyl alcohol	< 584	U, D	µg/kg dry	584	382	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1170	U, D	µg/kg dry	1170	1010	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 292	U, D	µg/kg dry	292	133	50	"	"	"	"	"	X
64-17-5	Ethanol	< 11700	U, D	µg/kg dry	11700	2180	50	"	"	"	"	"	
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	104			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	98			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	97			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	94			70-130 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-8 (15-17')

SC43071-02

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 12:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 72.9	U	µg/kg dry	72.9	36.3	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 72.9	U	µg/kg dry	72.9	36.0	1	"	"	"	"	"	X
62-53-3	Aniline	< 361	U	µg/kg dry	361	25.9	1	"	"	"	"	"	X
120-12-7	Anthracene	< 72.9	U	µg/kg dry	72.9	34.9	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 361	U	µg/kg dry	361	35.5	1	"	"	"	"	"	
92-87-5	Benzidine	< 361	U	µg/kg dry	361	72.6	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 72.9	U	µg/kg dry	72.9	38.5	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 72.9	U	µg/kg dry	72.9	27.1	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 72.9	U	µg/kg dry	72.9	35.3	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 72.9	U	µg/kg dry	72.9	29.3	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 72.9	U	µg/kg dry	72.9	28.5	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 361	U	µg/kg dry	361	75.7	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 361	U	µg/kg dry	361	29.5	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 361	U	µg/kg dry	361	32.0	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 183	U	µg/kg dry	183	26.1	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 183	U	µg/kg dry	183	28.1	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	47.7	J	µg/kg dry	183	45.0	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 361	U	µg/kg dry	361	33.8	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 361	U	µg/kg dry	361	42.1	1	"	"	"	"	"	X
86-74-8	Carbazole	< 183	U	µg/kg dry	183	102	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 361	U	µg/kg dry	361	34.4	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 183	U	µg/kg dry	183	39.5	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 361	U	µg/kg dry	361	33.3	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 183	U	µg/kg dry	183	32.5	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 361	U	µg/kg dry	361	42.9	1	"	"	"	"	"	X
218-01-9	Chrysene	< 72.9	U	µg/kg dry	72.9	36.4	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 72.9	U	µg/kg dry	72.9	28.0	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 183	U	µg/kg dry	183	27.8	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 361	U	µg/kg dry	361	31.5	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 361	U	µg/kg dry	361	31.5	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 361	U	µg/kg dry	361	33.4	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 361	U	µg/kg dry	361	54.9	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 183	U	µg/kg dry	183	34.1	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 361	U	µg/kg dry	361	44.6	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 361	U	µg/kg dry	361	39.5	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 361	U	µg/kg dry	361	25.8	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 361	U	µg/kg dry	361	38.3	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 361	U	µg/kg dry	361	46.3	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 361	U	µg/kg dry	361	36.7	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 183	U	µg/kg dry	183	70.6	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 183	U	µg/kg dry	183	41.1	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-8 (15-17')

SC43071-02

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 12:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 361	U	µg/kg dry	361	40.8	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 72.9	U	µg/kg dry	72.9	38.5	1	"	"	"	"	"	X
86-73-7	Fluorene	< 72.9	U	µg/kg dry	72.9	37.1	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 183	U	µg/kg dry	183	35.9	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 183	U	µg/kg dry	183	43.6	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 183	U	µg/kg dry	183	24.8	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 183	U	µg/kg dry	183	39.4	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 72.9	U	µg/kg dry	72.9	26.2	1	"	"	"	"	"	X
78-59-1	Isophorone	< 183	U	µg/kg dry	183	34.2	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 72.9	U	µg/kg dry	72.9	44.1	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 361	U	µg/kg dry	361	30.7	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 361	U	µg/kg dry	361	34.9	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 72.9	U	µg/kg dry	72.9	34.0	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 361	U	µg/kg dry	361	30.6	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 361	U	µg/kg dry	361	49.3	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 183	U	µg/kg dry	183	56.2	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 183	U	µg/kg dry	183	33.2	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 183	U	µg/kg dry	183	30.3	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1440	U	µg/kg dry	1440	58.3	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 183	U	µg/kg dry	183	33.9	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 183	U	µg/kg dry	183	35.5	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 361	U	µg/kg dry	361	39.1	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 361	U	µg/kg dry	361	38.5	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 72.9	U	µg/kg dry	72.9	33.9	1	"	"	"	"	"	X
108-95-2	Phenol	< 361	U	µg/kg dry	361	23.7	1	"	"	"	"	"	X
129-00-0	Pyrene	< 72.9	U	µg/kg dry	72.9	40.7	1	"	"	"	"	"	X
110-86-1	Pyridine	< 361	U	µg/kg dry	361	53.8	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 361	U	µg/kg dry	361	35.7	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 72.9	U	µg/kg dry	72.9	35.9	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 361	U	µg/kg dry	361	32.5	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 183	U	µg/kg dry	183	32.6	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 361	U	µg/kg dry	361	57.0	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 361	U	µg/kg dry	361	35.0	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	60			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	53			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	55			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	52			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	72			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	63			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 21.8	U	µg/kg dry	21.8	9.76	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*



Sample Identification

SB-8 (15-17')

SC43071-02

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 12:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 21.8	U	µg/kg dry	21.8	11.6	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 21.8	U	µg/kg dry	21.8	10.9	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 21.8	U	µg/kg dry	21.8	21.5	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 21.8	U	µg/kg dry	21.8	19.9	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 21.8	U	µg/kg dry	21.8	14.2	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 21.8	U	µg/kg dry	21.8	11.7	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 21.8	U	µg/kg dry	21.8	19.0	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 21.8	U	µg/kg dry	21.8	9.82	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	35			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	40			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	50			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.40	U	µg/kg dry	5.40	1.45	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.40	U	µg/kg dry	5.40	2.14	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.40	U	µg/kg dry	5.40	1.55	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.24	U	µg/kg dry	3.24	1.55	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.40	U	µg/kg dry	5.40	1.80	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.40	U	µg/kg dry	5.40	1.66	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.40	U	µg/kg dry	5.40	1.91	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.40	U	µg/kg dry	5.40	1.90	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.40	U	µg/kg dry	5.40	1.90	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.40	U	µg/kg dry	5.40	1.71	1	"	"	"	"	"	X
72-20-8	Endrin	< 8.64	U	µg/kg dry	8.64	1.90	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 8.64	U	µg/kg dry	8.64	2.03	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 8.64	U	µg/kg dry	8.64	1.88	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 8.64	U	µg/kg dry	8.64	1.80	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 8.64	U	µg/kg dry	8.64	1.66	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 8.64	U	µg/kg dry	8.64	1.91	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 8.64	U	µg/kg dry	8.64	1.94	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 8.64	U	µg/kg dry	8.64	1.80	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.40	U	µg/kg dry	5.40	1.85	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.40	U	µg/kg dry	5.40	1.94	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 108	U	µg/kg dry	108	23.4	1	"	"	"	"	"	X
57-74-9	Chlordane	< 21.6	U	µg/kg dry	21.6	21.4	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.40	U	µg/kg dry	5.40	2.64	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	62			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	65			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-8 (15-17')

SC43071-02

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 12:05

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	95			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	116			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.63	U	mg/kg dry	1.63	0.176	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	3,080		mg/kg dry	5.43	1.23	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.646	J	mg/kg dry	1.63	0.206	1	"	"	"	"	"	X
7440-39-3	Barium	13.9		mg/kg dry	1.09	0.128	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.187	J	mg/kg dry	0.543	0.0272	1	"	"	"	"	"	X
7440-70-2	Calcium	294		mg/kg dry	27.1	5.56	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.494	J	mg/kg dry	0.543	0.0281	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.05		mg/kg dry	1.10	0.0635	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	10.9		mg/kg dry	1.09	0.144	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	5.97		mg/kg dry	1.09	0.260	1	"	"	"	"	"	X
7439-89-6	Iron	6,290	R06	mg/kg dry	543	2.24	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0325	U	mg/kg dry	0.0325	0.0090	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	443		mg/kg dry	54.8	3.82	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	848		mg/kg dry	5.43	1.56	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	91.5		mg/kg dry	1.09	0.277	1	"	"	"	"	"	X
7440-23-5	Sodium	55.3		mg/kg dry	27.1	11.7	1	"	"	"	"	"	X
7440-02-0	Nickel	5.80		mg/kg dry	1.09	0.125	1	"	"	"	"	"	X
7439-92-1	Lead	3.28		mg/kg dry	1.63	0.230	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.48	U	mg/kg dry	5.48	0.412	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.65	U	mg/kg dry	1.65	0.314	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.26	U	mg/kg dry	3.26	1.20	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	8.08		mg/kg dry	1.63	0.289	1	"	"	"	"	"	X
7440-66-6	Zinc	8.75		mg/kg dry	1.09	0.840	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	91.1		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	0.298	J	mg/kg dry	0.326	0.275	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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Sample Identification

SB-6 (0-2')

SC43071-03

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 14:20

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (high level)</u>													
Initial weight: 14.35 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 58.9	U, D	µg/kg dry	58.9	29.9	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 58.9	U, D	µg/kg dry	58.9	236	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 58.9	U, D	µg/kg dry	58.9	56.6	50	"	"	"	"	"	X
71-43-2	Benzene	< 58.9	U, D	µg/kg dry	58.9	15.6	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 58.9	U, D	µg/kg dry	58.9	15.7	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 58.9	U, D	µg/kg dry	58.9	29.8	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 58.9	U, D	µg/kg dry	58.9	39.3	50	"	"	"	"	"	X
75-25-2	Bromoform	< 58.9	U, D	µg/kg dry	58.9	56.2	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 118	U, D	µg/kg dry	118	53.2	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 118	U, D	µg/kg dry	118	105	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 58.9	U, D	µg/kg dry	58.9	16.9	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 58.9	U, D	µg/kg dry	58.9	10.7	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 58.9	U, D	µg/kg dry	58.9	13.2	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 118	U, D	µg/kg dry	118	37.7	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 58.9	U, D	µg/kg dry	58.9	48.2	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 58.9	U, D	µg/kg dry	58.9	18.5	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 118	U, D	µg/kg dry	118	32.7	50	"	"	"	"	"	X
67-66-3	Chloroform	< 58.9	U, D	µg/kg dry	58.9	31.7	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 118	U, D	µg/kg dry	118	24.3	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 58.9	U, D	µg/kg dry	58.9	14.7	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 58.9	U, D	µg/kg dry	58.9	13.9	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 118	U, D	µg/kg dry	118	85.2	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 58.9	U, D	µg/kg dry	58.9	40.0	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 58.9	U, D	µg/kg dry	58.9	39.6	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 58.9	U, D	µg/kg dry	58.9	30.7	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 58.9	U, D	µg/kg dry	58.9	15.3	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 58.9	U, D	µg/kg dry	58.9	12.8	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 58.9	U, D	µg/kg dry	58.9	17.4	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 118	U, D	µg/kg dry	118	22.3	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 58.9	U, D	µg/kg dry	58.9	15.4	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 58.9	U, D	µg/kg dry	58.9	21.1	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 58.9	U, D	µg/kg dry	58.9	30.8	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 58.9	U, D	µg/kg dry	58.9	21.9	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 58.9	U, D	µg/kg dry	58.9	31.2	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 58.9	U, D	µg/kg dry	58.9	30.9	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 58.9	U, D	µg/kg dry	58.9	30.5	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 58.9	U, D	µg/kg dry	58.9	27.8	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 58.9	U, D	µg/kg dry	58.9	19.0	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 58.9	U, D	µg/kg dry	58.9	35.5	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 58.9	U, D	µg/kg dry	58.9	30.9	50	"	"	"	"	"	X

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## Sample Identification

SB-6 (0-2')

SC43071-03

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

09-Jan-18 14:20

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 14.35 g													
100-41-4	Ethylbenzene	< 58.9	U, D	µg/kg dry	58.9	8.49	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 58.9	U, D	µg/kg dry	58.9	29.6	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 118	U, D	µg/kg dry	118	72.3	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 58.9	U, D	µg/kg dry	58.9	11.6	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 58.9	U, D	µg/kg dry	58.9	12.7	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 58.9	U, D	µg/kg dry	58.9	21.7	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 118	U, D	µg/kg dry	118	30.3	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 118	U, D	µg/kg dry	118	23.4	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 58.9	U, D	µg/kg dry	58.9	35.1	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 58.9	U, D	µg/kg dry	58.9	9.55	50	"	"	"	"	"	X
100-42-5	Styrene	< 58.9	U, D	µg/kg dry	58.9	11.8	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 58.9	U, D	µg/kg dry	58.9	50.1	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 58.9	U, D	µg/kg dry	58.9	49.9	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 58.9	U, D	µg/kg dry	58.9	20.2	50	"	"	"	"	"	X
108-88-3	Toluene	< 58.9	U, D	µg/kg dry	58.9	19.1	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 58.9	U, D	µg/kg dry	58.9	20.7	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 58.9	U, D	µg/kg dry	58.9	43.4	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 58.9	U, D	µg/kg dry	58.9	18.5	50	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 58.9	U, D	µg/kg dry	58.9	19.6	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 58.9	U, D	µg/kg dry	58.9	42.7	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 58.9	U, D	µg/kg dry	58.9	16.1	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 58.9	U, D	µg/kg dry	58.9	31.8	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 58.9	U, D	µg/kg dry	58.9	44.2	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 58.9	U, D	µg/kg dry	58.9	14.3	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 58.9	U, D	µg/kg dry	58.9	10.1	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 58.9	U, D	µg/kg dry	58.9	19.9	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 118	U, D	µg/kg dry	118	10.6	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 58.9	U, D	µg/kg dry	58.9	16.5	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 118	U, D	µg/kg dry	118	92.9	50	"	"	"	"	"	
60-29-7	Ethyl ether	< 58.9	U, D	µg/kg dry	58.9	53.4	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 58.9	U, D	µg/kg dry	58.9	19.7	50	"	"	"	"	"	
637-92-3	Ethyl tert-butyl ether	< 58.9	U, D	µg/kg dry	58.9	31.8	50	"	"	"	"	"	
108-20-3	Di-isopropyl ether	< 58.9	U, D	µg/kg dry	58.9	11.0	50	"	"	"	"	"	
75-65-0	Tert-Butanol / butyl alcohol	< 589	U, D	µg/kg dry	589	386	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1180	U, D	µg/kg dry	1180	1020	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 295	U, D	µg/kg dry	295	135	50	"	"	"	"	"	X
64-17-5	Ethanol	< 11800	U, D	µg/kg dry	11800	2200	50	"	"	"	"	"	
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	102			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	99			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	98			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	94			70-130 %			"	"	"	"	"	

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Sample Identification

SB-6 (0-2')

SC43071-03

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 14:20

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 70.8	U	µg/kg dry	70.8	35.2	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 70.8	U	µg/kg dry	70.8	34.9	1	"	"	"	"	"	X
62-53-3	Aniline	< 350	U	µg/kg dry	350	25.2	1	"	"	"	"	"	X
120-12-7	Anthracene	< 70.8	U	µg/kg dry	70.8	33.9	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 350	U	µg/kg dry	350	34.4	1	"	"	"	"	"	
92-87-5	Benzidine	< 350	U	µg/kg dry	350	70.5	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 70.8	U	µg/kg dry	70.8	37.4	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	45.3	J	µg/kg dry	70.8	26.4	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	55.5	J	µg/kg dry	70.8	34.3	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	28.7	J	µg/kg dry	70.8	28.4	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	46.3	J	µg/kg dry	70.8	27.7	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 350	U	µg/kg dry	350	73.5	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 350	U	µg/kg dry	350	28.7	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 350	U	µg/kg dry	350	31.1	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 177	U	µg/kg dry	177	25.4	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 177	U	µg/kg dry	177	27.3	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 177	U	µg/kg dry	177	43.7	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 350	U	µg/kg dry	350	32.8	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 350	U	µg/kg dry	350	40.9	1	"	"	"	"	"	X
86-74-8	Carbazole	< 177	U	µg/kg dry	177	98.9	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 350	U	µg/kg dry	350	33.4	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 177	U	µg/kg dry	177	38.3	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 350	U	µg/kg dry	350	32.4	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 177	U	µg/kg dry	177	31.5	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 350	U	µg/kg dry	350	41.6	1	"	"	"	"	"	X
218-01-9	Chrysene	43.9	J	µg/kg dry	70.8	35.3	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 70.8	U	µg/kg dry	70.8	27.2	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 177	U	µg/kg dry	177	27.0	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 350	U	µg/kg dry	350	30.6	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 350	U	µg/kg dry	350	30.6	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 350	U	µg/kg dry	350	32.5	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 350	U	µg/kg dry	350	53.3	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 177	U	µg/kg dry	177	33.1	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 350	U	µg/kg dry	350	43.3	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 350	U	µg/kg dry	350	38.3	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 350	U	µg/kg dry	350	25.0	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 350	U	µg/kg dry	350	37.1	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 350	U	µg/kg dry	350	45.0	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 350	U	µg/kg dry	350	35.7	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 177	U	µg/kg dry	177	68.6	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 177	U	µg/kg dry	177	39.9	1	"	"	"	"	"	X

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Sample Identification

SB-6 (0-2')

SC43071-03

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[none]

Matrix

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
117-84-0	Di-n-octyl phthalate	< 350	U	µg/kg dry	350	39.6	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	47.1	J	µg/kg dry	70.8	37.4	1	"	"	"	"	"	X
86-73-7	Fluorene	< 70.8	U	µg/kg dry	70.8	36.0	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 177	U	µg/kg dry	177	34.9	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 177	U	µg/kg dry	177	42.3	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 177	U	µg/kg dry	177	24.1	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 177	U	µg/kg dry	177	38.2	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	26.9	J	µg/kg dry	70.8	25.5	1	"	"	"	"	"	X
78-59-1	Isophorone	< 177	U	µg/kg dry	177	33.2	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 70.8	U	µg/kg dry	70.8	42.8	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 350	U	µg/kg dry	350	29.8	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 350	U	µg/kg dry	350	33.9	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 70.8	U	µg/kg dry	70.8	33.0	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 350	U	µg/kg dry	350	29.7	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 350	U	µg/kg dry	350	47.9	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 177	U	µg/kg dry	177	54.6	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 177	U	µg/kg dry	177	32.3	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 177	U	µg/kg dry	177	29.4	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1400	U	µg/kg dry	1400	56.6	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 177	U	µg/kg dry	177	32.9	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 177	U	µg/kg dry	177	34.5	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 350	U	µg/kg dry	350	38.0	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 350	U	µg/kg dry	350	37.4	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 70.8	U	µg/kg dry	70.8	32.9	1	"	"	"	"	"	X
108-95-2	Phenol	< 350	U	µg/kg dry	350	23.1	1	"	"	"	"	"	X
129-00-0	Pyrene	53.8	J	µg/kg dry	70.8	39.5	1	"	"	"	"	"	X
110-86-1	Pyridine	< 350	U	µg/kg dry	350	52.2	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 350	U	µg/kg dry	350	34.7	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 70.8	U	µg/kg dry	70.8	34.8	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 350	U	µg/kg dry	350	31.5	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 177	U	µg/kg dry	177	31.6	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 350	U	µg/kg dry	350	55.3	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 350	U	µg/kg dry	350	34.0	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	66			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	57			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	64			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	55			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	75			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	71			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 21.2	U	µg/kg dry	21.2	9.48	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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Sample Identification

SB-6 (0-2')

SC43071-03

Client Project #

[none]

Matrix

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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 21.2	U	µg/kg dry	21.2	11.3	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 21.2	U	µg/kg dry	21.2	10.6	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 21.2	U	µg/kg dry	21.2	20.9	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 21.2	U	µg/kg dry	21.2	19.3	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 21.2	U	µg/kg dry	21.2	13.8	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 21.2	U	µg/kg dry	21.2	11.3	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 21.2	U	µg/kg dry	21.2	18.5	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 21.2	U	µg/kg dry	21.2	9.55	1	"	"	"	"	"	X

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	45			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	50			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	75			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	90			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 10.5	U, D	µg/kg dry	10.5	2.83	2	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 10.5	U, D	µg/kg dry	10.5	4.18	2	"	"	"	"	"	X
319-86-8	delta-BHC	< 10.5	U, D	µg/kg dry	10.5	3.04	2	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 6.33	U, D	µg/kg dry	6.33	3.04	2	"	"	"	"	"	X
76-44-8	Heptachlor	< 10.5	U, D	µg/kg dry	10.5	3.52	2	"	"	"	"	"	X
309-00-2	Aldrin	< 10.5	U, D	µg/kg dry	10.5	3.25	2	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 10.5	U, D	µg/kg dry	10.5	3.73	2	"	"	"	"	"	X
959-98-8	Endosulfan I	< 10.5	U, D	µg/kg dry	10.5	3.71	2	"	"	"	"	"	X
60-57-1	Dieldrin	< 10.5	U, D	µg/kg dry	10.5	3.71	2	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 10.5	U, D	µg/kg dry	10.5	3.33	2	"	"	"	"	"	X
72-20-8	Endrin	< 16.9	U, D	µg/kg dry	16.9	3.71	2	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 16.9	U, D	µg/kg dry	16.9	3.96	2	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 16.9	U, D	µg/kg dry	16.9	3.67	2	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 16.9	U, D	µg/kg dry	16.9	3.52	2	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 16.9	U, D	µg/kg dry	16.9	3.25	2	"	"	"	"	"	X
72-43-5	Methoxychlor	< 16.9	U, D	µg/kg dry	16.9	3.73	2	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 16.9	U, D	µg/kg dry	16.9	3.80	2	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 16.9	U, D	µg/kg dry	16.9	3.52	2	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 10.5	U, D	µg/kg dry	10.5	3.61	2	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 10.5	U, D	µg/kg dry	10.5	3.80	2	"	"	"	"	"	X
8001-35-2	Toxaphene	< 211	U, D	µg/kg dry	211	45.6	2	"	"	"	"	"	X
57-74-9	Chlordane	< 42.2	U, D	µg/kg dry	42.2	41.7	2	"	"	"	"	"	X
15972-60-8	Alachlor	< 10.5	U, D	µg/kg dry	10.5	5.17	2	"	"	"	"	"	

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	80			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	73			30-150 %			"	"	"	"	"	

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Sample Identification

SB-6 (0-2')

SC43071-03

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[none]

Matrix

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<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

R01

2051-24-3	Decachlorobiphenyl (Sr)	46			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	96			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.58	U	mg/kg dry	1.58	0.170	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	5,300		mg/kg dry	5.26	1.19	1	"	"	"	"	"	X
7440-38-2	Arsenic	2.32		mg/kg dry	1.58	0.200	1	"	"	"	"	"	X
7440-39-3	Barium	26.0		mg/kg dry	1.05	0.124	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.304	J	mg/kg dry	0.526	0.0264	1	"	"	"	"	"	X
7440-70-2	Calcium	708		mg/kg dry	26.3	5.38	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.582		mg/kg dry	0.526	0.0272	1	"	"	"	"	"	X
7440-48-4	Cobalt	3.15		mg/kg dry	1.05	0.0610	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	8.52		mg/kg dry	1.05	0.140	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	10.4		mg/kg dry	1.05	0.252	1	"	"	"	"	"	X
7439-89-6	Iron	7,370	R06	mg/kg dry	526	2.17	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0413		mg/kg dry	0.0311	0.0086	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	214		mg/kg dry	52.6	3.67	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	883		mg/kg dry	5.26	1.51	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	112		mg/kg dry	1.05	0.268	1	"	"	"	"	"	X
7440-23-5	Sodium	449		mg/kg dry	26.3	11.3	1	"	"	"	"	"	X
7440-02-0	Nickel	8.34		mg/kg dry	1.05	0.121	1	"	"	"	"	"	X
7439-92-1	Lead	20.3		mg/kg dry	1.58	0.223	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.26	U	mg/kg dry	5.26	0.396	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.58	U	mg/kg dry	1.58	0.301	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.15	U	mg/kg dry	3.15	1.16	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	13.4		mg/kg dry	1.58	0.280	1	"	"	"	"	"	X
7440-66-6	Zinc	21.8		mg/kg dry	1.05	0.814	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	93.9		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.290	U	mg/kg dry	0.290	0.245	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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## Sample Identification

SB-6 (15-17')

SC43071-04

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

09-Jan-18 15:15

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (high level)</u>													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 57.7	U, D	µg/kg dry	57.7	29.3	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 57.7	U, D	µg/kg dry	57.7	231	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 57.7	U, D	µg/kg dry	57.7	55.5	50	"	"	"	"	"	X
71-43-2	Benzene	< 57.7	U, D	µg/kg dry	57.7	15.3	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 57.7	U, D	µg/kg dry	57.7	15.4	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 57.7	U, D	µg/kg dry	57.7	29.2	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 57.7	U, D	µg/kg dry	57.7	38.5	50	"	"	"	"	"	X
75-25-2	Bromoform	< 57.7	U, D	µg/kg dry	57.7	55.1	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 115	U, D	µg/kg dry	115	52.1	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 115	U, D	µg/kg dry	115	103	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 57.7	U, D	µg/kg dry	57.7	16.5	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 57.7	U, D	µg/kg dry	57.7	10.5	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 57.7	U, D	µg/kg dry	57.7	12.9	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 115	U, D	µg/kg dry	115	37.0	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 57.7	U, D	µg/kg dry	57.7	47.2	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 57.7	U, D	µg/kg dry	57.7	18.1	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 115	U, D	µg/kg dry	115	32.0	50	"	"	"	"	"	X
67-66-3	Chloroform	< 57.7	U, D	µg/kg dry	57.7	31.0	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 115	U, D	µg/kg dry	115	23.8	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 57.7	U, D	µg/kg dry	57.7	14.4	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 57.7	U, D	µg/kg dry	57.7	13.6	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 115	U, D	µg/kg dry	115	83.4	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 57.7	U, D	µg/kg dry	57.7	39.1	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 57.7	U, D	µg/kg dry	57.7	38.7	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 57.7	U, D	µg/kg dry	57.7	30.0	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 57.7	U, D	µg/kg dry	57.7	15.0	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 57.7	U, D	µg/kg dry	57.7	12.5	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 57.7	U, D	µg/kg dry	57.7	17.1	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 115	U, D	µg/kg dry	115	21.9	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 57.7	U, D	µg/kg dry	57.7	15.1	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 57.7	U, D	µg/kg dry	57.7	20.7	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 57.7	U, D	µg/kg dry	57.7	30.2	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 57.7	U, D	µg/kg dry	57.7	21.4	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 57.7	U, D	µg/kg dry	57.7	30.6	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 57.7	U, D	µg/kg dry	57.7	30.3	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 57.7	U, D	µg/kg dry	57.7	29.9	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 57.7	U, D	µg/kg dry	57.7	27.3	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 57.7	U, D	µg/kg dry	57.7	18.6	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 57.7	U, D	µg/kg dry	57.7	34.8	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 57.7	U, D	µg/kg dry	57.7	30.3	50	"	"	"	"	"	X

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Sample Identification

SB-6 (15-17')

SC43071-04

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 15:15

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 14.68 g													
100-41-4	Ethylbenzene	< 57.7	U, D	µg/kg dry	57.7	8.31	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 57.7	U, D	µg/kg dry	57.7	29.0	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 115	U, D	µg/kg dry	115	70.8	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 57.7	U, D	µg/kg dry	57.7	11.4	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 57.7	U, D	µg/kg dry	57.7	12.4	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 57.7	U, D	µg/kg dry	57.7	21.2	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 115	U, D	µg/kg dry	115	29.7	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 115	U, D	µg/kg dry	115	22.9	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 57.7	U, D	µg/kg dry	57.7	34.4	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 57.7	U, D	µg/kg dry	57.7	9.35	50	"	"	"	"	"	X
100-42-5	Styrene	< 57.7	U, D	µg/kg dry	57.7	11.6	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 57.7	U, D	µg/kg dry	57.7	49.1	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 57.7	U, D	µg/kg dry	57.7	48.8	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 57.7	U, D	µg/kg dry	57.7	19.7	50	"	"	"	"	"	X
108-88-3	Toluene	< 57.7	U, D	µg/kg dry	57.7	18.7	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 57.7	U, D	µg/kg dry	57.7	20.3	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 57.7	U, D	µg/kg dry	57.7	42.6	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 57.7	U, D	µg/kg dry	57.7	18.1	50	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 57.7	U, D	µg/kg dry	57.7	19.2	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 57.7	U, D	µg/kg dry	57.7	41.9	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 57.7	U, D	µg/kg dry	57.7	15.8	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 57.7	U, D	µg/kg dry	57.7	31.1	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 57.7	U, D	µg/kg dry	57.7	43.3	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 57.7	U, D	µg/kg dry	57.7	14.0	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 57.7	U, D	µg/kg dry	57.7	9.93	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 57.7	U, D	µg/kg dry	57.7	19.5	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 115	U, D	µg/kg dry	115	10.4	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 57.7	U, D	µg/kg dry	57.7	16.2	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 115	U, D	µg/kg dry	115	91.0	50	"	"	"	"	"	X
60-29-7	Ethyl ether	< 57.7	U, D	µg/kg dry	57.7	52.3	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 57.7	U, D	µg/kg dry	57.7	19.3	50	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 57.7	U, D	µg/kg dry	57.7	31.1	50	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 57.7	U, D	µg/kg dry	57.7	10.7	50	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 577	U, D	µg/kg dry	577	378	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1150	U, D	µg/kg dry	1150	1000	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 289	U, D	µg/kg dry	289	132	50	"	"	"	"	"	X
64-17-5	Ethanol	< 11500	U, D	µg/kg dry	11500	2150	50	"	"	"	"	"	X
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	101			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	98			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	97			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	94			70-130 %			"	"	"	"	"	

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Sample Identification

SB-6 (15-17')

SC43071-04

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 15:15

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 354	U, D	µg/kg dry	354	176	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 354	U, D	µg/kg dry	354	175	5	"	"	"	"	"	X
62-53-3	Aniline	< 1750	U, D	µg/kg dry	1750	126	5	"	"	"	"	"	X
120-12-7	Anthracene	< 354	U, D	µg/kg dry	354	169	5	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 1750	U, D	µg/kg dry	1750	172	5	"	"	"	"	"	
92-87-5	Benzidine	< 1750	U, D	µg/kg dry	1750	353	5	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 354	U, D	µg/kg dry	354	187	5	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 354	U, D	µg/kg dry	354	132	5	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 354	U, D	µg/kg dry	354	172	5	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 354	U, D	µg/kg dry	354	142	5	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 354	U, D	µg/kg dry	354	139	5	"	"	"	"	"	X
65-85-0	Benzoic acid	< 1750	U, D	µg/kg dry	1750	368	5	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 1750	U, D	µg/kg dry	1750	144	5	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 1750	U, D	µg/kg dry	1750	156	5	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 887	U, D	µg/kg dry	887	127	5	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 887	U, D	µg/kg dry	887	137	5	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 887	U, D	µg/kg dry	887	219	5	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 1750	U, D	µg/kg dry	1750	164	5	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 1750	U, D	µg/kg dry	1750	205	5	"	"	"	"	"	X
86-74-8	Carbazole	< 887	U, D	µg/kg dry	887	495	5	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 1750	U, D	µg/kg dry	1750	167	5	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 887	U, D	µg/kg dry	887	192	5	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 1750	U, D	µg/kg dry	1750	162	5	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 887	U, D	µg/kg dry	887	158	5	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 1750	U, D	µg/kg dry	1750	208	5	"	"	"	"	"	X
218-01-9	Chrysene	< 354	U, D	µg/kg dry	354	177	5	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 354	U, D	µg/kg dry	354	136	5	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 887	U, D	µg/kg dry	887	135	5	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1750	U, D	µg/kg dry	1750	153	5	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1750	U, D	µg/kg dry	1750	153	5	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1750	U, D	µg/kg dry	1750	163	5	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 1750	U, D	µg/kg dry	1750	267	5	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 887	U, D	µg/kg dry	887	166	5	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 1750	U, D	µg/kg dry	1750	217	5	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 1750	U, D	µg/kg dry	1750	192	5	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 1750	U, D	µg/kg dry	1750	125	5	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 1750	U, D	µg/kg dry	1750	186	5	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 1750	U, D	µg/kg dry	1750	225	5	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 1750	U, D	µg/kg dry	1750	179	5	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 887	U, D	µg/kg dry	887	343	5	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 887	U, D	µg/kg dry	887	200	5	"	"	"	"	"	X

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Sample Identification

SB-6 (15-17')

SC43071-04

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

R01

117-84-0	Di-n-octyl phthalate	< 1750	U, D	µg/kg dry	1750	198	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 354	U, D	µg/kg dry	354	187	5	"	"	"	"	"	X
86-73-7	Fluorene	< 354	U, D	µg/kg dry	354	180	5	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 887	U, D	µg/kg dry	887	175	5	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 887	U, D	µg/kg dry	887	212	5	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 887	U, D	µg/kg dry	887	121	5	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 887	U, D	µg/kg dry	887	191	5	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 354	U, D	µg/kg dry	354	128	5	"	"	"	"	"	X
78-59-1	Isophorone	< 887	U, D	µg/kg dry	887	166	5	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 354	U, D	µg/kg dry	354	214	5	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 1750	U, D	µg/kg dry	1750	149	5	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 1750	U, D	µg/kg dry	1750	169	5	"	"	"	"	"	X
91-20-3	Naphthalene	< 354	U, D	µg/kg dry	354	165	5	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 1750	U, D	µg/kg dry	1750	149	5	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 1750	U, D	µg/kg dry	1750	240	5	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 887	U, D	µg/kg dry	887	273	5	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 887	U, D	µg/kg dry	887	162	5	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 887	U, D	µg/kg dry	887	147	5	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 7010	U, D	µg/kg dry	7010	283	5	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 887	U, D	µg/kg dry	887	165	5	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 887	U, D	µg/kg dry	887	173	5	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 1750	U, D	µg/kg dry	1750	190	5	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 1750	U, D	µg/kg dry	1750	187	5	"	"	"	"	"	X
85-01-8	Phenanthrene	< 354	U, D	µg/kg dry	354	165	5	"	"	"	"	"	X
108-95-2	Phenol	< 1750	U, D	µg/kg dry	1750	115	5	"	"	"	"	"	X
129-00-0	Pyrene	< 354	U, D	µg/kg dry	354	198	5	"	"	"	"	"	X
110-86-1	Pyridine	< 1750	U, D	µg/kg dry	1750	261	5	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1750	U, D	µg/kg dry	1750	174	5	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 354	U, D	µg/kg dry	354	174	5	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 1750	U, D	µg/kg dry	1750	158	5	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 887	U, D	µg/kg dry	887	158	5	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 1750	U, D	µg/kg dry	1750	277	5	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 1750	U, D	µg/kg dry	1750	170	5	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	75			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	60			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	66			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	51			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	80			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	65			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 21.1	U	µg/kg dry	21.1	9.47	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-6 (15-17')

SC43071-04

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 21.1	U	µg/kg dry	21.1	11.2	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 21.1	U	µg/kg dry	21.1	10.6	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 21.1	U	µg/kg dry	21.1	20.9	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 21.1	U	µg/kg dry	21.1	19.3	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 21.1	U	µg/kg dry	21.1	13.8	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 21.1	U	µg/kg dry	21.1	11.3	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 21.1	U	µg/kg dry	21.1	18.4	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 21.1	U	µg/kg dry	21.1	9.53	1	"	"	"	"	"	X

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	50			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	50			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	80			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	85			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 26.4	U, D	µg/kg dry	26.4	7.07	5	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 26.4	U, D	µg/kg dry	26.4	10.4	5	"	"	"	"	"	X
319-86-8	delta-BHC	< 26.4	U, D	µg/kg dry	26.4	7.59	5	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 15.8	U, D	µg/kg dry	15.8	7.59	5	"	"	"	"	"	X
76-44-8	Heptachlor	< 26.4	U, D	µg/kg dry	26.4	8.81	5	"	"	"	"	"	X
309-00-2	Aldrin	< 26.4	U, D	µg/kg dry	26.4	8.12	5	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 26.4	U, D	µg/kg dry	26.4	9.33	5	"	"	"	"	"	X
959-98-8	Endosulfan I	< 26.4	U, D	µg/kg dry	26.4	9.28	5	"	"	"	"	"	X
60-57-1	Dieldrin	< 26.4	U, D	µg/kg dry	26.4	9.28	5	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 26.4	U, D	µg/kg dry	26.4	8.33	5	"	"	"	"	"	X
72-20-8	Endrin	< 42.2	U, D	µg/kg dry	42.2	9.28	5	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 42.2	U, D	µg/kg dry	42.2	9.92	5	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 42.2	U, D	µg/kg dry	42.2	9.18	5	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 42.2	U, D	µg/kg dry	42.2	8.81	5	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 42.2	U, D	µg/kg dry	42.2	8.12	5	"	"	"	"	"	X
72-43-5	Methoxychlor	< 42.2	U, D	µg/kg dry	42.2	9.33	5	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 42.2	U, D	µg/kg dry	42.2	9.49	5	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 42.2	U, D	µg/kg dry	42.2	8.81	5	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 26.4	U, D	µg/kg dry	26.4	9.02	5	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 26.4	U, D	µg/kg dry	26.4	9.49	5	"	"	"	"	"	X
8001-35-2	Toxaphene	< 527	U, D	µg/kg dry	527	114	5	"	"	"	"	"	X
57-74-9	Chlordane	< 105	U, D	µg/kg dry	105	104	5	"	"	"	"	"	X
15972-60-8	Alachlor	< 26.4	U, D	µg/kg dry	26.4	12.9	5	"	"	"	"	"	

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	86			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	91			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-6 (15-17')

SC43071-04

Client Project #

[none]

Matrix

Soil

Collection Date/Time

09-Jan-18 15:15

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

R01

2051-24-3	Decachlorobiphenyl (Sr)	86			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	99			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.59	U	mg/kg dry	1.59	0.172	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	2,600		mg/kg dry	5.30	1.20	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.609	J	mg/kg dry	1.59	0.201	1	"	"	"	"	"	X
7440-39-3	Barium	17.6		mg/kg dry	1.06	0.125	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.139	J	mg/kg dry	0.530	0.0266	1	"	"	"	"	"	X
7440-70-2	Calcium	893		mg/kg dry	26.5	5.42	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.584		mg/kg dry	0.530	0.0274	1	"	"	"	"	"	X
7440-48-4	Cobalt	4.38		mg/kg dry	1.05	0.0609	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	17.2		mg/kg dry	1.06	0.141	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	14.4		mg/kg dry	1.06	0.254	1	"	"	"	"	"	X
7439-89-6	Iron	7,540	R06	mg/kg dry	530	2.18	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0313	U	mg/kg dry	0.0313	0.0087	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	590		mg/kg dry	52.6	3.67	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	1,170		mg/kg dry	5.30	1.53	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	206		mg/kg dry	1.06	0.270	1	"	"	"	"	"	X
7440-23-5	Sodium	222		mg/kg dry	26.5	11.4	1	"	"	"	"	"	X
7440-02-0	Nickel	8.61		mg/kg dry	1.06	0.122	1	"	"	"	"	"	X
7439-92-1	Lead	2.60		mg/kg dry	1.59	0.225	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.26	U	mg/kg dry	5.26	0.395	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.58	U	mg/kg dry	1.58	0.301	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.18	U	mg/kg dry	3.18	1.17	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	10.4		mg/kg dry	1.59	0.282	1	"	"	"	"	"	X
7440-66-6	Zinc	9.76		mg/kg dry	1.06	0.820	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	93.8		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.385	U	mg/kg dry	0.385	0.325	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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Sample Identification

SB-7 (0-2')

SC43071-05

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 10:15

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (high level)</u>													
Initial weight: 14.74 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 55.9	U, D	µg/kg dry	55.9	28.3	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 55.9	U, D	µg/kg dry	55.9	224	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 55.9	U, D	µg/kg dry	55.9	53.7	50	"	"	"	"	"	X
71-43-2	Benzene	< 55.9	U, D	µg/kg dry	55.9	14.8	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 55.9	U, D	µg/kg dry	55.9	14.9	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 55.9	U, D	µg/kg dry	55.9	28.2	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 55.9	U, D	µg/kg dry	55.9	37.3	50	"	"	"	"	"	X
75-25-2	Bromoform	< 55.9	U, D	µg/kg dry	55.9	53.3	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 112	U, D	µg/kg dry	112	50.5	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 112	U, D	µg/kg dry	112	100	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 55.9	U, D	µg/kg dry	55.9	16.0	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 55.9	U, D	µg/kg dry	55.9	10.2	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 55.9	U, D	µg/kg dry	55.9	12.5	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 112	U, D	µg/kg dry	112	35.8	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 55.9	U, D	µg/kg dry	55.9	45.7	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 55.9	U, D	µg/kg dry	55.9	17.5	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 112	U, D	µg/kg dry	112	31.0	50	"	"	"	"	"	X
67-66-3	Chloroform	< 55.9	U, D	µg/kg dry	55.9	30.0	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 112	U, D	µg/kg dry	112	23.1	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 55.9	U, D	µg/kg dry	55.9	13.9	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 55.9	U, D	µg/kg dry	55.9	13.1	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 112	U, D	µg/kg dry	112	80.8	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 55.9	U, D	µg/kg dry	55.9	37.9	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 55.9	U, D	µg/kg dry	55.9	37.5	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 55.9	U, D	µg/kg dry	55.9	29.1	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 55.9	U, D	µg/kg dry	55.9	14.5	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 55.9	U, D	µg/kg dry	55.9	12.1	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 55.9	U, D	µg/kg dry	55.9	16.5	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 112	U, D	µg/kg dry	112	21.2	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 55.9	U, D	µg/kg dry	55.9	14.6	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 55.9	U, D	µg/kg dry	55.9	20.0	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 55.9	U, D	µg/kg dry	55.9	29.2	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 55.9	U, D	µg/kg dry	55.9	20.7	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 55.9	U, D	µg/kg dry	55.9	29.6	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 55.9	U, D	µg/kg dry	55.9	29.3	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 55.9	U, D	µg/kg dry	55.9	29.0	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 55.9	U, D	µg/kg dry	55.9	26.4	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 55.9	U, D	µg/kg dry	55.9	18.0	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 55.9	U, D	µg/kg dry	55.9	33.7	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 55.9	U, D	µg/kg dry	55.9	29.4	50	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

## Sample Identification

SB-7 (0-2')

SC43071-05

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

10-Jan-18 10:15

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 14.74 g													
100-41-4	Ethylbenzene	< 55.9	U, D	µg/kg dry	55.9	8.05	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 55.9	U, D	µg/kg dry	55.9	28.1	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 112	U, D	µg/kg dry	112	68.6	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 55.9	U, D	µg/kg dry	55.9	11.0	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 55.9	U, D	µg/kg dry	55.9	12.0	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 55.9	U, D	µg/kg dry	55.9	20.6	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 112	U, D	µg/kg dry	112	28.7	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 112	U, D	µg/kg dry	112	22.2	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 55.9	U, D	µg/kg dry	55.9	33.3	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 55.9	U, D	µg/kg dry	55.9	9.06	50	"	"	"	"	"	X
100-42-5	Styrene	< 55.9	U, D	µg/kg dry	55.9	11.2	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 55.9	U, D	µg/kg dry	55.9	47.5	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 55.9	U, D	µg/kg dry	55.9	47.3	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 55.9	U, D	µg/kg dry	55.9	19.1	50	"	"	"	"	"	X
108-88-3	Toluene	< 55.9	U, D	µg/kg dry	55.9	18.1	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 55.9	U, D	µg/kg dry	55.9	19.6	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 55.9	U, D	µg/kg dry	55.9	41.2	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 55.9	U, D	µg/kg dry	55.9	17.6	50	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 55.9	U, D	µg/kg dry	55.9	18.6	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 55.9	U, D	µg/kg dry	55.9	40.5	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 55.9	U, D	µg/kg dry	55.9	15.3	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 55.9	U, D	µg/kg dry	55.9	30.1	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 55.9	U, D	µg/kg dry	55.9	41.9	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 55.9	U, D	µg/kg dry	55.9	13.6	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 55.9	U, D	µg/kg dry	55.9	9.62	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 55.9	U, D	µg/kg dry	55.9	18.9	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 112	U, D	µg/kg dry	112	10.1	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 55.9	U, D	µg/kg dry	55.9	15.7	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 112	U, D	µg/kg dry	112	88.1	50	"	"	"	"	"	
60-29-7	Ethyl ether	< 55.9	U, D	µg/kg dry	55.9	50.7	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 55.9	U, D	µg/kg dry	55.9	18.7	50	"	"	"	"	"	
637-92-3	Ethyl tert-butyl ether	< 55.9	U, D	µg/kg dry	55.9	30.1	50	"	"	"	"	"	
108-20-3	Di-isopropyl ether	< 55.9	U, D	µg/kg dry	55.9	10.4	50	"	"	"	"	"	
75-65-0	Tert-Butanol / butyl alcohol	< 559	U, D	µg/kg dry	559	366	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1120	U, D	µg/kg dry	1120	971	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 280	U, D	µg/kg dry	280	128	50	"	"	"	"	"	X
64-17-5	Ethanol	5,340	J, D	µg/kg dry	11200	2090	50	"	"	"	"	"	
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	104			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	99			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	96			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	93			70-130 %			"	"	"	"	"	

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Sample Identification

SB-7 (0-2')

SC43071-05

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[none]

Matrix

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CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 348	U, D	µg/kg dry	348	173	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 348	U, D	µg/kg dry	348	172	5	"	"	"	"	"	X
62-53-3	Aniline	< 1720	U, D	µg/kg dry	1720	124	5	"	"	"	"	"	X
120-12-7	Anthracene	< 348	U, D	µg/kg dry	348	167	5	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 1720	U, D	µg/kg dry	1720	169	5	"	"	"	"	"	
92-87-5	Benzidine	< 1720	U, D	µg/kg dry	1720	347	5	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 348	U, D	µg/kg dry	348	184	5	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 348	U, D	µg/kg dry	348	130	5	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 348	U, D	µg/kg dry	348	169	5	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 348	U, D	µg/kg dry	348	140	5	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 348	U, D	µg/kg dry	348	136	5	"	"	"	"	"	X
65-85-0	Benzoic acid	< 1720	U, D	µg/kg dry	1720	362	5	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 1720	U, D	µg/kg dry	1720	141	5	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 1720	U, D	µg/kg dry	1720	153	5	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 872	U, D	µg/kg dry	872	125	5	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 872	U, D	µg/kg dry	872	134	5	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 872	U, D	µg/kg dry	872	215	5	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 1720	U, D	µg/kg dry	1720	161	5	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 1720	U, D	µg/kg dry	1720	201	5	"	"	"	"	"	X
86-74-8	Carbazole	< 872	U, D	µg/kg dry	872	486	5	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 1720	U, D	µg/kg dry	1720	164	5	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 872	U, D	µg/kg dry	872	188	5	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 1720	U, D	µg/kg dry	1720	159	5	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 872	U, D	µg/kg dry	872	155	5	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 1720	U, D	µg/kg dry	1720	205	5	"	"	"	"	"	X
218-01-9	Chrysene	< 348	U, D	µg/kg dry	348	174	5	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 348	U, D	µg/kg dry	348	134	5	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 872	U, D	µg/kg dry	872	133	5	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1720	U, D	µg/kg dry	1720	150	5	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1720	U, D	µg/kg dry	1720	150	5	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1720	U, D	µg/kg dry	1720	160	5	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 1720	U, D	µg/kg dry	1720	262	5	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 872	U, D	µg/kg dry	872	163	5	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 1720	U, D	µg/kg dry	1720	213	5	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 1720	U, D	µg/kg dry	1720	188	5	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 1720	U, D	µg/kg dry	1720	123	5	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 1720	U, D	µg/kg dry	1720	183	5	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 1720	U, D	µg/kg dry	1720	221	5	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 1720	U, D	µg/kg dry	1720	175	5	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 872	U, D	µg/kg dry	872	337	5	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 872	U, D	µg/kg dry	872	196	5	"	"	"	"	"	X

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Sample Identification

SB-7 (0-2')

SC43071-05

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[none]

Matrix

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>				R01									
117-84-0	Di-n-octyl phthalate	< 1720	U, D	µg/kg dry	1720	195	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 348	U, D	µg/kg dry	348	184	5	"	"	"	"	"	X
86-73-7	Fluorene	< 348	U, D	µg/kg dry	348	177	5	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 872	U, D	µg/kg dry	872	172	5	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 872	U, D	µg/kg dry	872	208	5	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 872	U, D	µg/kg dry	872	119	5	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 872	U, D	µg/kg dry	872	188	5	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 348	U, D	µg/kg dry	348	125	5	"	"	"	"	"	X
78-59-1	Isophorone	< 872	U, D	µg/kg dry	872	163	5	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 348	U, D	µg/kg dry	348	210	5	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 1720	U, D	µg/kg dry	1720	146	5	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 1720	U, D	µg/kg dry	1720	167	5	"	"	"	"	"	X
91-20-3	Naphthalene	< 348	U, D	µg/kg dry	348	162	5	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 1720	U, D	µg/kg dry	1720	146	5	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 1720	U, D	µg/kg dry	1720	235	5	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 872	U, D	µg/kg dry	872	268	5	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 872	U, D	µg/kg dry	872	159	5	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 872	U, D	µg/kg dry	872	145	5	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 6890	U, D	µg/kg dry	6890	278	5	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 872	U, D	µg/kg dry	872	162	5	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 872	U, D	µg/kg dry	872	170	5	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 1720	U, D	µg/kg dry	1720	187	5	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 1720	U, D	µg/kg dry	1720	184	5	"	"	"	"	"	X
85-01-8	Phenanthrene	< 348	U, D	µg/kg dry	348	162	5	"	"	"	"	"	X
108-95-2	Phenol	< 1720	U, D	µg/kg dry	1720	113	5	"	"	"	"	"	X
129-00-0	Pyrene	< 348	U, D	µg/kg dry	348	194	5	"	"	"	"	"	X
110-86-1	Pyridine	< 1720	U, D	µg/kg dry	1720	257	5	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1720	U, D	µg/kg dry	1720	171	5	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 348	U, D	µg/kg dry	348	171	5	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 1720	U, D	µg/kg dry	1720	155	5	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 872	U, D	µg/kg dry	872	156	5	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 1720	U, D	µg/kg dry	1720	272	5	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 1720	U, D	µg/kg dry	1720	167	5	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	61			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	49			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	60			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	47			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	68			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	60			30-130 %			"	"	"	"	"	

Semivolatile Organic Compounds by GCPolychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 20.9	U	µg/kg dry	20.9	9.36	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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Sample Identification

SB-7 (0-2')

SC43071-05

Client Project #

[none]

Matrix

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 20.9	U	µg/kg dry	20.9	11.1	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 20.9	U	µg/kg dry	20.9	10.5	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 20.9	U	µg/kg dry	20.9	20.6	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 20.9	U	µg/kg dry	20.9	19.1	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 20.9	U	µg/kg dry	20.9	13.7	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 20.9	U	µg/kg dry	20.9	11.2	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 20.9	U	µg/kg dry	20.9	18.2	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 20.9	U	µg/kg dry	20.9	9.42	1	"	"	"	"	"	X

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	50			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	50			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	80			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	90			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 25.9	U, D	µg/kg dry	25.9	6.94	5	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 25.9	U, D	µg/kg dry	25.9	10.3	5	"	"	"	"	"	X
319-86-8	delta-BHC	< 25.9	U, D	µg/kg dry	25.9	7.46	5	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 15.5	U, D	µg/kg dry	15.5	7.46	5	"	"	"	"	"	X
76-44-8	Heptachlor	< 25.9	U, D	µg/kg dry	25.9	8.65	5	"	"	"	"	"	X
309-00-2	Aldrin	< 25.9	U, D	µg/kg dry	25.9	7.97	5	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 25.9	U, D	µg/kg dry	25.9	9.16	5	"	"	"	"	"	X
959-98-8	Endosulfan I	< 25.9	U, D	µg/kg dry	25.9	9.11	5	"	"	"	"	"	X
60-57-1	Dieldrin	< 25.9	U, D	µg/kg dry	25.9	9.11	5	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 25.9	U, D	µg/kg dry	25.9	8.18	5	"	"	"	"	"	X
72-20-8	Endrin	< 41.4	U, D	µg/kg dry	41.4	9.11	5	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 41.4	U, D	µg/kg dry	41.4	9.73	5	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 41.4	U, D	µg/kg dry	41.4	9.01	5	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 41.4	U, D	µg/kg dry	41.4	8.65	5	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 41.4	U, D	µg/kg dry	41.4	7.97	5	"	"	"	"	"	X
72-43-5	Methoxychlor	< 41.4	U, D	µg/kg dry	41.4	9.16	5	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 41.4	U, D	µg/kg dry	41.4	9.32	5	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 41.4	U, D	µg/kg dry	41.4	8.65	5	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 25.9	U, D	µg/kg dry	25.9	8.85	5	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 25.9	U, D	µg/kg dry	25.9	9.32	5	"	"	"	"	"	X
8001-35-2	Toxaphene	< 518	U, D	µg/kg dry	518	112	5	"	"	"	"	"	X
57-74-9	Chlordane	< 104	U, D	µg/kg dry	104	102	5	"	"	"	"	"	X
15972-60-8	Alachlor	< 25.9	U, D	µg/kg dry	25.9	12.7	5	"	"	"	"	"	

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	59			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	64			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-7 (0-2')

SC43071-05

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 10:15

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

R01

2051-24-3	Decachlorobiphenyl (Sr)	55			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	81			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.55	U	mg/kg dry	1.55	0.167	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	5,840		mg/kg dry	5.17	1.17	1	"	"	"	"	"	X
7440-38-2	Arsenic	1.81		mg/kg dry	1.55	0.196	1	"	"	"	"	"	X
7440-39-3	Barium	21.8		mg/kg dry	1.03	0.122	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.249	J	mg/kg dry	0.517	0.0259	1	"	"	"	"	"	X
7440-70-2	Calcium	5,660		mg/kg dry	25.8	5.29	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.641		mg/kg dry	0.517	0.0268	1	"	"	"	"	"	X
7440-48-4	Cobalt	3.03		mg/kg dry	1.05	0.0606	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	9.53		mg/kg dry	1.03	0.137	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	12.5		mg/kg dry	1.03	0.248	1	"	"	"	"	"	X
7439-89-6	Iron	7,950	R06	mg/kg dry	517	2.13	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0214	J	mg/kg dry	0.0293	0.0081	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	328		mg/kg dry	52.4	3.65	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	3,470		mg/kg dry	5.17	1.49	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	125		mg/kg dry	1.03	0.263	1	"	"	"	"	"	X
7440-23-5	Sodium	73.3		mg/kg dry	25.8	11.1	1	"	"	"	"	"	X
7440-02-0	Nickel	7.72		mg/kg dry	1.03	0.119	1	"	"	"	"	"	X
7439-92-1	Lead	10.5		mg/kg dry	1.55	0.219	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.24	U	mg/kg dry	5.24	0.394	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.57	U	mg/kg dry	1.57	0.299	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.10	U	mg/kg dry	3.10	1.14	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	13.1		mg/kg dry	1.55	0.275	1	"	"	"	"	"	X
7440-66-6	Zinc	16.8		mg/kg dry	1.03	0.800	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	95.3			%			1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.366	U	mg/kg dry	0.366	0.309	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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SC43071-06

[none]

Soil

10-Jan-18 11:20

12-Jan-18

Initial weight: 17.14 g

Page 62 of 193

## Sample Identification

SB-7 (15-17')

SC43071-06

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

10-Jan-18 11:20

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 17.14 g													
100-41-4	Ethylbenzene	< 61.7	U, D	µg/kg dry	61.7	8.89	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 61.7	U, D	µg/kg dry	61.7	31.0	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 123	U, D	µg/kg dry	123	75.8	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 61.7	U, D	µg/kg dry	61.7	12.2	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 61.7	U, D	µg/kg dry	61.7	13.3	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 61.7	U, D	µg/kg dry	61.7	22.7	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 123	U, D	µg/kg dry	123	31.7	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 123	U, D	µg/kg dry	123	24.5	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 61.7	U, D	µg/kg dry	61.7	36.7	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 61.7	U, D	µg/kg dry	61.7	10.0	50	"	"	"	"	"	X
100-42-5	Styrene	< 61.7	U, D	µg/kg dry	61.7	12.4	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 61.7	U, D	µg/kg dry	61.7	52.5	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 61.7	U, D	µg/kg dry	61.7	52.2	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 61.7	U, D	µg/kg dry	61.7	21.1	50	"	"	"	"	"	X
108-88-3	Toluene	< 61.7	U, D	µg/kg dry	61.7	20.0	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 61.7	U, D	µg/kg dry	61.7	21.7	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 61.7	U, D	µg/kg dry	61.7	45.5	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 61.7	U, D	µg/kg dry	61.7	19.4	50	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 61.7	U, D	µg/kg dry	61.7	20.5	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 61.7	U, D	µg/kg dry	61.7	44.8	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 61.7	U, D	µg/kg dry	61.7	16.9	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 61.7	U, D	µg/kg dry	61.7	33.3	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 61.7	U, D	µg/kg dry	61.7	46.3	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 61.7	U, D	µg/kg dry	61.7	15.0	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 61.7	U, D	µg/kg dry	61.7	10.6	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 61.7	U, D	µg/kg dry	61.7	20.9	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 123	U, D	µg/kg dry	123	11.1	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 61.7	U, D	µg/kg dry	61.7	17.3	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 123	U, D	µg/kg dry	123	97.3	50	"	"	"	"	"	X
60-29-7	Ethyl ether	< 61.7	U, D	µg/kg dry	61.7	55.9	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 61.7	U, D	µg/kg dry	61.7	20.6	50	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 61.7	U, D	µg/kg dry	61.7	33.3	50	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 61.7	U, D	µg/kg dry	61.7	11.5	50	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 617	U, D	µg/kg dry	617	404	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1230	U, D	µg/kg dry	1230	1070	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 309	U, D	µg/kg dry	309	141	50	"	"	"	"	"	X
64-17-5	Ethanol	5,220	J, D	µg/kg dry	12300	2300	50	"	"	"	"	"	
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	101			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	97			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	97			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	94			70-130 %			"	"	"	"	"	

This laboratory report is not valid without an authorized signature on the cover page.

Sample Identification

SB-7 (15-17')

SC43071-06

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 11:20

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 79.1	U	µg/kg dry	79.1	39.4	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 79.1	U	µg/kg dry	79.1	39.0	1	"	"	"	"	"	X
62-53-3	Aniline	< 391	U	µg/kg dry	391	28.1	1	"	"	"	"	"	X
120-12-7	Anthracene	< 79.1	U	µg/kg dry	79.1	37.8	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 391	U	µg/kg dry	391	38.5	1	"	"	"	"	"	
92-87-5	Benzidine	< 391	U	µg/kg dry	391	78.8	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 79.1	U	µg/kg dry	79.1	41.8	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 79.1	U	µg/kg dry	79.1	29.5	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 79.1	U	µg/kg dry	79.1	38.3	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 79.1	U	µg/kg dry	79.1	31.8	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 79.1	U	µg/kg dry	79.1	31.0	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 391	U	µg/kg dry	391	82.2	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 391	U	µg/kg dry	391	32.1	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 391	U	µg/kg dry	391	34.8	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 198	U	µg/kg dry	198	28.4	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 198	U	µg/kg dry	198	30.5	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 198	U	µg/kg dry	198	48.9	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 391	U	µg/kg dry	391	36.7	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 391	U	µg/kg dry	391	45.7	1	"	"	"	"	"	X
86-74-8	Carbazole	< 198	U	µg/kg dry	198	111	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 391	U	µg/kg dry	391	37.4	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 198	U	µg/kg dry	198	42.8	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 391	U	µg/kg dry	391	36.2	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 198	U	µg/kg dry	198	35.2	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 391	U	µg/kg dry	391	46.5	1	"	"	"	"	"	X
218-01-9	Chrysene	< 79.1	U	µg/kg dry	79.1	39.5	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 79.1	U	µg/kg dry	79.1	30.4	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 198	U	µg/kg dry	198	30.1	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 391	U	µg/kg dry	391	34.2	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 391	U	µg/kg dry	391	34.2	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 391	U	µg/kg dry	391	36.3	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 391	U	µg/kg dry	391	59.6	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 198	U	µg/kg dry	198	37.0	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 391	U	µg/kg dry	391	48.4	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 391	U	µg/kg dry	391	42.8	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 391	U	µg/kg dry	391	28.0	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 391	U	µg/kg dry	391	41.5	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 391	U	µg/kg dry	391	50.3	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 391	U	µg/kg dry	391	39.9	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 198	U	µg/kg dry	198	76.6	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 198	U	µg/kg dry	198	44.6	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-7 (15-17')

SC43071-06

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 11:20

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 391	U	µg/kg dry	391	44.2	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 79.1	U	µg/kg dry	79.1	41.8	1	"	"	"	"	"	X
86-73-7	Fluorene	< 79.1	U	µg/kg dry	79.1	40.2	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 198	U	µg/kg dry	198	39.0	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 198	U	µg/kg dry	198	47.3	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 198	U	µg/kg dry	198	26.9	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 198	U	µg/kg dry	198	42.7	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 79.1	U	µg/kg dry	79.1	28.5	1	"	"	"	"	"	X
78-59-1	Isophorone	< 198	U	µg/kg dry	198	37.1	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 79.1	U	µg/kg dry	79.1	47.8	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 391	U	µg/kg dry	391	33.3	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 391	U	µg/kg dry	391	37.8	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 79.1	U	µg/kg dry	79.1	36.9	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 391	U	µg/kg dry	391	33.2	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 391	U	µg/kg dry	391	53.5	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 198	U	µg/kg dry	198	61.0	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 198	U	µg/kg dry	198	36.1	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 198	U	µg/kg dry	198	32.9	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1570	U	µg/kg dry	1570	63.3	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 198	U	µg/kg dry	198	36.8	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 198	U	µg/kg dry	198	38.6	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 391	U	µg/kg dry	391	42.5	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 391	U	µg/kg dry	391	41.8	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 79.1	U	µg/kg dry	79.1	36.8	1	"	"	"	"	"	X
108-95-2	Phenol	< 391	U	µg/kg dry	391	25.8	1	"	"	"	"	"	X
129-00-0	Pyrene	< 79.1	U	µg/kg dry	79.1	44.1	1	"	"	"	"	"	X
110-86-1	Pyridine	< 391	U	µg/kg dry	391	58.4	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 391	U	µg/kg dry	391	38.8	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 79.1	U	µg/kg dry	79.1	38.9	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 391	U	µg/kg dry	391	35.2	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 198	U	µg/kg dry	198	35.3	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 391	U	µg/kg dry	391	61.8	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 391	U	µg/kg dry	391	38.0	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	69			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	61			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	60			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	54			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	84			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	68			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 23.6	U	µg/kg dry	23.6	10.6	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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Sample Identification

SB-7 (15-17')

SC43071-06

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 11:20

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 23.6	U	µg/kg dry	23.6	12.6	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 23.6	U	µg/kg dry	23.6	11.8	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 23.6	U	µg/kg dry	23.6	23.3	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 23.6	U	µg/kg dry	23.6	21.6	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 23.6	U	µg/kg dry	23.6	15.5	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 23.6	U	µg/kg dry	23.6	12.7	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 23.6	U	µg/kg dry	23.6	20.6	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 23.6	U	µg/kg dry	23.6	10.7	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	40			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	45			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	60			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	75			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.92	U	µg/kg dry	5.92	1.59	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.92	U	µg/kg dry	5.92	2.34	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.92	U	µg/kg dry	5.92	1.70	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.55	U	µg/kg dry	3.55	1.70	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.92	U	µg/kg dry	5.92	1.98	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.92	U	µg/kg dry	5.92	1.82	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.92	U	µg/kg dry	5.92	2.10	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.92	U	µg/kg dry	5.92	2.08	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.92	U	µg/kg dry	5.92	2.08	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.92	U	µg/kg dry	5.92	1.87	1	"	"	"	"	"	X
72-20-8	Endrin	< 9.47	U	µg/kg dry	9.47	2.08	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 9.47	U	µg/kg dry	9.47	2.23	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 9.47	U	µg/kg dry	9.47	2.06	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 9.47	U	µg/kg dry	9.47	1.98	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 9.47	U	µg/kg dry	9.47	1.82	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 9.47	U	µg/kg dry	9.47	2.10	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 9.47	U	µg/kg dry	9.47	2.13	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 9.47	U	µg/kg dry	9.47	1.98	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.92	U	µg/kg dry	5.92	2.02	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.92	U	µg/kg dry	5.92	2.13	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 118	U	µg/kg dry	118	25.6	1	"	"	"	"	"	X
57-74-9	Chlordane	< 23.7	U	µg/kg dry	23.7	23.4	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.92	U	µg/kg dry	5.92	2.90	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	81			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	73			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-7 (15-17')

SC43071-06

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 11:20

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	116			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	116			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.77	U	mg/kg dry	1.77	0.191	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	2,010		mg/kg dry	5.90	1.34	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.713	J	mg/kg dry	1.77	0.224	1	"	"	"	"	"	X
7440-39-3	Barium	10.2		mg/kg dry	1.18	0.139	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.117	J	mg/kg dry	0.590	0.0296	1	"	"	"	"	"	X
7440-70-2	Calcium	316		mg/kg dry	29.5	6.04	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.439	J	mg/kg dry	0.590	0.0305	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.32		mg/kg dry	1.18	0.0686	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	7.26		mg/kg dry	1.18	0.157	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	5.46		mg/kg dry	1.18	0.283	1	"	"	"	"	"	X
7439-89-6	Iron	5,920	R06	mg/kg dry	590	2.43	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0333	U	mg/kg dry	0.0333	0.0092	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	525		mg/kg dry	59.2	4.13	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	666		mg/kg dry	5.90	1.70	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	102		mg/kg dry	1.18	0.301	1	"	"	"	"	"	X
7440-23-5	Sodium	51.1		mg/kg dry	29.5	12.7	1	"	"	"	"	"	X
7440-02-0	Nickel	5.08		mg/kg dry	1.18	0.136	1	"	"	"	"	"	X
7439-92-1	Lead	2.28		mg/kg dry	1.77	0.250	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.92	U	mg/kg dry	5.92	0.446	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.78	U	mg/kg dry	1.78	0.339	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.54	U	mg/kg dry	3.54	1.30	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	6.28		mg/kg dry	1.77	0.314	1	"	"	"	"	"	X
7440-66-6	Zinc	7.72		mg/kg dry	1.18	0.913	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	83.9		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.383	U	mg/kg dry	0.383	0.323	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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## Sample Identification

SB-1 (0-2')

SC43071-07

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 14:30

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (high level)</u>													
Initial weight: 15.58 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 55.1	U, D	µg/kg dry	55.1	27.9	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 55.1	U, D	µg/kg dry	55.1	220	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 55.1	U, D	µg/kg dry	55.1	52.9	50	"	"	"	"	"	X
71-43-2	Benzene	< 55.1	U, D	µg/kg dry	55.1	14.6	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 55.1	U, D	µg/kg dry	55.1	14.7	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 55.1	U, D	µg/kg dry	55.1	27.8	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 55.1	U, D	µg/kg dry	55.1	36.7	50	"	"	"	"	"	X
75-25-2	Bromoform	< 55.1	U, D	µg/kg dry	55.1	52.5	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 110	U, D	µg/kg dry	110	49.7	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 110	U, D	µg/kg dry	110	98.4	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 55.1	U, D	µg/kg dry	55.1	15.7	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 55.1	U, D	µg/kg dry	55.1	10.0	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 55.1	U, D	µg/kg dry	55.1	12.3	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 110	U, D	µg/kg dry	110	35.2	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 55.1	U, D	µg/kg dry	55.1	45.0	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 55.1	U, D	µg/kg dry	55.1	17.2	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 110	U, D	µg/kg dry	110	30.6	50	"	"	"	"	"	X
67-66-3	Chloroform	< 55.1	U, D	µg/kg dry	55.1	29.6	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 110	U, D	µg/kg dry	110	22.7	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 55.1	U, D	µg/kg dry	55.1	13.7	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 55.1	U, D	µg/kg dry	55.1	12.9	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 110	U, D	µg/kg dry	110	79.6	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 55.1	U, D	µg/kg dry	55.1	37.3	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 55.1	U, D	µg/kg dry	55.1	36.9	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 55.1	U, D	µg/kg dry	55.1	28.6	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 55.1	U, D	µg/kg dry	55.1	14.3	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 55.1	U, D	µg/kg dry	55.1	11.9	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 55.1	U, D	µg/kg dry	55.1	16.3	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 110	U, D	µg/kg dry	110	20.9	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 55.1	U, D	µg/kg dry	55.1	14.4	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 55.1	U, D	µg/kg dry	55.1	19.7	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 55.1	U, D	µg/kg dry	55.1	28.8	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 55.1	U, D	µg/kg dry	55.1	20.4	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 55.1	U, D	µg/kg dry	55.1	29.2	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 55.1	U, D	µg/kg dry	55.1	28.9	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 55.1	U, D	µg/kg dry	55.1	28.5	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 55.1	U, D	µg/kg dry	55.1	26.0	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 55.1	U, D	µg/kg dry	55.1	17.7	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 55.1	U, D	µg/kg dry	55.1	33.2	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 55.1	U, D	µg/kg dry	55.1	28.9	50	"	"	"	"	"	X

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## Sample Identification

SB-1 (0-2')

SC43071-07

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

10-Jan-18 14:30

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 15.58 g													
100-41-4	Ethylbenzene	< 55.1	U, D	µg/kg dry	55.1	7.93	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 55.1	U, D	µg/kg dry	55.1	27.6	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 110	U, D	µg/kg dry	110	67.6	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 55.1	U, D	µg/kg dry	55.1	10.8	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 55.1	U, D	µg/kg dry	55.1	11.8	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 55.1	U, D	µg/kg dry	55.1	20.3	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 110	U, D	µg/kg dry	110	28.3	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 110	U, D	µg/kg dry	110	21.9	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 55.1	U, D	µg/kg dry	55.1	32.8	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 55.1	U, D	µg/kg dry	55.1	8.92	50	"	"	"	"	"	X
100-42-5	Styrene	< 55.1	U, D	µg/kg dry	55.1	11.1	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 55.1	U, D	µg/kg dry	55.1	46.8	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 55.1	U, D	µg/kg dry	55.1	46.6	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 55.1	U, D	µg/kg dry	55.1	18.8	50	"	"	"	"	"	X
108-88-3	Toluene	< 55.1	U, D	µg/kg dry	55.1	17.8	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 55.1	U, D	µg/kg dry	55.1	19.3	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 55.1	U, D	µg/kg dry	55.1	40.6	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 55.1	U, D	µg/kg dry	55.1	17.3	50	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 55.1	U, D	µg/kg dry	55.1	18.3	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 55.1	U, D	µg/kg dry	55.1	39.9	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 55.1	U, D	µg/kg dry	55.1	15.0	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 55.1	U, D	µg/kg dry	55.1	29.7	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 55.1	U, D	µg/kg dry	55.1	41.3	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 55.1	U, D	µg/kg dry	55.1	13.4	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 55.1	U, D	µg/kg dry	55.1	9.47	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 55.1	U, D	µg/kg dry	55.1	18.6	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 110	U, D	µg/kg dry	110	9.91	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 55.1	U, D	µg/kg dry	55.1	15.4	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 110	U, D	µg/kg dry	110	86.8	50	"	"	"	"	"	X
60-29-7	Ethyl ether	< 55.1	U, D	µg/kg dry	55.1	49.9	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 55.1	U, D	µg/kg dry	55.1	18.4	50	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 55.1	U, D	µg/kg dry	55.1	29.7	50	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 55.1	U, D	µg/kg dry	55.1	10.2	50	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 551	U, D	µg/kg dry	551	360	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1100	U, D	µg/kg dry	1100	956	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 275	U, D	µg/kg dry	275	126	50	"	"	"	"	"	X
64-17-5	Ethanol	< 11000	U, D	µg/kg dry	11000	2050	50	"	"	"	"	"	X
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	102			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	99			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	98			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	93			70-130 %			"	"	"	"	"	

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Sample Identification

SB-1 (0-2')

SC43071-07

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 14:30

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 356	U, D	µg/kg dry	356	177	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 356	U, D	µg/kg dry	356	175	5	"	"	"	"	"	X
62-53-3	Aniline	< 1760	U, D	µg/kg dry	1760	126	5	"	"	"	"	"	X
120-12-7	Anthracene	< 356	U, D	µg/kg dry	356	170	5	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 1760	U, D	µg/kg dry	1760	173	5	"	"	"	"	"	
92-87-5	Benzidine	< 1760	U, D	µg/kg dry	1760	354	5	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 356	U, D	µg/kg dry	356	188	5	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 356	U, D	µg/kg dry	356	132	5	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 356	U, D	µg/kg dry	356	172	5	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 356	U, D	µg/kg dry	356	143	5	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 356	U, D	µg/kg dry	356	139	5	"	"	"	"	"	X
65-85-0	Benzoic acid	< 1760	U, D	µg/kg dry	1760	369	5	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 1760	U, D	µg/kg dry	1760	144	5	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 1760	U, D	µg/kg dry	1760	156	5	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 891	U, D	µg/kg dry	891	128	5	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 891	U, D	µg/kg dry	891	137	5	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 891	U, D	µg/kg dry	891	220	5	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 1760	U, D	µg/kg dry	1760	165	5	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 1760	U, D	µg/kg dry	1760	205	5	"	"	"	"	"	X
86-74-8	Carbazole	< 891	U, D	µg/kg dry	891	497	5	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 1760	U, D	µg/kg dry	1760	168	5	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 891	U, D	µg/kg dry	891	193	5	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 1760	U, D	µg/kg dry	1760	163	5	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 891	U, D	µg/kg dry	891	158	5	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 1760	U, D	µg/kg dry	1760	209	5	"	"	"	"	"	X
218-01-9	Chrysene	< 356	U, D	µg/kg dry	356	178	5	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 356	U, D	µg/kg dry	356	137	5	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 891	U, D	µg/kg dry	891	135	5	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1760	U, D	µg/kg dry	1760	154	5	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1760	U, D	µg/kg dry	1760	154	5	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1760	U, D	µg/kg dry	1760	163	5	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 1760	U, D	µg/kg dry	1760	268	5	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 891	U, D	µg/kg dry	891	166	5	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 1760	U, D	µg/kg dry	1760	218	5	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 1760	U, D	µg/kg dry	1760	193	5	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 1760	U, D	µg/kg dry	1760	126	5	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 1760	U, D	µg/kg dry	1760	187	5	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 1760	U, D	µg/kg dry	1760	226	5	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 1760	U, D	µg/kg dry	1760	179	5	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 891	U, D	µg/kg dry	891	344	5	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 891	U, D	µg/kg dry	891	201	5	"	"	"	"	"	X

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Sample Identification

SB-1 (0-2')

SC43071-07

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[none]

Matrix

Soil

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12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>				R01									
117-84-0	Di-n-octyl phthalate	< 1760	U, D	µg/kg dry	1760	199	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 356	U, D	µg/kg dry	356	188	5	"	"	"	"	"	X
86-73-7	Fluorene	< 356	U, D	µg/kg dry	356	181	5	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 891	U, D	µg/kg dry	891	175	5	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 891	U, D	µg/kg dry	891	213	5	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 891	U, D	µg/kg dry	891	121	5	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 891	U, D	µg/kg dry	891	192	5	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 356	U, D	µg/kg dry	356	128	5	"	"	"	"	"	X
78-59-1	Isophorone	< 891	U, D	µg/kg dry	891	167	5	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 356	U, D	µg/kg dry	356	215	5	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 1760	U, D	µg/kg dry	1760	150	5	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 1760	U, D	µg/kg dry	1760	170	5	"	"	"	"	"	X
91-20-3	Naphthalene	< 356	U, D	µg/kg dry	356	166	5	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 1760	U, D	µg/kg dry	1760	149	5	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 1760	U, D	µg/kg dry	1760	241	5	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 891	U, D	µg/kg dry	891	274	5	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 891	U, D	µg/kg dry	891	162	5	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 891	U, D	µg/kg dry	891	148	5	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 7040	U, D	µg/kg dry	7040	284	5	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 891	U, D	µg/kg dry	891	165	5	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 891	U, D	µg/kg dry	891	173	5	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 1760	U, D	µg/kg dry	1760	191	5	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 1760	U, D	µg/kg dry	1760	188	5	"	"	"	"	"	X
85-01-8	Phenanthrene	< 356	U, D	µg/kg dry	356	166	5	"	"	"	"	"	X
108-95-2	Phenol	< 1760	U, D	µg/kg dry	1760	116	5	"	"	"	"	"	X
129-00-0	Pyrene	< 356	U, D	µg/kg dry	356	198	5	"	"	"	"	"	X
110-86-1	Pyridine	< 1760	U, D	µg/kg dry	1760	262	5	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1760	U, D	µg/kg dry	1760	174	5	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 356	U, D	µg/kg dry	356	175	5	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 1760	U, D	µg/kg dry	1760	158	5	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 891	U, D	µg/kg dry	891	159	5	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 1760	U, D	µg/kg dry	1760	278	5	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 1760	U, D	µg/kg dry	1760	171	5	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	57			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	50			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	52			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	48			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	62			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	51			30-130 %			"	"	"	"	"	

Semivolatile Organic Compounds by GCPolychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 21.2	U	µg/kg dry	21.2	9.50	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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Sample Identification

SB-1 (0-2')

SC43071-07

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[none]

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 21.2	U	µg/kg dry	21.2	11.3	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 21.2	U	µg/kg dry	21.2	10.6	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 21.2	U	µg/kg dry	21.2	20.9	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 21.2	U	µg/kg dry	21.2	19.4	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 21.2	U	µg/kg dry	21.2	13.9	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 21.2	U	µg/kg dry	21.2	11.4	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	32.3		µg/kg dry	21.2	18.5	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 21.2	U	µg/kg dry	21.2	9.57	1	"	"	"	"	"	X

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	50			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	55			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	120			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	125			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 26.3	U, D	µg/kg dry	26.3	7.06	5	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 26.3	U, D	µg/kg dry	26.3	10.4	5	"	"	"	"	"	X
319-86-8	delta-BHC	< 26.3	U, D	µg/kg dry	26.3	7.59	5	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 15.8	U, D	µg/kg dry	15.8	7.59	5	"	"	"	"	"	X
76-44-8	Heptachlor	< 26.3	U, D	µg/kg dry	26.3	8.80	5	"	"	"	"	"	X
309-00-2	Aldrin	< 26.3	U, D	µg/kg dry	26.3	8.11	5	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 26.3	U, D	µg/kg dry	26.3	9.33	5	"	"	"	"	"	X
959-98-8	Endosulfan I	< 26.3	U, D	µg/kg dry	26.3	9.27	5	"	"	"	"	"	X
60-57-1	Dieldrin	< 26.3	U, D	µg/kg dry	26.3	9.27	5	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 26.3	U, D	µg/kg dry	26.3	8.32	5	"	"	"	"	"	X
72-20-8	Endrin	< 42.2	U, D	µg/kg dry	42.2	9.27	5	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 42.2	U, D	µg/kg dry	42.2	9.91	5	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 42.2	U, D	µg/kg dry	42.2	9.17	5	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 42.2	U, D	µg/kg dry	42.2	8.80	5	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 42.2	U, D	µg/kg dry	42.2	8.11	5	"	"	"	"	"	X
72-43-5	Methoxychlor	< 42.2	U, D	µg/kg dry	42.2	9.33	5	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 42.2	U, D	µg/kg dry	42.2	9.48	5	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 42.2	U, D	µg/kg dry	42.2	8.80	5	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	125	D	µg/kg dry	26.3	9.01	5	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans) [2C]	125	D	µg/kg dry	26.3	9.48	5	"	"	"	"	"	X
8001-35-2	Toxaphene	< 527	U, D	µg/kg dry	527	114	5	"	"	"	"	"	X
57-74-9	Chlordane [2C]	95.4		µg/kg dry	21.1	20.7	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 26.3	U, D	µg/kg dry	26.3	12.9	5	"	"	"	"	"	

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	57			30-150 %			"	"	"	"	"	
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Sample Identification

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**Pesticides**Organochlorine Pesticides

R01

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	60			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr)	138			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	93			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.59	U	mg/kg dry	1.59	0.172	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	5,710		mg/kg dry	5.30	1.20	1	"	"	"	"	"	X
7440-38-2	Arsenic	3.12		mg/kg dry	1.59	0.202	1	"	"	"	"	"	X
7440-39-3	Barium	41.2		mg/kg dry	1.06	0.125	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.263	J	mg/kg dry	0.530	0.0266	1	"	"	"	"	"	X
7440-70-2	Calcium	6,050		mg/kg dry	26.5	5.43	1	"	"	"	"	"	X
7440-43-9	Cadmium	1.10		mg/kg dry	0.530	0.0275	1	"	"	"	"	"	X
7440-48-4	Cobalt	5.59		mg/kg dry	1.07	0.0617	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	9.94		mg/kg dry	1.06	0.141	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	45.2		mg/kg dry	1.06	0.255	1	"	"	"	"	"	X
7439-89-6	Iron	12,100	R06	mg/kg dry	530	2.19	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0582		mg/kg dry	0.0302	0.0084	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	587		mg/kg dry	53.3	3.71	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	3,360		mg/kg dry	5.30	1.53	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	225		mg/kg dry	1.06	0.271	1	"	"	"	"	"	X
7440-23-5	Sodium	272		mg/kg dry	26.5	11.4	1	"	"	"	"	"	X
7440-02-0	Nickel	10.3		mg/kg dry	1.06	0.122	1	"	"	"	"	"	X
7439-92-1	Lead	105		mg/kg dry	1.59	0.225	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.33	U	mg/kg dry	5.33	0.401	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.60	U	mg/kg dry	1.60	0.305	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.18	U	mg/kg dry	3.18	1.17	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	30.5		mg/kg dry	1.59	0.282	1	"	"	"	"	"	X
7440-66-6	Zinc	53.6		mg/kg dry	1.06	0.821	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	93.4		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.330	U	mg/kg dry	0.330	0.279	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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## Sample Identification

SB-1 (15-17')

SC43071-08

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 15:00

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 15.67 g													
100-41-4	Ethylbenzene	< 61.9	U, D	µg/kg dry	61.9	8.91	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 61.9	U, D	µg/kg dry	61.9	31.1	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 124	U, D	µg/kg dry	124	75.9	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 61.9	U, D	µg/kg dry	61.9	12.2	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 61.9	U, D	µg/kg dry	61.9	13.3	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 61.9	U, D	µg/kg dry	61.9	22.8	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 124	U, D	µg/kg dry	124	31.8	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 124	U, D	µg/kg dry	124	24.6	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 61.9	U, D	µg/kg dry	61.9	36.8	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 61.9	U, D	µg/kg dry	61.9	10.0	50	"	"	"	"	"	X
100-42-5	Styrene	< 61.9	U, D	µg/kg dry	61.9	12.4	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 61.9	U, D	µg/kg dry	61.9	52.6	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 61.9	U, D	µg/kg dry	61.9	52.4	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 61.9	U, D	µg/kg dry	61.9	21.2	50	"	"	"	"	"	X
108-88-3	Toluene	< 61.9	U, D	µg/kg dry	61.9	20.1	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 61.9	U, D	µg/kg dry	61.9	21.7	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 61.9	U, D	µg/kg dry	61.9	45.6	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 61.9	U, D	µg/kg dry	61.9	19.4	50	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 61.9	U, D	µg/kg dry	61.9	20.5	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 61.9	U, D	µg/kg dry	61.9	44.9	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 61.9	U, D	µg/kg dry	61.9	16.9	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 61.9	U, D	µg/kg dry	61.9	33.4	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 61.9	U, D	µg/kg dry	61.9	46.4	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 61.9	U, D	µg/kg dry	61.9	15.0	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 61.9	U, D	µg/kg dry	61.9	10.6	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 61.9	U, D	µg/kg dry	61.9	20.9	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 124	U, D	µg/kg dry	124	11.1	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 61.9	U, D	µg/kg dry	61.9	17.3	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 124	U, D	µg/kg dry	124	97.5	50	"	"	"	"	"	X
60-29-7	Ethyl ether	< 61.9	U, D	µg/kg dry	61.9	56.1	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 61.9	U, D	µg/kg dry	61.9	20.7	50	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 61.9	U, D	µg/kg dry	61.9	33.4	50	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 61.9	U, D	µg/kg dry	61.9	11.5	50	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 619	U, D	µg/kg dry	619	405	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1240	U, D	µg/kg dry	1240	1070	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 309	U, D	µg/kg dry	309	141	50	"	"	"	"	"	X
64-17-5	Ethanol	< 12400	U, D	µg/kg dry	12400	2310	50	"	"	"	"	"	X
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	100			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	97			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	97			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	92			70-130 %			"	"	"	"	"	

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Sample Identification

SB-1 (15-17')

SC43071-08

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 15:00

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 76.1	U	µg/kg dry	76.1	37.9	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 76.1	U	µg/kg dry	76.1	37.5	1	"	"	"	"	"	X
62-53-3	Aniline	< 376	U	µg/kg dry	376	27.0	1	"	"	"	"	"	X
120-12-7	Anthracene	< 76.1	U	µg/kg dry	76.1	36.4	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 376	U	µg/kg dry	376	37.0	1	"	"	"	"	"	
92-87-5	Benzidine	< 376	U	µg/kg dry	376	75.7	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 76.1	U	µg/kg dry	76.1	40.1	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 76.1	U	µg/kg dry	76.1	28.3	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 76.1	U	µg/kg dry	76.1	36.8	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 76.1	U	µg/kg dry	76.1	30.6	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 76.1	U	µg/kg dry	76.1	29.8	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 376	U	µg/kg dry	376	79.0	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 376	U	µg/kg dry	376	30.8	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 376	U	µg/kg dry	376	33.4	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 190	U	µg/kg dry	190	27.3	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 190	U	µg/kg dry	190	29.3	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 190	U	µg/kg dry	190	47.0	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 376	U	µg/kg dry	376	35.2	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 376	U	µg/kg dry	376	43.9	1	"	"	"	"	"	X
86-74-8	Carbazole	< 190	U	µg/kg dry	190	106	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 376	U	µg/kg dry	376	35.9	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 190	U	µg/kg dry	190	41.2	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 376	U	µg/kg dry	376	34.8	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 190	U	µg/kg dry	190	33.9	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 376	U	µg/kg dry	376	44.7	1	"	"	"	"	"	X
218-01-9	Chrysene	< 76.1	U	µg/kg dry	76.1	38.0	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 76.1	U	µg/kg dry	76.1	29.2	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 190	U	µg/kg dry	190	29.0	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 376	U	µg/kg dry	376	32.8	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 376	U	µg/kg dry	376	32.8	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 376	U	µg/kg dry	376	34.9	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 376	U	µg/kg dry	376	57.2	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 190	U	µg/kg dry	190	35.6	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 376	U	µg/kg dry	376	46.5	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 376	U	µg/kg dry	376	41.2	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 376	U	µg/kg dry	376	26.9	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 376	U	µg/kg dry	376	39.9	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 376	U	µg/kg dry	376	48.3	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 376	U	µg/kg dry	376	38.3	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 190	U	µg/kg dry	190	73.7	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 190	U	µg/kg dry	190	42.9	1	"	"	"	"	"	X

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Sample Identification

SB-1 (15-17')

SC43071-08

Client Project #

[none]

Matrix

Soil

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10-Jan-18 15:00

Received

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 376	U	µg/kg dry	376	42.5	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 76.1	U	µg/kg dry	76.1	40.2	1	"	"	"	"	"	X
86-73-7	Fluorene	< 76.1	U	µg/kg dry	76.1	38.7	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 190	U	µg/kg dry	190	37.5	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 190	U	µg/kg dry	190	45.5	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 190	U	µg/kg dry	190	25.9	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 190	U	µg/kg dry	190	41.0	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 76.1	U	µg/kg dry	76.1	27.4	1	"	"	"	"	"	X
78-59-1	Isophorone	< 190	U	µg/kg dry	190	35.7	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 76.1	U	µg/kg dry	76.1	46.0	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 376	U	µg/kg dry	376	32.0	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 376	U	µg/kg dry	376	36.4	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 76.1	U	µg/kg dry	76.1	35.5	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 376	U	µg/kg dry	376	31.9	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 376	U	µg/kg dry	376	51.4	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 190	U	µg/kg dry	190	58.6	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 190	U	µg/kg dry	190	34.7	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 190	U	µg/kg dry	190	31.6	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1510	U	µg/kg dry	1510	60.8	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 190	U	µg/kg dry	190	35.3	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 190	U	µg/kg dry	190	37.1	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 376	U	µg/kg dry	376	40.8	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 376	U	µg/kg dry	376	40.2	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 76.1	U	µg/kg dry	76.1	35.4	1	"	"	"	"	"	X
108-95-2	Phenol	< 376	U	µg/kg dry	376	24.8	1	"	"	"	"	"	X
129-00-0	Pyrene	< 76.1	U	µg/kg dry	76.1	42.4	1	"	"	"	"	"	X
110-86-1	Pyridine	< 376	U	µg/kg dry	376	56.1	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 376	U	µg/kg dry	376	37.3	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 76.1	U	µg/kg dry	76.1	37.4	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 376	U	µg/kg dry	376	33.9	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 190	U	µg/kg dry	190	34.0	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 376	U	µg/kg dry	376	59.4	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 376	U	µg/kg dry	376	36.5	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	62			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	57			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	57			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	51			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	75			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	59			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 22.7	U	µg/kg dry	22.7	10.2	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
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Sample Identification

SB-1 (15-17')

SC43071-08

Client Project #

[none]

Matrix

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 22.7	U	µg/kg dry	22.7	12.1	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 22.7	U	µg/kg dry	22.7	11.4	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 22.7	U	µg/kg dry	22.7	22.4	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 22.7	U	µg/kg dry	22.7	20.8	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 22.7	U	µg/kg dry	22.7	14.9	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 22.7	U	µg/kg dry	22.7	12.2	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 22.7	U	µg/kg dry	22.7	19.8	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 22.7	U	µg/kg dry	22.7	10.2	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	40			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	45			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	60			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.66	U	µg/kg dry	5.66	1.52	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.66	U	µg/kg dry	5.66	2.24	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.66	U	µg/kg dry	5.66	1.63	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.40	U	µg/kg dry	3.40	1.63	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.66	U	µg/kg dry	5.66	1.89	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.66	U	µg/kg dry	5.66	1.74	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.66	U	µg/kg dry	5.66	2.00	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.66	U	µg/kg dry	5.66	1.99	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.66	U	µg/kg dry	5.66	1.99	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.66	U	µg/kg dry	5.66	1.79	1	"	"	"	"	"	X
72-20-8	Endrin	< 9.06	U	µg/kg dry	9.06	1.99	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 9.06	U	µg/kg dry	9.06	2.13	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 9.06	U	µg/kg dry	9.06	1.97	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 9.06	U	µg/kg dry	9.06	1.89	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 9.06	U	µg/kg dry	9.06	1.74	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 9.06	U	µg/kg dry	9.06	2.00	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 9.06	U	µg/kg dry	9.06	2.04	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 9.06	U	µg/kg dry	9.06	1.89	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.66	U	µg/kg dry	5.66	1.94	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.66	U	µg/kg dry	5.66	2.04	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 113	U	µg/kg dry	113	24.5	1	"	"	"	"	"	X
57-74-9	Chlordane	< 22.7	U	µg/kg dry	22.7	22.4	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.66	U	µg/kg dry	5.66	2.78	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	78			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	82			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-1 (15-17')

SC43071-08

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 15:00

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	95			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
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2051-24-3	Decachlorobiphenyl (Sr) [2C]	116			30-150 %			"	"	"	"	"	
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**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.71	U	mg/kg dry	1.71	0.184	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	1,990		mg/kg dry	5.69	1.29	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.325	J	mg/kg dry	1.71	0.216	1	"	"	"	"	"	X
7440-39-3	Barium	11.2		mg/kg dry	1.14	0.134	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.112	J	mg/kg dry	0.569	0.0286	1	"	"	"	"	"	X
7440-70-2	Calcium	290		mg/kg dry	28.5	5.83	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.440	J	mg/kg dry	0.569	0.0295	1	"	"	"	"	"	X
7440-48-4	Cobalt	1.64		mg/kg dry	1.12	0.0651	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	7.50		mg/kg dry	1.14	0.151	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	5.88		mg/kg dry	1.14	0.273	1	"	"	"	"	"	X
7439-89-6	Iron	5,820	R06	mg/kg dry	569	2.35	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0323	U	mg/kg dry	0.0323	0.0090	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	420		mg/kg dry	56.2	3.92	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	725		mg/kg dry	5.69	1.64	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	118		mg/kg dry	1.14	0.290	1	"	"	"	"	"	X
7440-23-5	Sodium	54.2		mg/kg dry	28.5	12.2	1	"	"	"	"	"	X
7440-02-0	Nickel	5.64		mg/kg dry	1.14	0.131	1	"	"	"	"	"	X
7439-92-1	Lead	1.71		mg/kg dry	1.71	0.241	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.62	U	mg/kg dry	5.62	0.423	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.69	U	mg/kg dry	1.69	0.322	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.42	U	mg/kg dry	3.42	1.26	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	6.92		mg/kg dry	1.71	0.303	1	"	"	"	"	"	X
7440-66-6	Zinc	8.31		mg/kg dry	1.14	0.881	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	87.5		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.428	U	mg/kg dry	0.428	0.362	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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SC43071-09

[none]

Soil

10-Jan-18 16:05

12-Jan-18

Initial weight: 15.68 g

Page 80 of 193

## Sample Identification

SB-3 (0-2')

SC43071-09

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

10-Jan-18 16:05

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 15.68 g													
100-41-4	Ethylbenzene	< 58.3	U, D	µg/kg dry	58.3	8.39	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 58.3	U, D	µg/kg dry	58.3	29.2	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 117	U, D	µg/kg dry	117	71.5	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 58.3	U, D	µg/kg dry	58.3	11.5	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 58.3	U, D	µg/kg dry	58.3	12.5	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 58.3	U, D	µg/kg dry	58.3	21.4	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 117	U, D	µg/kg dry	117	29.9	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 117	U, D	µg/kg dry	117	23.1	50	"	"	"	"	"	X
91-20-3	Naphthalene	117	D	µg/kg dry	58.3	34.7	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 58.3	U, D	µg/kg dry	58.3	9.44	50	"	"	"	"	"	X
100-42-5	Styrene	< 58.3	U, D	µg/kg dry	58.3	11.7	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 58.3	U, D	µg/kg dry	58.3	49.5	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 58.3	U, D	µg/kg dry	58.3	49.3	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 58.3	U, D	µg/kg dry	58.3	19.9	50	"	"	"	"	"	X
108-88-3	Toluene	< 58.3	U, D	µg/kg dry	58.3	18.9	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 58.3	U, D	µg/kg dry	58.3	20.4	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 58.3	U, D	µg/kg dry	58.3	42.9	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 58.3	U, D	µg/kg dry	58.3	18.3	50	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 58.3	U, D	µg/kg dry	58.3	19.3	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 58.3	U, D	µg/kg dry	58.3	42.2	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 58.3	U, D	µg/kg dry	58.3	15.9	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 58.3	U, D	µg/kg dry	58.3	31.4	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 58.3	U, D	µg/kg dry	58.3	43.7	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 58.3	U, D	µg/kg dry	58.3	14.2	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 58.3	U, D	µg/kg dry	58.3	10.0	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 58.3	U, D	µg/kg dry	58.3	19.7	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 117	U, D	µg/kg dry	117	10.5	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 58.3	U, D	µg/kg dry	58.3	16.3	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 117	U, D	µg/kg dry	117	91.8	50	"	"	"	"	"	X
60-29-7	Ethyl ether	< 58.3	U, D	µg/kg dry	58.3	52.8	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 58.3	U, D	µg/kg dry	58.3	19.5	50	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 58.3	U, D	µg/kg dry	58.3	31.4	50	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 58.3	U, D	µg/kg dry	58.3	10.8	50	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 583	U, D	µg/kg dry	583	381	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1170	U, D	µg/kg dry	1170	1010	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 291	U, D	µg/kg dry	291	133	50	"	"	"	"	"	X
64-17-5	Ethanol	< 11700	U, D	µg/kg dry	11700	2170	50	"	"	"	"	"	X
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	102			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	98			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	99			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	95			70-130 %			"	"	"	"	"	

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Sample Identification

SB-3 (0-2')

SC43071-09

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 16:05

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 737	U, D	µg/kg dry	737	367	10	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 737	U, D	µg/kg dry	737	364	10	"	"	"	"	"	X
62-53-3	Aniline	< 3650	U, D	µg/kg dry	3650	262	10	"	"	"	"	"	X
120-12-7	Anthracene	< 737	U, D	µg/kg dry	737	353	10	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 3650	U, D	µg/kg dry	3650	359	10	"	"	"	"	"	
92-87-5	Benzidine	< 3650	U, D	µg/kg dry	3650	734	10	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	490	J, D	µg/kg dry	737	389	10	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	520	J, D	µg/kg dry	737	274	10	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	527	J, D	µg/kg dry	737	357	10	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	306	J, D	µg/kg dry	737	296	10	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	420	J, D	µg/kg dry	737	289	10	"	"	"	"	"	X
65-85-0	Benzoic acid	< 3650	U, D	µg/kg dry	3650	766	10	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 3650	U, D	µg/kg dry	3650	299	10	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 3650	U, D	µg/kg dry	3650	324	10	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 1850	U, D	µg/kg dry	1850	264	10	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 1850	U, D	µg/kg dry	1850	284	10	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 1850	U, D	µg/kg dry	1850	455	10	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 3650	U, D	µg/kg dry	3650	342	10	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 3650	U, D	µg/kg dry	3650	426	10	"	"	"	"	"	X
86-74-8	Carbazole	< 1850	U, D	µg/kg dry	1850	1030	10	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 3650	U, D	µg/kg dry	3650	348	10	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 1850	U, D	µg/kg dry	1850	399	10	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 3650	U, D	µg/kg dry	3650	337	10	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 1850	U, D	µg/kg dry	1850	328	10	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 3650	U, D	µg/kg dry	3650	433	10	"	"	"	"	"	X
218-01-9	Chrysene	450	J, D	µg/kg dry	737	368	10	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 737	U, D	µg/kg dry	737	283	10	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 1850	U, D	µg/kg dry	1850	281	10	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 3650	U, D	µg/kg dry	3650	318	10	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 3650	U, D	µg/kg dry	3650	318	10	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 3650	U, D	µg/kg dry	3650	338	10	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 3650	U, D	µg/kg dry	3650	555	10	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 1850	U, D	µg/kg dry	1850	345	10	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 3650	U, D	µg/kg dry	3650	451	10	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 3650	U, D	µg/kg dry	3650	399	10	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 3650	U, D	µg/kg dry	3650	261	10	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 3650	U, D	µg/kg dry	3650	387	10	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 3650	U, D	µg/kg dry	3650	468	10	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 3650	U, D	µg/kg dry	3650	371	10	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 1850	U, D	µg/kg dry	1850	714	10	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 1850	U, D	µg/kg dry	1850	416	10	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-3 (0-2')

SC43071-09

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 16:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>				R01									
117-84-0	Di-n-octyl phthalate	< 3650	U, D	µg/kg dry	3650	412	10	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	1,000	D	µg/kg dry	737	390	10	"	"	"	"	"	X
86-73-7	Fluorene	< 737	U, D	µg/kg dry	737	375	10	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 1850	U, D	µg/kg dry	1850	363	10	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 1850	U, D	µg/kg dry	1850	441	10	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 1850	U, D	µg/kg dry	1850	251	10	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 1850	U, D	µg/kg dry	1850	398	10	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	298	J, D	µg/kg dry	737	265	10	"	"	"	"	"	X
78-59-1	Isophorone	< 1850	U, D	µg/kg dry	1850	346	10	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 737	U, D	µg/kg dry	737	446	10	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 3650	U, D	µg/kg dry	3650	310	10	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 3650	U, D	µg/kg dry	3650	353	10	"	"	"	"	"	X
91-20-3	Naphthalene	< 737	U, D	µg/kg dry	737	344	10	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 3650	U, D	µg/kg dry	3650	310	10	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 3650	U, D	µg/kg dry	3650	499	10	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 1850	U, D	µg/kg dry	1850	568	10	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 1850	U, D	µg/kg dry	1850	336	10	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 1850	U, D	µg/kg dry	1850	306	10	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 14600	U, D	µg/kg dry	14600	589	10	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 1850	U, D	µg/kg dry	1850	343	10	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 1850	U, D	µg/kg dry	1850	359	10	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 3650	U, D	µg/kg dry	3650	396	10	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 3650	U, D	µg/kg dry	3650	390	10	"	"	"	"	"	X
85-01-8	Phenanthrene	615	J, D	µg/kg dry	737	343	10	"	"	"	"	"	X
108-95-2	Phenol	< 3650	U, D	µg/kg dry	3650	240	10	"	"	"	"	"	X
129-00-0	Pyrene	925	D	µg/kg dry	737	411	10	"	"	"	"	"	X
110-86-1	Pyridine	< 3650	U, D	µg/kg dry	3650	544	10	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 3650	U, D	µg/kg dry	3650	361	10	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 737	U, D	µg/kg dry	737	363	10	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 3650	U, D	µg/kg dry	3650	328	10	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 1850	U, D	µg/kg dry	1850	329	10	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 3650	U, D	µg/kg dry	3650	576	10	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 3650	U, D	µg/kg dry	3650	354	10	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	55			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	46			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	50			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	41			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	66			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	50			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 22.0	U	µg/kg dry	22.0	9.86	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-3 (0-2')

SC43071-09

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 16:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 22.0	U	µg/kg dry	22.0	11.7	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 22.0	U	µg/kg dry	22.0	11.0	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 22.0	U	µg/kg dry	22.0	21.7	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 22.0	U	µg/kg dry	22.0	20.1	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 22.0	U	µg/kg dry	22.0	14.4	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 22.0	U	µg/kg dry	22.0	11.8	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262 [2C]	10.5	J	µg/kg dry	11.0	7.97	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 22.0	U	µg/kg dry	22.0	9.93	1	"	"	"	"	"	X

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	55			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	60			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	115			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	105			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 27.5	U, D	µg/kg dry	27.5	7.37	5	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 27.5	U, D	µg/kg dry	27.5	10.9	5	"	"	"	"	"	X
319-86-8	delta-BHC	< 27.5	U, D	µg/kg dry	27.5	7.92	5	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 16.5	U, D	µg/kg dry	16.5	7.92	5	"	"	"	"	"	X
76-44-8	Heptachlor	< 27.5	U, D	µg/kg dry	27.5	9.18	5	"	"	"	"	"	X
309-00-2	Aldrin	< 27.5	U, D	µg/kg dry	27.5	8.47	5	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 27.5	U, D	µg/kg dry	27.5	9.73	5	"	"	"	"	"	X
959-98-8	Endosulfan I	< 27.5	U, D	µg/kg dry	27.5	9.68	5	"	"	"	"	"	X
60-57-1	Dieldrin	< 27.5	U, D	µg/kg dry	27.5	9.68	5	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 27.5	U, D	µg/kg dry	27.5	8.69	5	"	"	"	"	"	X
72-20-8	Endrin	< 44.0	U, D	µg/kg dry	44.0	9.68	5	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 44.0	U, D	µg/kg dry	44.0	10.3	5	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 44.0	U, D	µg/kg dry	44.0	9.57	5	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 44.0	U, D	µg/kg dry	44.0	9.18	5	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 44.0	U, D	µg/kg dry	44.0	8.47	5	"	"	"	"	"	X
72-43-5	Methoxychlor	< 44.0	U, D	µg/kg dry	44.0	9.73	5	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 44.0	U, D	µg/kg dry	44.0	9.90	5	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 44.0	U, D	µg/kg dry	44.0	9.18	5	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	10.9	J, D	µg/kg dry	27.5	9.40	5	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans) [2C]	< 27.5	U, D	µg/kg dry	27.5	9.90	5	"	"	"	"	"	X
8001-35-2	Toxaphene	< 550	U, D	µg/kg dry	550	119	5	"	"	"	"	"	X
57-74-9	Chlordane [2C]	< 22.0	U	µg/kg dry	22.0	21.6	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 27.5	U, D	µg/kg dry	27.5	13.5	5	"	"	"	"	"	

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	74			30-150 %			"	"	"	"	"	
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*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-3 (0-2')

SC43071-09

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 16:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Pesticides**Organochlorine Pesticides

R01

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	82			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr)	115			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	95			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.63	U	mg/kg dry	1.63	0.176	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	5,510		mg/kg dry	5.43	1.23	1	"	"	"	"	"	X
7440-38-2	Arsenic	2.25		mg/kg dry	1.63	0.206	1	"	"	"	"	"	X
7440-39-3	Barium	42.1		mg/kg dry	1.09	0.128	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.258	J	mg/kg dry	0.543	0.0273	1	"	"	"	"	"	X
7440-70-2	Calcium	4,100		mg/kg dry	27.2	5.56	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.877		mg/kg dry	0.543	0.0281	1	"	"	"	"	"	X
7440-48-4	Cobalt	4.75		mg/kg dry	1.09	0.0632	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	11.1		mg/kg dry	1.09	0.144	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	28.0		mg/kg dry	1.09	0.261	1	"	"	"	"	"	X
7439-89-6	Iron	9,220	R06	mg/kg dry	543	2.24	1	"	"	"	"	"	X
7439-97-6	Mercury	0.210		mg/kg dry	0.0324	0.0090	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	499		mg/kg dry	54.5	3.80	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	2,140		mg/kg dry	5.43	1.56	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	161		mg/kg dry	1.09	0.277	1	"	"	"	"	"	X
7440-23-5	Sodium	54.6		mg/kg dry	27.2	11.7	1	"	"	"	"	"	X
7440-02-0	Nickel	9.91		mg/kg dry	1.09	0.125	1	"	"	"	"	"	X
7439-92-1	Lead	50.1		mg/kg dry	1.63	0.230	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.45	U	mg/kg dry	5.45	0.410	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.64	U	mg/kg dry	1.64	0.312	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.26	U	mg/kg dry	3.26	1.20	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	16.9		mg/kg dry	1.63	0.289	1	"	"	"	"	"	X
7440-66-6	Zinc	57.2		mg/kg dry	1.09	0.841	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	90.4		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.346	U	mg/kg dry	0.346	0.292	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800661	X
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Sample Identification

SB-3 (15-17')

SC43071-10

Client Project #

[none]

Matrix

Soil

Collection Date/Time

10-Jan-18 16:30

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (high level)</u>													
Initial weight: 16.71 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 63.6	U, D	µg/kg dry	63.6	32.3	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 63.6	U, D	µg/kg dry	63.6	254	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 63.6	U, D	µg/kg dry	63.6	61.1	50	"	"	"	"	"	X
71-43-2	Benzene	< 63.6	U, D	µg/kg dry	63.6	16.9	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 63.6	U, D	µg/kg dry	63.6	17.0	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 63.6	U, D	µg/kg dry	63.6	32.1	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 63.6	U, D	µg/kg dry	63.6	42.4	50	"	"	"	"	"	X
75-25-2	Bromoform	< 63.6	U, D	µg/kg dry	63.6	60.7	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 127	U, D	µg/kg dry	127	57.5	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 127	U, D	µg/kg dry	127	114	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 63.6	U, D	µg/kg dry	63.6	18.2	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 63.6	U, D	µg/kg dry	63.6	11.6	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 63.6	U, D	µg/kg dry	63.6	14.3	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 127	U, D	µg/kg dry	127	40.7	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 63.6	U, D	µg/kg dry	63.6	52.0	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 63.6	U, D	µg/kg dry	63.6	19.9	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 127	U, D	µg/kg dry	127	35.3	50	"	"	"	"	"	X
67-66-3	Chloroform	< 63.6	U, D	µg/kg dry	63.6	34.2	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 127	U, D	µg/kg dry	127	26.3	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 63.6	U, D	µg/kg dry	63.6	15.8	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 63.6	U, D	µg/kg dry	63.6	15.0	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 127	U, D	µg/kg dry	127	91.9	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 63.6	U, D	µg/kg dry	63.6	43.1	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 63.6	U, D	µg/kg dry	63.6	42.7	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 63.6	U, D	µg/kg dry	63.6	33.1	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 63.6	U, D	µg/kg dry	63.6	16.5	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 63.6	U, D	µg/kg dry	63.6	13.8	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 63.6	U, D	µg/kg dry	63.6	18.8	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 127	U, D	µg/kg dry	127	24.1	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 63.6	U, D	µg/kg dry	63.6	16.7	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 63.6	U, D	µg/kg dry	63.6	22.8	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 63.6	U, D	µg/kg dry	63.6	33.3	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 63.6	U, D	µg/kg dry	63.6	23.6	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 63.6	U, D	µg/kg dry	63.6	33.7	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 63.6	U, D	µg/kg dry	63.6	33.3	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 63.6	U, D	µg/kg dry	63.6	33.0	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 63.6	U, D	µg/kg dry	63.6	30.0	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 63.6	U, D	µg/kg dry	63.6	20.5	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 63.6	U, D	µg/kg dry	63.6	38.4	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 63.6	U, D	µg/kg dry	63.6	33.4	50	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

## Sample Identification

SB-3 (15-17')

SC43071-10

## Client Project #

[none]

## Matrix

Soil

## Collection Date/Time

10-Jan-18 16:30

## Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 16.71 g													
100-41-4	Ethylbenzene	< 63.6	U, D	µg/kg dry	63.6	9.16	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 63.6	U, D	µg/kg dry	63.6	31.9	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 127	U, D	µg/kg dry	127	78.1	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 63.6	U, D	µg/kg dry	63.6	12.5	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 63.6	U, D	µg/kg dry	63.6	13.7	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 63.6	U, D	µg/kg dry	63.6	23.4	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 127	U, D	µg/kg dry	127	32.7	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 127	U, D	µg/kg dry	127	25.3	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 63.6	U, D	µg/kg dry	63.6	37.9	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 63.6	U, D	µg/kg dry	63.6	10.3	50	"	"	"	"	"	X
100-42-5	Styrene	< 63.6	U, D	µg/kg dry	63.6	12.8	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 63.6	U, D	µg/kg dry	63.6	54.1	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 63.6	U, D	µg/kg dry	63.6	53.8	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 63.6	U, D	µg/kg dry	63.6	21.8	50	"	"	"	"	"	X
108-88-3	Toluene	< 63.6	U, D	µg/kg dry	63.6	20.6	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 63.6	U, D	µg/kg dry	63.6	22.3	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 63.6	U, D	µg/kg dry	63.6	46.9	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 63.6	U, D	µg/kg dry	63.6	20.0	50	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 63.6	U, D	µg/kg dry	63.6	21.1	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 63.6	U, D	µg/kg dry	63.6	46.1	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 63.6	U, D	µg/kg dry	63.6	17.4	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 63.6	U, D	µg/kg dry	63.6	34.3	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 63.6	U, D	µg/kg dry	63.6	47.7	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 63.6	U, D	µg/kg dry	63.6	15.5	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 63.6	U, D	µg/kg dry	63.6	10.9	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 63.6	U, D	µg/kg dry	63.6	21.5	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 127	U, D	µg/kg dry	127	11.5	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 63.6	U, D	µg/kg dry	63.6	17.8	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 127	U, D	µg/kg dry	127	100	50	"	"	"	"	"	X
60-29-7	Ethyl ether	< 63.6	U, D	µg/kg dry	63.6	57.6	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 63.6	U, D	µg/kg dry	63.6	21.3	50	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 63.6	U, D	µg/kg dry	63.6	34.3	50	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 63.6	U, D	µg/kg dry	63.6	11.8	50	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 636	U, D	µg/kg dry	636	416	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1270	U, D	µg/kg dry	1270	1110	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 318	U, D	µg/kg dry	318	145	50	"	"	"	"	"	X
64-17-5	Ethanol	< 12700	U, D	µg/kg dry	12700	2370	50	"	"	"	"	"	X
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	99			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	97			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	98			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	93			70-130 %			"	"	"	"	"	

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Sample Identification

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[none]

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 79.7	U	µg/kg dry	79.7	39.6	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 79.7	U	µg/kg dry	79.7	39.3	1	"	"	"	"	"	X
62-53-3	Aniline	< 394	U	µg/kg dry	394	28.3	1	"	"	"	"	"	X
120-12-7	Anthracene	< 79.7	U	µg/kg dry	79.7	38.1	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 394	U	µg/kg dry	394	38.8	1	"	"	"	"	"	
92-87-5	Benzidine	< 394	U	µg/kg dry	394	79.3	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 79.7	U	µg/kg dry	79.7	42.0	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 79.7	U	µg/kg dry	79.7	29.7	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 79.7	U	µg/kg dry	79.7	38.6	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 79.7	U	µg/kg dry	79.7	32.0	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 79.7	U	µg/kg dry	79.7	31.2	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 394	U	µg/kg dry	394	82.7	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 394	U	µg/kg dry	394	32.3	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 394	U	µg/kg dry	394	35.0	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 199	U	µg/kg dry	199	28.6	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 199	U	µg/kg dry	199	30.7	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 199	U	µg/kg dry	199	49.2	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 394	U	µg/kg dry	394	36.9	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 394	U	µg/kg dry	394	46.0	1	"	"	"	"	"	X
86-74-8	Carbazole	< 199	U	µg/kg dry	199	111	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 394	U	µg/kg dry	394	37.6	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 199	U	µg/kg dry	199	43.1	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 394	U	µg/kg dry	394	36.4	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 199	U	µg/kg dry	199	35.5	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 394	U	µg/kg dry	394	46.8	1	"	"	"	"	"	X
218-01-9	Chrysene	< 79.7	U	µg/kg dry	79.7	39.8	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 79.7	U	µg/kg dry	79.7	30.6	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 199	U	µg/kg dry	199	30.3	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 394	U	µg/kg dry	394	34.4	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 394	U	µg/kg dry	394	34.4	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 394	U	µg/kg dry	394	36.5	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 394	U	µg/kg dry	394	59.9	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 199	U	µg/kg dry	199	37.3	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 394	U	µg/kg dry	394	48.7	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 394	U	µg/kg dry	394	43.1	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 394	U	µg/kg dry	394	28.2	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 394	U	µg/kg dry	394	41.8	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 394	U	µg/kg dry	394	50.6	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 394	U	µg/kg dry	394	40.1	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 199	U	µg/kg dry	199	77.1	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 199	U	µg/kg dry	199	44.9	1	"	"	"	"	"	X

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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 394	U	µg/kg dry	394	44.5	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 79.7	U	µg/kg dry	79.7	42.1	1	"	"	"	"	"	X
86-73-7	Fluorene	< 79.7	U	µg/kg dry	79.7	40.5	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 199	U	µg/kg dry	199	39.3	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 199	U	µg/kg dry	199	47.6	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 199	U	µg/kg dry	199	27.1	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 199	U	µg/kg dry	199	43.0	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 79.7	U	µg/kg dry	79.7	28.7	1	"	"	"	"	"	X
78-59-1	Isophorone	< 199	U	µg/kg dry	199	37.4	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 79.7	U	µg/kg dry	79.7	48.1	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 394	U	µg/kg dry	394	33.5	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 394	U	µg/kg dry	394	38.1	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 79.7	U	µg/kg dry	79.7	37.1	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 394	U	µg/kg dry	394	33.4	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 394	U	µg/kg dry	394	53.9	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 199	U	µg/kg dry	199	61.4	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 199	U	µg/kg dry	199	36.3	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 199	U	µg/kg dry	199	33.1	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1580	U	µg/kg dry	1580	63.7	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 199	U	µg/kg dry	199	37.0	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 199	U	µg/kg dry	199	38.8	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 394	U	µg/kg dry	394	42.7	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 394	U	µg/kg dry	394	42.1	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 79.7	U	µg/kg dry	79.7	37.1	1	"	"	"	"	"	X
108-95-2	Phenol	< 394	U	µg/kg dry	394	25.9	1	"	"	"	"	"	X
129-00-0	Pyrene	< 79.7	U	µg/kg dry	79.7	44.4	1	"	"	"	"	"	X
110-86-1	Pyridine	< 394	U	µg/kg dry	394	58.8	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 394	U	µg/kg dry	394	39.0	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 79.7	U	µg/kg dry	79.7	39.2	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 394	U	µg/kg dry	394	35.5	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 199	U	µg/kg dry	199	35.6	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 394	U	µg/kg dry	394	62.2	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 394	U	µg/kg dry	394	38.2	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	62			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	56			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	56			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	52			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	79			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	60			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 23.7	U	µg/kg dry	23.7	10.6	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 23.7	U	µg/kg dry	23.7	12.6	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 23.7	U	µg/kg dry	23.7	11.9	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 23.7	U	µg/kg dry	23.7	23.4	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 23.7	U	µg/kg dry	23.7	21.7	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 23.7	U	µg/kg dry	23.7	15.5	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 23.7	U	µg/kg dry	23.7	12.7	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 23.7	U	µg/kg dry	23.7	20.7	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 23.7	U	µg/kg dry	23.7	10.7	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	50			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	50			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	70			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	80			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.87	U	µg/kg dry	5.87	1.57	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.87	U	µg/kg dry	5.87	2.32	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.87	U	µg/kg dry	5.87	1.69	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.52	U	µg/kg dry	3.52	1.69	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.87	U	µg/kg dry	5.87	1.96	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.87	U	µg/kg dry	5.87	1.81	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.87	U	µg/kg dry	5.87	2.08	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.87	U	µg/kg dry	5.87	2.07	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.87	U	µg/kg dry	5.87	2.07	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.87	U	µg/kg dry	5.87	1.85	1	"	"	"	"	"	X
72-20-8	Endrin	< 9.39	U	µg/kg dry	9.39	2.07	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 9.39	U	µg/kg dry	9.39	2.21	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 9.39	U	µg/kg dry	9.39	2.04	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 9.39	U	µg/kg dry	9.39	1.96	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 9.39	U	µg/kg dry	9.39	1.81	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 9.39	U	µg/kg dry	9.39	2.08	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 9.39	U	µg/kg dry	9.39	2.11	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 9.39	U	µg/kg dry	9.39	1.96	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.87	U	µg/kg dry	5.87	2.01	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.87	U	µg/kg dry	5.87	2.11	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 117	U	µg/kg dry	117	25.4	1	"	"	"	"	"	X
57-74-9	Chlordane	< 23.5	U	µg/kg dry	23.5	23.2	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.87	U	µg/kg dry	5.87	2.88	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	78			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	82			30-150 %			"	"	"	"	"	

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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	93			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	119			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.77	U	mg/kg dry	1.77	0.191	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	2,410		mg/kg dry	5.90	1.34	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.348	J	mg/kg dry	1.77	0.224	1	"	"	"	"	"	X
7440-39-3	Barium	15.2		mg/kg dry	1.18	0.139	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.0902	J	mg/kg dry	0.590	0.0296	1	"	"	"	"	"	X
7440-70-2	Calcium	122		mg/kg dry	29.5	6.04	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.337	J	mg/kg dry	0.590	0.0305	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.12		mg/kg dry	1.18	0.0686	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	7.56		mg/kg dry	1.18	0.157	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	4.69		mg/kg dry	1.18	0.283	1	"	"	"	"	"	X
7439-89-6	Iron	4,420	R06	mg/kg dry	590	2.43	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0347	U	mg/kg dry	0.0347	0.0096	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	619		mg/kg dry	59.2	4.13	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	918		mg/kg dry	5.90	1.70	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	126		mg/kg dry	1.18	0.301	1	"	"	"	"	"	X
7440-23-5	Sodium	54.7		mg/kg dry	29.5	12.7	1	"	"	"	"	"	X
7440-02-0	Nickel	7.08		mg/kg dry	1.18	0.136	1	"	"	"	"	"	X
7439-92-1	Lead	1.38	J	mg/kg dry	1.77	0.250	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.92	U	mg/kg dry	5.92	0.445	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.78	U	mg/kg dry	1.78	0.339	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.54	U	mg/kg dry	3.54	1.30	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	6.73		mg/kg dry	1.77	0.314	1	"	"	"	"	"	X
7440-66-6	Zinc	9.46		mg/kg dry	1.18	0.913	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	83.5		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.306	U	mg/kg dry	0.306	0.258	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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## Sample Identification

SB-2 (0-2')

SC43071-11

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:10

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (high level)</u>													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 60.9	U, D	µg/kg dry	60.9	30.9	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
67-64-1	Acetone	< 60.9	U, D	µg/kg dry	60.9	244	50	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 60.9	U, D	µg/kg dry	60.9	58.5	50	"	"	"	"	"	X
71-43-2	Benzene	< 60.9	U, D	µg/kg dry	60.9	16.1	50	"	"	"	"	"	X
108-86-1	Bromobenzene	< 60.9	U, D	µg/kg dry	60.9	16.3	50	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 60.9	U, D	µg/kg dry	60.9	30.8	50	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 60.9	U, D	µg/kg dry	60.9	40.6	50	"	"	"	"	"	X
75-25-2	Bromoform	< 60.9	U, D	µg/kg dry	60.9	58.1	50	"	"	"	"	"	X
74-83-9	Bromomethane	< 122	U, D	µg/kg dry	122	55.0	50	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 122	U, D	µg/kg dry	122	109	50	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 60.9	U, D	µg/kg dry	60.9	17.4	50	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 60.9	U, D	µg/kg dry	60.9	11.1	50	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 60.9	U, D	µg/kg dry	60.9	13.6	50	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 122	U, D	µg/kg dry	122	39.0	50	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 60.9	U, D	µg/kg dry	60.9	49.8	50	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 60.9	U, D	µg/kg dry	60.9	19.1	50	"	"	"	"	"	X
75-00-3	Chloroethane	< 122	U, D	µg/kg dry	122	33.8	50	"	"	"	"	"	X
67-66-3	Chloroform	< 60.9	U, D	µg/kg dry	60.9	32.7	50	"	"	"	"	"	X
74-87-3	Chloromethane	< 122	U, D	µg/kg dry	122	25.2	50	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 60.9	U, D	µg/kg dry	60.9	15.2	50	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 60.9	U, D	µg/kg dry	60.9	14.3	50	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 122	U, D	µg/kg dry	122	88.0	50	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 60.9	U, D	µg/kg dry	60.9	41.3	50	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 60.9	U, D	µg/kg dry	60.9	40.9	50	"	"	"	"	"	X
74-95-3	Dibromomethane	< 60.9	U, D	µg/kg dry	60.9	31.7	50	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 60.9	U, D	µg/kg dry	60.9	15.8	50	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 60.9	U, D	µg/kg dry	60.9	13.2	50	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 60.9	U, D	µg/kg dry	60.9	18.0	50	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 122	U, D	µg/kg dry	122	23.1	50	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 60.9	U, D	µg/kg dry	60.9	16.0	50	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 60.9	U, D	µg/kg dry	60.9	21.8	50	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 60.9	U, D	µg/kg dry	60.9	31.9	50	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 60.9	U, D	µg/kg dry	60.9	22.6	50	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 60.9	U, D	µg/kg dry	60.9	32.3	50	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 60.9	U, D	µg/kg dry	60.9	31.9	50	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 60.9	U, D	µg/kg dry	60.9	31.5	50	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 60.9	U, D	µg/kg dry	60.9	28.7	50	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 60.9	U, D	µg/kg dry	60.9	19.6	50	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 60.9	U, D	µg/kg dry	60.9	36.7	50	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 60.9	U, D	µg/kg dry	60.9	32.0	50	"	"	"	"	"	X

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Sample Identification

SB-2 (0-2')

SC43071-11

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:10

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Volatile Organic Compounds													
Volatile Organic Compounds by SW846 8260			VOC8										
Initial weight: 14.98 g													
100-41-4	Ethylbenzene	< 60.9	U, D	µg/kg dry	60.9	8.77	50	SW846 8260C	22-Jan-18	22-Jan-18	EK	1800822	X
87-68-3	Hexachlorobutadiene	< 60.9	U, D	µg/kg dry	60.9	30.6	50	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 122	U, D	µg/kg dry	122	74.7	50	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 60.9	U, D	µg/kg dry	60.9	12.0	50	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 60.9	U, D	µg/kg dry	60.9	13.1	50	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 60.9	U, D	µg/kg dry	60.9	22.4	50	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 122	U, D	µg/kg dry	122	31.3	50	"	"	"	"	"	X
75-09-2	Methylene chloride	< 122	U, D	µg/kg dry	122	24.2	50	"	"	"	"	"	X
91-20-3	Naphthalene	< 60.9	U, D	µg/kg dry	60.9	36.2	50	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 60.9	U, D	µg/kg dry	60.9	9.87	50	"	"	"	"	"	X
100-42-5	Styrene	< 60.9	U, D	µg/kg dry	60.9	12.2	50	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 60.9	U, D	µg/kg dry	60.9	51.8	50	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 60.9	U, D	µg/kg dry	60.9	51.5	50	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 60.9	U, D	µg/kg dry	60.9	20.8	50	"	"	"	"	"	X
108-88-3	Toluene	< 60.9	U, D	µg/kg dry	60.9	19.7	50	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 60.9	U, D	µg/kg dry	60.9	21.4	50	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 60.9	U, D	µg/kg dry	60.9	44.9	50	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 60.9	U, D	µg/kg dry	60.9	19.1	50	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 60.9	U, D	µg/kg dry	60.9	20.2	50	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 60.9	U, D	µg/kg dry	60.9	44.2	50	"	"	"	"	"	X
79-01-6	Trichloroethene	< 60.9	U, D	µg/kg dry	60.9	16.6	50	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 60.9	U, D	µg/kg dry	60.9	32.8	50	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 60.9	U, D	µg/kg dry	60.9	45.7	50	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 60.9	U, D	µg/kg dry	60.9	14.8	50	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 60.9	U, D	µg/kg dry	60.9	10.5	50	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 60.9	U, D	µg/kg dry	60.9	20.6	50	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 122	U, D	µg/kg dry	122	11.0	50	"	"	"	"	"	X
95-47-6	o-Xylene	< 60.9	U, D	µg/kg dry	60.9	17.1	50	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 122	U, D	µg/kg dry	122	96.0	50	"	"	"	"	"	
60-29-7	Ethyl ether	< 60.9	U, D	µg/kg dry	60.9	55.2	50	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 60.9	U, D	µg/kg dry	60.9	20.3	50	"	"	"	"	"	
637-92-3	Ethyl tert-butyl ether	< 60.9	U, D	µg/kg dry	60.9	32.8	50	"	"	"	"	"	
108-20-3	Di-isopropyl ether	< 60.9	U, D	µg/kg dry	60.9	11.3	50	"	"	"	"	"	
75-65-0	Tert-Butanol / butyl alcohol	< 609	U, D	µg/kg dry	609	399	50	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 1220	U, D	µg/kg dry	1220	1060	50	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 305	U, D	µg/kg dry	305	139	50	"	"	"	"	"	X
64-17-5	Ethanol	< 12200	U, D	µg/kg dry	12200	2270	50	"	"	"	"	"	
Surrogate recoveries:													
460-00-4	4-Bromofluorobenzene	99			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	98			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	99			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	94			70-130 %			"	"	"	"	"	

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Sample Identification

SB-2 (0-2')

SC43071-11

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:10

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 368	U, D	µg/kg dry	368	183	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 368	U, D	µg/kg dry	368	181	5	"	"	"	"	"	X
62-53-3	Aniline	< 1820	U, D	µg/kg dry	1820	131	5	"	"	"	"	"	X
120-12-7	Anthracene	< 368	U, D	µg/kg dry	368	176	5	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 1820	U, D	µg/kg dry	1820	179	5	"	"	"	"	"	
92-87-5	Benzidine	< 1820	U, D	µg/kg dry	1820	366	5	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 368	U, D	µg/kg dry	368	194	5	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	250	J, D	µg/kg dry	368	137	5	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	257	J, D	µg/kg dry	368	178	5	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	303	J, D	µg/kg dry	368	148	5	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	193	J, D	µg/kg dry	368	144	5	"	"	"	"	"	X
65-85-0	Benzoic acid	< 1820	U, D	µg/kg dry	1820	382	5	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 1820	U, D	µg/kg dry	1820	149	5	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 1820	U, D	µg/kg dry	1820	162	5	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 921	U, D	µg/kg dry	921	132	5	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 921	U, D	µg/kg dry	921	142	5	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 921	U, D	µg/kg dry	921	227	5	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 1820	U, D	µg/kg dry	1820	170	5	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 1820	U, D	µg/kg dry	1820	212	5	"	"	"	"	"	X
86-74-8	Carbazole	< 921	U, D	µg/kg dry	921	514	5	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 1820	U, D	µg/kg dry	1820	174	5	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 921	U, D	µg/kg dry	921	199	5	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 1820	U, D	µg/kg dry	1820	168	5	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 921	U, D	µg/kg dry	921	164	5	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 1820	U, D	µg/kg dry	1820	216	5	"	"	"	"	"	X
218-01-9	Chrysene	189	J, D	µg/kg dry	368	184	5	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 368	U, D	µg/kg dry	368	141	5	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 921	U, D	µg/kg dry	921	140	5	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1820	U, D	µg/kg dry	1820	159	5	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1820	U, D	µg/kg dry	1820	159	5	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1820	U, D	µg/kg dry	1820	169	5	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 1820	U, D	µg/kg dry	1820	277	5	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 921	U, D	µg/kg dry	921	172	5	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 1820	U, D	µg/kg dry	1820	225	5	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 1820	U, D	µg/kg dry	1820	199	5	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 1820	U, D	µg/kg dry	1820	130	5	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 1820	U, D	µg/kg dry	1820	193	5	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 1820	U, D	µg/kg dry	1820	234	5	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 1820	U, D	µg/kg dry	1820	185	5	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 921	U, D	µg/kg dry	921	356	5	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 921	U, D	µg/kg dry	921	207	5	"	"	"	"	"	X

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Sample Identification

SB-2 (0-2')

SC43071-11

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:10

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

R01

117-84-0	Di-n-octyl phthalate	< 1820	U, D	µg/kg dry	1820	206	5	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	299	J, D	µg/kg dry	368	194	5	"	"	"	"	"	X
86-73-7	Fluorene	< 368	U, D	µg/kg dry	368	187	5	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 921	U, D	µg/kg dry	921	181	5	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 921	U, D	µg/kg dry	921	220	5	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 921	U, D	µg/kg dry	921	125	5	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 921	U, D	µg/kg dry	921	198	5	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	252	J, D	µg/kg dry	368	132	5	"	"	"	"	"	X
78-59-1	Isophorone	< 921	U, D	µg/kg dry	921	173	5	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 368	U, D	µg/kg dry	368	222	5	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 1820	U, D	µg/kg dry	1820	155	5	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 1820	U, D	µg/kg dry	1820	176	5	"	"	"	"	"	X
91-20-3	Naphthalene	< 368	U, D	µg/kg dry	368	171	5	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 1820	U, D	µg/kg dry	1820	154	5	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 1820	U, D	µg/kg dry	1820	249	5	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 921	U, D	µg/kg dry	921	283	5	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 921	U, D	µg/kg dry	921	168	5	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 921	U, D	µg/kg dry	921	153	5	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 7280	U, D	µg/kg dry	7280	294	5	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 921	U, D	µg/kg dry	921	171	5	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 921	U, D	µg/kg dry	921	179	5	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 1820	U, D	µg/kg dry	1820	197	5	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 1820	U, D	µg/kg dry	1820	194	5	"	"	"	"	"	X
85-01-8	Phenanthrene	< 368	U, D	µg/kg dry	368	171	5	"	"	"	"	"	X
108-95-2	Phenol	< 1820	U, D	µg/kg dry	1820	120	5	"	"	"	"	"	X
129-00-0	Pyrene	259	J, D	µg/kg dry	368	205	5	"	"	"	"	"	X
110-86-1	Pyridine	< 1820	U, D	µg/kg dry	1820	271	5	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1820	U, D	µg/kg dry	1820	180	5	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 368	U, D	µg/kg dry	368	181	5	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 1820	U, D	µg/kg dry	1820	164	5	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 921	U, D	µg/kg dry	921	164	5	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 1820	U, D	µg/kg dry	1820	287	5	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 1820	U, D	µg/kg dry	1820	176	5	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	50			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	42			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	49			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	43			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	54			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	56			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 22.0	U	µg/kg dry	22.0	9.84	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-2 (0-2')

SC43071-11

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:10

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 22.0	U	µg/kg dry	22.0	11.7	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 22.0	U	µg/kg dry	22.0	11.0	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 22.0	U	µg/kg dry	22.0	21.7	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 22.0	U	µg/kg dry	22.0	20.1	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 22.0	U	µg/kg dry	22.0	14.4	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 22.0	U	µg/kg dry	22.0	11.8	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	12.6		µg/kg dry	11.0	9.57	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 22.0	U	µg/kg dry	22.0	9.90	1	"	"	"	"	"	X

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	45			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	55			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	85			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	90			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine Pesticides

R01

Prepared by method SW846 3546

319-84-6	alpha-BHC	< 27.3	U, D	µg/kg dry	27.3	7.33	5	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 27.3	U, D	µg/kg dry	27.3	10.8	5	"	"	"	"	"	X
319-86-8	delta-BHC	< 27.3	U, D	µg/kg dry	27.3	7.88	5	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 16.4	U, D	µg/kg dry	16.4	7.88	5	"	"	"	"	"	X
76-44-8	Heptachlor	< 27.3	U, D	µg/kg dry	27.3	9.13	5	"	"	"	"	"	X
309-00-2	Aldrin	< 27.3	U, D	µg/kg dry	27.3	8.42	5	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 27.3	U, D	µg/kg dry	27.3	9.68	5	"	"	"	"	"	X
959-98-8	Endosulfan I	< 27.3	U, D	µg/kg dry	27.3	9.63	5	"	"	"	"	"	X
60-57-1	Dieldrin	< 27.3	U, D	µg/kg dry	27.3	9.63	5	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p') [2C]	< 27.3	U, D	µg/kg dry	27.3	9.41	5	"	"	"	"	"	X
72-20-8	Endrin	< 43.8	U, D	µg/kg dry	43.8	9.63	5	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 43.8	U, D	µg/kg dry	43.8	10.3	5	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 43.8	U, D	µg/kg dry	43.8	9.52	5	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 43.8	U, D	µg/kg dry	43.8	9.13	5	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p') [2C]	14.3	J, D	µg/kg dry	43.8	5.58	5	"	"	"	"	"	X
72-43-5	Methoxychlor	< 43.8	U, D	µg/kg dry	43.8	9.68	5	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 43.8	U, D	µg/kg dry	43.8	9.84	5	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 43.8	U, D	µg/kg dry	43.8	9.13	5	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	13.6	P, J, D	µg/kg dry	27.3	9.35	5	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	10.7	J, D	µg/kg dry	27.3	9.84	5	"	"	"	"	"	X
8001-35-2	Toxaphene	< 547	U, D	µg/kg dry	547	118	5	"	"	"	"	"	X
57-74-9	Chlordane	< 21.9	U	µg/kg dry	21.9	21.6	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 27.3	U, D	µg/kg dry	27.3	13.4	5	"	"	"	"	"	

*Surrogate recoveries:*

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	82			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	86			30-150 %			"	"	"	"	"	

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Sample Identification

SB-2 (0-2')

SC43071-11

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:10

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Pesticides</b>													
<u>Organochlorine Pesticides</u>													
2051-24-3	Decachlorobiphenyl (Sr)	103			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	160	S04		30-150 %			"	"	"	"	"	
<b>Total Metals by EPA 6000/7000 Series Methods</b>													
<u>Prepared by method SW846 3050B</u>													
7440-22-4	Silver	< 1.65	U	mg/kg dry	1.65	0.178	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	4,850		mg/kg dry	5.48	1.24	1	"	"	"	"	"	X
7440-38-2	Arsenic	2.45		mg/kg dry	1.65	0.208	1	"	"	"	"	"	X
7440-39-3	Barium	30.1		mg/kg dry	1.10	0.129	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.252	J	mg/kg dry	0.548	0.0275	1	"	"	"	"	"	X
7440-70-2	Calcium	5,160		mg/kg dry	27.4	5.62	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.893		mg/kg dry	0.548	0.0284	1	"	"	"	"	"	X
7440-48-4	Cobalt	3.29		mg/kg dry	1.11	0.0640	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	8.98		mg/kg dry	1.10	0.146	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	25.8		mg/kg dry	1.10	0.263	1	"	"	"	"	"	X
7439-89-6	Iron	8,960	R06	mg/kg dry	548	2.26	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0557		mg/kg dry	0.0287	0.0080	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X
<u>Prepared by method SW846 3050B</u>													
7440-09-7	Potassium	281		mg/kg dry	55.3	3.85	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	2,810		mg/kg dry	5.48	1.58	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	163		mg/kg dry	1.10	0.280	1	"	"	"	"	"	X
7440-23-5	Sodium	59.9		mg/kg dry	27.4	11.8	1	"	"	"	"	"	X
7440-02-0	Nickel	8.58		mg/kg dry	1.10	0.126	1	"	"	"	"	"	X
7439-92-1	Lead	44.6		mg/kg dry	1.65	0.233	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.53	U	mg/kg dry	5.53	0.416	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.66	U	mg/kg dry	1.66	0.316	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.29	U	mg/kg dry	3.29	1.21	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	13.9		mg/kg dry	1.65	0.292	1	"	"	"	"	"	X
7440-66-6	Zinc	44.9		mg/kg dry	1.10	0.849	1	"	"	"	"	"	X
<b>General Chemistry Parameters</b>													
	% Solids	90.2		%			1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800484	
<u>Prepared by method SW846 9010B</u>													
57-12-5	Cyanide (total)	< 0.369	U	mg/kg dry	0.369	0.311	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X

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Sample Identification

SB-2 (15-17')

SC43071-12

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:40

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Volatile Organic Compounds**Prepared by method Volatiles

VOC Extraction

Field  
extracted

N/A

1

VOC Soil  
Extraction

BD

1800494

Volatile Organic Compounds by SW846 8260Prepared by method SW846 5035A Soil (low level)

Initial weight: 6.15 g

76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 5.42	U	µg/kg dry	5.42	2.75	1	SW846 8260C	19-Jan-18	19-Jan-18	EK	1800741	X
67-64-1	Acetone	< 54.2	U	µg/kg dry	54.2	21.7	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 5.42	U	µg/kg dry	5.42	5.21	1	"	"	"	"	"	X
71-43-2	Benzene	< 5.42	U	µg/kg dry	5.42	1.44	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 5.42	U	µg/kg dry	5.42	1.45	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 5.42	U	µg/kg dry	5.42	2.74	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 5.42	U	µg/kg dry	5.42	3.62	1	"	"	"	"	"	X
75-25-2	Bromoform	< 5.42	U	µg/kg dry	5.42	5.17	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 10.8	U	µg/kg dry	10.8	4.89	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 10.8	U	µg/kg dry	10.8	9.69	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 5.42	U	µg/kg dry	5.42	1.55	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 5.42	U	µg/kg dry	5.42	0.99	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 5.42	U	µg/kg dry	5.42	1.21	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 10.8	U	µg/kg dry	10.8	3.47	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 5.42	U	µg/kg dry	5.42	4.43	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 5.42	U	µg/kg dry	5.42	1.70	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 10.8	U	µg/kg dry	10.8	3.01	1	"	"	"	"	"	X
67-66-3	Chloroform	< 5.42	U	µg/kg dry	5.42	2.91	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 10.8	U	µg/kg dry	10.8	2.24	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 5.42	U	µg/kg dry	5.42	1.35	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 5.42	U	µg/kg dry	5.42	1.27	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 10.8	U	µg/kg dry	10.8	7.83	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 5.42	U	µg/kg dry	5.42	3.68	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 5.42	U	µg/kg dry	5.42	3.64	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 5.42	U	µg/kg dry	5.42	2.82	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 5.42	U	µg/kg dry	5.42	1.41	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 5.42	U	µg/kg dry	5.42	1.18	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 5.42	U	µg/kg dry	5.42	1.60	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 10.8	U	µg/kg dry	10.8	2.05	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 5.42	U	µg/kg dry	5.42	1.42	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 5.42	U	µg/kg dry	5.42	1.94	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 5.42	U	µg/kg dry	5.42	2.84	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 5.42	U	µg/kg dry	5.42	2.01	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 5.42	U	µg/kg dry	5.42	2.87	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 5.42	U	µg/kg dry	5.42	2.84	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 5.42	U	µg/kg dry	5.42	2.81	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 5.42	U	µg/kg dry	5.42	2.56	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 5.42	U	µg/kg dry	5.42	1.75	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 5.42	U	µg/kg dry	5.42	3.27	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 5.42	U	µg/kg dry	5.42	2.85	1	"	"	"	"	"	X

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Sample Identification

SB-2 (15-17')

SC43071-12

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:40

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Volatile Organic Compounds**Volatile Organic Compounds by SW846 8260

Initial weight: 6.15 g

100-41-4	Ethylbenzene	< 5.42	U	µg/kg dry	5.42	0.78	1	SW846 8260C	19-Jan-18	19-Jan-18	EK	1800741	X
87-68-3	Hexachlorobutadiene	< 5.42	U	µg/kg dry	5.42	2.72	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 10.8	U	µg/kg dry	10.8	6.65	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 5.42	U	µg/kg dry	5.42	1.07	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 5.42	U	µg/kg dry	5.42	1.17	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 5.42	U	µg/kg dry	5.42	1.99	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 10.8	U	µg/kg dry	10.8	2.79	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 10.8	U	µg/kg dry	10.8	2.15	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 5.42	U	µg/kg dry	5.42	3.23	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 5.42	U	µg/kg dry	5.42	0.88	1	"	"	"	"	"	X
100-42-5	Styrene	< 5.42	U	µg/kg dry	5.42	1.09	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 5.42	U	µg/kg dry	5.42	4.61	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 5.42	U	µg/kg dry	5.42	4.59	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 5.42	U	µg/kg dry	5.42	1.85	1	"	"	"	"	"	X
108-88-3	Toluene	< 5.42	U	µg/kg dry	5.42	1.76	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 5.42	U	µg/kg dry	5.42	1.90	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 5.42	U	µg/kg dry	5.42	4.00	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 5.42	U	µg/kg dry	5.42	1.70	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 5.42	U	µg/kg dry	5.42	1.80	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 5.42	U	µg/kg dry	5.42	3.93	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 5.42	U	µg/kg dry	5.42	1.48	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 5.42	U	µg/kg dry	5.42	2.92	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 5.42	U	µg/kg dry	5.42	4.07	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 5.42	U	µg/kg dry	5.42	1.32	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 5.42	U	µg/kg dry	5.42	0.93	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 5.42	U	µg/kg dry	5.42	1.83	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 10.8	U	µg/kg dry	10.8	0.98	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 5.42	U	µg/kg dry	5.42	1.52	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 10.8	U	µg/kg dry	10.8	8.54	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 5.42	U	µg/kg dry	5.42	4.91	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 5.42	U	µg/kg dry	5.42	1.81	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 5.42	U	µg/kg dry	5.42	2.92	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 5.42	U	µg/kg dry	5.42	1.01	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 54.2	U	µg/kg dry	54.2	35.5	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 108	U	µg/kg dry	108	94.2	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 27.1	U	µg/kg dry	27.1	12.4	1	"	"	"	"	"	X
64-17-5	Ethanol	< 1080	U	µg/kg dry	1080	202	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	97			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	102			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	118			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	99			70-130 %		"	"	"	"	"	"	

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Sample Identification

SB-2 (15-17')

SC43071-12

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:40

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 76.2	U	µg/kg dry	76.2	37.9	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 76.2	U	µg/kg dry	76.2	37.6	1	"	"	"	"	"	X
62-53-3	Aniline	< 377	U	µg/kg dry	377	27.1	1	"	"	"	"	"	X
120-12-7	Anthracene	< 76.2	U	µg/kg dry	76.2	36.5	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 377	U	µg/kg dry	377	37.1	1	"	"	"	"	"	
92-87-5	Benzidine	< 377	U	µg/kg dry	377	75.9	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 76.2	U	µg/kg dry	76.2	40.2	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 76.2	U	µg/kg dry	76.2	28.4	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 76.2	U	µg/kg dry	76.2	36.9	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 76.2	U	µg/kg dry	76.2	30.6	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 76.2	U	µg/kg dry	76.2	29.8	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 377	U	µg/kg dry	377	79.2	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 377	U	µg/kg dry	377	30.9	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 377	U	µg/kg dry	377	33.5	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 191	U	µg/kg dry	191	27.3	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 191	U	µg/kg dry	191	29.4	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 191	U	µg/kg dry	191	47.1	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 377	U	µg/kg dry	377	35.3	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 377	U	µg/kg dry	377	44.0	1	"	"	"	"	"	X
86-74-8	Carbazole	< 191	U	µg/kg dry	191	106	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 377	U	µg/kg dry	377	36.0	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 191	U	µg/kg dry	191	41.3	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 377	U	µg/kg dry	377	34.9	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 191	U	µg/kg dry	191	33.9	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 377	U	µg/kg dry	377	44.8	1	"	"	"	"	"	X
218-01-9	Chrysene	< 76.2	U	µg/kg dry	76.2	38.1	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 76.2	U	µg/kg dry	76.2	29.3	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 191	U	µg/kg dry	191	29.0	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 377	U	µg/kg dry	377	32.9	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 377	U	µg/kg dry	377	32.9	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 377	U	µg/kg dry	377	35.0	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 377	U	µg/kg dry	377	57.4	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 191	U	µg/kg dry	191	35.7	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 377	U	µg/kg dry	377	46.6	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 377	U	µg/kg dry	377	41.3	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 377	U	µg/kg dry	377	27.0	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 377	U	µg/kg dry	377	40.0	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 377	U	µg/kg dry	377	48.4	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 377	U	µg/kg dry	377	38.4	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 191	U	µg/kg dry	191	73.8	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 191	U	µg/kg dry	191	43.0	1	"	"	"	"	"	X

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Sample Identification

SB-2 (15-17')

SC43071-12

Client Project #

[none]

Matrix

Soil

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Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 377	U	µg/kg dry	377	42.6	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 76.2	U	µg/kg dry	76.2	40.3	1	"	"	"	"	"	X
86-73-7	Fluorene	< 76.2	U	µg/kg dry	76.2	38.7	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 191	U	µg/kg dry	191	37.6	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 191	U	µg/kg dry	191	45.6	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 191	U	µg/kg dry	191	25.9	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 191	U	µg/kg dry	191	41.1	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 76.2	U	µg/kg dry	76.2	27.4	1	"	"	"	"	"	X
78-59-1	Isophorone	< 191	U	µg/kg dry	191	35.8	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 76.2	U	µg/kg dry	76.2	46.1	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 377	U	µg/kg dry	377	32.1	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 377	U	µg/kg dry	377	36.5	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 76.2	U	µg/kg dry	76.2	35.5	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 377	U	µg/kg dry	377	32.0	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 377	U	µg/kg dry	377	51.5	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 191	U	µg/kg dry	191	58.7	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 191	U	µg/kg dry	191	34.7	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 191	U	µg/kg dry	191	31.7	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1510	U	µg/kg dry	1510	60.9	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 191	U	µg/kg dry	191	35.4	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 191	U	µg/kg dry	191	37.2	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 377	U	µg/kg dry	377	40.9	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 377	U	µg/kg dry	377	40.3	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 76.2	U	µg/kg dry	76.2	35.5	1	"	"	"	"	"	X
108-95-2	Phenol	< 377	U	µg/kg dry	377	24.8	1	"	"	"	"	"	X
129-00-0	Pyrene	< 76.2	U	µg/kg dry	76.2	42.5	1	"	"	"	"	"	X
110-86-1	Pyridine	< 377	U	µg/kg dry	377	56.2	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 377	U	µg/kg dry	377	37.4	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 76.2	U	µg/kg dry	76.2	37.5	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 377	U	µg/kg dry	377	33.9	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 191	U	µg/kg dry	191	34.0	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 377	U	µg/kg dry	377	59.5	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 377	U	µg/kg dry	377	36.6	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	54			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	46			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	49			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	49			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	60			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	57			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 22.8	U	µg/kg dry	22.8	10.2	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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Sample Identification

SB-2 (15-17')

SC43071-12

Client Project #

[none]

Matrix

Soil

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 22.8	U	µg/kg dry	22.8	12.1	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 22.8	U	µg/kg dry	22.8	11.4	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 22.8	U	µg/kg dry	22.8	22.5	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 22.8	U	µg/kg dry	22.8	20.8	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 22.8	U	µg/kg dry	22.8	14.9	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 22.8	U	µg/kg dry	22.8	12.2	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 22.8	U	µg/kg dry	22.8	19.9	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 22.8	U	µg/kg dry	22.8	10.3	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	40			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	40			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	65			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	80			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.69	U	µg/kg dry	5.69	1.53	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.69	U	µg/kg dry	5.69	2.25	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.69	U	µg/kg dry	5.69	1.64	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.42	U	µg/kg dry	3.42	1.64	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.69	U	µg/kg dry	5.69	1.90	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.69	U	µg/kg dry	5.69	1.75	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.69	U	µg/kg dry	5.69	2.01	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.69	U	µg/kg dry	5.69	2.00	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.69	U	µg/kg dry	5.69	2.00	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.69	U	µg/kg dry	5.69	1.80	1	"	"	"	"	"	X
72-20-8	Endrin	< 9.11	U	µg/kg dry	9.11	2.00	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 9.11	U	µg/kg dry	9.11	2.14	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 9.11	U	µg/kg dry	9.11	1.98	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 9.11	U	µg/kg dry	9.11	1.90	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 9.11	U	µg/kg dry	9.11	1.75	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 9.11	U	µg/kg dry	9.11	2.01	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 9.11	U	µg/kg dry	9.11	2.05	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 9.11	U	µg/kg dry	9.11	1.90	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.69	U	µg/kg dry	5.69	1.95	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.69	U	µg/kg dry	5.69	2.05	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 114	U	µg/kg dry	114	24.6	1	"	"	"	"	"	X
57-74-9	Chlordane	< 22.8	U	µg/kg dry	22.8	22.5	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.69	U	µg/kg dry	5.69	2.79	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	67			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	68			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-2 (15-17')

SC43071-12

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 10:40

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	193	S04		30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	113			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.70	U	mg/kg dry	1.70	0.184	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	2,350		mg/kg dry	5.67	1.29	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.613	J	mg/kg dry	1.70	0.216	1	"	"	"	"	"	X
7440-39-3	Barium	16.6		mg/kg dry	1.13	0.134	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.153	J	mg/kg dry	0.567	0.0285	1	"	"	"	"	"	X
7440-70-2	Calcium	350		mg/kg dry	28.4	5.81	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.567		mg/kg dry	0.567	0.0294	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.10		mg/kg dry	1.13	0.0656	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	11.2		mg/kg dry	1.13	0.151	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	7.16		mg/kg dry	1.13	0.272	1	"	"	"	"	"	X
7439-89-6	Iron	7,220	R06	mg/kg dry	567	2.34	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0330	U	mg/kg dry	0.0330	0.0092	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	617		mg/kg dry	56.7	3.95	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	835		mg/kg dry	5.67	1.63	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	111		mg/kg dry	1.13	0.289	1	"	"	"	"	"	X
7440-23-5	Sodium	57.3		mg/kg dry	28.4	12.2	1	"	"	"	"	"	X
7440-02-0	Nickel	6.98		mg/kg dry	1.13	0.130	1	"	"	"	"	"	X
7439-92-1	Lead	2.10		mg/kg dry	1.70	0.240	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.67	U	mg/kg dry	5.67	0.426	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.70	U	mg/kg dry	1.70	0.324	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.40	U	mg/kg dry	3.40	1.25	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	8.28		mg/kg dry	1.70	0.302	1	"	"	"	"	"	X
7440-66-6	Zinc	9.82		mg/kg dry	1.13	0.878	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	87.0		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.385	U	mg/kg dry	0.385	0.325	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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Sample Identification

SB-4 (0-2')

SC43071-13

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:17

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (low level)</u>													
Initial weight: 5.53 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 5.28	U	µg/kg dry	5.28	2.68	1	SW846 8260C	19-Jan-18	19-Jan-18	EK	1800741	X
67-64-1	Acetone	< 52.8	U	µg/kg dry	52.8	21.1	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 5.28	U	µg/kg dry	5.28	5.07	1	"	"	"	"	"	X
71-43-2	Benzene	< 5.28	U	µg/kg dry	5.28	1.40	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 5.28	U	µg/kg dry	5.28	1.41	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 5.28	U	µg/kg dry	5.28	2.67	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 5.28	U	µg/kg dry	5.28	3.52	1	"	"	"	"	"	X
75-25-2	Bromoform	< 5.28	U	µg/kg dry	5.28	5.04	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 10.6	U	µg/kg dry	10.6	4.77	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 10.6	U	µg/kg dry	10.6	9.44	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 5.28	U	µg/kg dry	5.28	1.51	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 5.28	U	µg/kg dry	5.28	0.96	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 5.28	U	µg/kg dry	5.28	1.18	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 10.6	U	µg/kg dry	10.6	3.38	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 5.28	U	µg/kg dry	5.28	4.32	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 5.28	U	µg/kg dry	5.28	1.65	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 10.6	U	µg/kg dry	10.6	2.93	1	"	"	"	"	"	X
67-66-3	Chloroform	< 5.28	U	µg/kg dry	5.28	2.84	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 10.6	U	µg/kg dry	10.6	2.18	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 5.28	U	µg/kg dry	5.28	1.31	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 5.28	U	µg/kg dry	5.28	1.24	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 10.6	U	µg/kg dry	10.6	7.63	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 5.28	U	µg/kg dry	5.28	3.58	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 5.28	U	µg/kg dry	5.28	3.54	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 5.28	U	µg/kg dry	5.28	2.75	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 5.28	U	µg/kg dry	5.28	1.37	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 5.28	U	µg/kg dry	5.28	1.15	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 5.28	U	µg/kg dry	5.28	1.56	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 10.6	U	µg/kg dry	10.6	2.00	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 5.28	U	µg/kg dry	5.28	1.38	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 5.28	U	µg/kg dry	5.28	1.89	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 5.28	U	µg/kg dry	5.28	2.76	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 5.28	U	µg/kg dry	5.28	1.96	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 5.28	U	µg/kg dry	5.28	2.80	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 5.28	U	µg/kg dry	5.28	2.77	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 5.28	U	µg/kg dry	5.28	2.74	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 5.28	U	µg/kg dry	5.28	2.49	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 5.28	U	µg/kg dry	5.28	1.70	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 5.28	U	µg/kg dry	5.28	3.18	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 5.28	U	µg/kg dry	5.28	2.77	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-4 (0-2')

SC43071-13

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:17

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
Initial weight: 5.53 g													
100-41-4	Ethylbenzene	< 5.28	U	µg/kg dry	5.28	0.76	1	SW846 8260C	19-Jan-18	19-Jan-18	EK	1800741	X
87-68-3	Hexachlorobutadiene	< 5.28	U	µg/kg dry	5.28	2.65	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 10.6	U	µg/kg dry	10.6	6.48	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 5.28	U	µg/kg dry	5.28	1.04	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 5.28	U	µg/kg dry	5.28	1.14	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 5.28	U	µg/kg dry	5.28	1.94	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 10.6	U	µg/kg dry	10.6	2.71	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 10.6	U	µg/kg dry	10.6	2.10	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 5.28	U	µg/kg dry	5.28	3.14	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 5.28	U	µg/kg dry	5.28	0.86	1	"	"	"	"	"	X
100-42-5	Styrene	< 5.28	U	µg/kg dry	5.28	1.06	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 5.28	U	µg/kg dry	5.28	4.49	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 5.28	U	µg/kg dry	5.28	4.47	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 5.28	U	µg/kg dry	5.28	1.81	1	"	"	"	"	"	X
108-88-3	Toluene	< 5.28	U	µg/kg dry	5.28	1.71	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 5.28	U	µg/kg dry	5.28	1.85	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 5.28	U	µg/kg dry	5.28	3.89	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 5.28	U	µg/kg dry	5.28	1.66	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 5.28	U	µg/kg dry	5.28	1.75	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 5.28	U	µg/kg dry	5.28	3.83	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 5.28	U	µg/kg dry	5.28	1.44	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 5.28	U	µg/kg dry	5.28	2.85	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 5.28	U	µg/kg dry	5.28	3.96	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 5.28	U	µg/kg dry	5.28	1.28	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 5.28	U	µg/kg dry	5.28	0.91	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 5.28	U	µg/kg dry	5.28	1.78	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 10.6	U	µg/kg dry	10.6	0.95	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 5.28	U	µg/kg dry	5.28	1.48	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 10.6	U	µg/kg dry	10.6	8.32	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 5.28	U	µg/kg dry	5.28	4.78	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 5.28	U	µg/kg dry	5.28	1.76	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 5.28	U	µg/kg dry	5.28	2.85	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 5.28	U	µg/kg dry	5.28	0.98	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 52.8	U	µg/kg dry	52.8	34.6	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 106	U	µg/kg dry	106	91.7	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 26.4	U	µg/kg dry	26.4	12.0	1	"	"	"	"	"	X
64-17-5	Ethanol	< 1060	U	µg/kg dry	1060	197	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	96			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	100			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	121			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	101			70-130 %			"	"	"	"	"	

This laboratory report is not valid without an authorized signature on the cover page.



Sample Identification

SB-4 (0-2')

SC43071-13

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:17

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 71.9	U	µg/kg dry	71.9	35.8	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 71.9	U	µg/kg dry	71.9	35.5	1	"	"	"	"	"	X
62-53-3	Aniline	< 356	U	µg/kg dry	356	25.5	1	"	"	"	"	"	X
120-12-7	Anthracene	< 71.9	U	µg/kg dry	71.9	34.4	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 356	U	µg/kg dry	356	35.0	1	"	"	"	"	"	
92-87-5	Benzidine	< 356	U	µg/kg dry	356	71.6	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 71.9	U	µg/kg dry	71.9	37.9	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 71.9	U	µg/kg dry	71.9	26.8	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 71.9	U	µg/kg dry	71.9	34.8	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 71.9	U	µg/kg dry	71.9	28.9	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 71.9	U	µg/kg dry	71.9	28.1	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 356	U	µg/kg dry	356	74.7	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 356	U	µg/kg dry	356	29.1	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 356	U	µg/kg dry	356	31.6	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 180	U	µg/kg dry	180	25.8	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 180	U	µg/kg dry	180	27.7	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 180	U	µg/kg dry	180	44.4	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 356	U	µg/kg dry	356	33.3	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 356	U	µg/kg dry	356	41.5	1	"	"	"	"	"	X
86-74-8	Carbazole	< 180	U	µg/kg dry	180	100	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 356	U	µg/kg dry	356	34.0	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 180	U	µg/kg dry	180	38.9	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 356	U	µg/kg dry	356	32.9	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 180	U	µg/kg dry	180	32.0	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 356	U	µg/kg dry	356	42.2	1	"	"	"	"	"	X
218-01-9	Chrysene	< 71.9	U	µg/kg dry	71.9	35.9	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 71.9	U	µg/kg dry	71.9	27.6	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 180	U	µg/kg dry	180	27.4	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 356	U	µg/kg dry	356	31.0	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 356	U	µg/kg dry	356	31.0	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 356	U	µg/kg dry	356	33.0	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 356	U	µg/kg dry	356	54.1	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 180	U	µg/kg dry	180	33.6	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 356	U	µg/kg dry	356	44.0	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 356	U	µg/kg dry	356	38.9	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 356	U	µg/kg dry	356	25.4	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 356	U	µg/kg dry	356	37.7	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 356	U	µg/kg dry	356	45.7	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 356	U	µg/kg dry	356	36.2	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 180	U	µg/kg dry	180	69.6	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 180	U	µg/kg dry	180	40.5	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-4 (0-2')

SC43071-13

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:17

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
117-84-0	Di-n-octyl phthalate	< 356	U	µg/kg dry	356	40.2	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 71.9	U	µg/kg dry	71.9	38.0	1	"	"	"	"	"	X
86-73-7	Fluorene	< 71.9	U	µg/kg dry	71.9	36.5	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 180	U	µg/kg dry	180	35.4	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 180	U	µg/kg dry	180	43.0	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 180	U	µg/kg dry	180	24.5	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 180	U	µg/kg dry	180	38.8	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 71.9	U	µg/kg dry	71.9	25.9	1	"	"	"	"	"	X
78-59-1	Isophorone	< 180	U	µg/kg dry	180	33.7	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 71.9	U	µg/kg dry	71.9	43.4	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 356	U	µg/kg dry	356	30.2	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 356	U	µg/kg dry	356	34.4	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 71.9	U	µg/kg dry	71.9	33.5	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 356	U	µg/kg dry	356	30.2	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 356	U	µg/kg dry	356	48.6	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 180	U	µg/kg dry	180	55.4	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 180	U	µg/kg dry	180	32.8	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 180	U	µg/kg dry	180	29.9	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1420	U	µg/kg dry	1420	57.5	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 180	U	µg/kg dry	180	33.4	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 180	U	µg/kg dry	180	35.0	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 356	U	µg/kg dry	356	38.6	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 356	U	µg/kg dry	356	38.0	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 71.9	U	µg/kg dry	71.9	33.5	1	"	"	"	"	"	X
108-95-2	Phenol	< 356	U	µg/kg dry	356	23.4	1	"	"	"	"	"	X
129-00-0	Pyrene	< 71.9	U	µg/kg dry	71.9	40.1	1	"	"	"	"	"	X
110-86-1	Pyridine	< 356	U	µg/kg dry	356	53.0	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 356	U	µg/kg dry	356	35.2	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 71.9	U	µg/kg dry	71.9	35.4	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 356	U	µg/kg dry	356	32.0	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 180	U	µg/kg dry	180	32.1	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 356	U	µg/kg dry	356	56.2	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 356	U	µg/kg dry	356	34.5	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	61			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	48			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	55			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	51			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	61			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	62			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 21.4	U	µg/kg dry	21.4	9.59	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-4 (0-2')

SC43071-13

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:17

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 21.4	U	µg/kg dry	21.4	11.4	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 21.4	U	µg/kg dry	21.4	10.7	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 21.4	U	µg/kg dry	21.4	21.1	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 21.4	U	µg/kg dry	21.4	19.6	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 21.4	U	µg/kg dry	21.4	14.0	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 21.4	U	µg/kg dry	21.4	11.5	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 21.4	U	µg/kg dry	21.4	18.7	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 21.4	U	µg/kg dry	21.4	9.66	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	40			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	40			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	70			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	80			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.35	U	µg/kg dry	5.35	1.43	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.35	U	µg/kg dry	5.35	2.12	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.35	U	µg/kg dry	5.35	1.54	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.21	U	µg/kg dry	3.21	1.54	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.35	U	µg/kg dry	5.35	1.79	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.35	U	µg/kg dry	5.35	1.65	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.35	U	µg/kg dry	5.35	1.89	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.35	U	µg/kg dry	5.35	1.88	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.35	U	µg/kg dry	5.35	1.88	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.35	U	µg/kg dry	5.35	1.69	1	"	"	"	"	"	X
72-20-8	Endrin	< 8.55	U	µg/kg dry	8.55	1.88	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 8.55	U	µg/kg dry	8.55	2.01	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 8.55	U	µg/kg dry	8.55	1.86	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 8.55	U	µg/kg dry	8.55	1.79	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 8.55	U	µg/kg dry	8.55	1.65	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 8.55	U	µg/kg dry	8.55	1.89	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 8.55	U	µg/kg dry	8.55	1.92	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 8.55	U	µg/kg dry	8.55	1.79	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.35	U	µg/kg dry	5.35	1.83	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.35	U	µg/kg dry	5.35	1.92	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 107	U	µg/kg dry	107	23.1	1	"	"	"	"	"	X
57-74-9	Chlordane	< 21.4	U	µg/kg dry	21.4	21.1	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.35	U	µg/kg dry	5.35	2.62	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	78			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	75			30-150 %			"	"	"	"	"	

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Sample Identification

SB-4 (0-2')

SC43071-13

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:17

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	114			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
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2051-24-3	Decachlorobiphenyl (Sr) [2C]	118			30-150 %			"	"	"	"	"	
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**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.62	U	mg/kg dry	1.62	0.175	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	4,150		mg/kg dry	5.39	1.22	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.975	J	mg/kg dry	1.62	0.205	1	"	"	"	"	"	X
7440-39-3	Barium	13.8		mg/kg dry	1.08	0.127	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.223	J	mg/kg dry	0.539	0.0270	1	"	"	"	"	"	X
7440-70-2	Calcium	415		mg/kg dry	26.9	5.52	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.519	J	mg/kg dry	0.539	0.0279	1	"	"	"	"	"	X
7440-48-4	Cobalt	3.13		mg/kg dry	1.06	0.0615	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	6.94		mg/kg dry	1.08	0.143	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	4.78		mg/kg dry	1.08	0.259	1	"	"	"	"	"	X
7439-89-6	Iron	6,970	R06	mg/kg dry	539	2.22	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0319	U	mg/kg dry	0.0319	0.0088	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	244		mg/kg dry	53.1	3.70	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	900		mg/kg dry	5.39	1.55	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	107		mg/kg dry	1.08	0.275	1	"	"	"	"	"	X
7440-23-5	Sodium	52.1		mg/kg dry	26.9	11.6	1	"	"	"	"	"	X
7440-02-0	Nickel	7.51		mg/kg dry	1.08	0.124	1	"	"	"	"	"	X
7439-92-1	Lead	2.68		mg/kg dry	1.62	0.228	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.31	U	mg/kg dry	5.31	0.399	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.59	U	mg/kg dry	1.59	0.304	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.23	U	mg/kg dry	3.23	1.19	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	9.41		mg/kg dry	1.62	0.287	1	"	"	"	"	"	X
7440-66-6	Zinc	9.69		mg/kg dry	1.08	0.834	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	92.6		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.401	U	mg/kg dry	0.401	0.338	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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Sample Identification

SB-4 (15-17')

SC43071-14

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:40

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (low level)</u>													
Initial weight: 6.2 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 6.32	U	µg/kg dry	6.32	3.20	1	SW846 8260C	19-Jan-18	19-Jan-18	EK	1800741	X
67-64-1	Acetone	< 63.2	U	µg/kg dry	63.2	25.3	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 6.32	U	µg/kg dry	6.32	6.07	1	"	"	"	"	"	X
71-43-2	Benzene	< 6.32	U	µg/kg dry	6.32	1.67	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 6.32	U	µg/kg dry	6.32	1.69	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 6.32	U	µg/kg dry	6.32	3.19	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 6.32	U	µg/kg dry	6.32	4.21	1	"	"	"	"	"	X
75-25-2	Bromoform	< 6.32	U	µg/kg dry	6.32	6.03	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 12.6	U	µg/kg dry	12.6	5.70	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 12.6	U	µg/kg dry	12.6	11.3	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 6.32	U	µg/kg dry	6.32	1.81	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 6.32	U	µg/kg dry	6.32	1.15	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 6.32	U	µg/kg dry	6.32	1.41	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 12.6	U	µg/kg dry	12.6	4.04	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 6.32	U	µg/kg dry	6.32	5.17	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 6.32	U	µg/kg dry	6.32	1.98	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 12.6	U	µg/kg dry	12.6	3.51	1	"	"	"	"	"	X
67-66-3	Chloroform	< 6.32	U	µg/kg dry	6.32	3.39	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 12.6	U	µg/kg dry	12.6	2.61	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 6.32	U	µg/kg dry	6.32	1.57	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 6.32	U	µg/kg dry	6.32	1.48	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 12.6	U	µg/kg dry	12.6	9.13	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 6.32	U	µg/kg dry	6.32	4.28	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 6.32	U	µg/kg dry	6.32	4.24	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 6.32	U	µg/kg dry	6.32	3.28	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 6.32	U	µg/kg dry	6.32	1.64	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 6.32	U	µg/kg dry	6.32	1.37	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 6.32	U	µg/kg dry	6.32	1.87	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 12.6	U	µg/kg dry	12.6	2.39	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 6.32	U	µg/kg dry	6.32	1.65	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 6.32	U	µg/kg dry	6.32	2.26	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 6.32	U	µg/kg dry	6.32	3.30	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 6.32	U	µg/kg dry	6.32	2.34	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 6.32	U	µg/kg dry	6.32	3.35	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 6.32	U	µg/kg dry	6.32	3.31	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 6.32	U	µg/kg dry	6.32	3.27	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 6.32	U	µg/kg dry	6.32	2.98	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 6.32	U	µg/kg dry	6.32	2.03	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 6.32	U	µg/kg dry	6.32	3.81	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 6.32	U	µg/kg dry	6.32	3.32	1	"	"	"	"	"	X

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Sample Identification

SB-4 (15-17')

SC43071-14

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:40

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Volatile Organic Compounds**Volatile Organic Compounds by SW846 8260

Initial weight: 6.2 g

100-41-4	Ethylbenzene	< 6.32	U	µg/kg dry	6.32	0.91	1	SW846 8260C	19-Jan-18	19-Jan-18	EK	1800741	X
87-68-3	Hexachlorobutadiene	< 6.32	U	µg/kg dry	6.32	3.17	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 12.6	U	µg/kg dry	12.6	7.75	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 6.32	U	µg/kg dry	6.32	1.24	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 6.32	U	µg/kg dry	6.32	1.36	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 6.32	U	µg/kg dry	6.32	2.32	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 12.6	U	µg/kg dry	12.6	3.25	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 12.6	U	µg/kg dry	12.6	2.51	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 6.32	U	µg/kg dry	6.32	3.76	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 6.32	U	µg/kg dry	6.32	1.02	1	"	"	"	"	"	X
100-42-5	Styrene	< 6.32	U	µg/kg dry	6.32	1.27	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 6.32	U	µg/kg dry	6.32	5.37	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 6.32	U	µg/kg dry	6.32	5.34	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 6.32	U	µg/kg dry	6.32	2.16	1	"	"	"	"	"	X
108-88-3	Toluene	< 6.32	U	µg/kg dry	6.32	2.05	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 6.32	U	µg/kg dry	6.32	2.22	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 6.32	U	µg/kg dry	6.32	4.66	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 6.32	U	µg/kg dry	6.32	1.98	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 6.32	U	µg/kg dry	6.32	2.10	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 6.32	U	µg/kg dry	6.32	4.58	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 6.32	U	µg/kg dry	6.32	1.72	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 6.32	U	µg/kg dry	6.32	3.40	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 6.32	U	µg/kg dry	6.32	4.74	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 6.32	U	µg/kg dry	6.32	1.53	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 6.32	U	µg/kg dry	6.32	1.09	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 6.32	U	µg/kg dry	6.32	2.13	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 12.6	U	µg/kg dry	12.6	1.14	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 6.32	U	µg/kg dry	6.32	1.77	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 12.6	U	µg/kg dry	12.6	9.95	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 6.32	U	µg/kg dry	6.32	5.72	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 6.32	U	µg/kg dry	6.32	2.11	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 6.32	U	µg/kg dry	6.32	3.40	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 6.32	U	µg/kg dry	6.32	1.17	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 63.2	U	µg/kg dry	63.2	41.3	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 126	U	µg/kg dry	126	110	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 31.6	U	µg/kg dry	31.6	14.4	1	"	"	"	"	"	X
64-17-5	Ethanol	< 1260	U	µg/kg dry	1260	236	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	96			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	102			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	119			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	100			70-130 %		"	"	"	"	"	"	

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Sample Identification

SB-4 (15-17')

SC43071-14

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:40

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 83.2	U	µg/kg dry	83.2	41.4	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 83.2	U	µg/kg dry	83.2	41.0	1	"	"	"	"	"	X
62-53-3	Aniline	< 412	U	µg/kg dry	412	29.6	1	"	"	"	"	"	X
120-12-7	Anthracene	< 83.2	U	µg/kg dry	83.2	39.8	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiaz ene	< 412	U	µg/kg dry	412	40.5	1	"	"	"	"	"	
92-87-5	Benzidine	< 412	U	µg/kg dry	412	82.8	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 83.2	U	µg/kg dry	83.2	43.9	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 83.2	U	µg/kg dry	83.2	31.0	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 83.2	U	µg/kg dry	83.2	40.3	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 83.2	U	µg/kg dry	83.2	33.4	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 83.2	U	µg/kg dry	83.2	32.6	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 412	U	µg/kg dry	412	86.4	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 412	U	µg/kg dry	412	33.7	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)metha ne	< 412	U	µg/kg dry	412	36.5	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 208	U	µg/kg dry	208	29.8	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ethe r	< 208	U	µg/kg dry	208	32.1	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 208	U	µg/kg dry	208	51.4	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 412	U	µg/kg dry	412	38.6	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 412	U	µg/kg dry	412	48.0	1	"	"	"	"	"	X
86-74-8	Carbazole	< 208	U	µg/kg dry	208	116	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 412	U	µg/kg dry	412	39.3	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 208	U	µg/kg dry	208	45.0	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 412	U	µg/kg dry	412	38.0	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 208	U	µg/kg dry	208	37.0	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 412	U	µg/kg dry	412	48.9	1	"	"	"	"	"	X
218-01-9	Chrysene	< 83.2	U	µg/kg dry	83.2	41.5	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 83.2	U	µg/kg dry	83.2	31.9	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 208	U	µg/kg dry	208	31.7	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 412	U	µg/kg dry	412	35.9	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 412	U	µg/kg dry	412	35.9	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 412	U	µg/kg dry	412	38.2	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 412	U	µg/kg dry	412	62.6	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 208	U	µg/kg dry	208	38.9	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 412	U	µg/kg dry	412	50.9	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 412	U	µg/kg dry	412	45.0	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 412	U	µg/kg dry	412	29.4	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 412	U	µg/kg dry	412	43.7	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 412	U	µg/kg dry	412	52.8	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 412	U	µg/kg dry	412	41.9	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 208	U	µg/kg dry	208	80.6	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 208	U	µg/kg dry	208	46.9	1	"	"	"	"	"	X

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Sample Identification

SB-4 (15-17')

SC43071-14

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:40

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 412	U	µg/kg dry	412	46.5	1	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 83.2	U	µg/kg dry	83.2	44.0	1	"	"	"	"	"	X
86-73-7	Fluorene	< 83.2	U	µg/kg dry	83.2	42.3	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 208	U	µg/kg dry	208	41.0	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 208	U	µg/kg dry	208	49.8	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 208	U	µg/kg dry	208	28.3	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 208	U	µg/kg dry	208	44.9	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 83.2	U	µg/kg dry	83.2	29.9	1	"	"	"	"	"	X
78-59-1	Isophorone	< 208	U	µg/kg dry	208	39.0	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 83.2	U	µg/kg dry	83.2	50.3	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 412	U	µg/kg dry	412	35.0	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 412	U	µg/kg dry	412	39.8	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 83.2	U	µg/kg dry	83.2	38.8	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 412	U	µg/kg dry	412	34.9	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 412	U	µg/kg dry	412	56.3	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 208	U	µg/kg dry	208	64.1	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 208	U	µg/kg dry	208	37.9	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 208	U	µg/kg dry	208	34.6	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1650	U	µg/kg dry	1650	66.5	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 208	U	µg/kg dry	208	38.7	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 208	U	µg/kg dry	208	40.6	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 412	U	µg/kg dry	412	44.6	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 412	U	µg/kg dry	412	44.0	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 83.2	U	µg/kg dry	83.2	38.7	1	"	"	"	"	"	X
108-95-2	Phenol	< 412	U	µg/kg dry	412	27.1	1	"	"	"	"	"	X
129-00-0	Pyrene	< 83.2	U	µg/kg dry	83.2	46.4	1	"	"	"	"	"	X
110-86-1	Pyridine	< 412	U	µg/kg dry	412	61.4	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 412	U	µg/kg dry	412	40.8	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 83.2	U	µg/kg dry	83.2	40.9	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 412	U	µg/kg dry	412	37.0	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 208	U	µg/kg dry	208	37.2	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 412	U	µg/kg dry	412	65.0	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 412	U	µg/kg dry	412	39.9	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	57			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	45			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	54			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	49			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	64			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	60			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 24.8	U	µg/kg dry	24.8	11.1	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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Sample Identification

SB-4 (15-17')

SC43071-14

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:40

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 24.8	U	µg/kg dry	24.8	13.2	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 24.8	U	µg/kg dry	24.8	12.4	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 24.8	U	µg/kg dry	24.8	24.5	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 24.8	U	µg/kg dry	24.8	22.7	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 24.8	U	µg/kg dry	24.8	16.2	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 24.8	U	µg/kg dry	24.8	13.3	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 24.8	U	µg/kg dry	24.8	21.7	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 24.8	U	µg/kg dry	24.8	11.2	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	40			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	45			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	60			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 6.25	U	µg/kg dry	6.25	1.68	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 6.25	U	µg/kg dry	6.25	2.48	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 6.25	U	µg/kg dry	6.25	1.80	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.75	U	µg/kg dry	3.75	1.80	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 6.25	U	µg/kg dry	6.25	2.09	1	"	"	"	"	"	X
309-00-2	Aldrin	< 6.25	U	µg/kg dry	6.25	1.93	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 6.25	U	µg/kg dry	6.25	2.21	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 6.25	U	µg/kg dry	6.25	2.20	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 6.25	U	µg/kg dry	6.25	2.20	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 6.25	U	µg/kg dry	6.25	1.98	1	"	"	"	"	"	X
72-20-8	Endrin	< 10.0	U	µg/kg dry	10.0	2.20	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 10.0	U	µg/kg dry	10.0	2.35	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 10.0	U	µg/kg dry	10.0	2.18	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 10.0	U	µg/kg dry	10.0	2.09	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 10.0	U	µg/kg dry	10.0	1.93	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 10.0	U	µg/kg dry	10.0	2.21	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 10.0	U	µg/kg dry	10.0	2.25	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 10.0	U	µg/kg dry	10.0	2.09	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 6.25	U	µg/kg dry	6.25	2.14	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 6.25	U	µg/kg dry	6.25	2.25	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 125	U	µg/kg dry	125	27.1	1	"	"	"	"	"	X
57-74-9	Chlordane	< 25.0	U	µg/kg dry	25.0	24.7	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 6.25	U	µg/kg dry	6.25	3.06	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	64			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	67			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-4 (15-17')

SC43071-14

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 13:40

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	97			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	114			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.86	U	mg/kg dry	1.86	0.201	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	1,880		mg/kg dry	6.20	1.41	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.415	J	mg/kg dry	1.86	0.236	1	"	"	"	"	"	X
7440-39-3	Barium	10.9		mg/kg dry	1.24	0.146	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.0905	J	mg/kg dry	0.620	0.0311	1	"	"	"	"	"	X
7440-70-2	Calcium	189		mg/kg dry	31.0	6.35	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.341	J	mg/kg dry	0.620	0.0321	1	"	"	"	"	"	X
7440-48-4	Cobalt	1.19	J	mg/kg dry	1.24	0.0717	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	4.72		mg/kg dry	1.24	0.165	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	3.81		mg/kg dry	1.24	0.298	1	"	"	"	"	"	X
7439-89-6	Iron	4,680	R06	mg/kg dry	620	2.55	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0371	U	mg/kg dry	0.0371	0.0103	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	323		mg/kg dry	61.9	4.32	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	636		mg/kg dry	6.20	1.79	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	87.3		mg/kg dry	1.24	0.316	1	"	"	"	"	"	X
7440-23-5	Sodium	78.7		mg/kg dry	31.0	13.3	1	"	"	"	"	"	X
7440-02-0	Nickel	3.31		mg/kg dry	1.24	0.143	1	"	"	"	"	"	X
7439-92-1	Lead	1.33	J	mg/kg dry	1.86	0.263	1	"	"	"	"	"	X
7440-36-0	Antimony	< 6.19	U	mg/kg dry	6.19	0.466	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.86	U	mg/kg dry	1.86	0.354	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.72	U	mg/kg dry	3.72	1.37	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	5.51		mg/kg dry	1.86	0.330	1	"	"	"	"	"	X
7440-66-6	Zinc	6.30		mg/kg dry	1.24	0.959	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	79.8		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.415	U	mg/kg dry	0.415	0.350	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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Sample Identification

TB

SC43071-15

Client Project #

[none]

MatrixMethanol/Deionized  
WaterCollection Date/Time

11-Jan-18 16:00

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
Volatile Organic Compounds by SW846 8260													
Prepared by method SW846 5035A Soil (low level)													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 5.00	U	µg/kg wet	5.00	2.54	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
67-64-1	Acetone	< 50.0	U	µg/kg wet	50.0	20.0	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 5.00	U	µg/kg wet	5.00	4.80	1	"	"	"	"	"	X
71-43-2	Benzene	< 5.00	U	µg/kg wet	5.00	1.32	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 5.00	U	µg/kg wet	5.00	1.34	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 5.00	U	µg/kg wet	5.00	2.52	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 5.00	U	µg/kg wet	5.00	3.34	1	"	"	"	"	"	X
75-25-2	Bromoform	< 5.00	U	µg/kg wet	5.00	4.77	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 10.0	U	µg/kg wet	10.0	4.52	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 10.0	U	µg/kg wet	10.0	8.94	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 5.00	U	µg/kg wet	5.00	1.43	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 5.00	U	µg/kg wet	5.00	0.91	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 5.00	U	µg/kg wet	5.00	1.12	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 10.0	U	µg/kg wet	10.0	3.20	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 5.00	U	µg/kg wet	5.00	4.09	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 5.00	U	µg/kg wet	5.00	1.56	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 10.0	U	µg/kg wet	10.0	2.78	1	"	"	"	"	"	X
67-66-3	Chloroform	< 5.00	U	µg/kg wet	5.00	2.68	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 10.0	U	µg/kg wet	10.0	2.06	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 5.00	U	µg/kg wet	5.00	1.24	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 5.00	U	µg/kg wet	5.00	1.18	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 10.0	U	µg/kg wet	10.0	7.22	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 5.00	U	µg/kg wet	5.00	3.39	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 5.00	U	µg/kg wet	5.00	3.36	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 5.00	U	µg/kg wet	5.00	2.60	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00	1.30	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00	1.08	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00	1.48	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 10.0	U	µg/kg wet	10.0	1.90	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 5.00	U	µg/kg wet	5.00	1.31	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 5.00	U	µg/kg wet	5.00	1.79	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 5.00	U	µg/kg wet	5.00	2.62	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 5.00	U	µg/kg wet	5.00	1.86	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 5.00	U	µg/kg wet	5.00	2.65	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 5.00	U	µg/kg wet	5.00	2.62	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 5.00	U	µg/kg wet	5.00	2.59	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 5.00	U	µg/kg wet	5.00	2.36	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 5.00	U	µg/kg wet	5.00	1.61	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 5.00	U	µg/kg wet	5.00	3.02	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 5.00	U	µg/kg wet	5.00	2.62	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 5.00	U	µg/kg wet	5.00	0.72	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 5.00	U	µg/kg wet	5.00	2.51	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 10.0	U	µg/kg wet	10.0	6.14	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

TB

SC43071-15

Client Project #

[none]

MatrixMethanol/Deionized  
WaterCollection Date/Time

11-Jan-18 16:00

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<b>Volatile Organic Compounds by SW846 8260</b>													
98-82-8	Isopropylbenzene	< 5.00	U	µg/kg wet	5.00	0.98	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
99-87-6	4-Isopropyltoluene	< 5.00	U	µg/kg wet	5.00	1.08	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 5.00	U	µg/kg wet	5.00	1.84	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 10.0	U	µg/kg wet	10.0	2.57	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 10.0	U	µg/kg wet	10.0	1.98	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 5.00	U	µg/kg wet	5.00	2.98	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 5.00	U	µg/kg wet	5.00	0.81	1	"	"	"	"	"	X
100-42-5	Styrene	< 5.00	U	µg/kg wet	5.00	1.00	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 5.00	U	µg/kg wet	5.00	4.25	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 5.00	U	µg/kg wet	5.00	4.23	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 5.00	U	µg/kg wet	5.00	1.71	1	"	"	"	"	"	X
108-88-3	Toluene	< 5.00	U	µg/kg wet	5.00	1.62	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00	1.76	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00	3.68	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00	1.57	1	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 5.00	U	µg/kg wet	5.00	1.66	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 5.00	U	µg/kg wet	5.00	3.62	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 5.00	U	µg/kg wet	5.00	1.36	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 5.00	U	µg/kg wet	5.00	2.70	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 5.00	U	µg/kg wet	5.00	3.75	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 5.00	U	µg/kg wet	5.00	1.22	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 5.00	U	µg/kg wet	5.00	0.86	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 5.00	U	µg/kg wet	5.00	1.69	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 10.0	U	µg/kg wet	10.0	0.90	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 5.00	U	µg/kg wet	5.00	1.40	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 10.0	U	µg/kg wet	10.0	7.88	1	"	"	"	"	"	
60-29-7	Ethyl ether	< 5.00	U	µg/kg wet	5.00	4.53	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 5.00	U	µg/kg wet	5.00	1.67	1	"	"	"	"	"	
637-92-3	Ethyl tert-butyl ether	< 5.00	U	µg/kg wet	5.00	2.70	1	"	"	"	"	"	
108-20-3	Di-isopropyl ether	< 5.00	U	µg/kg wet	5.00	0.93	1	"	"	"	"	"	
75-65-0	Tert-Butanol / butyl alcohol	< 50.0	U	µg/kg wet	50.0	32.7	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 100	U	µg/kg wet	100	86.8	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 25.0	U	µg/kg wet	25.0	11.4	1	"	"	"	"	"	X
64-17-5	Ethanol	< 1000	U	µg/kg wet	1000	186	1	"	"	"	"	"	

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	95		70-130 %	"	"	"	"	"
2037-26-5	Toluene-d8	101		70-130 %	"	"	"	"	"
17060-07-0	1,2-Dichloroethane-d4	119		70-130 %	"	"	"	"	"
1868-53-7	Dibromofluoromethane	98		70-130 %	"	"	"	"	"

This laboratory report is not valid without an authorized signature on the cover page.

Sample Identification

SB-5 (0-2')

SC43071-16

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 14:30

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (low level)</u>													
Initial weight: 5.56 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 4.98	U	µg/kg dry	4.98	2.52	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
67-64-1	Acetone	< 49.8	U	µg/kg dry	49.8	19.9	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 4.98	U	µg/kg dry	4.98	4.78	1	"	"	"	"	"	X
71-43-2	Benzene	< 4.98	U	µg/kg dry	4.98	1.32	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 4.98	U	µg/kg dry	4.98	1.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 4.98	U	µg/kg dry	4.98	2.51	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 4.98	U	µg/kg dry	4.98	3.32	1	"	"	"	"	"	X
75-25-2	Bromoform	< 4.98	U	µg/kg dry	4.98	4.75	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 9.96	U	µg/kg dry	9.96	4.50	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 9.96	U	µg/kg dry	9.96	8.90	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 4.98	U	µg/kg dry	4.98	1.42	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 4.98	U	µg/kg dry	4.98	0.91	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 4.98	U	µg/kg dry	4.98	1.12	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 9.96	U	µg/kg dry	9.96	3.19	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 4.98	U	µg/kg dry	4.98	4.07	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 4.98	U	µg/kg dry	4.98	1.56	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 9.96	U	µg/kg dry	9.96	2.76	1	"	"	"	"	"	X
67-66-3	Chloroform	< 4.98	U	µg/kg dry	4.98	2.67	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 9.96	U	µg/kg dry	9.96	2.06	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 4.98	U	µg/kg dry	4.98	1.24	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 4.98	U	µg/kg dry	4.98	1.17	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 9.96	U	µg/kg dry	9.96	7.19	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 4.98	U	µg/kg dry	4.98	3.38	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 4.98	U	µg/kg dry	4.98	3.34	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 4.98	U	µg/kg dry	4.98	2.59	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.98	U	µg/kg dry	4.98	1.29	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.98	U	µg/kg dry	4.98	1.08	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.98	U	µg/kg dry	4.98	1.47	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 9.96	U	µg/kg dry	9.96	1.89	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 4.98	U	µg/kg dry	4.98	1.30	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 4.98	U	µg/kg dry	4.98	1.78	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 4.98	U	µg/kg dry	4.98	2.60	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 4.98	U	µg/kg dry	4.98	1.85	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 4.98	U	µg/kg dry	4.98	2.64	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 4.98	U	µg/kg dry	4.98	2.61	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 4.98	U	µg/kg dry	4.98	2.58	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 4.98	U	µg/kg dry	4.98	2.35	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 4.98	U	µg/kg dry	4.98	1.60	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 4.98	U	µg/kg dry	4.98	3.00	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 4.98	U	µg/kg dry	4.98	2.61	1	"	"	"	"	"	X

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Sample Identification

SB-5 (0-2')

SC43071-16

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 14:30

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Volatile Organic Compounds**Volatile Organic Compounds by SW846 8260

Initial weight: 5.56 g

100-41-4	Ethylbenzene	< 4.98	U	µg/kg dry	4.98	0.72	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
87-68-3	Hexachlorobutadiene	< 4.98	U	µg/kg dry	4.98	2.50	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 9.96	U	µg/kg dry	9.96	6.11	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 4.98	U	µg/kg dry	4.98	0.98	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 4.98	U	µg/kg dry	4.98	1.07	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 4.98	U	µg/kg dry	4.98	1.83	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 9.96	U	µg/kg dry	9.96	2.56	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 9.96	U	µg/kg dry	9.96	1.98	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.98	U	µg/kg dry	4.98	2.96	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 4.98	U	µg/kg dry	4.98	0.81	1	"	"	"	"	"	X
100-42-5	Styrene	< 4.98	U	µg/kg dry	4.98	1.00	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 4.98	U	µg/kg dry	4.98	4.23	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 4.98	U	µg/kg dry	4.98	4.21	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 4.98	U	µg/kg dry	4.98	1.70	1	"	"	"	"	"	X
108-88-3	Toluene	< 4.98	U	µg/kg dry	4.98	1.61	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 4.98	U	µg/kg dry	4.98	1.75	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.98	U	µg/kg dry	4.98	3.67	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 4.98	U	µg/kg dry	4.98	1.56	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 4.98	U	µg/kg dry	4.98	1.65	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 4.98	U	µg/kg dry	4.98	3.61	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 4.98	U	µg/kg dry	4.98	1.36	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 4.98	U	µg/kg dry	4.98	2.68	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 4.98	U	µg/kg dry	4.98	3.73	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 4.98	U	µg/kg dry	4.98	1.21	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 4.98	U	µg/kg dry	4.98	0.86	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 4.98	U	µg/kg dry	4.98	1.68	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 9.96	U	µg/kg dry	9.96	0.90	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 4.98	U	µg/kg dry	4.98	1.39	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 9.96	U	µg/kg dry	9.96	7.85	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 4.98	U	µg/kg dry	4.98	4.51	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 4.98	U	µg/kg dry	4.98	1.66	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 4.98	U	µg/kg dry	4.98	2.68	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 4.98	U	µg/kg dry	4.98	0.93	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 49.8	U	µg/kg dry	49.8	32.6	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 99.6	U	µg/kg dry	99.6	86.5	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 24.9	U	µg/kg dry	24.9	11.4	1	"	"	"	"	"	X
64-17-5	Ethanol	< 996	U	µg/kg dry	996	186	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	95			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	102			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	125			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	102			70-130 %		"	"	"	"	"	"	

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Sample Identification

SB-5 (0-2')

SC43071-16

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 14:30

Received

12-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Semivolatile Organic Compounds			R01										
Prepared by method SW846 3546													
83-32-9	Acenaphthene	< 139	U, D	µg/kg dry	139	69.4	2	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
208-96-8	Acenaphthylene	< 139	U, D	µg/kg dry	139	68.8	2	"	"	"	"	"	X
62-53-3	Aniline	< 690	U, D	µg/kg dry	690	49.6	2	"	"	"	"	"	X
120-12-7	Anthracene	< 139	U, D	µg/kg dry	139	66.7	2	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 690	U, D	µg/kg dry	690	67.9	2	"	"	"	"	"	
92-87-5	Benzidine	< 690	U, D	µg/kg dry	690	139	2	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 139	U, D	µg/kg dry	139	73.6	2	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 139	U, D	µg/kg dry	139	51.9	2	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 139	U, D	µg/kg dry	139	67.5	2	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 139	U, D	µg/kg dry	139	56.0	2	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 139	U, D	µg/kg dry	139	54.6	2	"	"	"	"	"	X
65-85-0	Benzoic acid	< 690	U, D	µg/kg dry	690	145	2	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 690	U, D	µg/kg dry	690	56.5	2	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 690	U, D	µg/kg dry	690	61.3	2	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 349	U, D	µg/kg dry	349	50.0	2	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 349	U, D	µg/kg dry	349	53.7	2	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 349	U, D	µg/kg dry	349	86.2	2	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 690	U, D	µg/kg dry	690	64.6	2	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 690	U, D	µg/kg dry	690	80.5	2	"	"	"	"	"	X
86-74-8	Carbazole	< 349	U, D	µg/kg dry	349	195	2	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 690	U, D	µg/kg dry	690	65.9	2	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 349	U, D	µg/kg dry	349	75.5	2	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 690	U, D	µg/kg dry	690	63.8	2	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 349	U, D	µg/kg dry	349	62.1	2	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 690	U, D	µg/kg dry	690	82.0	2	"	"	"	"	"	X
218-01-9	Chrysene	< 139	U, D	µg/kg dry	139	69.6	2	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 139	U, D	µg/kg dry	139	53.5	2	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 349	U, D	µg/kg dry	349	53.1	2	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 690	U, D	µg/kg dry	690	60.2	2	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 690	U, D	µg/kg dry	690	60.2	2	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 690	U, D	µg/kg dry	690	64.0	2	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 690	U, D	µg/kg dry	690	105	2	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 349	U, D	µg/kg dry	349	65.3	2	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 690	U, D	µg/kg dry	690	85.3	2	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 690	U, D	µg/kg dry	690	75.5	2	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 690	U, D	µg/kg dry	690	49.3	2	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 690	U, D	µg/kg dry	690	73.2	2	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 690	U, D	µg/kg dry	690	88.6	2	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 690	U, D	µg/kg dry	690	70.3	2	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 349	U, D	µg/kg dry	349	135	2	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 349	U, D	µg/kg dry	349	78.6	2	"	"	"	"	"	X

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Sample Identification

SB-5 (0-2')

SC43071-16

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 14:30

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>				R01									
117-84-0	Di-n-octyl phthalate	< 690	U, D	µg/kg dry	690	78.0	2	SW846 8270D	13-Jan-18	17-Jan-18	MSL	1800478	X
206-44-0	Fluoranthene	< 139	U, D	µg/kg dry	139	73.7	2	"	"	"	"	"	X
86-73-7	Fluorene	< 139	U, D	µg/kg dry	139	70.9	2	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 349	U, D	µg/kg dry	349	68.7	2	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 349	U, D	µg/kg dry	349	83.4	2	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 349	U, D	µg/kg dry	349	47.5	2	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 349	U, D	µg/kg dry	349	75.3	2	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 139	U, D	µg/kg dry	139	50.2	2	"	"	"	"	"	X
78-59-1	Isophorone	< 349	U, D	µg/kg dry	349	65.4	2	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 139	U, D	µg/kg dry	139	84.3	2	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 690	U, D	µg/kg dry	690	58.7	2	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 690	U, D	µg/kg dry	690	66.7	2	"	"	"	"	"	X
91-20-3	Naphthalene	< 139	U, D	µg/kg dry	139	65.0	2	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 690	U, D	µg/kg dry	690	58.5	2	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 690	U, D	µg/kg dry	690	94.3	2	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 349	U, D	µg/kg dry	349	107	2	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 349	U, D	µg/kg dry	349	63.6	2	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 349	U, D	µg/kg dry	349	57.9	2	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 2760	U, D	µg/kg dry	2760	111	2	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 349	U, D	µg/kg dry	349	64.8	2	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 349	U, D	µg/kg dry	349	68.0	2	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 690	U, D	µg/kg dry	690	74.8	2	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 690	U, D	µg/kg dry	690	73.7	2	"	"	"	"	"	X
85-01-8	Phenanthrene	< 139	U, D	µg/kg dry	139	64.9	2	"	"	"	"	"	X
108-95-2	Phenol	< 690	U, D	µg/kg dry	690	45.4	2	"	"	"	"	"	X
129-00-0	Pyrene	< 139	U, D	µg/kg dry	139	77.8	2	"	"	"	"	"	X
110-86-1	Pyridine	< 690	U, D	µg/kg dry	690	103	2	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 690	U, D	µg/kg dry	690	68.4	2	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 139	U, D	µg/kg dry	139	68.6	2	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 690	U, D	µg/kg dry	690	62.1	2	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 349	U, D	µg/kg dry	349	62.3	2	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 690	U, D	µg/kg dry	690	109	2	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 690	U, D	µg/kg dry	690	66.9	2	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	45			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	38			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	44			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	40			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	51			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	50			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 20.9	U	µg/kg dry	20.9	9.34	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*



Sample Identification

SB-5 (0-2')

SC43071-16

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 14:30

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 20.9	U	µg/kg dry	20.9	11.1	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 20.9	U	µg/kg dry	20.9	10.4	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 20.9	U	µg/kg dry	20.9	20.6	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 20.9	U	µg/kg dry	20.9	19.1	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 20.9	U	µg/kg dry	20.9	13.6	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 20.9	U	µg/kg dry	20.9	11.2	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 20.9	U	µg/kg dry	20.9	18.2	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 20.9	U	µg/kg dry	20.9	9.41	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	35			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	35			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	65			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.17	U	µg/kg dry	5.17	1.38	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.17	U	µg/kg dry	5.17	2.05	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.17	U	µg/kg dry	5.17	1.49	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.10	U	µg/kg dry	3.10	1.49	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.17	U	µg/kg dry	5.17	1.73	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.17	U	µg/kg dry	5.17	1.59	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.17	U	µg/kg dry	5.17	1.83	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.17	U	µg/kg dry	5.17	1.82	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.17	U	µg/kg dry	5.17	1.82	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	13.2		µg/kg dry	5.17	1.63	1	"	"	"	"	"	X
72-20-8	Endrin	< 8.27	U	µg/kg dry	8.27	1.82	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 8.27	U	µg/kg dry	8.27	1.94	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 8.27	U	µg/kg dry	8.27	1.80	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 8.27	U	µg/kg dry	8.27	1.73	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	10.7		µg/kg dry	8.27	1.59	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 8.27	U	µg/kg dry	8.27	1.83	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 8.27	U	µg/kg dry	8.27	1.86	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 8.27	U	µg/kg dry	8.27	1.73	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	2.20	P, J	µg/kg dry	5.17	1.77	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.17	U	µg/kg dry	5.17	1.86	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 103	U	µg/kg dry	103	22.4	1	"	"	"	"	"	X
57-74-9	Chlordane [2C]	< 20.7	U	µg/kg dry	20.7	20.3	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.17	U	µg/kg dry	5.17	2.53	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	70			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	72			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-5 (0-2')

SC43071-16

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 14:30

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	91			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	102			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.55	U	mg/kg dry	1.55	0.167	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	5,190		mg/kg dry	5.16	1.17	1	"	"	"	"	"	X
7440-38-2	Arsenic	1.53	J	mg/kg dry	1.55	0.196	1	"	"	"	"	"	X
7440-39-3	Barium	24.2		mg/kg dry	1.03	0.122	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.261	J	mg/kg dry	0.516	0.0259	1	"	"	"	"	"	X
7440-70-2	Calcium	7,780		mg/kg dry	25.8	5.29	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.657		mg/kg dry	0.516	0.0268	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.75		mg/kg dry	1.03	0.0599	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	8.18		mg/kg dry	1.03	0.137	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	31.0		mg/kg dry	1.03	0.248	1	"	"	"	"	"	X
7439-89-6	Iron	7,980	R06	mg/kg dry	516	2.13	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0156	J	mg/kg dry	0.0300	0.0083	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	214		mg/kg dry	51.7	3.61	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	4,360		mg/kg dry	5.16	1.49	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	137		mg/kg dry	1.03	0.263	1	"	"	"	"	"	X
7440-23-5	Sodium	79.6		mg/kg dry	25.8	11.1	1	"	"	"	"	"	X
7440-02-0	Nickel	7.97		mg/kg dry	1.03	0.119	1	"	"	"	"	"	X
7439-92-1	Lead	28.9		mg/kg dry	1.55	0.219	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.17	U	mg/kg dry	5.17	0.389	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.55	U	mg/kg dry	1.55	0.296	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.10	U	mg/kg dry	3.10	1.14	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	13.9		mg/kg dry	1.55	0.275	1	"	"	"	"	"	X
7440-66-6	Zinc	22.4		mg/kg dry	1.03	0.799	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	95.2		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.369	U	mg/kg dry	0.369	0.312	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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Sample Identification

SB-5 (12-14')

SC43071-17

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:05

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (low level)</u>													
Initial weight: 4.58 g													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 6.34	U	µg/kg dry	6.34	3.21	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
67-64-1	Acetone	< 63.4	U	µg/kg dry	63.4	25.4	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 6.34	U	µg/kg dry	6.34	6.09	1	"	"	"	"	"	X
71-43-2	Benzene	< 6.34	U	µg/kg dry	6.34	1.68	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 6.34	U	µg/kg dry	6.34	1.69	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 6.34	U	µg/kg dry	6.34	3.20	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 6.34	U	µg/kg dry	6.34	4.23	1	"	"	"	"	"	X
75-25-2	Bromoform	< 6.34	U	µg/kg dry	6.34	6.05	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 12.7	U	µg/kg dry	12.7	5.72	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 12.7	U	µg/kg dry	12.7	11.3	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 6.34	U	µg/kg dry	6.34	1.81	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 6.34	U	µg/kg dry	6.34	1.15	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 6.34	U	µg/kg dry	6.34	1.42	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 12.7	U	µg/kg dry	12.7	4.06	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 6.34	U	µg/kg dry	6.34	5.19	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 6.34	U	µg/kg dry	6.34	1.98	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 12.7	U	µg/kg dry	12.7	3.52	1	"	"	"	"	"	X
67-66-3	Chloroform	< 6.34	U	µg/kg dry	6.34	3.40	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 12.7	U	µg/kg dry	12.7	2.62	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 6.34	U	µg/kg dry	6.34	1.58	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 6.34	U	µg/kg dry	6.34	1.49	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 12.7	U	µg/kg dry	12.7	9.16	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 6.34	U	µg/kg dry	6.34	4.30	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 6.34	U	µg/kg dry	6.34	4.25	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 6.34	U	µg/kg dry	6.34	3.30	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 6.34	U	µg/kg dry	6.34	1.65	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 6.34	U	µg/kg dry	6.34	1.38	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 6.34	U	µg/kg dry	6.34	1.88	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 12.7	U	µg/kg dry	12.7	2.40	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 6.34	U	µg/kg dry	6.34	1.66	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 6.34	U	µg/kg dry	6.34	2.27	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 6.34	U	µg/kg dry	6.34	3.32	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 6.34	U	µg/kg dry	6.34	2.35	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 6.34	U	µg/kg dry	6.34	3.36	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 6.34	U	µg/kg dry	6.34	3.32	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 6.34	U	µg/kg dry	6.34	3.28	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 6.34	U	µg/kg dry	6.34	2.99	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 6.34	U	µg/kg dry	6.34	2.04	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 6.34	U	µg/kg dry	6.34	3.82	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 6.34	U	µg/kg dry	6.34	3.33	1	"	"	"	"	"	X

This laboratory report is not valid without an authorized signature on the cover page.

Sample Identification

SB-5 (12-14')

SC43071-17

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:05

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Volatile Organic Compounds**Volatile Organic Compounds by SW846 8260

Initial weight: 4.58 g

100-41-4	Ethylbenzene	< 6.34	U	µg/kg dry	6.34	0.91	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
87-68-3	Hexachlorobutadiene	< 6.34	U	µg/kg dry	6.34	3.18	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 12.7	U	µg/kg dry	12.7	7.78	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 6.34	U	µg/kg dry	6.34	1.25	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 6.34	U	µg/kg dry	6.34	1.36	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 6.34	U	µg/kg dry	6.34	2.33	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 12.7	U	µg/kg dry	12.7	3.26	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 12.7	U	µg/kg dry	12.7	2.52	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 6.34	U	µg/kg dry	6.34	3.77	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 6.34	U	µg/kg dry	6.34	1.03	1	"	"	"	"	"	X
100-42-5	Styrene	< 6.34	U	µg/kg dry	6.34	1.27	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 6.34	U	µg/kg dry	6.34	5.39	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 6.34	U	µg/kg dry	6.34	5.36	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 6.34	U	µg/kg dry	6.34	2.17	1	"	"	"	"	"	X
108-88-3	Toluene	< 6.34	U	µg/kg dry	6.34	2.05	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 6.34	U	µg/kg dry	6.34	2.23	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 6.34	U	µg/kg dry	6.34	4.67	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 6.34	U	µg/kg dry	6.34	1.99	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 6.34	U	µg/kg dry	6.34	2.10	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 6.34	U	µg/kg dry	6.34	4.60	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 6.34	U	µg/kg dry	6.34	1.73	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 6.34	U	µg/kg dry	6.34	3.42	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 6.34	U	µg/kg dry	6.34	4.75	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 6.34	U	µg/kg dry	6.34	1.54	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 6.34	U	µg/kg dry	6.34	1.09	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 6.34	U	µg/kg dry	6.34	2.14	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 12.7	U	µg/kg dry	12.7	1.14	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 6.34	U	µg/kg dry	6.34	1.78	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 12.7	U	µg/kg dry	12.7	9.99	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 6.34	U	µg/kg dry	6.34	5.74	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 6.34	U	µg/kg dry	6.34	2.12	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 6.34	U	µg/kg dry	6.34	3.42	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 6.34	U	µg/kg dry	6.34	1.18	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 63.4	U	µg/kg dry	63.4	41.5	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 127	U	µg/kg dry	127	110	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 31.7	U	µg/kg dry	31.7	14.5	1	"	"	"	"	"	X
64-17-5	Ethanol	< 1270	U	µg/kg dry	1270	236	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	97			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	102			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	124			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	101			70-130 %			"	"	"	"	"	

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Sample Identification

SB-5 (12-14')

SC43071-17

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[none]

Matrix

Soil

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<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 72.0	U	µg/kg dry	72.0	35.8	1	SW846 8270D	17-Jan-18	17-Jan-18	MSL	1800643	X
208-96-8	Acenaphthylene	< 72.0	U	µg/kg dry	72.0	35.5	1	"	"	"	"	"	X
62-53-3	Aniline	< 356	U	µg/kg dry	356	25.6	1	"	"	"	"	"	X
120-12-7	Anthracene	< 72.0	U	µg/kg dry	72.0	34.4	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 356	U	µg/kg dry	356	35.0	1	"	"	"	"	"	
92-87-5	Benzidine	< 356	U	µg/kg dry	356	71.6	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 72.0	U	µg/kg dry	72.0	38.0	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 72.0	U	µg/kg dry	72.0	26.8	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 72.0	U	µg/kg dry	72.0	34.8	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 72.0	U	µg/kg dry	72.0	28.9	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 72.0	U	µg/kg dry	72.0	28.2	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 356	U	µg/kg dry	356	74.8	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 356	U	µg/kg dry	356	29.2	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 356	U	µg/kg dry	356	31.6	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 180	U	µg/kg dry	180	25.8	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 180	U	µg/kg dry	180	27.7	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 180	U	µg/kg dry	180	44.4	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 356	U	µg/kg dry	356	33.3	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 356	U	µg/kg dry	356	41.5	1	"	"	"	"	"	X
86-74-8	Carbazole	< 180	U	µg/kg dry	180	101	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 356	U	µg/kg dry	356	34.0	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 180	U	µg/kg dry	180	38.9	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 356	U	µg/kg dry	356	32.9	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 180	U	µg/kg dry	180	32.0	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 356	U	µg/kg dry	356	42.3	1	"	"	"	"	"	X
218-01-9	Chrysene	< 72.0	U	µg/kg dry	72.0	35.9	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 72.0	U	µg/kg dry	72.0	27.6	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 180	U	µg/kg dry	180	27.4	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 356	U	µg/kg dry	356	31.1	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 356	U	µg/kg dry	356	31.1	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 356	U	µg/kg dry	356	33.0	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 356	U	µg/kg dry	356	54.2	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 180	U	µg/kg dry	180	33.7	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 356	U	µg/kg dry	356	44.0	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 356	U	µg/kg dry	356	38.9	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 356	U	µg/kg dry	356	25.5	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 356	U	µg/kg dry	356	37.8	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 356	U	µg/kg dry	356	45.7	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 356	U	µg/kg dry	356	36.2	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 180	U	µg/kg dry	180	69.7	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 180	U	µg/kg dry	180	40.6	1	"	"	"	"	"	X

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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 356	U	µg/kg dry	356	40.2	1	SW846 8270D	17-Jan-18	17-Jan-18	MSL	1800643	X
206-44-0	Fluoranthene	< 72.0	U	µg/kg dry	72.0	38.0	1	"	"	"	"	"	X
86-73-7	Fluorene	< 72.0	U	µg/kg dry	72.0	36.6	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 180	U	µg/kg dry	180	35.5	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 180	U	µg/kg dry	180	43.0	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 180	U	µg/kg dry	180	24.5	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 180	U	µg/kg dry	180	38.8	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 72.0	U	µg/kg dry	72.0	25.9	1	"	"	"	"	"	X
78-59-1	Isophorone	< 180	U	µg/kg dry	180	33.8	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 72.0	U	µg/kg dry	72.0	43.5	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 356	U	µg/kg dry	356	30.3	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 356	U	µg/kg dry	356	34.4	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 72.0	U	µg/kg dry	72.0	33.6	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 356	U	µg/kg dry	356	30.2	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 356	U	µg/kg dry	356	48.7	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 180	U	µg/kg dry	180	55.5	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 180	U	µg/kg dry	180	32.8	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 180	U	µg/kg dry	180	29.9	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1420	U	µg/kg dry	1420	57.5	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 180	U	µg/kg dry	180	33.4	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 180	U	µg/kg dry	180	35.1	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 356	U	µg/kg dry	356	38.6	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 356	U	µg/kg dry	356	38.0	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 72.0	U	µg/kg dry	72.0	33.5	1	"	"	"	"	"	X
108-95-2	Phenol	< 356	U	µg/kg dry	356	23.4	1	"	"	"	"	"	X
129-00-0	Pyrene	< 72.0	U	µg/kg dry	72.0	40.1	1	"	"	"	"	"	X
110-86-1	Pyridine	< 356	U	µg/kg dry	356	53.1	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 356	U	µg/kg dry	356	35.3	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 72.0	U	µg/kg dry	72.0	35.4	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 356	U	µg/kg dry	356	32.0	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 180	U	µg/kg dry	180	32.1	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 356	U	µg/kg dry	356	56.2	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 356	U	µg/kg dry	356	34.5	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	67			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	62			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	61			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	59			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	81			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	78			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 21.5	U	µg/kg dry	21.5	9.63	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 21.5	U	µg/kg dry	21.5	11.4	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 21.5	U	µg/kg dry	21.5	10.8	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 21.5	U	µg/kg dry	21.5	21.2	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 21.5	U	µg/kg dry	21.5	19.6	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 21.5	U	µg/kg dry	21.5	14.1	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 21.5	U	µg/kg dry	21.5	11.5	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 21.5	U	µg/kg dry	21.5	18.7	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 21.5	U	µg/kg dry	21.5	9.69	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	35			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	35			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	55			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	65			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.42	U	µg/kg dry	5.42	1.45	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.42	U	µg/kg dry	5.42	2.15	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.42	U	µg/kg dry	5.42	1.56	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.25	U	µg/kg dry	3.25	1.56	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.42	U	µg/kg dry	5.42	1.81	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.42	U	µg/kg dry	5.42	1.67	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.42	U	µg/kg dry	5.42	1.92	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.42	U	µg/kg dry	5.42	1.91	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.42	U	µg/kg dry	5.42	1.91	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.42	U	µg/kg dry	5.42	1.71	1	"	"	"	"	"	X
72-20-8	Endrin	< 8.67	U	µg/kg dry	8.67	1.91	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 8.67	U	µg/kg dry	8.67	2.04	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 8.67	U	µg/kg dry	8.67	1.89	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 8.67	U	µg/kg dry	8.67	1.81	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 8.67	U	µg/kg dry	8.67	1.67	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 8.67	U	µg/kg dry	8.67	1.92	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 8.67	U	µg/kg dry	8.67	1.95	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 8.67	U	µg/kg dry	8.67	1.81	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.42	U	µg/kg dry	5.42	1.85	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.42	U	µg/kg dry	5.42	1.95	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 108	U	µg/kg dry	108	23.4	1	"	"	"	"	"	X
57-74-9	Chlordane	< 21.7	U	µg/kg dry	21.7	21.4	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.42	U	µg/kg dry	5.42	2.66	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	62			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	64			30-150 %			"	"	"	"	"	

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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	103			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	119			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.62	U	mg/kg dry	1.62	0.175	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	2,940		mg/kg dry	5.39	1.22	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.323	J	mg/kg dry	1.62	0.205	1	"	"	"	"	"	X
7440-39-3	Barium	18.4		mg/kg dry	1.08	0.127	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.117	J	mg/kg dry	0.539	0.0270	1	"	"	"	"	"	X
7440-70-2	Calcium	251		mg/kg dry	26.9	5.52	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.418	J	mg/kg dry	0.539	0.0279	1	"	"	"	"	"	X
7440-48-4	Cobalt	1.41		mg/kg dry	1.08	0.0625	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	8.77		mg/kg dry	1.08	0.143	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	5.29		mg/kg dry	1.08	0.259	1	"	"	"	"	"	X
7439-89-6	Iron	5,780	R06	mg/kg dry	539	2.22	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0321	U	mg/kg dry	0.0321	0.0089	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	597		mg/kg dry	54.0	3.76	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	1,130		mg/kg dry	5.39	1.55	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	82.8		mg/kg dry	1.08	0.275	1	"	"	"	"	"	X
7440-23-5	Sodium	59.3		mg/kg dry	26.9	11.6	1	"	"	"	"	"	X
7440-02-0	Nickel	6.88		mg/kg dry	1.08	0.124	1	"	"	"	"	"	X
7439-92-1	Lead	1.68		mg/kg dry	1.62	0.228	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.40	U	mg/kg dry	5.40	0.406	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.62	U	mg/kg dry	1.62	0.309	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.23	U	mg/kg dry	3.23	1.19	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	9.11		mg/kg dry	1.62	0.287	1	"	"	"	"	"	X
7440-66-6	Zinc	9.65		mg/kg dry	1.08	0.834	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	92.2		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	0.256	J	mg/kg dry	0.296	0.250	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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Sample Identification

SB-5 (15-17')

SC43071-18

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:15

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Volatile Organic Compounds**Prepared by method Volatiles

VOC Extraction

Field  
extracted

N/A

1

VOC Soil  
Extraction

BD

1800494

Volatile Organic Compounds by SW846 8260Prepared by method SW846 5035A Soil (low level)

Initial weight: 6.14 g

76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 6.05	U	µg/kg dry	6.05	3.07	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
67-64-1	Acetone	< 60.5	U	µg/kg dry	60.5	24.2	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 6.05	U	µg/kg dry	6.05	5.81	1	"	"	"	"	"	X
71-43-2	Benzene	< 6.05	U	µg/kg dry	6.05	1.60	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 6.05	U	µg/kg dry	6.05	1.61	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 6.05	U	µg/kg dry	6.05	3.05	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 6.05	U	µg/kg dry	6.05	4.03	1	"	"	"	"	"	X
75-25-2	Bromoform	< 6.05	U	µg/kg dry	6.05	5.77	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 12.1	U	µg/kg dry	12.1	5.46	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 12.1	U	µg/kg dry	12.1	10.8	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 6.05	U	µg/kg dry	6.05	1.73	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 6.05	U	µg/kg dry	6.05	1.10	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 6.05	U	µg/kg dry	6.05	1.35	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 12.1	U	µg/kg dry	12.1	3.87	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 6.05	U	µg/kg dry	6.05	4.95	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 6.05	U	µg/kg dry	6.05	1.89	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 12.1	U	µg/kg dry	12.1	3.36	1	"	"	"	"	"	X
67-66-3	Chloroform	< 6.05	U	µg/kg dry	6.05	3.25	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 12.1	U	µg/kg dry	12.1	2.50	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 6.05	U	µg/kg dry	6.05	1.51	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 6.05	U	µg/kg dry	6.05	1.42	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 12.1	U	µg/kg dry	12.1	8.74	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 6.05	U	µg/kg dry	6.05	4.10	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 6.05	U	µg/kg dry	6.05	4.06	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 6.05	U	µg/kg dry	6.05	3.14	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 6.05	U	µg/kg dry	6.05	1.57	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 6.05	U	µg/kg dry	6.05	1.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 6.05	U	µg/kg dry	6.05	1.79	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 12.1	U	µg/kg dry	12.1	2.29	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 6.05	U	µg/kg dry	6.05	1.58	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 6.05	U	µg/kg dry	6.05	2.16	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 6.05	U	µg/kg dry	6.05	3.16	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 6.05	U	µg/kg dry	6.05	2.24	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 6.05	U	µg/kg dry	6.05	3.20	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 6.05	U	µg/kg dry	6.05	3.17	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 6.05	U	µg/kg dry	6.05	3.13	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 6.05	U	µg/kg dry	6.05	2.85	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 6.05	U	µg/kg dry	6.05	1.95	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 6.05	U	µg/kg dry	6.05	3.65	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 6.05	U	µg/kg dry	6.05	3.17	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-5 (15-17')

SC43071-18

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Volatile Organic Compounds**Volatile Organic Compounds by SW846 8260

Initial weight: 6.14 g

100-41-4	Ethylbenzene	< 6.05	U	µg/kg dry	6.05	0.87	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
87-68-3	Hexachlorobutadiene	< 6.05	U	µg/kg dry	6.05	3.04	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 12.1	U	µg/kg dry	12.1	7.42	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 6.05	U	µg/kg dry	6.05	1.19	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 6.05	U	µg/kg dry	6.05	1.30	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 6.05	U	µg/kg dry	6.05	2.23	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 12.1	U	µg/kg dry	12.1	3.11	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 12.1	U	µg/kg dry	12.1	2.40	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 6.05	U	µg/kg dry	6.05	3.60	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 6.05	U	µg/kg dry	6.05	0.98	1	"	"	"	"	"	X
100-42-5	Styrene	< 6.05	U	µg/kg dry	6.05	1.22	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 6.05	U	µg/kg dry	6.05	5.14	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 6.05	U	µg/kg dry	6.05	5.12	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 6.05	U	µg/kg dry	6.05	2.07	1	"	"	"	"	"	X
108-88-3	Toluene	< 6.05	U	µg/kg dry	6.05	1.96	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 6.05	U	µg/kg dry	6.05	2.12	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 6.05	U	µg/kg dry	6.05	4.46	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 6.05	U	µg/kg dry	6.05	1.90	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 6.05	U	µg/kg dry	6.05	2.01	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 6.05	U	µg/kg dry	6.05	4.38	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 6.05	U	µg/kg dry	6.05	1.65	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 6.05	U	µg/kg dry	6.05	3.26	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 6.05	U	µg/kg dry	6.05	4.53	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 6.05	U	µg/kg dry	6.05	1.47	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 6.05	U	µg/kg dry	6.05	1.04	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 6.05	U	µg/kg dry	6.05	2.04	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 12.1	U	µg/kg dry	12.1	1.09	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 6.05	U	µg/kg dry	6.05	1.69	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 12.1	U	µg/kg dry	12.1	9.53	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 6.05	U	µg/kg dry	6.05	5.48	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 6.05	U	µg/kg dry	6.05	2.02	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 6.05	U	µg/kg dry	6.05	3.26	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 6.05	U	µg/kg dry	6.05	1.12	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 60.5	U	µg/kg dry	60.5	39.6	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 121	U	µg/kg dry	121	105	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 30.2	U	µg/kg dry	30.2	13.8	1	"	"	"	"	"	X
64-17-5	Ethanol	< 1210	U	µg/kg dry	1210	226	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	95			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	102			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	121			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	100			70-130 %			"	"	"	"	"	

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Sample Identification

SB-5 (15-17')

SC43071-18

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 80.4	U	µg/kg dry	80.4	40.0	1	SW846 8270D	17-Jan-18	18-Jan-18	MSL	1800643	X
208-96-8	Acenaphthylene	< 80.4	U	µg/kg dry	80.4	39.6	1	"	"	"	"	"	X
62-53-3	Aniline	< 398	U	µg/kg dry	398	28.6	1	"	"	"	"	"	X
120-12-7	Anthracene	< 80.4	U	µg/kg dry	80.4	38.4	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 398	U	µg/kg dry	398	39.1	1	"	"	"	"	"	
92-87-5	Benzidine	< 398	U	µg/kg dry	398	80.0	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 80.4	U	µg/kg dry	80.4	42.4	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 80.4	U	µg/kg dry	80.4	29.9	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 80.4	U	µg/kg dry	80.4	38.9	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 80.4	U	µg/kg dry	80.4	32.3	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 80.4	U	µg/kg dry	80.4	31.4	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 398	U	µg/kg dry	398	83.5	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 398	U	µg/kg dry	398	32.6	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 398	U	µg/kg dry	398	35.3	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 201	U	µg/kg dry	201	28.8	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 201	U	µg/kg dry	201	31.0	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 201	U	µg/kg dry	201	49.6	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 398	U	µg/kg dry	398	37.2	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 398	U	µg/kg dry	398	46.4	1	"	"	"	"	"	X
86-74-8	Carbazole	< 201	U	µg/kg dry	201	112	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 398	U	µg/kg dry	398	37.9	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 201	U	µg/kg dry	201	43.5	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 398	U	µg/kg dry	398	36.7	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 201	U	µg/kg dry	201	35.8	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 398	U	µg/kg dry	398	47.2	1	"	"	"	"	"	X
218-01-9	Chrysene	< 80.4	U	µg/kg dry	80.4	40.1	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 80.4	U	µg/kg dry	80.4	30.8	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 201	U	µg/kg dry	201	30.6	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 398	U	µg/kg dry	398	34.7	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 398	U	µg/kg dry	398	34.7	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 398	U	µg/kg dry	398	36.9	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 398	U	µg/kg dry	398	60.5	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 201	U	µg/kg dry	201	37.6	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 398	U	µg/kg dry	398	49.2	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 398	U	µg/kg dry	398	43.5	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 398	U	µg/kg dry	398	28.4	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 398	U	µg/kg dry	398	42.2	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 398	U	µg/kg dry	398	51.0	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 398	U	µg/kg dry	398	40.5	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 201	U	µg/kg dry	201	77.8	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 201	U	µg/kg dry	201	45.3	1	"	"	"	"	"	X

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Sample Identification

SB-5 (15-17')

SC43071-18

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 398	U	µg/kg dry	398	44.9	1	SW846 8270D	17-Jan-18	18-Jan-18	MSL	1800643	X
206-44-0	Fluoranthene	< 80.4	U	µg/kg dry	80.4	42.5	1	"	"	"	"	"	X
86-73-7	Fluorene	< 80.4	U	µg/kg dry	80.4	40.8	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 201	U	µg/kg dry	201	39.6	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 201	U	µg/kg dry	201	48.1	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 201	U	µg/kg dry	201	27.3	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 201	U	µg/kg dry	201	43.4	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 80.4	U	µg/kg dry	80.4	28.9	1	"	"	"	"	"	X
78-59-1	Isophorone	< 201	U	µg/kg dry	201	37.7	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 80.4	U	µg/kg dry	80.4	48.5	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 398	U	µg/kg dry	398	33.8	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 398	U	µg/kg dry	398	38.4	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 80.4	U	µg/kg dry	80.4	37.5	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 398	U	µg/kg dry	398	33.7	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 398	U	µg/kg dry	398	54.3	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 201	U	µg/kg dry	201	61.9	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 201	U	µg/kg dry	201	36.6	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 201	U	µg/kg dry	201	33.4	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1590	U	µg/kg dry	1590	64.2	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 201	U	µg/kg dry	201	37.3	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 201	U	µg/kg dry	201	39.2	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 398	U	µg/kg dry	398	43.1	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 398	U	µg/kg dry	398	42.5	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 80.4	U	µg/kg dry	80.4	37.4	1	"	"	"	"	"	X
108-95-2	Phenol	< 398	U	µg/kg dry	398	26.2	1	"	"	"	"	"	X
129-00-0	Pyrene	< 80.4	U	µg/kg dry	80.4	44.8	1	"	"	"	"	"	X
110-86-1	Pyridine	< 398	U	µg/kg dry	398	59.3	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 398	U	µg/kg dry	398	39.4	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 80.4	U	µg/kg dry	80.4	39.5	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 398	U	µg/kg dry	398	35.8	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 201	U	µg/kg dry	201	35.9	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 398	U	µg/kg dry	398	62.8	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 398	U	µg/kg dry	398	38.5	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	60			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	47			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	57			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	48			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	79			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	66			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 24.2	U	µg/kg dry	24.2	10.8	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-5 (15-17')

SC43071-18

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 24.2	U	µg/kg dry	24.2	12.9	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 24.2	U	µg/kg dry	24.2	12.1	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 24.2	U	µg/kg dry	24.2	23.9	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 24.2	U	µg/kg dry	24.2	22.1	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 24.2	U	µg/kg dry	24.2	15.8	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 24.2	U	µg/kg dry	24.2	13.0	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 24.2	U	µg/kg dry	24.2	21.1	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 24.2	U	µg/kg dry	24.2	10.9	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	45			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	45			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	65			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.99	U	µg/kg dry	5.99	1.61	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.99	U	µg/kg dry	5.99	2.37	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.99	U	µg/kg dry	5.99	1.73	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.60	U	µg/kg dry	3.60	1.73	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.99	U	µg/kg dry	5.99	2.00	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.99	U	µg/kg dry	5.99	1.85	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.99	U	µg/kg dry	5.99	2.12	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.99	U	µg/kg dry	5.99	2.11	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.99	U	µg/kg dry	5.99	2.11	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.99	U	µg/kg dry	5.99	1.89	1	"	"	"	"	"	X
72-20-8	Endrin	< 9.59	U	µg/kg dry	9.59	2.11	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 9.59	U	µg/kg dry	9.59	2.25	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 9.59	U	µg/kg dry	9.59	2.09	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 9.59	U	µg/kg dry	9.59	2.00	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 9.59	U	µg/kg dry	9.59	1.85	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 9.59	U	µg/kg dry	9.59	2.12	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 9.59	U	µg/kg dry	9.59	2.16	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 9.59	U	µg/kg dry	9.59	2.00	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.99	U	µg/kg dry	5.99	2.05	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.99	U	µg/kg dry	5.99	2.16	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 120	U	µg/kg dry	120	25.9	1	"	"	"	"	"	X
57-74-9	Chlordane	< 24.0	U	µg/kg dry	24.0	23.7	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.99	U	µg/kg dry	5.99	2.94	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	53			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	56			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

SB-5 (15-17')

SC43071-18

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 15:15

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	76			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	99			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.79	U	mg/kg dry	1.79	0.194	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	2,450		mg/kg dry	5.98	1.36	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.526	J	mg/kg dry	1.79	0.227	1	"	"	"	"	"	X
7440-39-3	Barium	14.7		mg/kg dry	1.20	0.141	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.121	J	mg/kg dry	0.598	0.0300	1	"	"	"	"	"	X
7440-70-2	Calcium	217		mg/kg dry	29.9	6.12	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.480	J	mg/kg dry	0.598	0.0310	1	"	"	"	"	"	X
7440-48-4	Cobalt	1.73		mg/kg dry	1.20	0.0696	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	7.18		mg/kg dry	1.20	0.159	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	5.71		mg/kg dry	1.20	0.287	1	"	"	"	"	"	X
7439-89-6	Iron	6,510	R06	mg/kg dry	598	2.46	1	"	"	"	"	"	X
7439-97-6	Mercury	< 0.0362	U	mg/kg dry	0.0362	0.0101	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	504		mg/kg dry	60.1	4.19	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	838		mg/kg dry	5.98	1.72	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	209		mg/kg dry	1.20	0.305	1	"	"	"	"	"	X
7440-23-5	Sodium	48.4		mg/kg dry	29.9	12.9	1	"	"	"	"	"	X
7440-02-0	Nickel	5.23		mg/kg dry	1.20	0.138	1	"	"	"	"	"	X
7439-92-1	Lead	1.83		mg/kg dry	1.79	0.254	1	"	"	"	"	"	X
7440-36-0	Antimony	< 6.01	U	mg/kg dry	6.01	0.452	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.80	U	mg/kg dry	1.80	0.344	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.59	U	mg/kg dry	3.59	1.32	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	8.23		mg/kg dry	1.79	0.318	1	"	"	"	"	"	X
7440-66-6	Zinc	8.54		mg/kg dry	1.20	0.926	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	82.1		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	0.264	J	mg/kg dry	0.310	0.261	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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Sample Identification

DUP-011118

SC43071-19

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 08:00

Received

12-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
<u>Prepared by method Volatiles</u>													
	VOC Extraction	Field extracted		N/A			1	VOC Soil Extraction			BD	1800494	
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5035A Soil (low level)</u>													
								Initial weight: 5.56 g					
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 4.95	U	µg/kg dry	4.95	2.51	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
67-64-1	Acetone	< 49.5	U	µg/kg dry	49.5	19.8	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 4.95	U	µg/kg dry	4.95	4.75	1	"	"	"	"	"	X
71-43-2	Benzene	< 4.95	U	µg/kg dry	4.95	1.31	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 4.95	U	µg/kg dry	4.95	1.32	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 4.95	U	µg/kg dry	4.95	2.50	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 4.95	U	µg/kg dry	4.95	3.30	1	"	"	"	"	"	X
75-25-2	Bromoform	< 4.95	U	µg/kg dry	4.95	4.72	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 9.90	U	µg/kg dry	9.90	4.47	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 9.90	U	µg/kg dry	9.90	8.85	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 4.95	U	µg/kg dry	4.95	1.42	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 4.95	U	µg/kg dry	4.95	0.90	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 4.95	U	µg/kg dry	4.95	1.11	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 9.90	U	µg/kg dry	9.90	3.17	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 4.95	U	µg/kg dry	4.95	4.05	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 4.95	U	µg/kg dry	4.95	1.55	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 9.90	U	µg/kg dry	9.90	2.75	1	"	"	"	"	"	X
67-66-3	Chloroform	< 4.95	U	µg/kg dry	4.95	2.66	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 9.90	U	µg/kg dry	9.90	2.04	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 4.95	U	µg/kg dry	4.95	1.23	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 4.95	U	µg/kg dry	4.95	1.16	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 9.90	U	µg/kg dry	9.90	7.15	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 4.95	U	µg/kg dry	4.95	3.35	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 4.95	U	µg/kg dry	4.95	3.32	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 4.95	U	µg/kg dry	4.95	2.57	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.95	U	µg/kg dry	4.95	1.29	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.95	U	µg/kg dry	4.95	1.07	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.95	U	µg/kg dry	4.95	1.46	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 9.90	U	µg/kg dry	9.90	1.88	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 4.95	U	µg/kg dry	4.95	1.30	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 4.95	U	µg/kg dry	4.95	1.77	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 4.95	U	µg/kg dry	4.95	2.59	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 4.95	U	µg/kg dry	4.95	1.84	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 4.95	U	µg/kg dry	4.95	2.62	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 4.95	U	µg/kg dry	4.95	2.59	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 4.95	U	µg/kg dry	4.95	2.56	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 4.95	U	µg/kg dry	4.95	2.34	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 4.95	U	µg/kg dry	4.95	1.59	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 4.95	U	µg/kg dry	4.95	2.98	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 4.95	U	µg/kg dry	4.95	2.60	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

DUP-011118

SC43071-19

Client Project #

[none]

Matrix

Soil

Collection Date/Time

11-Jan-18 08:00

Received

12-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Volatile Organic Compounds**Volatile Organic Compounds by SW846 8260

Initial weight: 5.56 g

100-41-4	Ethylbenzene	< 4.95	U	µg/kg dry	4.95	0.71	1	SW846 8260C	22-Jan-18	23-Jan-18	EK	1800813	X
87-68-3	Hexachlorobutadiene	< 4.95	U	µg/kg dry	4.95	2.48	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 9.90	U	µg/kg dry	9.90	6.07	1	"	"	"	"	"	X
98-82-8	Isopropylbenzene	< 4.95	U	µg/kg dry	4.95	0.97	1	"	"	"	"	"	X
99-87-6	4-Isopropyltoluene	< 4.95	U	µg/kg dry	4.95	1.06	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 4.95	U	µg/kg dry	4.95	1.82	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 9.90	U	µg/kg dry	9.90	2.54	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 9.90	U	µg/kg dry	9.90	1.96	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.95	U	µg/kg dry	4.95	2.94	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 4.95	U	µg/kg dry	4.95	0.80	1	"	"	"	"	"	X
100-42-5	Styrene	< 4.95	U	µg/kg dry	4.95	0.99	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 4.95	U	µg/kg dry	4.95	4.21	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 4.95	U	µg/kg dry	4.95	4.19	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 4.95	U	µg/kg dry	4.95	1.69	1	"	"	"	"	"	X
108-88-3	Toluene	< 4.95	U	µg/kg dry	4.95	1.60	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 4.95	U	µg/kg dry	4.95	1.74	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.95	U	µg/kg dry	4.95	3.65	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 4.95	U	µg/kg dry	4.95	1.55	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 4.95	U	µg/kg dry	4.95	1.64	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 4.95	U	µg/kg dry	4.95	3.59	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 4.95	U	µg/kg dry	4.95	1.35	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 4.95	U	µg/kg dry	4.95	2.67	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 4.95	U	µg/kg dry	4.95	3.71	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 4.95	U	µg/kg dry	4.95	1.20	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 4.95	U	µg/kg dry	4.95	0.85	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 4.95	U	µg/kg dry	4.95	1.67	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 9.90	U	µg/kg dry	9.90	0.89	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 4.95	U	µg/kg dry	4.95	1.39	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 9.90	U	µg/kg dry	9.90	7.80	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 4.95	U	µg/kg dry	4.95	4.48	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 4.95	U	µg/kg dry	4.95	1.65	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 4.95	U	µg/kg dry	4.95	2.67	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 4.95	U	µg/kg dry	4.95	0.92	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 49.5	U	µg/kg dry	49.5	32.4	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 99.0	U	µg/kg dry	99.0	85.9	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-butene	< 24.7	U	µg/kg dry	24.7	11.3	1	"	"	"	"	"	X
64-17-5	Ethanol	< 990	U	µg/kg dry	990	185	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	97			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	102			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	128			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	99			70-130 %		"	"	"	"	"	"	

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<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
<u>Prepared by method SW846 3546</u>													
83-32-9	Acenaphthene	< 69.9	U	µg/kg dry	69.9	34.8	1	SW846 8270D	17-Jan-18	18-Jan-18	MSL	1800643	X
208-96-8	Acenaphthylene	< 69.9	U	µg/kg dry	69.9	34.5	1	"	"	"	"	"	X
62-53-3	Aniline	< 346	U	µg/kg dry	346	24.8	1	"	"	"	"	"	X
120-12-7	Anthracene	< 69.9	U	µg/kg dry	69.9	33.4	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 346	U	µg/kg dry	346	34.0	1	"	"	"	"	"	
92-87-5	Benzidine	< 346	U	µg/kg dry	346	69.5	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 69.9	U	µg/kg dry	69.9	36.9	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 69.9	U	µg/kg dry	69.9	26.0	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 69.9	U	µg/kg dry	69.9	33.8	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 69.9	U	µg/kg dry	69.9	28.1	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 69.9	U	µg/kg dry	69.9	27.3	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 346	U	µg/kg dry	346	72.6	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 346	U	µg/kg dry	346	28.3	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 346	U	µg/kg dry	346	30.7	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 175	U	µg/kg dry	175	25.1	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 175	U	µg/kg dry	175	26.9	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 175	U	µg/kg dry	175	43.1	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 346	U	µg/kg dry	346	32.4	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 346	U	µg/kg dry	346	40.3	1	"	"	"	"	"	X
86-74-8	Carbazole	< 175	U	µg/kg dry	175	97.6	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 346	U	µg/kg dry	346	33.0	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 175	U	µg/kg dry	175	37.8	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 346	U	µg/kg dry	346	31.9	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 175	U	µg/kg dry	175	31.1	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 346	U	µg/kg dry	346	41.1	1	"	"	"	"	"	X
218-01-9	Chrysene	< 69.9	U	µg/kg dry	69.9	34.9	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 69.9	U	µg/kg dry	69.9	26.8	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 175	U	µg/kg dry	175	26.6	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 346	U	µg/kg dry	346	30.2	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 346	U	µg/kg dry	346	30.2	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 346	U	µg/kg dry	346	32.0	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 346	U	µg/kg dry	346	52.6	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 175	U	µg/kg dry	175	32.7	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 346	U	µg/kg dry	346	42.7	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 346	U	µg/kg dry	346	37.8	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 346	U	µg/kg dry	346	24.7	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 346	U	µg/kg dry	346	36.7	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 346	U	µg/kg dry	346	44.4	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 346	U	µg/kg dry	346	35.2	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 175	U	µg/kg dry	175	67.6	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 175	U	µg/kg dry	175	39.4	1	"	"	"	"	"	X

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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

117-84-0	Di-n-octyl phthalate	< 346	U	µg/kg dry	346	39.1	1	SW846 8270D	17-Jan-18	18-Jan-18	MSL	1800643	X
206-44-0	Fluoranthene	< 69.9	U	µg/kg dry	69.9	36.9	1	"	"	"	"	"	X
86-73-7	Fluorene	< 69.9	U	µg/kg dry	69.9	35.5	1	"	"	"	"	"	X
118-74-1	Hexachlorobenzene	< 175	U	µg/kg dry	175	34.4	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 175	U	µg/kg dry	175	41.8	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 175	U	µg/kg dry	175	23.8	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 175	U	µg/kg dry	175	37.7	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 69.9	U	µg/kg dry	69.9	25.1	1	"	"	"	"	"	X
78-59-1	Isophorone	< 175	U	µg/kg dry	175	32.8	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 69.9	U	µg/kg dry	69.9	42.2	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 346	U	µg/kg dry	346	29.4	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 346	U	µg/kg dry	346	33.4	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 69.9	U	µg/kg dry	69.9	32.6	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 346	U	µg/kg dry	346	29.3	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 346	U	µg/kg dry	346	47.2	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 175	U	µg/kg dry	175	53.8	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 175	U	µg/kg dry	175	31.8	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 175	U	µg/kg dry	175	29.0	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 1380	U	µg/kg dry	1380	55.8	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 175	U	µg/kg dry	175	32.5	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 175	U	µg/kg dry	175	34.1	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 346	U	µg/kg dry	346	37.5	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 346	U	µg/kg dry	346	36.9	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 69.9	U	µg/kg dry	69.9	32.5	1	"	"	"	"	"	X
108-95-2	Phenol	< 346	U	µg/kg dry	346	22.7	1	"	"	"	"	"	X
129-00-0	Pyrene	< 69.9	U	µg/kg dry	69.9	39.0	1	"	"	"	"	"	X
110-86-1	Pyridine	< 346	U	µg/kg dry	346	51.5	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 346	U	µg/kg dry	346	34.2	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 69.9	U	µg/kg dry	69.9	34.4	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 346	U	µg/kg dry	346	31.1	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 175	U	µg/kg dry	175	31.2	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 346	U	µg/kg dry	346	54.6	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 346	U	µg/kg dry	346	33.5	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	68			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	56			30-130 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	63			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	58			30-130 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	81			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	77			30-130 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3546

12674-11-2	Aroclor-1016	< 20.8	U	µg/kg dry	20.8	9.31	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

11104-28-2	Aroclor-1221	< 20.8	U	µg/kg dry	20.8	11.1	1	SW846 8082A	16-Jan-18	17-Jan-18	AM	1800575	X
11141-16-5	Aroclor-1232	< 20.8	U	µg/kg dry	20.8	10.4	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 20.8	U	µg/kg dry	20.8	20.5	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 20.8	U	µg/kg dry	20.8	19.0	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 20.8	U	µg/kg dry	20.8	13.6	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 20.8	U	µg/kg dry	20.8	11.1	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 20.8	U	µg/kg dry	20.8	18.1	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 20.8	U	µg/kg dry	20.8	9.37	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	45			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	45			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	85			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	90			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3546

319-84-6	alpha-BHC	< 5.21	U	µg/kg dry	5.21	1.40	1	SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	X
319-85-7	beta-BHC	< 5.21	U	µg/kg dry	5.21	2.06	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 5.21	U	µg/kg dry	5.21	1.50	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 3.13	U	µg/kg dry	3.13	1.50	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 5.21	U	µg/kg dry	5.21	1.74	1	"	"	"	"	"	X
309-00-2	Aldrin	< 5.21	U	µg/kg dry	5.21	1.61	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 5.21	U	µg/kg dry	5.21	1.85	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 5.21	U	µg/kg dry	5.21	1.83	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 5.21	U	µg/kg dry	5.21	1.83	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 5.21	U	µg/kg dry	5.21	1.65	1	"	"	"	"	"	X
72-20-8	Endrin	< 8.34	U	µg/kg dry	8.34	1.83	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 8.34	U	µg/kg dry	8.34	1.96	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 8.34	U	µg/kg dry	8.34	1.81	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 8.34	U	µg/kg dry	8.34	1.74	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 8.34	U	µg/kg dry	8.34	1.61	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 8.34	U	µg/kg dry	8.34	1.85	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 8.34	U	µg/kg dry	8.34	1.88	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 8.34	U	µg/kg dry	8.34	1.74	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 5.21	U	µg/kg dry	5.21	1.78	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 5.21	U	µg/kg dry	5.21	1.88	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 104	U	µg/kg dry	104	22.5	1	"	"	"	"	"	X
57-74-9	Chlordane [2C]	< 20.8	U	µg/kg dry	20.8	20.5	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 5.21	U	µg/kg dry	5.21	2.55	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	74			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	74			30-150 %			"	"	"	"	"	

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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr)	100			30-150 %			SW846 8081B	16-Jan-18	25-Jan-18	SM	1800576	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	89			30-150 %			"	"	"	"	"	

**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3050B

7440-22-4	Silver	< 1.56	U	mg/kg dry	1.56	0.168	1	SW846 6010C	16-Jan-18	24-Jan-18	SJR/T	1800473	X
7429-90-5	Aluminum	4,700		mg/kg dry	5.19	1.18	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.996	J	mg/kg dry	1.56	0.197	1	"	"	"	"	"	X
7440-39-3	Barium	16.5		mg/kg dry	1.04	0.122	1	"	"	"	"	"	X
7440-41-7	Beryllium	0.236	J	mg/kg dry	0.519	0.0260	1	"	"	"	"	"	X
7440-70-2	Calcium	430		mg/kg dry	25.9	5.31	1	"	"	"	"	"	X
7440-43-9	Cadmium	0.550		mg/kg dry	0.519	0.0269	1	"	"	"	"	"	X
7440-48-4	Cobalt	2.58		mg/kg dry	1.03	0.0596	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7440-47-3	Chromium	7.96		mg/kg dry	1.04	0.138	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-50-8	Copper	4.97		mg/kg dry	1.04	0.249	1	"	"	"	"	"	X
7439-89-6	Iron	7,490	R06	mg/kg dry	519	2.14	1	"	"	"	"	"	X
7439-97-6	Mercury	0.0087	J	mg/kg dry	0.0304	0.0084	1	SW846 7471B	"	23-Jan-18	ABW	1800474	X

Prepared by method SW846 3050B

7440-09-7	Potassium	193		mg/kg dry	51.5	3.59	1	SW846 6010C	26-Jan-18	29-Jan-18	SJR/T	1801087	X
7439-95-4	Magnesium	962		mg/kg dry	5.19	1.49	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7439-96-5	Manganese	112		mg/kg dry	1.04	0.265	1	"	"	"	"	"	X
7440-23-5	Sodium	61.4		mg/kg dry	25.9	11.2	1	"	"	"	"	"	X
7440-02-0	Nickel	8.31		mg/kg dry	1.04	0.119	1	"	"	"	"	"	X
7439-92-1	Lead	2.94		mg/kg dry	1.56	0.220	1	"	"	"	"	"	X
7440-36-0	Antimony	< 5.15	U	mg/kg dry	5.15	0.387	1	"	26-Jan-18	29-Jan-18	"	1801087	X
7782-49-2	Selenium	< 1.54	U	mg/kg dry	1.54	0.295	1	"	"	"	"	"	X
7440-28-0	Thallium	< 3.11	U	mg/kg dry	3.11	1.14	1	"	16-Jan-18	24-Jan-18	"	1800473	X
7440-62-2	Vanadium	10.4		mg/kg dry	1.56	0.276	1	"	"	"	"	"	X
7440-66-6	Zinc	10.2		mg/kg dry	1.04	0.803	1	"	"	"	"	"	X

**General Chemistry Parameters**

% Solids	95.5		%				1	SM2540 G (11) Mod.	12-Jan-18	12-Jan-18	VO	1800475	
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Prepared by method SW846 9010B

57-12-5	Cyanide (total)	< 0.320	U	mg/kg dry	0.320	0.270	1	SW846 9012B	17-Jan-18	18-Jan-18	RLT	1800670	X
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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800741 - SW846 5035A Soil (low level)</b>										
<b>Blank (1800741-BLK1)</b>					<b>Prepared &amp; Analyzed: 19-Jan-18</b>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	< 5.00	U	µg/kg wet	5.00						
Acetone	< 50.0	U	µg/kg wet	50.0						
Acrylonitrile	< 5.00	U	µg/kg wet	5.00						
Benzene	< 5.00	U	µg/kg wet	5.00						
Bromobenzene	< 5.00	U	µg/kg wet	5.00						
Bromochloromethane	< 5.00	U	µg/kg wet	5.00						
Bromodichloromethane	< 5.00	U	µg/kg wet	5.00						
Bromoform	< 5.00	U	µg/kg wet	5.00						
Bromomethane	< 10.0	U	µg/kg wet	10.0						
2-Butanone (MEK)	< 10.0	U	µg/kg wet	10.0						
n-Butylbenzene	< 5.00	U	µg/kg wet	5.00						
sec-Butylbenzene	< 5.00	U	µg/kg wet	5.00						
tert-Butylbenzene	< 5.00	U	µg/kg wet	5.00						
Carbon disulfide	< 10.0	U	µg/kg wet	10.0						
Carbon tetrachloride	< 5.00	U	µg/kg wet	5.00						
Chlorobenzene	< 5.00	U	µg/kg wet	5.00						
Chloroethane	< 10.0	U	µg/kg wet	10.0						
Chloroform	< 5.00	U	µg/kg wet	5.00						
Chloromethane	< 10.0	U	µg/kg wet	10.0						
2-Chlorotoluene	< 5.00	U	µg/kg wet	5.00						
4-Chlorotoluene	< 5.00	U	µg/kg wet	5.00						
1,2-Dibromo-3-chloropropane	< 10.0	U	µg/kg wet	10.0						
Dibromochloromethane	< 5.00	U	µg/kg wet	5.00						
1,2-Dibromoethane (EDB)	< 5.00	U	µg/kg wet	5.00						
Dibromomethane	< 5.00	U	µg/kg wet	5.00						
1,2-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,3-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,4-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00						
Dichlorodifluoromethane (Freon12)	< 10.0	U	µg/kg wet	10.0						
1,1-Dichloroethane	< 5.00	U	µg/kg wet	5.00						
1,2-Dichloroethane	< 5.00	U	µg/kg wet	5.00						
1,1-Dichloroethene	< 5.00	U	µg/kg wet	5.00						
cis-1,2-Dichloroethene	< 5.00	U	µg/kg wet	5.00						
trans-1,2-Dichloroethene	< 5.00	U	µg/kg wet	5.00						
1,2-Dichloropropane	< 5.00	U	µg/kg wet	5.00						
1,3-Dichloropropane	< 5.00	U	µg/kg wet	5.00						
2,2-Dichloropropane	< 5.00	U	µg/kg wet	5.00						
1,1-Dichloropropene	< 5.00	U	µg/kg wet	5.00						
cis-1,3-Dichloropropene	< 5.00	U	µg/kg wet	5.00						
trans-1,3-Dichloropropene	< 5.00	U	µg/kg wet	5.00						
Ethylbenzene	< 5.00	U	µg/kg wet	5.00						
Hexachlorobutadiene	< 5.00	U	µg/kg wet	5.00						
2-Hexanone (MBK)	< 10.0	U	µg/kg wet	10.0						
Isopropylbenzene	< 5.00	U	µg/kg wet	5.00						
4-Isopropyltoluene	< 5.00	U	µg/kg wet	5.00						
Methyl tert-butyl ether	< 5.00	U	µg/kg wet	5.00						
4-Methyl-2-pentanone (MIBK)	< 10.0	U	µg/kg wet	10.0						
Methylene chloride	< 10.0	U	µg/kg wet	10.0						
Naphthalene	< 5.00	U	µg/kg wet	5.00						
n-Propylbenzene	< 5.00	U	µg/kg wet	5.00						

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800741 - SW846 5035A Soil (low level)</b>										
<b><u>Blank (1800741-BLK1)</u></b>					<b><u>Prepared &amp; Analyzed: 19-Jan-18</u></b>					
Styrene	< 5.00	U	µg/kg wet	5.00						
1,1,1,2-Tetrachloroethane	< 5.00	U	µg/kg wet	5.00						
1,1,2,2-Tetrachloroethane	< 5.00	U	µg/kg wet	5.00						
Tetrachloroethene	< 5.00	U	µg/kg wet	5.00						
Toluene	< 5.00	U	µg/kg wet	5.00						
1,2,3-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,2,4-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,3,5-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,1,1-Trichloroethane	< 5.00	U	µg/kg wet	5.00						
1,1,2-Trichloroethane	< 5.00	U	µg/kg wet	5.00						
Trichloroethene	< 5.00	U	µg/kg wet	5.00						
Trichlorofluoromethane (Freon 11)	< 5.00	U	µg/kg wet	5.00						
1,2,3-Trichloropropane	< 5.00	U	µg/kg wet	5.00						
1,2,4-Trimethylbenzene	< 5.00	U	µg/kg wet	5.00						
1,3,5-Trimethylbenzene	< 5.00	U	µg/kg wet	5.00						
Vinyl chloride	< 5.00	U	µg/kg wet	5.00						
m,p-Xylene	< 10.0	U	µg/kg wet	10.0						
o-Xylene	< 5.00	U	µg/kg wet	5.00						
Tetrahydrofuran	< 10.0	U	µg/kg wet	10.0						
Ethyl ether	< 5.00	U	µg/kg wet	5.00						
Tert-amyl methyl ether	< 5.00	U	µg/kg wet	5.00						
Ethyl tert-butyl ether	< 5.00	U	µg/kg wet	5.00						
Di-isopropyl ether	< 5.00	U	µg/kg wet	5.00						
Tert-Butanol / butyl alcohol	< 50.0	U	µg/kg wet	50.0						
1,4-Dioxane	< 100	U	µg/kg wet	100						
trans-1,4-Dichloro-2-butene	< 25.0	U	µg/kg wet	25.0						
Ethanol	< 1000	U	µg/kg wet	1000						
<i>Surrogate: 4-Bromofluorobenzene</i>	48.2		µg/kg		50.0		96	70-130		
<i>Surrogate: Toluene-d8</i>	50.3		µg/kg		50.0		101	70-130		
<i>Surrogate: 1,2-Dichloroethane-d4</i>	59.8		µg/kg		50.0		120	70-130		
<i>Surrogate: Dibromofluoromethane</i>	49.3		µg/kg		50.0		99	70-130		
<b><u>LCS (1800741-BS1)</u></b>					<b><u>Prepared &amp; Analyzed: 19-Jan-18</u></b>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	19.6		µg/kg		20.0		98	70-130		
Acetone	31.6		µg/kg		20.0		158	70-130		
Acrylonitrile	22.8		µg/kg		20.0		114	70-130		
Benzene	20.7		µg/kg		20.0		104	70-130		
Bromobenzene	20.3		µg/kg		20.0		101	70-130		
Bromochloromethane	21.1		µg/kg		20.0		106	70-130		
Bromodichloromethane	21.0		µg/kg		20.0		105	70-130		
Bromoform	19.9		µg/kg		20.0		100	70-130		
Bromomethane	20.9		µg/kg		20.0		104	70-130		
2-Butanone (MEK)	25.5		µg/kg		20.0		127	70-130		
n-Butylbenzene	21.8		µg/kg		20.0		109	70-130		
sec-Butylbenzene	20.7		µg/kg		20.0		103	70-130		
tert-Butylbenzene	20.5		µg/kg		20.0		102	70-130		
Carbon disulfide	19.8		µg/kg		20.0		99	70-130		
Carbon tetrachloride	20.4		µg/kg		20.0		102	70-130		
Chlorobenzene	20.1		µg/kg		20.0		100	70-130		
Chloroethane	22.6		µg/kg		20.0		113	70-130		
Chloroform	20.4		µg/kg		20.0		102	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800741 - SW846 5035A Soil (low level)</b>										
<b><u>LCS (1800741-BS1)</u></b>	<b><u>Prepared &amp; Analyzed: 19-Jan-18</u></b>									
Chloromethane	19.8		µg/kg		20.0		99	70-130		
2-Chlorotoluene	20.9		µg/kg		20.0		104	70-130		
4-Chlorotoluene	21.1		µg/kg		20.0		106	70-130		
1,2-Dibromo-3-chloropropane	20.8		µg/kg		20.0		104	70-130		
Dibromochloromethane	19.1		µg/kg		20.0		95	70-130		
1,2-Dibromoethane (EDB)	22.4		µg/kg		20.0		112	70-130		
Dibromomethane	21.4		µg/kg		20.0		107	70-130		
1,2-Dichlorobenzene	20.7		µg/kg		20.0		103	70-130		
1,3-Dichlorobenzene	20.5		µg/kg		20.0		102	70-130		
1,4-Dichlorobenzene	20.3		µg/kg		20.0		101	70-130		
Dichlorodifluoromethane (Freon12)	18.3		µg/kg		20.0		91	70-130		
1,1-Dichloroethane	20.4		µg/kg		20.0		102	70-130		
1,2-Dichloroethane	21.2		µg/kg		20.0		106	70-130		
1,1-Dichloroethene	19.7		µg/kg		20.0		99	70-130		
cis-1,2-Dichloroethene	20.9		µg/kg		20.0		104	70-130		
trans-1,2-Dichloroethene	20.4		µg/kg		20.0		102	70-130		
1,2-Dichloropropane	20.9		µg/kg		20.0		105	70-130		
1,3-Dichloropropane	21.6		µg/kg		20.0		108	70-130		
2,2-Dichloropropane	20.5		µg/kg		20.0		103	70-130		
1,1-Dichloropropene	19.9		µg/kg		20.0		99	70-130		
cis-1,3-Dichloropropene	20.5		µg/kg		20.0		103	70-130		
trans-1,3-Dichloropropene	19.8		µg/kg		20.0		99	70-130		
Ethylbenzene	20.6		µg/kg		20.0		103	70-130		
Hexachlorobutadiene	20.6		µg/kg		20.0		103	70-130		
2-Hexanone (MBK)	27.1		µg/kg		20.0		135	70-130		
Isopropylbenzene	20.4		µg/kg		20.0		102	70-130		
4-Isopropyltoluene	20.9		µg/kg		20.0		104	70-130		
Methyl tert-butyl ether	21.9		µg/kg		20.0		110	70-130		
4-Methyl-2-pentanone (MIBK)	25.2		µg/kg		20.0		126	70-130		
Methylene chloride	16.6		µg/kg		20.0		83	70-130		
Naphthalene	21.6		µg/kg		20.0		108	70-130		
n-Propylbenzene	21.0		µg/kg		20.0		105	70-130		
Styrene	21.0		µg/kg		20.0		105	70-130		
1,1,1,2-Tetrachloroethane	20.5		µg/kg		20.0		102	70-130		
1,1,2,2-Tetrachloroethane	22.4		µg/kg		20.0		112	70-130		
Tetrachloroethene	20.0		µg/kg		20.0		100	70-130		
Toluene	20.4		µg/kg		20.0		102	70-130		
1,2,3-Trichlorobenzene	22.1		µg/kg		20.0		110	70-130		
1,2,4-Trichlorobenzene	22.1		µg/kg		20.0		111	70-130		
1,3,5-Trichlorobenzene	21.6		µg/kg		20.0		108	70-130		
1,1,1-Trichloroethane	20.5		µg/kg		20.0		102	70-130		
1,1,2-Trichloroethane	21.7		µg/kg		20.0		108	70-130		
Trichloroethene	20.4		µg/kg		20.0		102	70-130		
Trichlorofluoromethane (Freon 11)	20.2		µg/kg		20.0		101	70-130		
1,2,3-Trichloropropane	22.0		µg/kg		20.0		110	70-130		
1,2,4-Trimethylbenzene	21.2		µg/kg		20.0		106	70-130		
1,3,5-Trimethylbenzene	21.0		µg/kg		20.0		105	70-130		
Vinyl chloride	21.0		µg/kg		20.0		105	70-130		
m,p-Xylene	20.5		µg/kg		20.0		102	70-130		
o-Xylene	20.7		µg/kg		20.0		104	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800741 - SW846 5035A Soil (low level)</b>										
<b><u>LCS (1800741-BS1)</u></b>					<b><u>Prepared &amp; Analyzed: 19-Jan-18</u></b>					
Tetrahydrofuran	21.0		µg/kg		20.0		105	70-130		
Ethyl ether	21.2		µg/kg		20.0		106	70-130		
Tert-amyl methyl ether	21.2		µg/kg		20.0		106	70-130		
Ethyl tert-butyl ether	20.8		µg/kg		20.0		104	70-130		
Di-isopropyl ether	20.7		µg/kg		20.0		104	70-130		
Tert-Butanol / butyl alcohol	212		µg/kg		200		106	70-130		
1,4-Dioxane	206		µg/kg		200		103	70-130		
trans-1,4-Dichloro-2-butene	19.9		µg/kg		20.0		99	70-130		
Ethanol	399		µg/kg		400		100	70-130		
Surrogate: 4-Bromofluorobenzene	50.3		µg/kg		50.0		101	70-130		
Surrogate: Toluene-d8	50.4		µg/kg		50.0		101	70-130		
Surrogate: 1,2-Dichloroethane-d4	52.5		µg/kg		50.0		105	70-130		
Surrogate: Dibromofluoromethane	51.0		µg/kg		50.0		102	70-130		
<b><u>LCS Dup (1800741-BSD1)</u></b>					<b><u>Prepared &amp; Analyzed: 19-Jan-18</u></b>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	19.3		µg/kg		20.0		96	70-130	2	30
Acetone	24.6		µg/kg		20.0		123	70-130	25	30
Acrylonitrile	20.0		µg/kg		20.0		100	70-130	13	30
Benzene	19.8		µg/kg		20.0		99	70-130	4	30
Bromobenzene	19.9		µg/kg		20.0		99	70-130	2	30
Bromochloromethane	19.6		µg/kg		20.0		98	70-130	8	30
Bromodichloromethane	20.2		µg/kg		20.0		101	70-130	4	30
Bromoform	18.0		µg/kg		20.0		90	70-130	10	30
Bromomethane	20.1		µg/kg		20.0		100	70-130	4	30
2-Butanone (MEK)	19.8		µg/kg		20.0		99	70-130	25	30
n-Butylbenzene	21.4		µg/kg		20.0		107	70-130	2	30
sec-Butylbenzene	20.3		µg/kg		20.0		102	70-130	2	30
tert-Butylbenzene	20.1		µg/kg		20.0		101	70-130	2	30
Carbon disulfide	19.5		µg/kg		20.0		98	70-130	1	30
Carbon tetrachloride	19.6		µg/kg		20.0		98	70-130	4	30
Chlorobenzene	19.5		µg/kg		20.0		97	70-130	3	30
Chloroethane	19.0		µg/kg		20.0		95	70-130	17	30
Chloroform	19.6		µg/kg		20.0		98	70-130	4	30
Chloromethane	19.6		µg/kg		20.0		98	70-130	1	30
2-Chlorotoluene	20.4		µg/kg		20.0		102	70-130	2	30
4-Chlorotoluene	20.7		µg/kg		20.0		104	70-130	2	30
1,2-Dibromo-3-chloropropane	18.9		µg/kg		20.0		95	70-130	9	30
Dibromochloromethane	17.8		µg/kg		20.0		89	70-130	7	30
1,2-Dibromoethane (EDB)	20.3		µg/kg		20.0		102	70-130	10	30
Dibromomethane	19.8		µg/kg		20.0		99	70-130	8	30
1,2-Dichlorobenzene	20.2		µg/kg		20.0		101	70-130	2	30
1,3-Dichlorobenzene	19.8		µg/kg		20.0		99	70-130	3	30
1,4-Dichlorobenzene	19.8		µg/kg		20.0		99	70-130	2	30
Dichlorodifluoromethane (Freon12)	18.1		µg/kg		20.0		90	70-130	1	30
1,1-Dichloroethane	20.0		µg/kg		20.0		100	70-130	2	30
1,2-Dichloroethane	19.8		µg/kg		20.0		99	70-130	7	30
1,1-Dichloroethene	19.3		µg/kg		20.0		96	70-130	2	30
cis-1,2-Dichloroethene	20.0		µg/kg		20.0		100	70-130	4	30
trans-1,2-Dichloroethene	19.6		µg/kg		20.0		98	70-130	4	30
1,2-Dichloropropane	20.0		µg/kg		20.0		100	70-130	5	30
1,3-Dichloropropane	19.7		µg/kg		20.0		99	70-130	9	30

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800741 - SW846 5035A Soil (low level)</b>										
<b>LCS Dup (1800741-BSD1)</b>					<b>Prepared &amp; Analyzed: 19-Jan-18</b>					
2,2-Dichloropropane	20.0		µg/kg		20.0		100	70-130	3	30
1,1-Dichloropropene	19.4		µg/kg		20.0		97	70-130	2	30
cis-1,3-Dichloropropene	19.6		µg/kg		20.0		98	70-130	5	30
trans-1,3-Dichloropropene	18.9		µg/kg		20.0		94	70-130	5	30
Ethylbenzene	20.2		µg/kg		20.0		101	70-130	2	30
Hexachlorobutadiene	19.9		µg/kg		20.0		99	70-130	3	30
2-Hexanone (MBK)	24.4		µg/kg		20.0		122	70-130	11	30
Isopropylbenzene	19.9		µg/kg		20.0		100	70-130	2	30
4-Isopropyltoluene	20.6		µg/kg		20.0		103	70-130	1	30
Methyl tert-butyl ether	19.9		µg/kg		20.0		99	70-130	10	30
4-Methyl-2-pentanone (MIBK)	20.5		µg/kg		20.0		102	70-130	21	30
Methylene chloride	16.2		µg/kg		20.0		81	70-130	2	30
Naphthalene	20.8		µg/kg		20.0		104	70-130	4	30
n-Propylbenzene	20.5		µg/kg		20.0		102	70-130	2	30
Styrene	20.4		µg/kg		20.0		102	70-130	3	30
1,1,1,2-Tetrachloroethane	20.0		µg/kg		20.0		100	70-130	3	30
1,1,2,2-Tetrachloroethane	20.0		µg/kg		20.0		100	70-130	12	30
Tetrachloroethene	19.5		µg/kg		20.0		97	70-130	3	30
Toluene	19.6		µg/kg		20.0		98	70-130	4	30
1,2,3-Trichlorobenzene	20.7		µg/kg		20.0		104	70-130	6	30
1,2,4-Trichlorobenzene	21.0		µg/kg		20.0		105	70-130	5	30
1,3,5-Trichlorobenzene	20.9		µg/kg		20.0		105	70-130	3	30
1,1,1-Trichloroethane	19.7		µg/kg		20.0		99	70-130	4	30
1,1,2-Trichloroethane	19.8		µg/kg		20.0		99	70-130	9	30
Trichloroethene	19.7		µg/kg		20.0		99	70-130	3	30
Trichlorofluoromethane (Freon 11)	19.8		µg/kg		20.0		99	70-130	2	30
1,2,3-Trichloropropane	20.0		µg/kg		20.0		100	70-130	9	30
1,2,4-Trimethylbenzene	20.5		µg/kg		20.0		102	70-130	3	30
1,3,5-Trimethylbenzene	20.5		µg/kg		20.0		103	70-130	2	30
Vinyl chloride	19.4		µg/kg		20.0		97	70-130	8	30
m,p-Xylene	20.1		µg/kg		20.0		101	70-130	2	30
o-Xylene	20.3		µg/kg		20.0		101	70-130	2	30
Tetrahydrofuran	18.6		µg/kg		20.0		93	70-130	12	30
Ethyl ether	19.5		µg/kg		20.0		97	70-130	8	30
Tert-amyl methyl ether	19.6		µg/kg		20.0		98	70-130	8	30
Ethyl tert-butyl ether	19.2		µg/kg		20.0		96	70-130	8	30
Di-isopropyl ether	19.7		µg/kg		20.0		98	70-130	5	30
Tert-Butanol / butyl alcohol	178		µg/kg		200		89	70-130	17	30
1,4-Dioxane	193		µg/kg		200		97	70-130	6	30
trans-1,4-Dichloro-2-butene	17.8		µg/kg		20.0		89	70-130	11	30
Ethanol	399		µg/kg		400		100	70-130	0.1	30
Surrogate: 4-Bromofluorobenzene	49.9		µg/kg		50.0		100	70-130		
Surrogate: Toluene-d8	50.4		µg/kg		50.0		101	70-130		
Surrogate: 1,2-Dichloroethane-d4	50.3		µg/kg		50.0		101	70-130		
Surrogate: Dibromofluoromethane	50.3		µg/kg		50.0		101	70-130		
<b>Batch 1800813 - SW846 5035A Soil (low level)</b>										
<b>Blank (1800813-BLK1)</b>					<b>Prepared &amp; Analyzed: 22-Jan-18</b>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	< 5.00	U	µg/kg wet	5.00						
Acetone	< 50.0	U	µg/kg wet	50.0						
Acrylonitrile	< 5.00	U	µg/kg wet	5.00						

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800813 - SW846 5035A Soil (low level)</b>										
<b>Blank (1800813-BLK1)</b>	<b>Prepared &amp; Analyzed: 22-Jan-18</b>									
Benzene	< 5.00	U	µg/kg wet	5.00						
Bromobenzene	< 5.00	U	µg/kg wet	5.00						
Bromochloromethane	< 5.00	U	µg/kg wet	5.00						
Bromodichloromethane	< 5.00	U	µg/kg wet	5.00						
Bromoform	< 5.00	U	µg/kg wet	5.00						
Bromomethane	< 10.0	U	µg/kg wet	10.0						
2-Butanone (MEK)	< 10.0	U	µg/kg wet	10.0						
n-Butylbenzene	< 5.00	U	µg/kg wet	5.00						
sec-Butylbenzene	< 5.00	U	µg/kg wet	5.00						
tert-Butylbenzene	< 5.00	U	µg/kg wet	5.00						
Carbon disulfide	< 10.0	U	µg/kg wet	10.0						
Carbon tetrachloride	< 5.00	U	µg/kg wet	5.00						
Chlorobenzene	< 5.00	U	µg/kg wet	5.00						
Chloroethane	< 10.0	U	µg/kg wet	10.0						
Chloroform	< 5.00	U	µg/kg wet	5.00						
Chloromethane	< 10.0	U	µg/kg wet	10.0						
2-Chlorotoluene	< 5.00	U	µg/kg wet	5.00						
4-Chlorotoluene	< 5.00	U	µg/kg wet	5.00						
1,2-Dibromo-3-chloropropane	< 10.0	U	µg/kg wet	10.0						
Dibromochloromethane	< 5.00	U	µg/kg wet	5.00						
1,2-Dibromoethane (EDB)	< 5.00	U	µg/kg wet	5.00						
Dibromomethane	< 5.00	U	µg/kg wet	5.00						
1,2-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,3-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,4-Dichlorobenzene	< 5.00	U	µg/kg wet	5.00						
Dichlorodifluoromethane (Freon12)	< 10.0	U	µg/kg wet	10.0						
1,1-Dichloroethane	< 5.00	U	µg/kg wet	5.00						
1,2-Dichloroethane	< 5.00	U	µg/kg wet	5.00						
1,1-Dichloroethene	< 5.00	U	µg/kg wet	5.00						
cis-1,2-Dichloroethene	< 5.00	U	µg/kg wet	5.00						
trans-1,2-Dichloroethene	< 5.00	U	µg/kg wet	5.00						
1,2-Dichloropropane	< 5.00	U	µg/kg wet	5.00						
1,3-Dichloropropane	< 5.00	U	µg/kg wet	5.00						
2,2-Dichloropropane	< 5.00	U	µg/kg wet	5.00						
1,1-Dichloropropene	< 5.00	U	µg/kg wet	5.00						
cis-1,3-Dichloropropene	< 5.00	U	µg/kg wet	5.00						
trans-1,3-Dichloropropene	< 5.00	U	µg/kg wet	5.00						
Ethylbenzene	< 5.00	U	µg/kg wet	5.00						
Hexachlorobutadiene	< 5.00	U	µg/kg wet	5.00						
2-Hexanone (MBK)	< 10.0	U	µg/kg wet	10.0						
Isopropylbenzene	< 5.00	U	µg/kg wet	5.00						
4-Isopropyltoluene	< 5.00	U	µg/kg wet	5.00						
Methyl tert-butyl ether	< 5.00	U	µg/kg wet	5.00						
4-Methyl-2-pentanone (MIBK)	< 10.0	U	µg/kg wet	10.0						
Methylene chloride	< 10.0	U	µg/kg wet	10.0						
Naphthalene	< 5.00	U	µg/kg wet	5.00						
n-Propylbenzene	< 5.00	U	µg/kg wet	5.00						
Styrene	< 5.00	U	µg/kg wet	5.00						
1,1,1,2-Tetrachloroethane	< 5.00	U	µg/kg wet	5.00						
1,1,2,2-Tetrachloroethane	< 5.00	U	µg/kg wet	5.00						

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800813 - SW846 5035A Soil (low level)</b>										
<b><u>Blank (1800813-BLK1)</u></b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
Tetrachloroethene	< 5.00	U	µg/kg wet	5.00						
Toluene	< 5.00	U	µg/kg wet	5.00						
1,2,3-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,2,4-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,3,5-Trichlorobenzene	< 5.00	U	µg/kg wet	5.00						
1,1,1-Trichloroethane	< 5.00	U	µg/kg wet	5.00						
1,1,2-Trichloroethane	< 5.00	U	µg/kg wet	5.00						
Trichloroethene	< 5.00	U	µg/kg wet	5.00						
Trichlorofluoromethane (Freon 11)	< 5.00	U	µg/kg wet	5.00						
1,2,3-Trichloropropane	< 5.00	U	µg/kg wet	5.00						
1,2,4-Trimethylbenzene	< 5.00	U	µg/kg wet	5.00						
1,3,5-Trimethylbenzene	< 5.00	U	µg/kg wet	5.00						
Vinyl chloride	< 5.00	U	µg/kg wet	5.00						
m,p-Xylene	< 10.0	U	µg/kg wet	10.0						
o-Xylene	< 5.00	U	µg/kg wet	5.00						
Tetrahydrofuran	< 10.0	U	µg/kg wet	10.0						
Ethyl ether	< 5.00	U	µg/kg wet	5.00						
Tert-amyl methyl ether	< 5.00	U	µg/kg wet	5.00						
Ethyl tert-butyl ether	< 5.00	U	µg/kg wet	5.00						
Di-isopropyl ether	< 5.00	U	µg/kg wet	5.00						
Tert-Butanol / butyl alcohol	< 50.0	U	µg/kg wet	50.0						
1,4-Dioxane	< 100	U	µg/kg wet	100						
trans-1,4-Dichloro-2-butene	< 25.0	U	µg/kg wet	25.0						
Ethanol	< 1000	U	µg/kg wet	1000						
<i>Surrogate: 4-Bromofluorobenzene</i>	47.2		µg/kg		50.0		94	70-130		
<i>Surrogate: Toluene-d8</i>	51.2		µg/kg		50.0		102	70-130		
<i>Surrogate: 1,2-Dichloroethane-d4</i>	61.1		µg/kg		50.0		122	70-130		
<i>Surrogate: Dibromofluoromethane</i>	49.7		µg/kg		50.0		99	70-130		
<b><u>LCS (1800813-BB1)</u></b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	19.0		µg/kg		20.0		95	70-130		
Acetone	14.0		µg/kg		20.0		70	70-130		
Acrylonitrile	23.5		µg/kg		20.0		117	70-130		
Benzene	19.8		µg/kg		20.0		99	70-130		
Bromobenzene	18.8		µg/kg		20.0		94	70-130		
Bromochloromethane	20.3		µg/kg		20.0		102	70-130		
Bromodichloromethane	19.9		µg/kg		20.0		99	70-130		
Bromoform	18.5		µg/kg		20.0		93	70-130		
Bromomethane	19.5		µg/kg		20.0		98	70-130		
2-Butanone (MEK)	19.0		µg/kg		20.0		95	70-130		
n-Butylbenzene	19.9		µg/kg		20.0		100	70-130		
sec-Butylbenzene	19.3		µg/kg		20.0		97	70-130		
tert-Butylbenzene	18.9		µg/kg		20.0		95	70-130		
Carbon disulfide	18.0		µg/kg		20.0		90	70-130		
Carbon tetrachloride	19.1		µg/kg		20.0		95	70-130		
Chlorobenzene	18.6		µg/kg		20.0		93	70-130		
Chloroethane	21.7		µg/kg		20.0		108	70-130		
Chloroform	19.2		µg/kg		20.0		96	70-130		
Chloromethane	19.5		µg/kg		20.0		98	70-130		
2-Chlorotoluene	19.5		µg/kg		20.0		97	70-130		
4-Chlorotoluene	19.4		µg/kg		20.0		97	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800813 - SW846 5035A Soil (low level)</b>										
<b>LCS (1800813-BS1)</b>					<b>Prepared &amp; Analyzed: 22-Jan-18</b>					
1,2-Dibromo-3-chloropropane	21.0		µg/kg		20.0		105	70-130		
Dibromochloromethane	18.1		µg/kg		20.0		90	70-130		
1,2-Dibromoethane (EDB)	21.1		µg/kg		20.0		106	70-130		
Dibromomethane	20.6		µg/kg		20.0		103	70-130		
1,2-Dichlorobenzene	19.5		µg/kg		20.0		97	70-130		
1,3-Dichlorobenzene	18.7		µg/kg		20.0		94	70-130		
1,4-Dichlorobenzene	18.6		µg/kg		20.0		93	70-130		
Dichlorodifluoromethane (Freon12)	18.7		µg/kg		20.0		94	70-130		
1,1-Dichloroethane	19.7		µg/kg		20.0		99	70-130		
1,2-Dichloroethane	20.5		µg/kg		20.0		103	70-130		
1,1-Dichloroethene	19.1		µg/kg		20.0		96	70-130		
cis-1,2-Dichloroethene	19.9		µg/kg		20.0		100	70-130		
trans-1,2-Dichloroethene	19.0		µg/kg		20.0		95	70-130		
1,2-Dichloropropane	20.2		µg/kg		20.0		101	70-130		
1,3-Dichloropropane	21.2		µg/kg		20.0		106	70-130		
2,2-Dichloropropane	17.6		µg/kg		20.0		88	70-130		
1,1-Dichloropropene	18.6		µg/kg		20.0		93	70-130		
cis-1,3-Dichloropropene	18.7		µg/kg		20.0		94	70-130		
trans-1,3-Dichloropropene	18.5		µg/kg		20.0		92	70-130		
Ethylbenzene	19.0		µg/kg		20.0		95	70-130		
Hexachlorobutadiene	18.4		µg/kg		20.0		92	70-130		
2-Hexanone (MBK)	14.4		µg/kg		20.0		72	70-130		
Isopropylbenzene	18.9		µg/kg		20.0		94	70-130		
4-Isopropyltoluene	19.2		µg/kg		20.0		96	70-130		
Methyl tert-butyl ether	20.8		µg/kg		20.0		104	70-130		
4-Methyl-2-pentanone (MIBK)	21.6		µg/kg		20.0		108	70-130		
Methylene chloride	16.4		µg/kg		20.0		82	70-130		
Naphthalene	22.0		µg/kg		20.0		110	70-130		
n-Propylbenzene	19.3		µg/kg		20.0		96	70-130		
Styrene	19.3		µg/kg		20.0		97	70-130		
1,1,1,2-Tetrachloroethane	19.1		µg/kg		20.0		95	70-130		
1,1,2,2-Tetrachloroethane	21.9		µg/kg		20.0		110	70-130		
Tetrachloroethene	18.6		µg/kg		20.0		93	70-130		
Toluene	19.4		µg/kg		20.0		97	70-130		
1,2,3-Trichlorobenzene	20.4		µg/kg		20.0		102	70-130		
1,2,4-Trichlorobenzene	19.9		µg/kg		20.0		99	70-130		
1,3,5-Trichlorobenzene	19.1		µg/kg		20.0		95	70-130		
1,1,1-Trichloroethane	19.1		µg/kg		20.0		95	70-130		
1,1,2-Trichloroethane	21.2		µg/kg		20.0		106	70-130		
Trichloroethene	19.1		µg/kg		20.0		95	70-130		
Trichlorofluoromethane (Freon 11)	20.0		µg/kg		20.0		100	70-130		
1,2,3-Trichloropropane	21.9		µg/kg		20.0		110	70-130		
1,2,4-Trimethylbenzene	19.6		µg/kg		20.0		98	70-130		
1,3,5-Trimethylbenzene	19.4		µg/kg		20.0		97	70-130		
Vinyl chloride	20.2		µg/kg		20.0		101	70-130		
m,p-Xylene	18.9		µg/kg		20.0		94	70-130		
o-Xylene	19.3		µg/kg		20.0		96	70-130		
Tetrahydrofuran	23.0		µg/kg		20.0		115	70-130		
Ethyl ether	20.4		µg/kg		20.0		102	70-130		
Tert-amyl methyl ether	21.6		µg/kg		20.0		108	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800813 - SW846 5035A Soil (low level)</b>										
<b>LCS (1800813-BS1)</b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
Ethyl tert-butyl ether	19.5		µg/kg		20.0		97	70-130		
Di-isopropyl ether	19.7		µg/kg		20.0		99	70-130		
Tert-Butanol / butyl alcohol	225		µg/kg		200		113	70-130		
1,4-Dioxane	197		µg/kg		200		98	70-130		
trans-1,4-Dichloro-2-butene	18.5		µg/kg		20.0		93	70-130		
Ethanol	441		µg/kg		400		110	70-130		
<i>Surrogate: 4-Bromofluorobenzene</i>	<i>50.6</i>		<i>µg/kg</i>		<i>50.0</i>		<i>101</i>	<i>70-130</i>		
<i>Surrogate: Toluene-d8</i>	<i>50.1</i>		<i>µg/kg</i>		<i>50.0</i>		<i>100</i>	<i>70-130</i>		
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>53.0</i>		<i>µg/kg</i>		<i>50.0</i>		<i>106</i>	<i>70-130</i>		
<i>Surrogate: Dibromofluoromethane</i>	<i>50.2</i>		<i>µg/kg</i>		<i>50.0</i>		<i>100</i>	<i>70-130</i>		
<b>LCS Dup (1800813-BSD1)</b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	19.0		µg/kg		20.0		95	70-130	0.2	30
Acetone	15.1		µg/kg		20.0		76	70-130	7	30
Acrylonitrile	21.3		µg/kg		20.0		106	70-130	10	30
Benzene	19.4		µg/kg		20.0		97	70-130	2	30
Bromobenzene	18.0		µg/kg		20.0		90	70-130	4	30
Bromochloromethane	19.3		µg/kg		20.0		97	70-130	5	30
Bromodichloromethane	19.5		µg/kg		20.0		98	70-130	2	30
Bromoform	17.5		µg/kg		20.0		87	70-130	6	30
Bromomethane	19.4		µg/kg		20.0		97	70-130	0.8	30
2-Butanone (MEK)	20.6		µg/kg		20.0		103	70-130	8	30
n-Butylbenzene	18.2		µg/kg		20.0		91	70-130	9	30
sec-Butylbenzene	17.9		µg/kg		20.0		90	70-130	7	30
tert-Butylbenzene	18.0		µg/kg		20.0		90	70-130	5	30
Carbon disulfide	17.8		µg/kg		20.0		89	70-130	1	30
Carbon tetrachloride	18.6		µg/kg		20.0		93	70-130	2	30
Chlorobenzene	17.9		µg/kg		20.0		90	70-130	4	30
Chloroethane	21.6		µg/kg		20.0		108	70-130	0.3	30
Chloroform	19.1		µg/kg		20.0		95	70-130	0.7	30
Chloromethane	19.4		µg/kg		20.0		97	70-130	0.5	30
2-Chlorotoluene	18.4		µg/kg		20.0		92	70-130	5	30
4-Chlorotoluene	18.7		µg/kg		20.0		93	70-130	4	30
1,2-Dibromo-3-chloropropane	19.8		µg/kg		20.0		99	70-130	6	30
Dibromochloromethane	17.2		µg/kg		20.0		86	70-130	5	30
1,2-Dibromoethane (EDB)	19.6		µg/kg		20.0		98	70-130	7	30
Dibromomethane	19.3		µg/kg		20.0		97	70-130	6	30
1,2-Dichlorobenzene	18.7		µg/kg		20.0		94	70-130	4	30
1,3-Dichlorobenzene	17.7		µg/kg		20.0		89	70-130	5	30
1,4-Dichlorobenzene	17.9		µg/kg		20.0		89	70-130	4	30
Dichlorodifluoromethane (Freon12)	17.0		µg/kg		20.0		85	70-130	10	30
1,1-Dichloroethane	19.4		µg/kg		20.0		97	70-130	2	30
1,2-Dichloroethane	19.8		µg/kg		20.0		99	70-130	4	30
1,1-Dichloroethene	18.9		µg/kg		20.0		94	70-130	1	30
cis-1,2-Dichloroethene	19.7		µg/kg		20.0		98	70-130	1	30
trans-1,2-Dichloroethene	19.0		µg/kg		20.0		95	70-130	0.3	30
1,2-Dichloropropane	19.5		µg/kg		20.0		97	70-130	4	30
1,3-Dichloropropane	19.7		µg/kg		20.0		98	70-130	7	30
2,2-Dichloropropane	17.2		µg/kg		20.0		86	70-130	2	30
1,1-Dichloropropene	18.4		µg/kg		20.0		92	70-130	1	30
cis-1,3-Dichloropropene	18.4		µg/kg		20.0		92	70-130	2	30

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800813 - SW846 5035A Soil (low level)</b>										
<b>LCS Dup (1800813-BSD1)</b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
trans-1,3-Dichloropropene	17.4		µg/kg		20.0		87	70-130	6	30
Ethylbenzene	18.4		µg/kg		20.0		92	70-130	3	30
Hexachlorobutadiene	16.1		µg/kg		20.0		81	70-130	13	30
2-Hexanone (MBK)	14.5		µg/kg		20.0		72	70-130	0.1	30
Isopropylbenzene	18.0		µg/kg		20.0		90	70-130	5	30
4-Isopropyltoluene	18.0		µg/kg		20.0		90	70-130	6	30
Methyl tert-butyl ether	19.7		µg/kg		20.0		99	70-130	5	30
4-Methyl-2-pentanone (MIBK)	18.1		µg/kg		20.0		90	70-130	18	30
Methylene chloride	21.8		µg/kg		20.0		109	70-130	28	30
Naphthalene	20.6		µg/kg		20.0		103	70-130	6	30
n-Propylbenzene	18.4		µg/kg		20.0		92	70-130	5	30
Styrene	18.6		µg/kg		20.0		93	70-130	4	30
1,1,1,2-Tetrachloroethane	18.6		µg/kg		20.0		93	70-130	3	30
1,1,2,2-Tetrachloroethane	20.2		µg/kg		20.0		101	70-130	8	30
Tetrachloroethene	17.8		µg/kg		20.0		89	70-130	4	30
Toluene	18.7		µg/kg		20.0		94	70-130	3	30
1,2,3-Trichlorobenzene	18.9		µg/kg		20.0		95	70-130	7	30
1,2,4-Trichlorobenzene	18.6		µg/kg		20.0		93	70-130	7	30
1,3,5-Trichlorobenzene	17.9		µg/kg		20.0		90	70-130	6	30
1,1,1-Trichloroethane	19.0		µg/kg		20.0		95	70-130	0.4	30
1,1,2-Trichloroethane	19.8		µg/kg		20.0		99	70-130	7	30
Trichloroethene	18.6		µg/kg		20.0		93	70-130	3	30
Trichlorofluoromethane (Freon 11)	19.5		µg/kg		20.0		97	70-130	3	30
1,2,3-Trichloropropane	20.0		µg/kg		20.0		100	70-130	9	30
1,2,4-Trimethylbenzene	18.6		µg/kg		20.0		93	70-130	5	30
1,3,5-Trimethylbenzene	18.4		µg/kg		20.0		92	70-130	5	30
Vinyl chloride	20.0		µg/kg		20.0		100	70-130	1	30
m,p-Xylene	18.1		µg/kg		20.0		91	70-130	4	30
o-Xylene	18.7		µg/kg		20.0		93	70-130	3	30
Tetrahydrofuran	17.3		µg/kg		20.0		86	70-130	28	30
Ethyl ether	19.7		µg/kg		20.0		98	70-130	4	30
Tert-amyl methyl ether	20.3		µg/kg		20.0		102	70-130	6	30
Ethyl tert-butyl ether	18.9		µg/kg		20.0		95	70-130	3	30
Di-isopropyl ether	19.6		µg/kg		20.0		98	70-130	0.9	30
Tert-Butanol / butyl alcohol	186		µg/kg		200		93	70-130	19	30
1,4-Dioxane	164		µg/kg		200		82	70-130	18	30
trans-1,4-Dichloro-2-butene	16.4		µg/kg		20.0		82	70-130	12	30
Ethanol	425		µg/kg		400		106	70-130	4	30
Surrogate: 4-Bromofluorobenzene	49.8		µg/kg		50.0		100	70-130		
Surrogate: Toluene-d8	49.9		µg/kg		50.0		100	70-130		
Surrogate: 1,2-Dichloroethane-d4	52.0		µg/kg		50.0		104	70-130		
Surrogate: Dibromofluoromethane	50.7		µg/kg		50.0		101	70-130		
<b>Batch 1800822 - SW846 5035A Soil (high level)</b>										
<b>Blank (1800822-BLK1)</b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	< 50.0	U, D	µg/kg wet	50.0						
Acetone	< 500	U, D	µg/kg wet	500						
Acrylonitrile	< 50.0	U, D	µg/kg wet	50.0						
Benzene	< 50.0	U, D	µg/kg wet	50.0						
Bromobenzene	< 50.0	U, D	µg/kg wet	50.0						
Bromochloromethane	< 50.0	U, D	µg/kg wet	50.0						

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800822 - SW846 5035A Soil (high level)</b>										
<b>Blank (1800822-BLK1)</b>	<b>Prepared &amp; Analyzed: 22-Jan-18</b>									
Bromodichloromethane	< 50.0	U, D	µg/kg wet	50.0						
Bromoform	< 50.0	U, D	µg/kg wet	50.0						
Bromomethane	< 100	U, D	µg/kg wet	100						
2-Butanone (MEK)	< 100	U, D	µg/kg wet	100						
n-Butylbenzene	< 50.0	U, D	µg/kg wet	50.0						
sec-Butylbenzene	< 50.0	U, D	µg/kg wet	50.0						
tert-Butylbenzene	< 50.0	U, D	µg/kg wet	50.0						
Carbon disulfide	< 100	U, D	µg/kg wet	100						
Carbon tetrachloride	< 50.0	U, D	µg/kg wet	50.0						
Chlorobenzene	< 50.0	U, D	µg/kg wet	50.0						
Chloroethane	< 100	U, D	µg/kg wet	100						
Chloroform	< 50.0	U, D	µg/kg wet	50.0						
Chloromethane	< 100	U, D	µg/kg wet	100						
2-Chlorotoluene	< 50.0	U, D	µg/kg wet	50.0						
4-Chlorotoluene	< 50.0	U, D	µg/kg wet	50.0						
1,2-Dibromo-3-chloropropane	< 100	U, D	µg/kg wet	100						
Dibromochloromethane	< 50.0	U, D	µg/kg wet	50.0						
1,2-Dibromoethane (EDB)	< 50.0	U, D	µg/kg wet	50.0						
Dibromomethane	< 50.0	U, D	µg/kg wet	50.0						
1,2-Dichlorobenzene	< 50.0	U, D	µg/kg wet	50.0						
1,3-Dichlorobenzene	< 50.0	U, D	µg/kg wet	50.0						
1,4-Dichlorobenzene	< 50.0	U, D	µg/kg wet	50.0						
Dichlorodifluoromethane (Freon12)	< 100	U, D	µg/kg wet	100						
1,1-Dichloroethane	< 50.0	U, D	µg/kg wet	50.0						
1,2-Dichloroethane	< 50.0	U, D	µg/kg wet	50.0						
1,1-Dichloroethene	< 50.0	U, D	µg/kg wet	50.0						
cis-1,2-Dichloroethene	< 50.0	U, D	µg/kg wet	50.0						
trans-1,2-Dichloroethene	< 50.0	U, D	µg/kg wet	50.0						
1,2-Dichloropropane	< 50.0	U, D	µg/kg wet	50.0						
1,3-Dichloropropane	< 50.0	U, D	µg/kg wet	50.0						
2,2-Dichloropropane	< 50.0	U, D	µg/kg wet	50.0						
1,1-Dichloropropene	< 50.0	U, D	µg/kg wet	50.0						
cis-1,3-Dichloropropene	< 50.0	U, D	µg/kg wet	50.0						
trans-1,3-Dichloropropene	< 50.0	U, D	µg/kg wet	50.0						
Ethylbenzene	< 50.0	U, D	µg/kg wet	50.0						
Hexachlorobutadiene	< 50.0	U, D	µg/kg wet	50.0						
2-Hexanone (MBK)	< 100	U, D	µg/kg wet	100						
Isopropylbenzene	< 50.0	U, D	µg/kg wet	50.0						
4-Isopropyltoluene	< 50.0	U, D	µg/kg wet	50.0						
Methyl tert-butyl ether	< 50.0	U, D	µg/kg wet	50.0						
4-Methyl-2-pentanone (MIBK)	< 100	U, D	µg/kg wet	100						
Methylene chloride	< 100	U, D	µg/kg wet	100						
Naphthalene	< 50.0	U, D	µg/kg wet	50.0						
n-Propylbenzene	< 50.0	U, D	µg/kg wet	50.0						
Styrene	< 50.0	U, D	µg/kg wet	50.0						
1,1,1,2-Tetrachloroethane	< 50.0	U, D	µg/kg wet	50.0						
1,1,2,2-Tetrachloroethane	< 50.0	U, D	µg/kg wet	50.0						
Tetrachloroethene	< 50.0	U, D	µg/kg wet	50.0						
Toluene	< 50.0	U, D	µg/kg wet	50.0						
1,2,3-Trichlorobenzene	< 50.0	U, D	µg/kg wet	50.0						

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800822 - SW846 5035A Soil (high level)</b>										
<b><u>Blank (1800822-BLK1)</u></b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
1,2,4-Trichlorobenzene	< 50.0	U, D	µg/kg wet	50.0						
1,3,5-Trichlorobenzene	< 50.0	U, D	µg/kg wet	50.0						
1,1,1-Trichloroethane	< 50.0	U, D	µg/kg wet	50.0						
1,1,2-Trichloroethane	< 50.0	U, D	µg/kg wet	50.0						
Trichloroethene	< 50.0	U, D	µg/kg wet	50.0						
Trichlorofluoromethane (Freon 11)	< 50.0	U, D	µg/kg wet	50.0						
1,2,3-Trichloropropane	< 50.0	U, D	µg/kg wet	50.0						
1,2,4-Trimethylbenzene	< 50.0	U, D	µg/kg wet	50.0						
1,3,5-Trimethylbenzene	< 50.0	U, D	µg/kg wet	50.0						
Vinyl chloride	< 50.0	U, D	µg/kg wet	50.0						
m,p-Xylene	< 100	U, D	µg/kg wet	100						
o-Xylene	< 50.0	U, D	µg/kg wet	50.0						
Tetrahydrofuran	< 100	U, D	µg/kg wet	100						
Ethyl ether	< 50.0	U, D	µg/kg wet	50.0						
Tert-amyl methyl ether	< 50.0	U, D	µg/kg wet	50.0						
Ethyl tert-butyl ether	< 50.0	U, D	µg/kg wet	50.0						
Di-isopropyl ether	< 50.0	U, D	µg/kg wet	50.0						
Tert-Butanol / butyl alcohol	< 500	U, D	µg/kg wet	500						
1,4-Dioxane	< 1000	U, D	µg/kg wet	1000						
trans-1,4-Dichloro-2-butene	< 250	U, D	µg/kg wet	250						
Ethanol	< 10000	U, D	µg/kg wet	10000						
<i>Surrogate: 4-Bromofluorobenzene</i>	50.7		µg/kg		50.0		101	70-130		
<i>Surrogate: Toluene-d8</i>	49.6		µg/kg		50.0		99	70-130		
<i>Surrogate: 1,2-Dichloroethane-d4</i>	47.5		µg/kg		50.0		95	70-130		
<i>Surrogate: Dibromofluoromethane</i>	50.2		µg/kg		50.0		100	70-130		
<b><u>LCS (1800822-BS1)</u></b>					<u>Prepared &amp; Analyzed: 22-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	13.3	QC2, D	µg/kg		20.0		66	70-130		
Acetone	16.5	D	µg/kg		20.0		82	70-130		
Acrylonitrile	16.3	D	µg/kg		20.0		82	70-130		
Benzene	20.1	D	µg/kg		20.0		100	70-130		
Bromobenzene	23.0	D	µg/kg		20.0		115	70-130		
Bromochloromethane	22.7	D	µg/kg		20.0		114	70-130		
Bromodichloromethane	20.7	D	µg/kg		20.0		104	70-130		
Bromoform	24.4	D	µg/kg		20.0		122	70-130		
Bromomethane	22.4	D	µg/kg		20.0		112	70-130		
2-Butanone (MEK)	18.4	D	µg/kg		20.0		92	70-130		
n-Butylbenzene	18.0	D	µg/kg		20.0		90	70-130		
sec-Butylbenzene	19.7	D	µg/kg		20.0		99	70-130		
tert-Butylbenzene	21.2	D	µg/kg		20.0		106	70-130		
Carbon disulfide	12.3	QM9, D	µg/kg		20.0		62	70-130		
Carbon tetrachloride	19.6	D	µg/kg		20.0		98	70-130		
Chlorobenzene	20.8	D	µg/kg		20.0		104	70-130		
Chloroethane	14.7	D	µg/kg		20.0		74	70-130		
Chloroform	19.4	D	µg/kg		20.0		97	70-130		
Chloromethane	13.1	D	µg/kg		20.0		66	70-130		
2-Chlorotoluene	21.8	D	µg/kg		20.0		109	70-130		
4-Chlorotoluene	20.7	D	µg/kg		20.0		104	70-130		
1,2-Dibromo-3-chloropropane	18.6	D	µg/kg		20.0		93	70-130		
Dibromochloromethane	20.2	D	µg/kg		20.0		101	70-130		
1,2-Dibromoethane (EDB)	22.8	D	µg/kg		20.0		114	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800822 - SW846 5035A Soil (high level)</b>										
<b>LCS (1800822-BS1)</b>	<b>Prepared &amp; Analyzed: 22-Jan-18</b>									
Dibromomethane	20.4	D	µg/kg		20.0		102	70-130		
1,2-Dichlorobenzene	21.8	D	µg/kg		20.0		109	70-130		
1,3-Dichlorobenzene	21.7	D	µg/kg		20.0		109	70-130		
1,4-Dichlorobenzene	19.8	D	µg/kg		20.0		99	70-130		
Dichlorodifluoromethane (Freon12)	13.4	D	µg/kg		20.0		67	70-130		
1,1-Dichloroethane	18.8	D	µg/kg		20.0		94	70-130		
1,2-Dichloroethane	19.2	D	µg/kg		20.0		96	70-130		
1,1-Dichloroethene	15.6	D	µg/kg		20.0		78	70-130		
cis-1,2-Dichloroethene	21.6	D	µg/kg		20.0		108	70-130		
trans-1,2-Dichloroethene	19.6	D	µg/kg		20.0		98	70-130		
1,2-Dichloropropane	19.5	D	µg/kg		20.0		98	70-130		
1,3-Dichloropropane	20.1	D	µg/kg		20.0		100	70-130		
2,2-Dichloropropane	21.7	D	µg/kg		20.0		108	70-130		
1,1-Dichloropropene	20.5	D	µg/kg		20.0		102	70-130		
cis-1,3-Dichloropropene	20.5	D	µg/kg		20.0		102	70-130		
trans-1,3-Dichloropropene	20.9	D	µg/kg		20.0		104	70-130		
Ethylbenzene	21.0	D	µg/kg		20.0		105	70-130		
Hexachlorobutadiene	22.3	D	µg/kg		20.0		112	70-130		
2-Hexanone (MBK)	19.4	D	µg/kg		20.0		97	70-130		
Isopropylbenzene	21.8	D	µg/kg		20.0		109	70-130		
4-Isopropyltoluene	19.5	D	µg/kg		20.0		98	70-130		
Methyl tert-butyl ether	23.9	D	µg/kg		20.0		120	70-130		
4-Methyl-2-pentanone (MIBK)	19.7	D	µg/kg		20.0		98	70-130		
Methylene chloride	15.2	D	µg/kg		20.0		76	70-130		
Naphthalene	23.2	D	µg/kg		20.0		116	70-130		
n-Propylbenzene	19.8	D	µg/kg		20.0		99	70-130		
Styrene	21.2	D	µg/kg		20.0		106	70-130		
1,1,1,2-Tetrachloroethane	23.2	D	µg/kg		20.0		116	70-130		
1,1,2,2-Tetrachloroethane	20.0	D	µg/kg		20.0		100	70-130		
Tetrachloroethene	20.8	D	µg/kg		20.0		104	70-130		
Toluene	20.2	D	µg/kg		20.0		101	70-130		
1,2,3-Trichlorobenzene	21.6	D	µg/kg		20.0		108	70-130		
1,2,4-Trichlorobenzene	20.7	D	µg/kg		20.0		103	70-130		
1,3,5-Trichlorobenzene	20.7	D	µg/kg		20.0		104	70-130		
1,1,1-Trichloroethane	19.6	D	µg/kg		20.0		98	70-130		
1,1,2-Trichloroethane	20.1	D	µg/kg		20.0		101	70-130		
Trichloroethene	20.3	D	µg/kg		20.0		102	70-130		
Trichlorofluoromethane (Freon 11)	16.2	D	µg/kg		20.0		81	70-130		
1,2,3-Trichloropropane	20.7	D	µg/kg		20.0		104	70-130		
1,2,4-Trimethylbenzene	21.1	D	µg/kg		20.0		106	70-130		
1,3,5-Trimethylbenzene	21.0	D	µg/kg		20.0		105	70-130		
Vinyl chloride	15.5	D	µg/kg		20.0		78	70-130		
m,p-Xylene	21.0	D	µg/kg		20.0		105	70-130		
o-Xylene	21.5	D	µg/kg		20.0		107	70-130		
Tetrahydrofuran	19.0	D	µg/kg		20.0		95	70-130		
Ethyl ether	17.4	D	µg/kg		20.0		87	70-130		
Tert-amyl methyl ether	17.6	D	µg/kg		20.0		88	70-130		
Ethyl tert-butyl ether	21.0	D	µg/kg		20.0		105	70-130		
Di-isopropyl ether	18.9	D	µg/kg		20.0		95	70-130		
Tert-Butanol / butyl alcohol	186	D	µg/kg		200		93	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800822 - SW846 5035A Soil (high level)</b>										
<b>LCS (1800822-BS1)</b>					<b>Prepared &amp; Analyzed: 22-Jan-18</b>					
1,4-Dioxane	219	D	µg/kg		200		109	70-130		
trans-1,4-Dichloro-2-butene	19.6	D	µg/kg		20.0		98	70-130		
Ethanol	370	D	µg/kg		400		93	70-130		
Surrogate: 4-Bromofluorobenzene	49.8		µg/kg		50.0		100	70-130		
Surrogate: Toluene-d8	49.7		µg/kg		50.0		99	70-130		
Surrogate: 1,2-Dichloroethane-d4	48.1		µg/kg		50.0		96	70-130		
Surrogate: Dibromofluoromethane	50.8		µg/kg		50.0		102	70-130		
<b>LCS Dup (1800822-BS1)</b>					<b>Prepared &amp; Analyzed: 22-Jan-18</b>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	12.3	QC2, D	µg/kg		20.0		62	70-130	7	30
Acetone	16.9	D	µg/kg		20.0		85	70-130	3	30
Acrylonitrile	16.2	D	µg/kg		20.0		81	70-130	0.9	30
Benzene	19.1	D	µg/kg		20.0		96	70-130	5	30
Bromobenzene	22.5	D	µg/kg		20.0		113	70-130	2	30
Bromochloromethane	21.8	D	µg/kg		20.0		109	70-130	4	30
Bromodichloromethane	20.0	D	µg/kg		20.0		100	70-130	3	30
Bromoform	24.0	D	µg/kg		20.0		120	70-130	2	30
Bromomethane	21.0	D	µg/kg		20.0		105	70-130	6	30
2-Butanone (MEK)	19.4	D	µg/kg		20.0		97	70-130	5	30
n-Butylbenzene	16.5	D	µg/kg		20.0		82	70-130	9	30
sec-Butylbenzene	19.0	D	µg/kg		20.0		95	70-130	4	30
tert-Butylbenzene	20.3	D	µg/kg		20.0		102	70-130	4	30
Carbon disulfide	16.0	D	µg/kg		20.0		80	70-130	26	30
Carbon tetrachloride	18.8	D	µg/kg		20.0		94	70-130	4	30
Chlorobenzene	20.0	D	µg/kg		20.0		100	70-130	4	30
Chloroethane	14.8	D	µg/kg		20.0		74	70-130	0.2	30
Chloroform	18.5	D	µg/kg		20.0		92	70-130	5	30
Chloromethane	12.1	D	µg/kg		20.0		60	70-130	8	30
2-Chlorotoluene	20.8	D	µg/kg		20.0		104	70-130	5	30
4-Chlorotoluene	19.6	D	µg/kg		20.0		98	70-130	6	30
1,2-Dibromo-3-chloropropane	17.6	D	µg/kg		20.0		88	70-130	5	30
Dibromochloromethane	19.6	D	µg/kg		20.0		98	70-130	3	30
1,2-Dibromoethane (EDB)	21.9	D	µg/kg		20.0		109	70-130	4	30
Dibromomethane	19.6	D	µg/kg		20.0		98	70-130	4	30
1,2-Dichlorobenzene	21.0	D	µg/kg		20.0		105	70-130	4	30
1,3-Dichlorobenzene	20.8	D	µg/kg		20.0		104	70-130	4	30
1,4-Dichlorobenzene	18.8	D	µg/kg		20.0		94	70-130	5	30
Dichlorodifluoromethane (Freon12)	12.5	D	µg/kg		20.0		63	70-130	7	30
1,1-Dichloroethane	17.5	D	µg/kg		20.0		88	70-130	7	30
1,2-Dichloroethane	18.3	D	µg/kg		20.0		92	70-130	4	30
1,1-Dichloroethene	14.8	D	µg/kg		20.0		74	70-130	5	30
cis-1,2-Dichloroethene	20.4	D	µg/kg		20.0		102	70-130	6	30
trans-1,2-Dichloroethene	18.4	D	µg/kg		20.0		92	70-130	6	30
1,2-Dichloropropane	18.7	D	µg/kg		20.0		94	70-130	4	30
1,3-Dichloropropane	19.2	D	µg/kg		20.0		96	70-130	4	30
2,2-Dichloropropane	20.0	D	µg/kg		20.0		100	70-130	8	30
1,1-Dichloropropene	18.8	D	µg/kg		20.0		94	70-130	9	30
cis-1,3-Dichloropropene	19.4	D	µg/kg		20.0		97	70-130	6	30
trans-1,3-Dichloropropene	20.0	D	µg/kg		20.0		100	70-130	5	30
Ethylbenzene	19.7	D	µg/kg		20.0		99	70-130	6	30
Hexachlorobutadiene	21.8	D	µg/kg		20.0		109	70-130	3	30

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800822 - SW846 5035A Soil (high level)</b>										
<b>LCS Dup (1800822-BSD1)</b>					<b>Prepared &amp; Analyzed: 22-Jan-18</b>					
2-Hexanone (MBK)	18.9	D	µg/kg		20.0		94	70-130	3	30
Isopropylbenzene	21.0	D	µg/kg		20.0		105	70-130	4	30
4-Isopropyltoluene	18.6	D	µg/kg		20.0		93	70-130	5	30
Methyl tert-butyl ether	23.1	D	µg/kg		20.0		115	70-130	4	30
4-Methyl-2-pentanone (MIBK)	19.1	D	µg/kg		20.0		96	70-130	3	30
Methylene chloride	14.6	D	µg/kg		20.0		73	70-130	4	30
Naphthalene	22.5	D	µg/kg		20.0		113	70-130	3	30
n-Propylbenzene	18.8	D	µg/kg		20.0		94	70-130	5	30
Styrene	20.6	D	µg/kg		20.0		103	70-130	3	30
1,1,1,2-Tetrachloroethane	22.4	D	µg/kg		20.0		112	70-130	4	30
1,1,2,2-Tetrachloroethane	19.7	D	µg/kg		20.0		98	70-130	2	30
Tetrachloroethene	20.1	D	µg/kg		20.0		100	70-130	4	30
Toluene	19.0	D	µg/kg		20.0		95	70-130	6	30
1,2,3-Trichlorobenzene	20.6	D	µg/kg		20.0		103	70-130	5	30
1,2,4-Trichlorobenzene	19.6	D	µg/kg		20.0		98	70-130	5	30
1,3,5-Trichlorobenzene	20.0	D	µg/kg		20.0		100	70-130	3	30
1,1,1-Trichloroethane	18.7	D	µg/kg		20.0		93	70-130	5	30
1,1,2-Trichloroethane	19.4	D	µg/kg		20.0		97	70-130	4	30
Trichloroethene	19.0	D	µg/kg		20.0		95	70-130	7	30
Trichlorofluoromethane (Freon 11)	15.2	D	µg/kg		20.0		76	70-130	6	30
1,2,3-Trichloropropane	20.2	D	µg/kg		20.0		101	70-130	3	30
1,2,4-Trimethylbenzene	20.5	D	µg/kg		20.0		103	70-130	3	30
1,3,5-Trimethylbenzene	20.3	D	µg/kg		20.0		101	70-130	4	30
Vinyl chloride	13.7	QM9, D	µg/kg		20.0		68	70-130	13	30
m,p-Xylene	20.2	D	µg/kg		20.0		101	70-130	3	30
o-Xylene	21.0	D	µg/kg		20.0		105	70-130	2	30
Tetrahydrofuran	18.1	D	µg/kg		20.0		90	70-130	5	30
Ethyl ether	16.8	D	µg/kg		20.0		84	70-130	4	30
Tert-amyl methyl ether	16.8	D	µg/kg		20.0		84	70-130	5	30
Ethyl tert-butyl ether	20.1	D	µg/kg		20.0		100	70-130	5	30
Di-isopropyl ether	17.6	D	µg/kg		20.0		88	70-130	7	30
Tert-Butanol / butyl alcohol	191	D	µg/kg		200		96	70-130	3	30
1,4-Dioxane	207	D	µg/kg		200		104	70-130	6	30
trans-1,4-Dichloro-2-butene	19.5	D	µg/kg		20.0		98	70-130	0.5	30
Ethanol	374	D	µg/kg		400		94	70-130	1	30
Surrogate: 4-Bromofluorobenzene	50.7		µg/kg		50.0		101	70-130		
Surrogate: Toluene-d8	50.4		µg/kg		50.0		101	70-130		
Surrogate: 1,2-Dichloroethane-d4	47.0		µg/kg		50.0		94	70-130		
Surrogate: Dibromofluoromethane	50.0		µg/kg		50.0		100	70-130		

# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8270D</u></b>										
<b>Batch 1800478 - SW846 3546</b>										
<b><u>Blank (1800478-BLK1)</u></b>	<b><u>Prepared: 13-Jan-18 Analyzed: 16-Jan-18</u></b>									
Acenaphthene	< 66.5	U	µg/kg wet	66.5						
Acenaphthylene	< 66.5	U	µg/kg wet	66.5						
Aniline	< 329	U	µg/kg wet	329						
Anthracene	< 66.5	U	µg/kg wet	66.5						
Azobenzene/Diphenyldiazene	< 329	U	µg/kg wet	329						
Benzidine	< 329	U	µg/kg wet	329						
Benzo (a) anthracene	< 66.5	U	µg/kg wet	66.5						
Benzo (a) pyrene	< 66.5	U	µg/kg wet	66.5						
Benzo (b) fluoranthene	< 66.5	U	µg/kg wet	66.5						
Benzo (g,h,i) perylene	< 66.5	U	µg/kg wet	66.5						
Benzo (k) fluoranthene	< 66.5	U	µg/kg wet	66.5						
Benzoic acid	< 329	U	µg/kg wet	329						
Benzyl alcohol	< 329	U	µg/kg wet	329						
Bis(2-chloroethoxy)methane	< 329	U	µg/kg wet	329						
Bis(2-chloroethyl)ether	< 166	U	µg/kg wet	166						
Bis(2-chloroisopropyl)ether	< 166	U	µg/kg wet	166						
Bis(2-ethylhexyl)phthalate	< 166	U	µg/kg wet	166						
4-Bromophenyl phenyl ether	< 329	U	µg/kg wet	329						
Butyl benzyl phthalate	< 329	U	µg/kg wet	329						
Carbazole	< 166	U	µg/kg wet	166						
4-Chloro-3-methylphenol	< 329	U	µg/kg wet	329						
4-Chloroaniline	< 166	U	µg/kg wet	166						
2-Chloronaphthalene	< 329	U	µg/kg wet	329						
2-Chlorophenol	< 166	U	µg/kg wet	166						
4-Chlorophenyl phenyl ether	< 329	U	µg/kg wet	329						
Chrysene	< 66.5	U	µg/kg wet	66.5						
Dibenzo (a,h) anthracene	< 66.5	U	µg/kg wet	66.5						
Dibenzofuran	< 166	U	µg/kg wet	166						
1,2-Dichlorobenzene	< 329	U	µg/kg wet	329						
1,3-Dichlorobenzene	< 329	U	µg/kg wet	329						
1,4-Dichlorobenzene	< 329	U	µg/kg wet	329						
3,3'-Dichlorobenzidine	< 329	U	µg/kg wet	329						
2,4-Dichlorophenol	< 166	U	µg/kg wet	166						
Diethyl phthalate	< 329	U	µg/kg wet	329						
Dimethyl phthalate	< 329	U	µg/kg wet	329						
2,4-Dimethylphenol	< 329	U	µg/kg wet	329						
Di-n-butyl phthalate	< 329	U	µg/kg wet	329						
4,6-Dinitro-2-methylphenol	< 329	U	µg/kg wet	329						
2,4-Dinitrophenol	< 329	U	µg/kg wet	329						
2,4-Dinitrotoluene	< 166	U	µg/kg wet	166						
2,6-Dinitrotoluene	< 166	U	µg/kg wet	166						
Di-n-octyl phthalate	< 329	U	µg/kg wet	329						
Fluoranthene	< 66.5	U	µg/kg wet	66.5						
Fluorene	< 66.5	U	µg/kg wet	66.5						
Hexachlorobenzene	< 166	U	µg/kg wet	166						
Hexachlorobutadiene	< 166	U	µg/kg wet	166						
Hexachlorocyclopentadiene	< 166	U	µg/kg wet	166						
Hexachloroethane	< 166	U	µg/kg wet	166						
Indeno (1,2,3-cd) pyrene	< 66.5	U	µg/kg wet	66.5						
Isophorone	< 166	U	µg/kg wet	166						

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>Blank (1800478-BLK1)</b>					<u>Prepared: 13-Jan-18 Analyzed: 16-Jan-18</u>					
2-Methylnaphthalene	< 66.5	U	µg/kg wet	66.5						
2-Methylphenol	< 329	U	µg/kg wet	329						
3 & 4-Methylphenol	< 329	U	µg/kg wet	329						
Naphthalene	< 66.5	U	µg/kg wet	66.5						
2-Nitroaniline	< 329	U	µg/kg wet	329						
3-Nitroaniline	< 329	U	µg/kg wet	329						
4-Nitroaniline	< 166	U	µg/kg wet	166						
Nitrobenzene	< 166	U	µg/kg wet	166						
2-Nitrophenol	< 166	U	µg/kg wet	166						
4-Nitrophenol	< 1320	U	µg/kg wet	1320						
N-Nitrosodimethylamine	< 166	U	µg/kg wet	166						
N-Nitrosodi-n-propylamine	< 166	U	µg/kg wet	166						
N-Nitrosodiphenylamine	< 329	U	µg/kg wet	329						
Pentachlorophenol	< 329	U	µg/kg wet	329						
Phenanthrene	< 66.5	U	µg/kg wet	66.5						
Phenol	< 329	U	µg/kg wet	329						
Pyrene	< 66.5	U	µg/kg wet	66.5						
Pyridine	< 329	U	µg/kg wet	329						
1,2,4-Trichlorobenzene	< 329	U	µg/kg wet	329						
1-Methylnaphthalene	< 66.5	U	µg/kg wet	66.5						
2,4,5-Trichlorophenol	< 329	U	µg/kg wet	329						
2,4,6-Trichlorophenol	< 166	U	µg/kg wet	166						
Pentachloronitrobenzene	< 329	U	µg/kg wet	329						
1,2,4,5-Tetrachlorobenzene	< 329	U	µg/kg wet	329						
Surrogate: 2-Fluorobiphenyl	1020		µg/kg wet		1660		61	30-130		
Surrogate: 2-Fluorophenol	818		µg/kg wet		1660		49	30-130		
Surrogate: Nitrobenzene-d5	976		µg/kg wet		1660		59	30-130		
Surrogate: Phenol-d5	937		µg/kg wet		1660		56	30-130		
Surrogate: Terphenyl-dl4	1430		µg/kg wet		1660		86	30-130		
Surrogate: 2,4,6-Tribromophenol	908		µg/kg wet		1660		55	30-130		
<b>LCS (1800478-BS1)</b>					<u>Prepared: 13-Jan-18 Analyzed: 16-Jan-18</u>					
Acenaphthene	1370		µg/kg wet	66.7	1670		82	40-140		
Acenaphthylene	1340		µg/kg wet	66.7	1670		81	40-140		
Aniline	628	QC2	µg/kg wet	330	1670		38	40-140		
Anthracene	1090		µg/kg wet	66.7	1670		66	40-140		
Azobenzene/Diphenyldiazene	1150		µg/kg wet	330	1670		69	40-140		
Benzidine	931		µg/kg wet	330	1670		56	40-140		
Benzo (a) anthracene	1230		µg/kg wet	66.7	1670		74	40-140		
Benzo (a) pyrene	1310		µg/kg wet	66.7	1670		79	40-140		
Benzo (b) fluoranthene	1240		µg/kg wet	66.7	1670		75	40-140		
Benzo (g,h,i) perylene	1220		µg/kg wet	66.7	1670		73	40-140		
Benzo (k) fluoranthene	1380		µg/kg wet	66.7	1670		83	40-140		
Benzoic acid	405	QC2	µg/kg wet	330	1670		24	30-130		
Benzyl alcohol	1060		µg/kg wet	330	1670		64	40-140		
Bis(2-chloroethoxy)methane	809		µg/kg wet	330	1670		49	40-140		
Bis(2-chloroethyl)ether	943		µg/kg wet	167	1670		57	40-140		
Bis(2-chloroisopropyl)ether	821		µg/kg wet	167	1670		49	40-140		
Bis(2-ethylhexyl)phthalate	1150		µg/kg wet	167	1670		69	40-140		
4-Bromophenyl phenyl ether	1230		µg/kg wet	330	1670		74	40-140		
Butyl benzyl phthalate	1170		µg/kg wet	330	1670		70	40-140		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>LCS (1800478-BS1)</b>	Prepared: 13-Jan-18 Analyzed: 16-Jan-18									
Carbazole	1230		µg/kg wet	167	1670		74	40-140		
4-Chloro-3-methylphenol	1330		µg/kg wet	330	1670		80	30-130		
4-Chloroaniline	677		µg/kg wet	167	1670		41	40-140		
2-Chloronaphthalene	1540		µg/kg wet	330	1670		93	40-140		
2-Chlorophenol	1060		µg/kg wet	167	1670		64	30-130		
4-Chlorophenyl phenyl ether	1450		µg/kg wet	330	1670		87	40-140		
Chrysene	1260		µg/kg wet	66.7	1670		76	40-140		
Dibenzo (a,h) anthracene	1340		µg/kg wet	66.7	1670		81	40-140		
Dibenzofuran	1460		µg/kg wet	167	1670		88	40-140		
1,2-Dichlorobenzene	1330		µg/kg wet	330	1670		80	40-140		
1,3-Dichlorobenzene	1240		µg/kg wet	330	1670		75	40-140		
1,4-Dichlorobenzene	1310		µg/kg wet	330	1670		79	40-140		
3,3'-Dichlorobenzidine	1800		µg/kg wet	330	1670		108	40-140		
2,4-Dichlorophenol	1230		µg/kg wet	167	1670		74	30-130		
Diethyl phthalate	1470		µg/kg wet	330	1670		88	40-140		
Dimethyl phthalate	1380		µg/kg wet	330	1670		83	40-140		
2,4-Dimethylphenol	905		µg/kg wet	330	1670		54	30-130		
Di-n-butyl phthalate	1110		µg/kg wet	330	1670		67	40-140		
4,6-Dinitro-2-methylphenol	996		µg/kg wet	330	1670		60	30-130		
2,4-Dinitrophenol	601		µg/kg wet	330	1670		36	30-130		
2,4-Dinitrotoluene	1610		µg/kg wet	167	1670		96	40-140		
2,6-Dinitrotoluene	1560		µg/kg wet	167	1670		93	40-140		
Di-n-octyl phthalate	1320		µg/kg wet	330	1670		79	40-140		
Fluoranthene	1220		µg/kg wet	66.7	1670		73	40-140		
Fluorene	1290		µg/kg wet	66.7	1670		78	40-140		
Hexachlorobenzene	1510		µg/kg wet	167	1670		91	40-140		
Hexachlorobutadiene	1610		µg/kg wet	167	1670		97	40-140		
Hexachlorocyclopentadiene	1730		µg/kg wet	167	1670		104	40-140		
Hexachloroethane	1460		µg/kg wet	167	1670		88	40-140		
Indeno (1,2,3-cd) pyrene	1250		µg/kg wet	66.7	1670		75	40-140		
Isophorone	1040		µg/kg wet	167	1670		63	40-140		
2-Methylnaphthalene	1460		µg/kg wet	66.7	1670		88	40-140		
2-Methylphenol	1000		µg/kg wet	330	1670		60	30-130		
3 & 4-Methylphenol	1050		µg/kg wet	330	1670		63	30-130		
Naphthalene	1120		µg/kg wet	66.7	1670		67	40-140		
2-Nitroaniline	1150		µg/kg wet	330	1670		69	40-140		
3-Nitroaniline	1100		µg/kg wet	330	1670		66	40-140		
4-Nitroaniline	1230		µg/kg wet	167	1670		74	40-140		
Nitrobenzene	1360		µg/kg wet	167	1670		82	40-140		
2-Nitrophenol	1110		µg/kg wet	167	1670		67	30-130		
4-Nitrophenol	1190	J	µg/kg wet	1320	1670		71	30-130		
N-Nitrosodimethylamine	1330		µg/kg wet	167	1670		80	40-140		
N-Nitrosodi-n-propylamine	1040		µg/kg wet	167	1670		62	40-140		
N-Nitrosodiphenylamine	1240		µg/kg wet	330	1670		74	40-140		
Pentachlorophenol	928		µg/kg wet	330	1670		56	30-130		
Phenanthrene	1120		µg/kg wet	66.7	1670		67	40-140		
Phenol	999		µg/kg wet	330	1670		60	30-130		
Pyrene	1270		µg/kg wet	66.7	1670		76	40-140		
Pyridine	1020		µg/kg wet	330	1670		61	40-140		
1,2,4-Trichlorobenzene	1460		µg/kg wet	330	1670		88	40-140		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>LCS (1800478-BS1)</b>					Prepared: 13-Jan-18 Analyzed: 16-Jan-18					
1-Methylnaphthalene	1170		µg/kg wet	66.7	1670		70	40-140		
2,4,5-Trichlorophenol	1460		µg/kg wet	330	1670		88	30-130		
2,4,6-Trichlorophenol	1300		µg/kg wet	167	1670		78	30-130		
Pentachloronitrobenzene	1710		µg/kg wet	330	1670		103	40-140		
1,2,4,5-Tetrachlorobenzene	1370		µg/kg wet	330	1670		82	40-140		
Surrogate: 2-Fluorobiphenyl	1420		µg/kg wet		1670		85	30-130		
Surrogate: 2-Fluorophenol	1030		µg/kg wet		1670		62	30-130		
Surrogate: Nitrobenzene-d5	1230		µg/kg wet		1670		74	30-130		
Surrogate: Phenol-d5	1100		µg/kg wet		1670		66	30-130		
Surrogate: Terphenyl-d14	1470		µg/kg wet		1670		88	30-130		
Surrogate: 2,4,6-Tribromophenol	1450		µg/kg wet		1670		87	30-130		
<b>LCS Dup (1800478-BSD1)</b>					Prepared: 13-Jan-18 Analyzed: 16-Jan-18					
Acenaphthene	1420		µg/kg wet	66.6	1660		85	40-140	4	30
Acenaphthylene	1410		µg/kg wet	66.6	1660		85	40-140	5	30
Aniline	678		µg/kg wet	329	1660		41	40-140	8	30
Anthracene	1180		µg/kg wet	66.6	1660		71	40-140	8	30
Azobenzene/Diphenyldiazene	1200		µg/kg wet	329	1660		72	40-140	4	30
Benzidine	1330	QR2	µg/kg wet	329	1660		80	40-140	35	30
Benzo (a) anthracene	1310		µg/kg wet	66.6	1660		78	40-140	6	30
Benzo (a) pyrene	1220		µg/kg wet	66.6	1660		74	40-140	7	30
Benzo (b) fluoranthene	1250		µg/kg wet	66.6	1660		75	40-140	0.4	30
Benzo (g,h,i) perylene	1170		µg/kg wet	66.6	1660		70	40-140	4	30
Benzo (k) fluoranthene	1400		µg/kg wet	66.6	1660		84	40-140	2	30
Benzoic acid	390	QC2	µg/kg wet	329	1660		23	30-130	4	30
Benzyl alcohol	1150		µg/kg wet	329	1660		69	40-140	7	30
Bis(2-chloroethoxy)methane	850		µg/kg wet	329	1660		51	40-140	5	30
Bis(2-chloroethyl)ether	937		µg/kg wet	167	1660		56	40-140	0.6	30
Bis(2-chloroisopropyl)ether	842		µg/kg wet	167	1660		51	40-140	3	30
Bis(2-ethylhexyl)phthalate	1240		µg/kg wet	167	1660		75	40-140	7	30
4-Bromophenyl phenyl ether	1290		µg/kg wet	329	1660		77	40-140	4	30
Butyl benzyl phthalate	1310		µg/kg wet	329	1660		79	40-140	11	30
Carbazole	1290		µg/kg wet	167	1660		78	40-140	5	30
4-Chloro-3-methylphenol	1300		µg/kg wet	329	1660		78	30-130	2	30
4-Chloroaniline	845		µg/kg wet	167	1660		51	40-140	22	30
2-Chloronaphthalene	1580		µg/kg wet	329	1660		95	40-140	3	30
2-Chlorophenol	1080		µg/kg wet	167	1660		65	30-130	2	30
4-Chlorophenyl phenyl ether	1450		µg/kg wet	329	1660		87	40-140	0.3	30
Chrysene	1270		µg/kg wet	66.6	1660		76	40-140	1	30
Dibenzo (a,h) anthracene	1270		µg/kg wet	66.6	1660		76	40-140	6	30
Dibenzofuran	1520		µg/kg wet	167	1660		91	40-140	4	30
1,2-Dichlorobenzene	1380		µg/kg wet	329	1660		83	40-140	4	30
1,3-Dichlorobenzene	1290		µg/kg wet	329	1660		77	40-140	3	30
1,4-Dichlorobenzene	1340		µg/kg wet	329	1660		81	40-140	2	30
3,3'-Dichlorobenzidine	1850		µg/kg wet	329	1660		111	40-140	3	30
2,4-Dichlorophenol	1280		µg/kg wet	167	1660		77	30-130	4	30
Diethyl phthalate	1500		µg/kg wet	329	1660		90	40-140	2	30
Dimethyl phthalate	1430		µg/kg wet	329	1660		86	40-140	4	30
2,4-Dimethylphenol	973		µg/kg wet	329	1660		58	30-130	7	30
Di-n-butyl phthalate	1140		µg/kg wet	329	1660		68	40-140	2	30
4,6-Dinitro-2-methylphenol	1040		µg/kg wet	329	1660		63	30-130	4	30

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>LCS Dup (1800478-BSD1)</b>					Prepared: 13-Jan-18 Analyzed: 16-Jan-18					
2,4-Dinitrophenol	620		µg/kg wet	329	1660		37	30-130	3	30
2,4-Dinitrotoluene	1650		µg/kg wet	167	1660		99	40-140	3	30
2,6-Dinitrotoluene	1630		µg/kg wet	167	1660		98	40-140	5	30
Di-n-octyl phthalate	1340		µg/kg wet	329	1660		81	40-140	2	30
Fluoranthene	1220		µg/kg wet	66.6	1660		73	40-140	0.2	30
Fluorene	1320		µg/kg wet	66.6	1660		80	40-140	2	30
Hexachlorobenzene	1530		µg/kg wet	167	1660		92	40-140	1	30
Hexachlorobutadiene	1630		µg/kg wet	167	1660		98	40-140	1	30
Hexachlorocyclopentadiene	1790		µg/kg wet	167	1660		108	40-140	3	30
Hexachloroethane	1590		µg/kg wet	167	1660		96	40-140	8	30
Indeno (1,2,3-cd) pyrene	1140		µg/kg wet	66.6	1660		69	40-140	9	30
Isophorone	1150		µg/kg wet	167	1660		69	40-140	10	30
2-Methylnaphthalene	1280		µg/kg wet	66.6	1660		77	40-140	13	30
2-Methylphenol	1040		µg/kg wet	329	1660		62	30-130	4	30
3 & 4-Methylphenol	1180		µg/kg wet	329	1660		71	30-130	12	30
Naphthalene	1130		µg/kg wet	66.6	1660		68	40-140	0.9	30
2-Nitroaniline	1190		µg/kg wet	329	1660		72	40-140	3	30
3-Nitroaniline	1270		µg/kg wet	329	1660		76	40-140	15	30
4-Nitroaniline	1330		µg/kg wet	167	1660		80	40-140	8	30
Nitrobenzene	1410		µg/kg wet	167	1660		85	40-140	3	30
2-Nitrophenol	1170		µg/kg wet	167	1660		71	30-130	6	30
4-Nitrophenol	1190	J	µg/kg wet	1320	1660		72	30-130	0.5	30
N-Nitrosodimethylamine	1090		µg/kg wet	167	1660		65	40-140	20	30
N-Nitrosodi-n-propylamine	1130		µg/kg wet	167	1660		68	40-140	9	30
N-Nitrosodiphenylamine	1290		µg/kg wet	329	1660		77	40-140	4	30
Pentachlorophenol	917		µg/kg wet	329	1660		55	30-130	1	30
Phenanthrene	1200		µg/kg wet	66.6	1660		72	40-140	7	30
Phenol	1020		µg/kg wet	329	1660		62	30-130	3	30
Pyrene	1370		µg/kg wet	66.6	1660		82	40-140	8	30
Pyridine	888		µg/kg wet	329	1660		53	40-140	14	30
1,2,4-Trichlorobenzene	1620		µg/kg wet	329	1660		97	40-140	10	30
1-Methylnaphthalene	1200		µg/kg wet	66.6	1660		72	40-140	3	30
2,4,5-Trichlorophenol	1430		µg/kg wet	329	1660		86	30-130	2	30
2,4,6-Trichlorophenol	1360		µg/kg wet	167	1660		82	30-130	4	30
Pentachloronitrobenzene	1730		µg/kg wet	329	1660		104	40-140	1	30
1,2,4,5-Tetrachlorobenzene	1440		µg/kg wet	329	1660		86	40-140	5	30
Surrogate: 2-Fluorobiphenyl	1430		µg/kg wet		1660		86	30-130		
Surrogate: 2-Fluorophenol	1040		µg/kg wet		1660		63	30-130		
Surrogate: Nitrobenzene-d5	1270		µg/kg wet		1660		76	30-130		
Surrogate: Phenol-d5	1100		µg/kg wet		1660		66	30-130		
Surrogate: Terphenyl-dl4	1540		µg/kg wet		1660		92	30-130		
Surrogate: 2,4,6-Tribromophenol	1460		µg/kg wet		1660		88	30-130		
<b>Duplicate (1800478-DUP1)</b>				<b>Source: SC43071-01</b>		Prepared: 13-Jan-18 Analyzed: 17-Jan-18				
Acenaphthene	< 350	U, D	µg/kg dry	350		BRL				30
Acenaphthylene	< 350	U, D	µg/kg dry	350		BRL				30
Aniline	< 1730	U, D	µg/kg dry	1730		BRL				30
Anthracene	< 350	U, D	µg/kg dry	350		BRL				30
Azobenzene/Diphenyldiazene	< 1730	U, D	µg/kg dry	1730		BRL				30
Benzidine	< 1730	U, D	µg/kg dry	1730		BRL				30
Benzo (a) anthracene	< 350	U, D	µg/kg dry	350		BRL				30

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>Duplicate (1800478-DUP1)</b>				<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>		
Benzo (a) pyrene	< 350	U, D	µg/kg dry	350		BRL				30
Benzo (b) fluoranthene	< 350	U, D	µg/kg dry	350		BRL				30
Benzo (g,h,i) perylene	< 350	U, D	µg/kg dry	350		BRL				30
Benzo (k) fluoranthene	< 350	U, D	µg/kg dry	350		BRL				30
Benzoic acid	< 1730	U, D	µg/kg dry	1730		BRL				30
Benzyl alcohol	< 1730	U, D	µg/kg dry	1730		BRL				30
Bis(2-chloroethoxy)methane	< 1730	U, D	µg/kg dry	1730		BRL				30
Bis(2-chloroethyl)ether	< 877	U, D	µg/kg dry	877		BRL				30
Bis(2-chloroisopropyl)ether	< 877	U, D	µg/kg dry	877		BRL				30
Bis(2-ethylhexyl)phthalate	< 877	U, D	µg/kg dry	877		BRL				30
4-Bromophenyl phenyl ether	< 1730	U, D	µg/kg dry	1730		BRL				30
Butyl benzyl phthalate	< 1730	U, D	µg/kg dry	1730		BRL				30
Carbazole	< 877	U, D	µg/kg dry	877		BRL				30
4-Chloro-3-methylphenol	< 1730	U, D	µg/kg dry	1730		BRL				30
4-Chloroaniline	< 877	U, D	µg/kg dry	877		BRL				30
2-Chloronaphthalene	< 1730	U, D	µg/kg dry	1730		BRL				30
2-Chlorophenol	< 877	U, D	µg/kg dry	877		BRL				30
4-Chlorophenyl phenyl ether	< 1730	U, D	µg/kg dry	1730		BRL				30
Chrysene	< 350	U, D	µg/kg dry	350		BRL				30
Dibenzo (a,h) anthracene	< 350	U, D	µg/kg dry	350		BRL				30
Dibenzofuran	< 877	U, D	µg/kg dry	877		BRL				30
1,2-Dichlorobenzene	< 1730	U, D	µg/kg dry	1730		BRL				30
1,3-Dichlorobenzene	< 1730	U, D	µg/kg dry	1730		BRL				30
1,4-Dichlorobenzene	< 1730	U, D	µg/kg dry	1730		BRL				30
3,3'-Dichlorobenzidine	< 1730	U, D	µg/kg dry	1730		BRL				30
2,4-Dichlorophenol	< 877	U, D	µg/kg dry	877		BRL				30
Diethyl phthalate	< 1730	U, D	µg/kg dry	1730		BRL				30
Dimethyl phthalate	< 1730	U, D	µg/kg dry	1730		BRL				30
2,4-Dimethylphenol	< 1730	U, D	µg/kg dry	1730		BRL				30
Di-n-butyl phthalate	< 1730	U, D	µg/kg dry	1730		BRL				30
4,6-Dinitro-2-methylphenol	< 1730	U, D	µg/kg dry	1730		BRL				30
2,4-Dinitrophenol	< 1730	U, D	µg/kg dry	1730		BRL				30
2,4-Dinitrotoluene	< 877	U, D	µg/kg dry	877		BRL				30
2,6-Dinitrotoluene	< 877	U, D	µg/kg dry	877		BRL				30
Di-n-octyl phthalate	< 1730	U, D	µg/kg dry	1730		BRL				30
Fluoranthene	< 350	U, D	µg/kg dry	350		BRL				30
Fluorene	< 350	U, D	µg/kg dry	350		BRL				30
Hexachlorobenzene	< 877	U, D	µg/kg dry	877		BRL				30
Hexachlorobutadiene	< 877	U, D	µg/kg dry	877		BRL				30
Hexachlorocyclopentadiene	< 877	U, D	µg/kg dry	877		BRL				30
Hexachloroethane	< 877	U, D	µg/kg dry	877		BRL				30
Indeno (1,2,3-cd) pyrene	< 350	U, D	µg/kg dry	350		BRL				30
Isophorone	< 877	U, D	µg/kg dry	877		BRL				30
2-Methylnaphthalene	< 350	U, D	µg/kg dry	350		BRL				30
2-Methylphenol	< 1730	U, D	µg/kg dry	1730		BRL				30
3 & 4-Methylphenol	< 1730	U, D	µg/kg dry	1730		BRL				30
Naphthalene	< 350	U, D	µg/kg dry	350		BRL				30
2-Nitroaniline	< 1730	U, D	µg/kg dry	1730		BRL				30
3-Nitroaniline	< 1730	U, D	µg/kg dry	1730		BRL				30
4-Nitroaniline	< 877	U, D	µg/kg dry	877		BRL				30

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>Duplicate (1800478-DUP1)</b>				<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>		
Nitrobenzene	< 877	U, D	µg/kg dry	877		BRL				30
2-Nitrophenol	< 877	U, D	µg/kg dry	877		BRL				30
4-Nitrophenol	< 6930	U, D	µg/kg dry	6930		BRL				30
N-Nitrosodimethylamine	< 877	U, D	µg/kg dry	877		BRL				30
N-Nitrosodi-n-propylamine	< 877	U, D	µg/kg dry	877		BRL				30
N-Nitrosodiphenylamine	< 1730	U, D	µg/kg dry	1730		BRL				30
Pentachlorophenol	< 1730	U, D	µg/kg dry	1730		BRL				30
Phenanthrene	< 350	U, D	µg/kg dry	350		BRL				30
Phenol	< 1730	U, D	µg/kg dry	1730		BRL				30
Pyrene	< 350	U, D	µg/kg dry	350		BRL				30
Pyridine	< 1730	U, D	µg/kg dry	1730		BRL				30
1,2,4-Trichlorobenzene	< 1730	U, D	µg/kg dry	1730		BRL				30
1-Methylnaphthalene	< 350	U, D	µg/kg dry	350		BRL				30
2,4,5-Trichlorophenol	< 1730	U, D	µg/kg dry	1730		BRL				30
2,4,6-Trichlorophenol	< 877	U, D	µg/kg dry	877		BRL				30
Pentachloronitrobenzene	< 1730	U, D	µg/kg dry	1730		BRL				30
1,2,4,5-Tetrachlorobenzene	< 1730	U, D	µg/kg dry	1730		BRL				30
Surrogate: 2-Fluorobiphenyl	996		µg/kg dry		1750		57	30-130		
Surrogate: 2-Fluorophenol	861		µg/kg dry		1750		49	30-130		
Surrogate: Nitrobenzene-d5	877		µg/kg dry		1750		50	30-130		
Surrogate: Phenol-d5	824		µg/kg dry		1750		47	30-130		
Surrogate: Terphenyl-dl4	1060		µg/kg dry		1750		60	30-130		
Surrogate: 2,4,6-Tribromophenol	926		µg/kg dry		1750		53	30-130		
<b>Matrix Spike (1800478-MS1)</b>				<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>		
Acenaphthene	980	D	µg/kg dry	349	1740	BRL	56	40-140		
Acenaphthylene	983	D	µg/kg dry	349	1740	BRL	56	40-140		
Aniline	366	QC2, J, D	µg/kg dry	1730	1740	BRL	21	40-140		
Anthracene	921	D	µg/kg dry	349	1740	BRL	53	40-140		
Azobenzene/Diphenyldiazene	905	J, D	µg/kg dry	1730	1740	BRL	52	40-140		
Benzidine	983	J, D	µg/kg dry	1730	1740	BRL	56	40-140		
Benzo (a) anthracene	1000	D	µg/kg dry	349	1740	BRL	58	40-140		
Benzo (a) pyrene	950	D	µg/kg dry	349	1740	BRL	55	40-140		
Benzo (b) fluoranthene	978	D	µg/kg dry	349	1740	BRL	56	40-140		
Benzo (g,h,i) perylene	727	D	µg/kg dry	349	1740	BRL	42	40-140		
Benzo (k) fluoranthene	1030	D	µg/kg dry	349	1740	BRL	59	40-140		
Benzoic acid	612	J, D	µg/kg dry	1730	1740	BRL	35	30-130		
Benzyl alcohol	891	J, D	µg/kg dry	1730	1740	BRL	51	40-140		
Bis(2-chloroethoxy)methane	657	QM7, J, D	µg/kg dry	1730	1740	BRL	38	40-140		
Bis(2-chloroethyl)ether	834	J, D	µg/kg dry	874	1740	BRL	48	40-140		
Bis(2-chloroisopropyl)ether	760	J, D	µg/kg dry	874	1740	BRL	44	40-140		
Bis(2-ethylhexyl)phthalate	959	D	µg/kg dry	874	1740	BRL	55	40-140		
4-Bromophenyl phenyl ether	992	J, D	µg/kg dry	1730	1740	BRL	57	40-140		
Butyl benzyl phthalate	945	J, D	µg/kg dry	1730	1740	BRL	54	40-140		
Carbazole	851	J, D	µg/kg dry	874	1740	BRL	49	40-140		
4-Chloro-3-methylphenol	865	J, D	µg/kg dry	1730	1740	BRL	50	30-130		
4-Chloroaniline	535	QM7, J, D	µg/kg dry	874	1740	BRL	31	40-140		
2-Chloronaphthalene	1100	J, D	µg/kg dry	1730	1740	BRL	63	40-140		
2-Chlorophenol	917	D	µg/kg dry	874	1740	BRL	53	30-130		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>Matrix Spike (1800478-MS1)</b>				<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>		
4-Chlorophenyl phenyl ether	977	J, D	µg/kg dry	1730	1740	BRL	56	40-140		
Chrysene	924	D	µg/kg dry	349	1740	BRL	53	40-140		
Dibenzo (a,h) anthracene	772	D	µg/kg dry	349	1740	BRL	44	40-140		
Dibenzofuran	1150	D	µg/kg dry	874	1740	BRL	66	40-140		
1,2-Dichlorobenzene	1150	J, D	µg/kg dry	1730	1740	BRL	66	40-140		
1,3-Dichlorobenzene	1140	J, D	µg/kg dry	1730	1740	BRL	66	40-140		
1,4-Dichlorobenzene	1240	J, D	µg/kg dry	1730	1740	BRL	71	40-140		
3,3'-Dichlorobenzidine	1030	J, D	µg/kg dry	1730	1740	BRL	59	40-140		
2,4-Dichlorophenol	907	D	µg/kg dry	874	1740	BRL	52	30-130		
Diethyl phthalate	1020	J, D	µg/kg dry	1730	1740	BRL	59	40-140		
Dimethyl phthalate	945	J, D	µg/kg dry	1730	1740	BRL	54	40-140		
2,4-Dimethylphenol	806	J, D	µg/kg dry	1730	1740	BRL	46	30-130		
Di-n-butyl phthalate	872	J, D	µg/kg dry	1730	1740	BRL	50	40-140		
4,6-Dinitro-2-methylphenol	< 1730	QM7, U, D	µg/kg dry	1730	1740	BRL	<1	30-130		
2,4-Dinitrophenol	< 1730	QM7, U, D	µg/kg dry	1730	1740	BRL	<1	30-130		
2,4-Dinitrotoluene	853	J, D	µg/kg dry	874	1740	BRL	49	40-140		
2,6-Dinitrotoluene	1040	D	µg/kg dry	874	1740	BRL	60	40-140		
Di-n-octyl phthalate	1220	J, D	µg/kg dry	1730	1740	BRL	70	40-140		
Fluoranthene	902	D	µg/kg dry	349	1740	BRL	52	40-140		
Fluorene	949	D	µg/kg dry	349	1740	BRL	54	40-140		
Hexachlorobenzene	1200	D	µg/kg dry	874	1740	BRL	69	40-140		
Hexachlorobutadiene	1210	D	µg/kg dry	874	1740	BRL	70	40-140		
Hexachlorocyclopentadiene	195	QM7, J, D	µg/kg dry	874	1740	BRL	11	40-140		
Hexachloroethane	1050	D	µg/kg dry	874	1740	BRL	60	40-140		
Indeno (1,2,3-cd) pyrene	799	D	µg/kg dry	349	1740	BRL	46	40-140		
Isophorone	846	J, D	µg/kg dry	874	1740	BRL	49	30-130		
2-Methylnaphthalene	1100	D	µg/kg dry	349	1740	BRL	63	40-140		
2-Methylphenol	811	J, D	µg/kg dry	1730	1740	BRL	47	30-130		
3 & 4-Methylphenol	846	J, D	µg/kg dry	1730	1740	BRL	49	30-130		
Naphthalene	907	D	µg/kg dry	349	1740	BRL	52	40-140		
2-Nitroaniline	797	J, D	µg/kg dry	1730	1740	BRL	46	40-140		
3-Nitroaniline	1070	J, D	µg/kg dry	1730	1740	BRL	61	40-140		
4-Nitroaniline	1130	D	µg/kg dry	874	1740	BRL	65	40-140		
Nitrobenzene	1060	D	µg/kg dry	874	1740	BRL	61	40-140		
2-Nitrophenol	218	QM7, J, D	µg/kg dry	874	1740	BRL	12	30-130		
4-Nitrophenol	684	J, D	µg/kg dry	6910	1740	BRL	39	30-130		
N-Nitrosodimethylamine	970	D	µg/kg dry	874	1740	BRL	56	40-140		
N-Nitrosodi-n-propylamine	835	J, D	µg/kg dry	874	1740	BRL	48	40-140		
N-Nitrosodiphenylamine	952	J, D	µg/kg dry	1730	1740	BRL	55	40-140		
Pentachlorophenol	631	J, D	µg/kg dry	1730	1740	BRL	36	30-130		
Phenanthrene	931	D	µg/kg dry	349	1740	BRL	53	40-140		
Phenol	804	J, D	µg/kg dry	1730	1740	BRL	46	30-130		
Pyrene	1000	D	µg/kg dry	349	1740	BRL	58	40-140		
Pyridine	881	J, D	µg/kg dry	1730	1740	BRL	51	40-140		
1,2,4-Trichlorobenzene	1170	J, D	µg/kg dry	1730	1740	BRL	67	40-140		
1-Methylnaphthalene	882	D	µg/kg dry	349	1740	BRL	51	40-140		
2,4,5-Trichlorophenol	966	J, D	µg/kg dry	1730	1740	BRL	55	30-130		
2,4,6-Trichlorophenol	973	D	µg/kg dry	874	1740	BRL	56	30-130		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>Matrix Spike (1800478-MS1)</b>				<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>		
Pentachloronitrobenzene	1090	J, D	µg/kg dry	1730	1740	BRL	62	40-140		
1,2,4,5-Tetrachlorobenzene	1040	J, D	µg/kg dry	1730	1740	BRL	60	40-140		
Surrogate: 2-Fluorobiphenyl	994		µg/kg dry		1740		57	30-130		
Surrogate: 2-Fluorophenol	804		µg/kg dry		1740		46	30-130		
Surrogate: Nitrobenzene-d5	879		µg/kg dry		1740		50	30-130		
Surrogate: Phenol-d5	837		µg/kg dry		1740		48	30-130		
Surrogate: Terphenyl-dl4	1050		µg/kg dry		1740		60	30-130		
Surrogate: 2,4,6-Tribromophenol	1030		µg/kg dry		1740		59	30-130		
<b>Matrix Spike Dup (1800478-MSD1)</b>				<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>		
Acenaphthene	880	D	µg/kg dry	350	1750	BRL	50	40-140	11	30
Acenaphthylene	908	D	µg/kg dry	350	1750	BRL	52	40-140	8	30
Aniline	350	QC2, J, D	µg/kg dry	1730	1750	BRL	20	40-140	5	30
Anthracene	892	D	µg/kg dry	350	1750	BRL	51	40-140	3	30
Azobenzene/Diphenyldiazene	864	J, D	µg/kg dry	1730	1750	BRL	49	40-140	5	30
Benzidine	1040	J, D	µg/kg dry	1730	1750	BRL	59	40-140	5	30
Benzo (a) anthracene	945	D	µg/kg dry	350	1750	BRL	54	40-140	6	30
Benzo (a) pyrene	954	D	µg/kg dry	350	1750	BRL	54	40-140	0.4	30
Benzo (b) fluoranthene	927	D	µg/kg dry	350	1750	BRL	53	40-140	5	30
Benzo (g,h,i) perylene	705	D	µg/kg dry	350	1750	BRL	40	40-140	3	30
Benzo (k) fluoranthene	1130	D	µg/kg dry	350	1750	BRL	65	40-140	9	30
Benzoic acid	590	J, D	µg/kg dry	1730	1750	BRL	34	30-130	4	30
Benzyl alcohol	807	J, D	µg/kg dry	1730	1750	BRL	46	40-140	10	30
Bis(2-chloroethoxy)methane	663	QC2, J, D	µg/kg dry	1730	1750	BRL	38	40-140	0.9	30
Bis(2-chloroethyl)ether	728	J, D	µg/kg dry	877	1750	BRL	42	40-140	14	30
Bis(2-chloroisopropyl)ether	670	QC2, J, D	µg/kg dry	877	1750	BRL	38	40-140	13	30
Bis(2-ethylhexyl)phthalate	899	D	µg/kg dry	877	1750	BRL	51	40-140	6	30
4-Bromophenyl phenyl ether	924	J, D	µg/kg dry	1730	1750	BRL	53	40-140	7	30
Butyl benzyl phthalate	877	J, D	µg/kg dry	1730	1750	BRL	50	40-140	8	30
Carbazole	817	J, D	µg/kg dry	877	1750	BRL	47	40-140	4	30
4-Chloro-3-methylphenol	845	J, D	µg/kg dry	1730	1750	BRL	48	30-130	2	30
4-Chloroaniline	458	QC2, J, D	µg/kg dry	877	1750	BRL	26	40-140	15	30
2-Chloronaphthalene	1070	J, D	µg/kg dry	1730	1750	BRL	61	40-140	3	30
2-Chlorophenol	894	D	µg/kg dry	877	1750	BRL	51	30-130	3	30
4-Chlorophenyl phenyl ether	955	J, D	µg/kg dry	1730	1750	BRL	55	40-140	2	30
Chrysene	850	D	µg/kg dry	350	1750	BRL	49	40-140	8	30
Dibenzo (a,h) anthracene	761	D	µg/kg dry	350	1750	BRL	43	40-140	1	30
Dibenzofuran	1060	D	µg/kg dry	877	1750	BRL	60	40-140	8	30
1,2-Dichlorobenzene	1090	J, D	µg/kg dry	1730	1750	BRL	62	40-140	6	30
1,3-Dichlorobenzene	1080	J, D	µg/kg dry	1730	1750	BRL	62	40-140	6	30
1,4-Dichlorobenzene	1140	J, D	µg/kg dry	1730	1750	BRL	65	40-140	8	30
3,3'-Dichlorobenzidine	980	J, D	µg/kg dry	1730	1750	BRL	56	40-140	5	30
2,4-Dichlorophenol	873	J, D	µg/kg dry	877	1750	BRL	50	30-130	4	30
Diethyl phthalate	985	J, D	µg/kg dry	1730	1750	BRL	56	40-140	3	30
Dimethyl phthalate	898	J, D	µg/kg dry	1730	1750	BRL	51	40-140	5	30
2,4-Dimethylphenol	768	J, D	µg/kg dry	1730	1750	BRL	44	30-130	5	30
Di-n-butyl phthalate	835	J, D	µg/kg dry	1730	1750	BRL	48	40-140	4	30
4,6-Dinitro-2-methylphenol	< 1730	QC2, U, D	µg/kg dry	1730	1750	BRL	<1	30-130		30

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800478 - SW846 3546</b>										
<b>Matrix Spike Dup (1800478-MSD1)</b>	<b>Source: SC43071-01</b>				<b>Prepared: 13-Jan-18 Analyzed: 17-Jan-18</b>					
2,4-Dinitrophenol	< 1730	QC2, U, D	µg/kg dry	1730	1750	BRL	<1	30-130		30
2,4-Dinitrotoluene	775	J, D	µg/kg dry	877	1750	BRL	44	40-140	10	30
2,6-Dinitrotoluene	889	D	µg/kg dry	877	1750	BRL	51	40-140	16	30
Di-n-octyl phthalate	1270	J, D	µg/kg dry	1730	1750	BRL	73	40-140	4	30
Fluoranthene	947	D	µg/kg dry	350	1750	BRL	54	40-140	5	30
Fluorene	912	D	µg/kg dry	350	1750	BRL	52	40-140	4	30
Hexachlorobenzene	1080	D	µg/kg dry	877	1750	BRL	62	40-140	11	30
Hexachlorobutadiene	1230	D	µg/kg dry	877	1750	BRL	70	40-140	1	30
Hexachlorocyclopentadiene	135	QC2, J, D	µg/kg dry	877	1750	BRL	8	40-140	37	30
Hexachloroethane	1020	D	µg/kg dry	877	1750	BRL	58	40-140	3	30
Indeno (1,2,3-cd) pyrene	735	D	µg/kg dry	350	1750	BRL	42	40-140	8	30
Isophorone	770	J, D	µg/kg dry	877	1750	BRL	44	30-130	9	30
2-Methylnaphthalene	1080	D	µg/kg dry	350	1750	BRL	62	40-140	2	30
2-Methylphenol	735	J, D	µg/kg dry	1730	1750	BRL	42	30-130	10	30
3 & 4-Methylphenol	784	J, D	µg/kg dry	1730	1750	BRL	45	30-130	8	30
Naphthalene	882	D	µg/kg dry	350	1750	BRL	50	40-140	3	30
2-Nitroaniline	817	J, D	µg/kg dry	1730	1750	BRL	47	40-140	3	30
3-Nitroaniline	976	J, D	µg/kg dry	1730	1750	BRL	56	40-140	9	30
4-Nitroaniline	1060	D	µg/kg dry	877	1750	BRL	61	40-140	6	30
Nitrobenzene	985	D	µg/kg dry	877	1750	BRL	56	40-140	7	30
2-Nitrophenol	182	QC2, J, D	µg/kg dry	877	1750	BRL	10	30-130	18	30
4-Nitrophenol	614	J, D	µg/kg dry	6930	1750	BRL	35	30-130	11	30
N-Nitrosodimethylamine	875	J, D	µg/kg dry	877	1750	BRL	50	40-140	10	30
N-Nitrosodi-n-propylamine	836	J, D	µg/kg dry	877	1750	BRL	48	40-140	0.1	30
N-Nitrosodiphenylamine	920	J, D	µg/kg dry	1730	1750	BRL	53	40-140	3	30
Pentachlorophenol	583	J, D	µg/kg dry	1730	1750	BRL	33	30-130	8	30
Phenanthrene	878	D	µg/kg dry	350	1750	BRL	50	40-140	6	30
Phenol	728	J, D	µg/kg dry	1730	1750	BRL	42	30-130	10	30
Pyrene	980	D	µg/kg dry	350	1750	BRL	56	40-140	2	30
Pyridine	793	J, D	µg/kg dry	1730	1750	BRL	45	40-140	11	30
1,2,4-Trichlorobenzene	1170	J, D	µg/kg dry	1730	1750	BRL	67	40-140	0.4	30
1-Methylnaphthalene	840	D	µg/kg dry	350	1750	BRL	48	40-140	5	30
2,4,5-Trichlorophenol	864	J, D	µg/kg dry	1730	1750	BRL	49	30-130	11	30
2,4,6-Trichlorophenol	947	D	µg/kg dry	877	1750	BRL	54	30-130	3	30
Pentachloronitrobenzene	997	J, D	µg/kg dry	1730	1750	BRL	57	40-140	9	30
1,2,4,5-Tetrachlorobenzene	990	J, D	µg/kg dry	1730	1750	BRL	57	40-140	5	30
Surrogate: 2-Fluorobiphenyl	915		µg/kg dry		1750		52	30-130		
Surrogate: 2-Fluorophenol	780		µg/kg dry		1750		45	30-130		
Surrogate: Nitrobenzene-d5	854		µg/kg dry		1750		49	30-130		
Surrogate: Phenol-d5	752		µg/kg dry		1750		43	30-130		
Surrogate: Terphenyl-d14	996		µg/kg dry		1750		57	30-130		
Surrogate: 2,4,6-Tribromophenol	961		µg/kg dry		1750		55	30-130		
<b>Batch 1800643 - SW846 3546</b>										
<b>Blank (1800643-BLK1)</b>	<b>Prepared &amp; Analyzed: 17-Jan-18</b>									
Acenaphthene	< 66.6	U	µg/kg wet	66.6						
Acenaphthylene	< 66.6	U	µg/kg wet	66.6						
Aniline	< 330	U	µg/kg wet	330						
Anthracene	< 66.6	U	µg/kg wet	66.6						

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>Blank (1800643-BLK1)</b>	<b>Prepared &amp; Analyzed: 17-Jan-18</b>									
Azobenzene/Diphenyldiazene	< 330	U	µg/kg wet	330						
Benzidine	< 330	U	µg/kg wet	330						
Benzo (a) anthracene	< 66.6	U	µg/kg wet	66.6						
Benzo (a) pyrene	< 66.6	U	µg/kg wet	66.6						
Benzo (b) fluoranthene	< 66.6	U	µg/kg wet	66.6						
Benzo (g,h,i) perylene	< 66.6	U	µg/kg wet	66.6						
Benzo (k) fluoranthene	< 66.6	U	µg/kg wet	66.6						
Benzoic acid	< 330	U	µg/kg wet	330						
Benzyl alcohol	< 330	U	µg/kg wet	330						
Bis(2-chloroethoxy)methane	< 330	U	µg/kg wet	330						
Bis(2-chloroethyl)ether	< 167	U	µg/kg wet	167						
Bis(2-chloroisopropyl)ether	< 167	U	µg/kg wet	167						
Bis(2-ethylhexyl)phthalate	< 167	U	µg/kg wet	167						
4-Bromophenyl phenyl ether	< 330	U	µg/kg wet	330						
Butyl benzyl phthalate	< 330	U	µg/kg wet	330						
Carbazole	< 167	U	µg/kg wet	167						
4-Chloro-3-methylphenol	< 330	U	µg/kg wet	330						
4-Chloroaniline	< 167	U	µg/kg wet	167						
2-Chloronaphthalene	< 330	U	µg/kg wet	330						
2-Chlorophenol	< 167	U	µg/kg wet	167						
4-Chlorophenyl phenyl ether	< 330	U	µg/kg wet	330						
Chrysene	< 66.6	U	µg/kg wet	66.6						
Dibenzo (a,h) anthracene	< 66.6	U	µg/kg wet	66.6						
Dibenzofuran	< 167	U	µg/kg wet	167						
1,2-Dichlorobenzene	< 330	U	µg/kg wet	330						
1,3-Dichlorobenzene	< 330	U	µg/kg wet	330						
1,4-Dichlorobenzene	< 330	U	µg/kg wet	330						
3,3'-Dichlorobenzidine	< 330	U	µg/kg wet	330						
2,4-Dichlorophenol	< 167	U	µg/kg wet	167						
Diethyl phthalate	< 330	U	µg/kg wet	330						
Dimethyl phthalate	< 330	U	µg/kg wet	330						
2,4-Dimethylphenol	< 330	U	µg/kg wet	330						
Di-n-butyl phthalate	< 330	U	µg/kg wet	330						
4,6-Dinitro-2-methylphenol	< 330	U	µg/kg wet	330						
2,4-Dinitrophenol	< 330	U	µg/kg wet	330						
2,4-Dinitrotoluene	< 167	U	µg/kg wet	167						
2,6-Dinitrotoluene	< 167	U	µg/kg wet	167						
Di-n-octyl phthalate	< 330	U	µg/kg wet	330						
Fluoranthene	< 66.6	U	µg/kg wet	66.6						
Fluorene	< 66.6	U	µg/kg wet	66.6						
Hexachlorobenzene	< 167	U	µg/kg wet	167						
Hexachlorobutadiene	< 167	U	µg/kg wet	167						
Hexachlorocyclopentadiene	< 167	U	µg/kg wet	167						
Hexachloroethane	< 167	U	µg/kg wet	167						
Indeno (1,2,3-cd) pyrene	< 66.6	U	µg/kg wet	66.6						
Isophorone	< 167	U	µg/kg wet	167						
2-Methylnaphthalene	< 66.6	U	µg/kg wet	66.6						
2-Methylphenol	< 330	U	µg/kg wet	330						
3 & 4-Methylphenol	< 330	U	µg/kg wet	330						
Naphthalene	< 66.6	U	µg/kg wet	66.6						

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8270D</u></b>										
<b>Batch 1800643 - SW846 3546</b>										
<b><u>Blank (1800643-BLK1)</u></b>					<u>Prepared &amp; Analyzed: 17-Jan-18</u>					
2-Nitroaniline	< 330	U	µg/kg wet	330						
3-Nitroaniline	< 330	U	µg/kg wet	330						
4-Nitroaniline	< 167	U	µg/kg wet	167						
Nitrobenzene	< 167	U	µg/kg wet	167						
2-Nitrophenol	< 167	U	µg/kg wet	167						
4-Nitrophenol	< 1320	U	µg/kg wet	1320						
N-Nitrosodimethylamine	< 167	U	µg/kg wet	167						
N-Nitrosodi-n-propylamine	< 167	U	µg/kg wet	167						
N-Nitrosodiphenylamine	< 330	U	µg/kg wet	330						
Pentachlorophenol	< 330	U	µg/kg wet	330						
Phenanthrene	< 66.6	U	µg/kg wet	66.6						
Phenol	< 330	U	µg/kg wet	330						
Pyrene	< 66.6	U	µg/kg wet	66.6						
Pyridine	< 330	U	µg/kg wet	330						
1,2,4-Trichlorobenzene	< 330	U	µg/kg wet	330						
1-Methylnaphthalene	< 66.6	U	µg/kg wet	66.6						
2,4,5-Trichlorophenol	< 330	U	µg/kg wet	330						
2,4,6-Trichlorophenol	< 167	U	µg/kg wet	167						
Pentachloronitrobenzene	< 330	U	µg/kg wet	330						
1,2,4,5-Tetrachlorobenzene	< 330	U	µg/kg wet	330						
Surrogate: 2-Fluorobiphenyl	1110		µg/kg wet		1660		67	30-130		
Surrogate: 2-Fluorophenol	781		µg/kg wet		1660		47	30-130		
Surrogate: Nitrobenzene-d5	1030		µg/kg wet		1660		62	30-130		
Surrogate: Phenol-d5	872		µg/kg wet		1660		52	30-130		
Surrogate: Terphenyl-dl4	1350		µg/kg wet		1660		81	30-130		
Surrogate: 2,4,6-Tribromophenol	896		µg/kg wet		1660		54	30-130		
<b><u>LCS (1800643-BS1)</u></b>					<u>Prepared &amp; Analyzed: 17-Jan-18</u>					
Acenaphthene	1360		µg/kg wet	66.7	1670		82	40-140		
Acenaphthylene	1320		µg/kg wet	66.7	1670		79	40-140		
Aniline	591	QC2	µg/kg wet	330	1670		36	40-140		
Anthracene	1130		µg/kg wet	66.7	1670		68	40-140		
Azobenzene/Diphenyldiazene	1170		µg/kg wet	330	1670		70	40-140		
Benzidine	885		µg/kg wet	330	1670		53	40-140		
Benzo (a) anthracene	1250		µg/kg wet	66.7	1670		75	40-140		
Benzo (a) pyrene	1320		µg/kg wet	66.7	1670		79	40-140		
Benzo (b) fluoranthene	1290		µg/kg wet	66.7	1670		78	40-140		
Benzo (g,h,i) perylene	1230		µg/kg wet	66.7	1670		74	40-140		
Benzo (k) fluoranthene	1340		µg/kg wet	66.7	1670		81	40-140		
Benzoic acid	442	QC2	µg/kg wet	330	1670		27	30-130		
Benzyl alcohol	970		µg/kg wet	330	1670		58	40-140		
Bis(2-chloroethoxy)methane	834		µg/kg wet	330	1670		50	40-140		
Bis(2-chloroethyl)ether	939		µg/kg wet	167	1670		56	40-140		
Bis(2-chloroisopropyl)ether	789		µg/kg wet	167	1670		47	40-140		
Bis(2-ethylhexyl)phthalate	1170		µg/kg wet	167	1670		70	40-140		
4-Bromophenyl phenyl ether	1250		µg/kg wet	330	1670		75	40-140		
Butyl benzyl phthalate	1200		µg/kg wet	330	1670		72	40-140		
Carbazole	1270		µg/kg wet	167	1670		76	40-140		
4-Chloro-3-methylphenol	1350		µg/kg wet	330	1670		81	30-130		
4-Chloroaniline	631	QC2	µg/kg wet	167	1670		38	40-140		
2-Chloronaphthalene	1580		µg/kg wet	330	1670		95	40-140		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>LCS (1800643-BS1)</b>	Prepared & Analyzed: 17-Jan-18									
2-Chlorophenol	1030		µg/kg wet	167	1670		62	30-130		
4-Chlorophenyl phenyl ether	1500		µg/kg wet	330	1670		90	40-140		
Chrysene	1270		µg/kg wet	66.7	1670		76	40-140		
Dibenzo (a,h) anthracene	1350		µg/kg wet	66.7	1670		81	40-140		
Dibenzofuran	1470		µg/kg wet	167	1670		88	40-140		
1,2-Dichlorobenzene	1320		µg/kg wet	330	1670		79	40-140		
1,3-Dichlorobenzene	1200		µg/kg wet	330	1670		72	40-140		
1,4-Dichlorobenzene	1310		µg/kg wet	330	1670		78	40-140		
3,3'-Dichlorobenzidine	1800		µg/kg wet	330	1670		108	40-140		
2,4-Dichlorophenol	1250		µg/kg wet	167	1670		75	30-130		
Diethyl phthalate	1540		µg/kg wet	330	1670		93	40-140		
Dimethyl phthalate	1360		µg/kg wet	330	1670		82	40-140		
2,4-Dimethylphenol	900		µg/kg wet	330	1670		54	30-130		
Di-n-butyl phthalate	1120		µg/kg wet	330	1670		67	40-140		
4,6-Dinitro-2-methylphenol	1040		µg/kg wet	330	1670		62	30-130		
2,4-Dinitrophenol	658		µg/kg wet	330	1670		39	30-130		
2,4-Dinitrotoluene	1630		µg/kg wet	167	1670		98	40-140		
2,6-Dinitrotoluene	1590		µg/kg wet	167	1670		95	40-140		
Di-n-octyl phthalate	1330		µg/kg wet	330	1670		80	40-140		
Fluoranthene	1260		µg/kg wet	66.7	1670		75	40-140		
Fluorene	1290		µg/kg wet	66.7	1670		78	40-140		
Hexachlorobenzene	1530		µg/kg wet	167	1670		92	40-140		
Hexachlorobutadiene	1630		µg/kg wet	167	1670		98	40-140		
Hexachlorocyclopentadiene	1770		µg/kg wet	167	1670		106	40-140		
Hexachloroethane	1460		µg/kg wet	167	1670		88	40-140		
Indeno (1,2,3-cd) pyrene	1230		µg/kg wet	66.7	1670		74	40-140		
Isophorone	1050		µg/kg wet	167	1670		63	40-140		
2-Methylnaphthalene	1400		µg/kg wet	66.7	1670		84	40-140		
2-Methylphenol	967		µg/kg wet	330	1670		58	30-130		
3 & 4-Methylphenol	1040		µg/kg wet	330	1670		62	30-130		
Naphthalene	1150		µg/kg wet	66.7	1670		69	40-140		
2-Nitroaniline	1160		µg/kg wet	330	1670		70	40-140		
3-Nitroaniline	1040		µg/kg wet	330	1670		62	40-140		
4-Nitroaniline	1170		µg/kg wet	167	1670		70	40-140		
Nitrobenzene	1350		µg/kg wet	167	1670		81	40-140		
2-Nitrophenol	1140		µg/kg wet	167	1670		68	30-130		
4-Nitrophenol	1200	J	µg/kg wet	1320	1670		72	30-130		
N-Nitrosodimethylamine	1100		µg/kg wet	167	1670		66	40-140		
N-Nitrosodi-n-propylamine	1020		µg/kg wet	167	1670		61	40-140		
N-Nitrosodiphenylamine	1280		µg/kg wet	330	1670		77	40-140		
Pentachlorophenol	967		µg/kg wet	330	1670		58	30-130		
Phenanthrene	1200		µg/kg wet	66.7	1670		72	40-140		
Phenol	1000		µg/kg wet	330	1670		60	30-130		
Pyrene	1330		µg/kg wet	66.7	1670		80	40-140		
Pyridine	903		µg/kg wet	330	1670		54	40-140		
1,2,4-Trichlorobenzene	1490		µg/kg wet	330	1670		90	40-140		
1-Methylnaphthalene	1200		µg/kg wet	66.7	1670		72	40-140		
2,4,5-Trichlorophenol	1480		µg/kg wet	330	1670		89	30-130		
2,4,6-Trichlorophenol	1340		µg/kg wet	167	1670		80	30-130		
Pentachloronitrobenzene	1730		µg/kg wet	330	1670		104	40-140		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>LCS (1800643-BS1)</b>					Prepared & Analyzed: 17-Jan-18					
1,2,4,5-Tetrachlorobenzene	1410		µg/kg wet	330	1670		85	40-140		
Surrogate: 2-Fluorobiphenyl	1450		µg/kg wet		1670		87	30-130		
Surrogate: 2-Fluorophenol	939		µg/kg wet		1670		56	30-130		
Surrogate: Nitrobenzene-d5	1230		µg/kg wet		1670		74	30-130		
Surrogate: Phenol-d5	1100		µg/kg wet		1670		66	30-130		
Surrogate: Terphenyl-dl4	1520		µg/kg wet		1670		91	30-130		
Surrogate: 2,4,6-Tribromophenol	1480		µg/kg wet		1670		89	30-130		
<b>LCS Dup (1800643-BSD1)</b>					Prepared & Analyzed: 17-Jan-18					
Acenaphthene	1450		µg/kg wet	66.5	1660		87	40-140	6	30
Acenaphthylene	1410		µg/kg wet	66.5	1660		85	40-140	6	30
Aniline	656	QC2	µg/kg wet	329	1660		39	40-140	10	30
Anthracene	1150		µg/kg wet	66.5	1660		69	40-140	2	30
Azobenzene/Diphenyldiazene	1200		µg/kg wet	329	1660		72	40-140	2	30
Benzidine	1320	QR2	µg/kg wet	329	1660		79	40-140	39	30
Benzo (a) anthracene	1240		µg/kg wet	66.5	1660		75	40-140	0.3	30
Benzo (a) pyrene	1330		µg/kg wet	66.5	1660		80	40-140	0.9	30
Benzo (b) fluoranthene	1290		µg/kg wet	66.5	1660		78	40-140	0.3	30
Benzo (g,h,i) perylene	1230		µg/kg wet	66.5	1660		74	40-140	0.2	30
Benzo (k) fluoranthene	1430		µg/kg wet	66.5	1660		86	40-140	7	30
Benzoic acid	402	QC2	µg/kg wet	329	1660		24	30-130	10	30
Benzyl alcohol	1020		µg/kg wet	329	1660		62	40-140	5	30
Bis(2-chloroethoxy)methane	862		µg/kg wet	329	1660		52	40-140	3	30
Bis(2-chloroethyl)ether	917		µg/kg wet	167	1660		55	40-140	2	30
Bis(2-chloroisopropyl)ether	815		µg/kg wet	167	1660		49	40-140	3	30
Bis(2-ethylhexyl)phthalate	1170		µg/kg wet	167	1660		71	40-140	0.1	30
4-Bromophenyl phenyl ether	1280		µg/kg wet	329	1660		77	40-140	2	30
Butyl benzyl phthalate	1200		µg/kg wet	329	1660		72	40-140	0.2	30
Carbazole	1270		µg/kg wet	167	1660		77	40-140	0.3	30
4-Chloro-3-methylphenol	1360		µg/kg wet	329	1660		82	30-130	0.7	30
4-Chloroaniline	839		µg/kg wet	167	1660		50	40-140	28	30
2-Chloronaphthalene	1590		µg/kg wet	329	1660		96	40-140	0.7	30
2-Chlorophenol	1070		µg/kg wet	167	1660		64	30-130	3	30
4-Chlorophenyl phenyl ether	1520		µg/kg wet	329	1660		91	40-140	1	30
Chrysene	1300		µg/kg wet	66.5	1660		78	40-140	2	30
Dibenzo (a,h) anthracene	1380		µg/kg wet	66.5	1660		83	40-140	2	30
Dibenzofuran	1520		µg/kg wet	167	1660		92	40-140	4	30
1,2-Dichlorobenzene	1360		µg/kg wet	329	1660		82	40-140	3	30
1,3-Dichlorobenzene	1280		µg/kg wet	329	1660		77	40-140	6	30
1,4-Dichlorobenzene	1360		µg/kg wet	329	1660		82	40-140	4	30
3,3'-Dichlorobenzidine	1910		µg/kg wet	329	1660		115	40-140	6	30
2,4-Dichlorophenol	1270		µg/kg wet	167	1660		76	30-130	2	30
Diethyl phthalate	1550		µg/kg wet	329	1660		93	40-140	0.6	30
Dimethyl phthalate	1460		µg/kg wet	329	1660		88	40-140	7	30
2,4-Dimethylphenol	963		µg/kg wet	329	1660		58	30-130	7	30
Di-n-butyl phthalate	1110		µg/kg wet	329	1660		67	40-140	0.6	30
4,6-Dinitro-2-methylphenol	1010		µg/kg wet	329	1660		61	30-130	3	30
2,4-Dinitrophenol	667		µg/kg wet	329	1660		40	30-130	2	30
2,4-Dinitrotoluene	1680		µg/kg wet	167	1660		101	40-140	3	30
2,6-Dinitrotoluene	1680		µg/kg wet	167	1660		101	40-140	5	30
Di-n-octyl phthalate	1360		µg/kg wet	329	1660		82	40-140	2	30

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>LCS Dup (1800643-BSD1)</b>					<b>Prepared &amp; Analyzed: 17-Jan-18</b>					
Fluoranthene	1260		µg/kg wet	66.5	1660		76	40-140	0.05	30
Fluorene	1330		µg/kg wet	66.5	1660		80	40-140	3	30
Hexachlorobenzene	1590		µg/kg wet	167	1660		96	40-140	4	30
Hexachlorobutadiene	1640		µg/kg wet	167	1660		99	40-140	1	30
Hexachlorocyclopentadiene	1860		µg/kg wet	167	1660		112	40-140	5	30
Hexachloroethane	1520		µg/kg wet	167	1660		92	40-140	4	30
Indeno (1,2,3-cd) pyrene	1270		µg/kg wet	66.5	1660		77	40-140	3	30
Isophorone	1060		µg/kg wet	167	1660		64	40-140	0.9	30
2-Methylnaphthalene	1220		µg/kg wet	66.5	1660		74	40-140	14	30
2-Methylphenol	994		µg/kg wet	329	1660		60	30-130	3	30
3 & 4-Methylphenol	1060		µg/kg wet	329	1660		64	30-130	2	30
Naphthalene	1160		µg/kg wet	66.5	1660		70	40-140	0.7	30
2-Nitroaniline	1200		µg/kg wet	329	1660		72	40-140	3	30
3-Nitroaniline	1310		µg/kg wet	329	1660		79	40-140	23	30
4-Nitroaniline	1320		µg/kg wet	167	1660		79	40-140	12	30
Nitrobenzene	1370		µg/kg wet	167	1660		82	40-140	1	30
2-Nitrophenol	1140		µg/kg wet	167	1660		69	30-130	0.2	30
4-Nitrophenol	1190	J	µg/kg wet	1320	1660		72	30-130	0.6	30
N-Nitrosodimethylamine	1050		µg/kg wet	167	1660		63	40-140	4	30
N-Nitrosodi-n-propylamine	1060		µg/kg wet	167	1660		63	40-140	3	30
N-Nitrosodiphenylamine	1270		µg/kg wet	329	1660		77	40-140	0.5	30
Pentachlorophenol	968		µg/kg wet	329	1660		58	30-130	0.1	30
Phenanthrene	1250		µg/kg wet	66.5	1660		75	40-140	4	30
Phenol	1010		µg/kg wet	329	1660		61	30-130	1	30
Pyrene	1260		µg/kg wet	66.5	1660		76	40-140	5	30
Pyridine	874		µg/kg wet	329	1660		53	40-140	3	30
1,2,4-Trichlorobenzene	1530		µg/kg wet	329	1660		92	40-140	2	30
1-Methylnaphthalene	1210		µg/kg wet	66.5	1660		73	40-140	1	30
2,4,5-Trichlorophenol	1440		µg/kg wet	329	1660		87	30-130	3	30
2,4,6-Trichlorophenol	1340		µg/kg wet	167	1660		81	30-130	0.09	30
Pentachloronitrobenzene	1780		µg/kg wet	329	1660		107	40-140	3	30
1,2,4,5-Tetrachlorobenzene	1460		µg/kg wet	329	1660		88	40-140	3	30
Surrogate: 2-Fluorobiphenyl	1410		µg/kg wet		1660		85	30-130		
Surrogate: 2-Fluorophenol	1020		µg/kg wet		1660		62	30-130		
Surrogate: Nitrobenzene-d5	1230		µg/kg wet		1660		74	30-130		
Surrogate: Phenol-d5	1100		µg/kg wet		1660		66	30-130		
Surrogate: Terphenyl-dl4	1480		µg/kg wet		1660		89	30-130		
Surrogate: 2,4,6-Tribromophenol	1450		µg/kg wet		1660		87	30-130		
<b>Duplicate (1800643-DUP1)</b>				<b>Source: SC43071-17</b>		<b>Prepared &amp; Analyzed: 17-Jan-18</b>				
Acenaphthene	< 71.9	U	µg/kg dry	71.9		BRL				30
Acenaphthylene	< 71.9	U	µg/kg dry	71.9		BRL				30
Aniline	< 356	U	µg/kg dry	356		BRL				30
Anthracene	< 71.9	U	µg/kg dry	71.9		BRL				30
Azobenzene/Diphenyldiazene	< 356	U	µg/kg dry	356		BRL				30
Benzidine	< 356	U	µg/kg dry	356		BRL				30
Benzo (a) anthracene	< 71.9	U	µg/kg dry	71.9		BRL				30
Benzo (a) pyrene	< 71.9	U	µg/kg dry	71.9		BRL				30
Benzo (b) fluoranthene	< 71.9	U	µg/kg dry	71.9		BRL				30
Benzo (g,h,i) perylene	< 71.9	U	µg/kg dry	71.9		BRL				30
Benzo (k) fluoranthene	< 71.9	U	µg/kg dry	71.9		BRL				30

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>Duplicate (1800643-DUP1)</b>				<b>Source: SC43071-17</b>		<b>Prepared &amp; Analyzed: 17-Jan-18</b>				
Benzoic acid	< 356	U	µg/kg dry	356		BRL				30
Benzyl alcohol	< 356	U	µg/kg dry	356		BRL				30
Bis(2-chloroethoxy)methane	< 356	U	µg/kg dry	356		BRL				30
Bis(2-chloroethyl)ether	< 180	U	µg/kg dry	180		BRL				30
Bis(2-chloroisopropyl)ether	< 180	U	µg/kg dry	180		BRL				30
Bis(2-ethylhexyl)phthalate	< 180	U	µg/kg dry	180		BRL				30
4-Bromophenyl phenyl ether	< 356	U	µg/kg dry	356		BRL				30
Butyl benzyl phthalate	< 356	U	µg/kg dry	356		BRL				30
Carbazole	< 180	U	µg/kg dry	180		BRL				30
4-Chloro-3-methylphenol	< 356	U	µg/kg dry	356		BRL				30
4-Chloroaniline	< 180	U	µg/kg dry	180		BRL				30
2-Chloronaphthalene	< 356	U	µg/kg dry	356		BRL				30
2-Chlorophenol	< 180	U	µg/kg dry	180		BRL				30
4-Chlorophenyl phenyl ether	< 356	U	µg/kg dry	356		BRL				30
Chrysene	< 71.9	U	µg/kg dry	71.9		BRL				30
Dibenzo (a,h) anthracene	< 71.9	U	µg/kg dry	71.9		BRL				30
Dibenzofuran	< 180	U	µg/kg dry	180		BRL				30
1,2-Dichlorobenzene	< 356	U	µg/kg dry	356		BRL				30
1,3-Dichlorobenzene	< 356	U	µg/kg dry	356		BRL				30
1,4-Dichlorobenzene	< 356	U	µg/kg dry	356		BRL				30
3,3'-Dichlorobenzidine	< 356	U	µg/kg dry	356		BRL				30
2,4-Dichlorophenol	< 180	U	µg/kg dry	180		BRL				30
Diethyl phthalate	< 356	U	µg/kg dry	356		BRL				30
Dimethyl phthalate	< 356	U	µg/kg dry	356		BRL				30
2,4-Dimethylphenol	< 356	U	µg/kg dry	356		BRL				30
Di-n-butyl phthalate	< 356	U	µg/kg dry	356		BRL				30
4,6-Dinitro-2-methylphenol	< 356	U	µg/kg dry	356		BRL				30
2,4-Dinitrophenol	< 356	U	µg/kg dry	356		BRL				30
2,4-Dinitrotoluene	< 180	U	µg/kg dry	180		BRL				30
2,6-Dinitrotoluene	< 180	U	µg/kg dry	180		BRL				30
Di-n-octyl phthalate	< 356	U	µg/kg dry	356		BRL				30
Fluoranthene	< 71.9	U	µg/kg dry	71.9		BRL				30
Fluorene	< 71.9	U	µg/kg dry	71.9		BRL				30
Hexachlorobenzene	< 180	U	µg/kg dry	180		BRL				30
Hexachlorobutadiene	< 180	U	µg/kg dry	180		BRL				30
Hexachlorocyclopentadiene	< 180	U	µg/kg dry	180		BRL				30
Hexachloroethane	< 180	U	µg/kg dry	180		BRL				30
Indeno (1,2,3-cd) pyrene	< 71.9	U	µg/kg dry	71.9		BRL				30
Isophorone	< 180	U	µg/kg dry	180		BRL				30
2-Methylnaphthalene	< 71.9	U	µg/kg dry	71.9		BRL				30
2-Methylphenol	< 356	U	µg/kg dry	356		BRL				30
3 & 4-Methylphenol	< 356	U	µg/kg dry	356		BRL				30
Naphthalene	< 71.9	U	µg/kg dry	71.9		BRL				30
2-Nitroaniline	< 356	U	µg/kg dry	356		BRL				30
3-Nitroaniline	< 356	U	µg/kg dry	356		BRL				30
4-Nitroaniline	< 180	U	µg/kg dry	180		BRL				30
Nitrobenzene	< 180	U	µg/kg dry	180		BRL				30
2-Nitrophenol	< 180	U	µg/kg dry	180		BRL				30
4-Nitrophenol	< 1420	U	µg/kg dry	1420		BRL				30
N-Nitrosodimethylamine	< 180	U	µg/kg dry	180		BRL				30

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>Duplicate (1800643-DUP1)</b>										
				<b>Source: SC43071-17</b>			<b>Prepared &amp; Analyzed: 17-Jan-18</b>			
N-Nitrosodi-n-propylamine	< 180	U	µg/kg dry	180		BRL				30
N-Nitrosodiphenylamine	< 356	U	µg/kg dry	356		BRL				30
Pentachlorophenol	< 356	U	µg/kg dry	356		BRL				30
Phenanthrene	< 71.9	U	µg/kg dry	71.9		BRL				30
Phenol	< 356	U	µg/kg dry	356		BRL				30
Pyrene	< 71.9	U	µg/kg dry	71.9		BRL				30
Pyridine	< 356	U	µg/kg dry	356		BRL				30
1,2,4-Trichlorobenzene	< 356	U	µg/kg dry	356		BRL				30
1-Methylnaphthalene	< 71.9	U	µg/kg dry	71.9		BRL				30
2,4,5-Trichlorophenol	< 356	U	µg/kg dry	356		BRL				30
2,4,6-Trichlorophenol	< 180	U	µg/kg dry	180		BRL				30
Pentachloronitrobenzene	< 356	U	µg/kg dry	356		BRL				30
1,2,4,5-Tetrachlorobenzene	< 356	U	µg/kg dry	356		BRL				30
<i>Surrogate: 2-Fluorobiphenyl</i>	<i>1160</i>		µg/kg dry		<i>1800</i>		<i>64</i>	<i>30-130</i>		
<i>Surrogate: 2-Fluorophenol</i>	<i>1110</i>		µg/kg dry		<i>1800</i>		<i>62</i>	<i>30-130</i>		
<i>Surrogate: Nitrobenzene-d5</i>	<i>1110</i>		µg/kg dry		<i>1800</i>		<i>62</i>	<i>30-130</i>		
<i>Surrogate: Phenol-d5</i>	<i>1030</i>		µg/kg dry		<i>1800</i>		<i>57</i>	<i>30-130</i>		
<i>Surrogate: Terphenyl-dl4</i>	<i>1430</i>		µg/kg dry		<i>1800</i>		<i>79</i>	<i>30-130</i>		
<i>Surrogate: 2,4,6-Tribromophenol</i>	<i>1300</i>		µg/kg dry		<i>1800</i>		<i>72</i>	<i>30-130</i>		
<b>Matrix Spike (1800643-MS1)</b>				<b>Source: SC43071-17</b>			<b>Prepared &amp; Analyzed: 17-Jan-18</b>			
Acenaphthene	<b>1550</b>		µg/kg dry	72.3	1810	BRL	86	40-140		
Acenaphthylene	<b>1490</b>		µg/kg dry	72.3	1810	BRL	83	40-140		
Aniline	<b>635</b>	QC2	µg/kg dry	358	1810	BRL	35	40-140		
Anthracene	<b>1170</b>		µg/kg dry	72.3	1810	BRL	65	40-140		
Azobenzene/Diphenyldiazene	<b>1200</b>		µg/kg dry	358	1810	BRL	66	40-140		
Benzidine	<b>1310</b>		µg/kg dry	358	1810	BRL	73	40-140		
Benzo (a) anthracene	<b>1320</b>		µg/kg dry	72.3	1810	BRL	73	40-140		
Benzo (a) pyrene	<b>1420</b>		µg/kg dry	72.3	1810	BRL	79	40-140		
Benzo (b) fluoranthene	<b>1470</b>		µg/kg dry	72.3	1810	BRL	81	40-140		
Benzo (g,h,i) perylene	<b>1260</b>		µg/kg dry	72.3	1810	BRL	70	40-140		
Benzo (k) fluoranthene	<b>1360</b>		µg/kg dry	72.3	1810	BRL	75	40-140		
Benzoic acid	<b>1070</b>		µg/kg dry	358	1810	BRL	59	30-130		
Benzyl alcohol	<b>1160</b>		µg/kg dry	358	1810	BRL	64	40-140		
Bis(2-chloroethoxy)methane	<b>881</b>		µg/kg dry	358	1810	BRL	49	40-140		
Bis(2-chloroethyl)ether	<b>1060</b>		µg/kg dry	181	1810	BRL	59	40-140		
Bis(2-chloroisopropyl)ether	<b>884</b>		µg/kg dry	181	1810	BRL	49	40-140		
Bis(2-ethylhexyl)phthalate	<b>1190</b>		µg/kg dry	181	1810	BRL	66	40-140		
4-Bromophenyl phenyl ether	<b>1280</b>		µg/kg dry	358	1810	BRL	71	40-140		
Butyl benzyl phthalate	<b>1190</b>		µg/kg dry	358	1810	BRL	66	40-140		
Carbazole	<b>1340</b>		µg/kg dry	181	1810	BRL	74	40-140		
4-Chloro-3-methylphenol	<b>1510</b>		µg/kg dry	358	1810	BRL	84	30-130		
4-Chloroaniline	<b>722</b>		µg/kg dry	181	1810	BRL	40	40-140		
2-Chloronaphthalene	<b>1790</b>		µg/kg dry	358	1810	BRL	99	40-140		
2-Chlorophenol	<b>1190</b>		µg/kg dry	181	1810	BRL	66	30-130		
4-Chlorophenyl phenyl ether	<b>1650</b>		µg/kg dry	358	1810	BRL	91	40-140		
Chrysene	<b>1360</b>		µg/kg dry	72.3	1810	BRL	75	40-140		
Dibenzo (a,h) anthracene	<b>1450</b>		µg/kg dry	72.3	1810	BRL	80	40-140		
Dibenzofuran	<b>1620</b>		µg/kg dry	181	1810	BRL	89	40-140		
1,2-Dichlorobenzene	<b>1520</b>		µg/kg dry	358	1810	BRL	84	40-140		
1,3-Dichlorobenzene	<b>1450</b>		µg/kg dry	358	1810	BRL	81	40-140		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>Matrix Spike (1800643-MS1)</b>				<b>Source: SC43071-17</b>		<b>Prepared &amp; Analyzed: 17-Jan-18</b>				
1,4-Dichlorobenzene	1560		µg/kg dry	358	1810	BRL	86	40-140		
3,3'-Dichlorobenzidine	2030		µg/kg dry	358	1810	BRL	113	40-140		
2,4-Dichlorophenol	1360		µg/kg dry	181	1810	BRL	75	30-130		
Diethyl phthalate	1680		µg/kg dry	358	1810	BRL	93	40-140		
Dimethyl phthalate	1460		µg/kg dry	358	1810	BRL	81	40-140		
2,4-Dimethylphenol	1120		µg/kg dry	358	1810	BRL	62	30-130		
Di-n-butyl phthalate	1150		µg/kg dry	358	1810	BRL	64	40-140		
4,6-Dinitro-2-methylphenol	636		µg/kg dry	358	1810	BRL	35	30-130		
2,4-Dinitrophenol	323	QM7, J	µg/kg dry	358	1810	BRL	18	30-130		
2,4-Dinitrotoluene	1700		µg/kg dry	181	1810	BRL	94	40-140		
2,6-Dinitrotoluene	1620		µg/kg dry	181	1810	BRL	90	40-140		
Di-n-octyl phthalate	1380		µg/kg dry	358	1810	BRL	77	40-140		
Fluoranthene	1290		µg/kg dry	72.3	1810	BRL	72	40-140		
Fluorene	1450		µg/kg dry	72.3	1810	BRL	80	40-140		
Hexachlorobenzene	1620		µg/kg dry	181	1810	BRL	90	40-140		
Hexachlorobutadiene	1830		µg/kg dry	181	1810	BRL	101	40-140		
Hexachlorocyclopentadiene	1430		µg/kg dry	181	1810	BRL	79	40-140		
Hexachloroethane	1580		µg/kg dry	181	1810	BRL	87	40-140		
Indeno (1,2,3-cd) pyrene	1330		µg/kg dry	72.3	1810	BRL	74	40-140		
Isophorone	1110		µg/kg dry	181	1810	BRL	61	30-130		
2-Methylnaphthalene	1390		µg/kg dry	72.3	1810	BRL	77	40-140		
2-Methylphenol	1090		µg/kg dry	358	1810	BRL	61	30-130		
3 & 4-Methylphenol	1180		µg/kg dry	358	1810	BRL	65	30-130		
Naphthalene	1330		µg/kg dry	72.3	1810	BRL	74	40-140		
2-Nitroaniline	1230		µg/kg dry	358	1810	BRL	68	40-140		
3-Nitroaniline	1080		µg/kg dry	358	1810	BRL	60	40-140		
4-Nitroaniline	1250		µg/kg dry	181	1810	BRL	69	40-140		
Nitrobenzene	1500		µg/kg dry	181	1810	BRL	83	40-140		
2-Nitrophenol	1190		µg/kg dry	181	1810	BRL	66	30-130		
4-Nitrophenol	1290	J	µg/kg dry	1430	1810	BRL	72	30-130		
N-Nitrosodimethylamine	1480		µg/kg dry	181	1810	BRL	82	40-140		
N-Nitrosodi-n-propylamine	1140		µg/kg dry	181	1810	BRL	63	40-140		
N-Nitrosodiphenylamine	1290		µg/kg dry	358	1810	BRL	71	40-140		
Pentachlorophenol	1150		µg/kg dry	358	1810	BRL	64	30-130		
Phenanthrene	1260		µg/kg dry	72.3	1810	BRL	70	40-140		
Phenol	1220		µg/kg dry	358	1810	BRL	67	30-130		
Pyrene	1360		µg/kg dry	72.3	1810	BRL	75	40-140		
Pyridine	1310		µg/kg dry	358	1810	BRL	72	40-140		
1,2,4-Trichlorobenzene	1650		µg/kg dry	358	1810	BRL	92	40-140		
1-Methylnaphthalene	1330		µg/kg dry	72.3	1810	BRL	73	40-140		
2,4,5-Trichlorophenol	1720		µg/kg dry	358	1810	BRL	95	30-130		
2,4,6-Trichlorophenol	1490		µg/kg dry	181	1810	BRL	82	30-130		
Pentachloronitrobenzene	1760		µg/kg dry	358	1810	BRL	97	40-140		
1,2,4,5-Tetrachlorobenzene	1600		µg/kg dry	358	1810	BRL	89	40-140		
Surrogate: 2-Fluorobiphenyl	1550		µg/kg dry		1810		86	30-130		
Surrogate: 2-Fluorophenol	1160		µg/kg dry		1810		64	30-130		
Surrogate: Nitrobenzene-d5	1230		µg/kg dry		1810		68	30-130		
Surrogate: Phenol-d5	1200		µg/kg dry		1810		66	30-130		
Surrogate: Terphenyl-d14	1470		µg/kg dry		1810		81	30-130		
Surrogate: 2,4,6-Tribromophenol	1510		µg/kg dry		1810		83	30-130		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>Matrix Spike Dup (1800643-MSD1)</b>				<b>Source: SC43071-17</b>		<b>Prepared &amp; Analyzed: 17-Jan-18</b>				
Acenaphthene	1380	QC2	µg/kg dry	72.3	1810	BRL	77	40-140	11	30
Acenaphthylene	1350		µg/kg dry	72.3	1810	BRL	75	40-140	10	30
Aniline	609		µg/kg dry	358	1810	BRL	34	40-140	4	30
Anthracene	1030		µg/kg dry	72.3	1810	BRL	57	40-140	12	30
Azobenzene/Diphenyldiazene	1080		µg/kg dry	358	1810	BRL	60	40-140	10	30
Benzidine	1510		µg/kg dry	358	1810	BRL	84	40-140	14	30
Benzo (a) anthracene	1210		µg/kg dry	72.3	1810	BRL	67	40-140	8	30
Benzo (a) pyrene	1290		µg/kg dry	72.3	1810	BRL	71	40-140	10	30
Benzo (b) fluoranthene	1340		µg/kg dry	72.3	1810	BRL	74	40-140	9	30
Benzo (g,h,i) perylene	1180		µg/kg dry	72.3	1810	BRL	65	40-140	6	30
Benzo (k) fluoranthene	1230		µg/kg dry	72.3	1810	BRL	68	40-140	10	30
Benzoic acid	922		µg/kg dry	358	1810	BRL	51	30-130	15	30
Benzyl alcohol	1050		µg/kg dry	358	1810	BRL	58	40-140	10	30
Bis(2-chloroethoxy)methane	789		µg/kg dry	358	1810	BRL	44	40-140	11	30
Bis(2-chloroethyl)ether	984		µg/kg dry	181	1810	BRL	55	40-140	8	30
Bis(2-chloroisopropyl)ether	809		µg/kg dry	181	1810	BRL	45	40-140	9	30
Bis(2-ethylhexyl)phthalate	1060		µg/kg dry	181	1810	BRL	58	40-140	12	30
4-Bromophenyl phenyl ether	1160	QM7	µg/kg dry	358	1810	BRL	64	40-140	9	30
Butyl benzyl phthalate	1060		µg/kg dry	358	1810	BRL	59	40-140	11	30
Carbazole	1150		µg/kg dry	181	1810	BRL	63	40-140	15	30
4-Chloro-3-methylphenol	1340		µg/kg dry	358	1810	BRL	74	30-130	12	30
4-Chloroaniline	703		µg/kg dry	181	1810	BRL	39	40-140	3	30
2-Chloronaphthalene	1620		µg/kg dry	358	1810	BRL	89	40-140	10	30
2-Chlorophenol	1090		µg/kg dry	181	1810	BRL	61	30-130	9	30
4-Chlorophenyl phenyl ether	1480		µg/kg dry	358	1810	BRL	82	40-140	11	30
Chrysene	1180		µg/kg dry	72.3	1810	BRL	65	40-140	15	30
Dibenzo (a,h) anthracene	1360		µg/kg dry	72.3	1810	BRL	75	40-140	6	30
Dibenzofuran	1440		µg/kg dry	181	1810	BRL	79	40-140	12	30
1,2-Dichlorobenzene	1400		µg/kg dry	358	1810	BRL	78	40-140	8	30
1,3-Dichlorobenzene	1310		µg/kg dry	358	1810	BRL	73	40-140	10	30
1,4-Dichlorobenzene	1430		µg/kg dry	358	1810	BRL	79	40-140	9	30
3,3'-Dichlorobenzidine	1920		µg/kg dry	358	1810	BRL	106	40-140	6	30
2,4-Dichlorophenol	1230		µg/kg dry	181	1810	BRL	68	30-130	10	30
Diethyl phthalate	1520	QM7, QR9	µg/kg dry	358	1810	BRL	84	40-140	10	30
Dimethyl phthalate	1310		µg/kg dry	358	1810	BRL	72	40-140	11	30
2,4-Dimethylphenol	1040		µg/kg dry	358	1810	BRL	58	30-130	8	30
Di-n-butyl phthalate	1020		µg/kg dry	358	1810	BRL	56	40-140	12	30
4,6-Dinitro-2-methylphenol	845		µg/kg dry	358	1810	BRL	47	30-130	28	30
2,4-Dinitrophenol	531		µg/kg dry	358	1810	BRL	29	30-130	49	30
2,4-Dinitrotoluene	1540		µg/kg dry	181	1810	BRL	85	40-140	10	30
2,6-Dinitrotoluene	1480		µg/kg dry	181	1810	BRL	82	40-140	9	30
Di-n-octyl phthalate	1250		µg/kg dry	358	1810	BRL	69	40-140	10	30
Fluoranthene	1170		µg/kg dry	72.3	1810	BRL	65	40-140	10	30
Fluorene	1300		µg/kg dry	72.3	1810	BRL	72	40-140	11	30
Hexachlorobenzene	1430		µg/kg dry	181	1810	BRL	79	40-140	13	30
Hexachlorobutadiene	1610		µg/kg dry	181	1810	BRL	89	40-140	13	30
Hexachlorocyclopentadiene	1800		µg/kg dry	181	1810	BRL	100	40-140	23	30
Hexachloroethane	1500		µg/kg dry	181	1810	BRL	83	40-140	5	30
Indeno (1,2,3-cd) pyrene	1220		µg/kg dry	72.3	1810	BRL	68	40-140	8	30
Isophorone	999		µg/kg dry	181	1810	BRL	55	30-130	10	30

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800643 - SW846 3546</b>										
<b>Matrix Spike Dup (1800643-MSD1)</b>				<b>Source: SC43071-17</b>		<b>Prepared &amp; Analyzed: 17-Jan-18</b>				
2-Methylnaphthalene	1490		µg/kg dry	72.3	1810	BRL	83	40-140	7	30
2-Methylphenol	984		µg/kg dry	358	1810	BRL	54	30-130	10	30
3 & 4-Methylphenol	1060		µg/kg dry	358	1810	BRL	59	30-130	10	30
Naphthalene	1190		µg/kg dry	72.3	1810	BRL	66	40-140	11	30
2-Nitroaniline	1100		µg/kg dry	358	1810	BRL	61	40-140	11	30
3-Nitroaniline	1220		µg/kg dry	358	1810	BRL	68	40-140	12	30
4-Nitroaniline	1150		µg/kg dry	181	1810	BRL	63	40-140	9	30
Nitrobenzene	1380		µg/kg dry	181	1810	BRL	76	40-140	8	30
2-Nitrophenol	1090		µg/kg dry	181	1810	BRL	60	30-130	9	30
4-Nitrophenol	1160	J	µg/kg dry	1430	1810	BRL	64	30-130	11	30
N-Nitrosodimethylamine	1430		µg/kg dry	181	1810	BRL	79	40-140	3	30
N-Nitrosodi-n-propylamine	1030		µg/kg dry	181	1810	BRL	57	40-140	9	30
N-Nitrosodiphenylamine	1170		µg/kg dry	358	1810	BRL	65	40-140	9	30
Pentachlorophenol	1000		µg/kg dry	358	1810	BRL	56	30-130	14	30
Phenanthrene	1170		µg/kg dry	72.3	1810	BRL	65	40-140	8	30
Phenol	1100		µg/kg dry	358	1810	BRL	61	30-130	10	30
Pyrene	1190		µg/kg dry	72.3	1810	BRL	66	40-140	13	30
Pyridine	1250		µg/kg dry	358	1810	BRL	69	40-140	4	30
1,2,4-Trichlorobenzene	1510		µg/kg dry	358	1810	BRL	83	40-140	9	30
1-Methylnaphthalene	1180		µg/kg dry	72.3	1810	BRL	65	40-140	12	30
2,4,5-Trichlorophenol	1520		µg/kg dry	358	1810	BRL	84	30-130	12	30
2,4,6-Trichlorophenol	1340		µg/kg dry	181	1810	BRL	74	30-130	10	30
Pentachloronitrobenzene	1420		µg/kg dry	358	1810	BRL	78	40-140	22	30
1,2,4,5-Tetrachlorobenzene	1450		µg/kg dry	358	1810	BRL	80	40-140	10	30
Surrogate: 2-Fluorobiphenyl	1370		µg/kg dry		1810		76	30-130		
Surrogate: 2-Fluorophenol	1070		µg/kg dry		1810		59	30-130		
Surrogate: Nitrobenzene-d5	1120		µg/kg dry		1810		62	30-130		
Surrogate: Phenol-d5	1090		µg/kg dry		1810		60	30-130		
Surrogate: Terphenyl-dl4	1260		µg/kg dry		1810		70	30-130		
Surrogate: 2,4,6-Tribromophenol	1280		µg/kg dry		1810		71	30-130		

## Semivolatile Organic Compounds by GC - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8082A</u></b>										
<b>Batch 1800575 - SW846 3546</b>										
<b><u>Blank (1800575-BLK1)</u></b>					<u>Prepared &amp; Analyzed: 16-Jan-18</u>					
Aroclor-1016	< 19.9	U	µg/kg wet	19.9						
Aroclor-1016 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1221	< 19.9	U	µg/kg wet	19.9						
Aroclor-1221 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1232	< 19.9	U	µg/kg wet	19.9						
Aroclor-1232 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1242	< 19.9	U	µg/kg wet	19.9						
Aroclor-1242 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1248	< 19.9	U	µg/kg wet	19.9						
Aroclor-1248 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1254	< 19.9	U	µg/kg wet	19.9						
Aroclor-1254 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1260	< 19.9	U	µg/kg wet	19.9						
Aroclor-1260 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1262	< 19.9	U	µg/kg wet	19.9						
Aroclor-1262 [2C]	< 19.9	U	µg/kg wet	19.9						
Aroclor-1268	< 19.9	U	µg/kg wet	19.9						
Aroclor-1268 [2C]	< 19.9	U	µg/kg wet	19.9						
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	9.93		µg/kg wet		19.9		50	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	10.9		µg/kg wet		19.9		55	30-150		
Surrogate: Decachlorobiphenyl (Sr)	20.9		µg/kg wet		19.9		105	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	24.8		µg/kg wet		19.9		125	30-150		
<b><u>LCS (1800575-BS1)</u></b>					<u>Prepared &amp; Analyzed: 16-Jan-18</u>					
Aroclor-1016	170		µg/kg wet	19.8	247		69	40-140		
Aroclor-1016 [2C]	162		µg/kg wet	19.8	247		66	40-140		
Aroclor-1260	191		µg/kg wet	19.8	247		77	40-140		
Aroclor-1260 [2C]	188		µg/kg wet	19.8	247		76	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	10.9		µg/kg wet		19.8		55	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	10.9		µg/kg wet		19.8		55	30-150		
Surrogate: Decachlorobiphenyl (Sr)	20.8		µg/kg wet		19.8		105	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	23.7		µg/kg wet		19.8		120	30-150		
<b><u>LCS Dup (1800575-BSD1)</u></b>					<u>Prepared &amp; Analyzed: 16-Jan-18</u>					
Aroclor-1016	162		µg/kg wet	19.9	249		65	40-140	5	30
Aroclor-1016 [2C]	153		µg/kg wet	19.9	249		62	40-140	5	30
Aroclor-1260	188		µg/kg wet	19.9	249		76	40-140	1	30
Aroclor-1260 [2C]	175		µg/kg wet	19.9	249		70	40-140	7	30
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	9.97		µg/kg wet		19.9		50	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	9.97		µg/kg wet		19.9		50	30-150		
Surrogate: Decachlorobiphenyl (Sr)	21.9		µg/kg wet		19.9		110	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	23.9		µg/kg wet		19.9		120	30-150		
<b><u>Duplicate (1800575-DUP1)</u></b>					<u>Source: SC43071-01</u> <u>Prepared &amp; Analyzed: 16-Jan-18</u>					
Aroclor-1016	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1016 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1221	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1221 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1232	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1232 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30

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## Semivolatile Organic Compounds by GC - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8082A</b>										
<b>Batch 1800575 - SW846 3546</b>										
<b><u>Duplicate (1800575-DUP1)</u></b>			<b><u>Source: SC43071-01</u></b>		<b><u>Prepared &amp; Analyzed: 16-Jan-18</u></b>					
Aroclor-1242	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1242 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1248	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1248 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1254	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1254 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1260	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1260 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1262	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1262 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1268	< 20.8	U	µg/kg dry	20.8		BRL				30
Aroclor-1268 [2C]	< 20.8	U	µg/kg dry	20.8		BRL				30
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	11.4		µg/kg dry		20.8		55	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	11.4		µg/kg dry		20.8		55	30-150		
Surrogate: Decachlorobiphenyl (Sr)	20.8		µg/kg dry		20.8		100	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	23.9		µg/kg dry		20.8		115	30-150		
<b><u>Matrix Spike (1800575-MS1)</u></b>			<b><u>Source: SC43071-01</u></b>		<b><u>Prepared &amp; Analyzed: 16-Jan-18</u></b>					
Aroclor-1016	170		µg/kg dry	20.7	258	BRL	66	40-140		
Aroclor-1016 [2C]	181		µg/kg dry	20.7	258	BRL	70	40-140		
Aroclor-1260	171		µg/kg dry	20.7	258	BRL	66	40-140		
Aroclor-1260 [2C]	162		µg/kg dry	20.7	258	BRL	63	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	9.30		µg/kg dry		20.7		45	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	9.30		µg/kg dry		20.7		45	30-150		
Surrogate: Decachlorobiphenyl (Sr)	16.5		µg/kg dry		20.7		80	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	19.6		µg/kg dry		20.7		95	30-150		
<b><u>Matrix Spike Dup (1800575-MSD1)</u></b>			<b><u>Source: SC43071-01</u></b>		<b><u>Prepared &amp; Analyzed: 16-Jan-18</u></b>					
Aroclor-1016	170		µg/kg dry	20.7	259	BRL	66	40-140	0.1	30
Aroclor-1016 [2C]	185		µg/kg dry	20.7	259	BRL	72	40-140	2	30
Aroclor-1260	178		µg/kg dry	20.7	259	BRL	69	40-140	4	30
Aroclor-1260 [2C]	165		µg/kg dry	20.7	259	BRL	64	40-140	1	30
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	8.28		µg/kg dry		20.7		40	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	8.28		µg/kg dry		20.7		40	30-150		
Surrogate: Decachlorobiphenyl (Sr)	14.5		µg/kg dry		20.7		70	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	15.5		µg/kg dry		20.7		75	30-150		

# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800576 - SW846 3546</b>										
<b>Blank (1800576-BLK1)</b>	<b>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</b>									
alpha-BHC	< 4.90	U	µg/kg wet	4.90						
alpha-BHC [2C]	< 4.90	U	µg/kg wet	4.90						
beta-BHC	< 4.90	U	µg/kg wet	4.90						
beta-BHC [2C]	< 4.90	U	µg/kg wet	4.90						
delta-BHC	< 4.90	U	µg/kg wet	4.90						
delta-BHC [2C]	< 4.90	U	µg/kg wet	4.90						
gamma-BHC (Lindane)	< 2.94	U	µg/kg wet	2.94						
gamma-BHC (Lindane) [2C]	< 2.94	U	µg/kg wet	2.94						
Heptachlor	< 4.90	U	µg/kg wet	4.90						
Heptachlor [2C]	< 4.90	U	µg/kg wet	4.90						
Aldrin	< 4.90	U	µg/kg wet	4.90						
Aldrin [2C]	< 4.90	U	µg/kg wet	4.90						
Heptachlor epoxide	< 4.90	U	µg/kg wet	4.90						
Heptachlor epoxide [2C]	< 4.90	U	µg/kg wet	4.90						
Endosulfan I	< 4.90	U	µg/kg wet	4.90						
Endosulfan I [2C]	< 4.90	U	µg/kg wet	4.90						
Dieldrin	< 4.90	U	µg/kg wet	4.90						
Dieldrin [2C]	< 4.90	U	µg/kg wet	4.90						
4,4'-DDE (p,p')	< 4.90	U	µg/kg wet	4.90						
4,4'-DDE (p,p') [2C]	< 4.90	U	µg/kg wet	4.90						
Endrin	< 7.84	U	µg/kg wet	7.84						
Endrin [2C]	< 7.84	U	µg/kg wet	7.84						
Endosulfan II	< 7.84	U	µg/kg wet	7.84						
Endosulfan II [2C]	< 7.84	U	µg/kg wet	7.84						
4,4'-DDD (p,p')	< 7.84	U	µg/kg wet	7.84						
4,4'-DDD (p,p') [2C]	< 7.84	U	µg/kg wet	7.84						
Endosulfan sulfate	< 7.84	U	µg/kg wet	7.84						
Endosulfan sulfate [2C]	< 7.84	U	µg/kg wet	7.84						
4,4'-DDT (p,p')	< 7.84	U	µg/kg wet	7.84						
4,4'-DDT (p,p') [2C]	< 7.84	U	µg/kg wet	7.84						
Methoxychlor	< 7.84	U	µg/kg wet	7.84						
Methoxychlor [2C]	< 7.84	U	µg/kg wet	7.84						
Endrin ketone	< 7.84	U	µg/kg wet	7.84						
Endrin ketone [2C]	< 7.84	U	µg/kg wet	7.84						
Endrin aldehyde	< 7.84	U	µg/kg wet	7.84						
Endrin aldehyde [2C]	< 7.84	U	µg/kg wet	7.84						
alpha-Chlordane	< 4.90	U	µg/kg wet	4.90						
alpha-Chlordane [2C]	< 4.90	U	µg/kg wet	4.90						
Chlordane (gamma)(trans)	< 4.90	U	µg/kg wet	4.90						
Chlordane (gamma)(trans) [2C]	< 4.90	U	µg/kg wet	4.90						
Toxaphene	< 98.0	U	µg/kg wet	98.0						
Toxaphene [2C]	< 98.0	U	µg/kg wet	98.0						
Chlordane	< 19.6	U	µg/kg wet	19.6						
Chlordane [2C]	< 19.6	U	µg/kg wet	19.6						
Alachlor	< 4.90	U	µg/kg wet	4.90						
Alachlor [2C]	< 4.90	U	µg/kg wet	4.90						
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	7.15		µg/kg wet		9.80		73	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	7.32		µg/kg wet		9.80		75	30-150		
Surrogate: Decachlorobiphenyl (Sr)	7.86		µg/kg wet		9.80		80	30-150		

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800576 - SW846 3546</b>										
<b>Blank (1800576-BLK1)</b>					Prepared: 16-Jan-18 Analyzed: 25-Jan-18					
Surrogate: Decachlorobiphenyl (Sr) [2C]	9.23		µg/kg wet		9.80		94	30-150		
<b>LCS (1800576-BS1)</b>					Prepared: 16-Jan-18 Analyzed: 25-Jan-18					
alpha-BHC	16.8		µg/kg wet	5.00	25.0		67	40-140		
alpha-BHC [2C]	18.5		µg/kg wet	5.00	25.0		74	40-140		
beta-BHC	18.1		µg/kg wet	5.00	25.0		73	40-140		
beta-BHC [2C]	19.6		µg/kg wet	5.00	25.0		79	40-140		
delta-BHC	17.0		µg/kg wet	5.00	25.0		68	40-140		
delta-BHC [2C]	19.2		µg/kg wet	5.00	25.0		77	40-140		
gamma-BHC (Lindane)	17.6		µg/kg wet	3.00	25.0		70	40-140		
gamma-BHC (Lindane) [2C]	19.2		µg/kg wet	3.00	25.0		77	40-140		
Heptachlor	17.9		µg/kg wet	5.00	25.0		71	40-140		
Heptachlor [2C]	18.7		µg/kg wet	5.00	25.0		75	40-140		
Aldrin	17.7		µg/kg wet	5.00	25.0		71	40-140		
Aldrin [2C]	19.0		µg/kg wet	5.00	25.0		76	40-140		
Heptachlor epoxide	17.5		µg/kg wet	5.00	25.0		70	40-140		
Heptachlor epoxide [2C]	19.0		µg/kg wet	5.00	25.0		76	40-140		
Endosulfan I	21.1		µg/kg wet	5.00	25.0		85	40-140		
Endosulfan I [2C]	20.9		µg/kg wet	5.00	25.0		84	40-140		
Dieldrin	17.6		µg/kg wet	5.00	25.0		70	40-140		
Dieldrin [2C]	20.3		µg/kg wet	5.00	25.0		81	40-140		
4,4'-DDE (p,p')	16.5		µg/kg wet	5.00	25.0		66	40-140		
4,4'-DDE (p,p') [2C]	20.3		µg/kg wet	5.00	25.0		81	40-140		
Endrin	21.7		µg/kg wet	8.00	25.0		87	40-140		
Endrin [2C]	24.1		µg/kg wet	8.00	25.0		96	40-140		
Endosulfan II	17.5		µg/kg wet	8.00	25.0		70	40-140		
Endosulfan II [2C]	20.2		µg/kg wet	8.00	25.0		81	40-140		
4,4'-DDD (p,p')	16.5		µg/kg wet	8.00	25.0		66	40-140		
4,4'-DDD (p,p') [2C]	21.0		µg/kg wet	8.00	25.0		84	40-140		
Endosulfan sulfate	17.8		µg/kg wet	8.00	25.0		71	40-140		
Endosulfan sulfate [2C]	21.3		µg/kg wet	8.00	25.0		85	40-140		
4,4'-DDT (p,p')	16.7		µg/kg wet	8.00	25.0		67	40-140		
4,4'-DDT (p,p') [2C]	20.3		µg/kg wet	8.00	25.0		81	40-140		
Methoxychlor	18.4		µg/kg wet	8.00	25.0		74	40-140		
Methoxychlor [2C]	21.8		µg/kg wet	8.00	25.0		87	40-140		
Endrin ketone	15.6		µg/kg wet	8.00	25.0		62	40-140		
Endrin ketone [2C]	18.6		µg/kg wet	8.00	25.0		75	40-140		
Endrin aldehyde	21.5		µg/kg wet	8.00	25.0		86	40-140		
Endrin aldehyde [2C]	24.5		µg/kg wet	8.00	25.0		98	40-140		
alpha-Chlordane	18.4		µg/kg wet	5.00	25.0		74	40-140		
alpha-Chlordane [2C]	19.7		µg/kg wet	5.00	25.0		79	40-140		
Chlordane (gamma)(trans)	18.4		µg/kg wet	5.00	25.0		74	40-140		
Chlordane (gamma)(trans) [2C]	19.8		µg/kg wet	5.00	25.0		79	40-140		
Alachlor	23.1		µg/kg wet	5.00	25.0		93	40-140		
Alachlor [2C]	24.6		µg/kg wet	5.00	25.0		98	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	6.96		µg/kg wet		9.99		70	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	7.09		µg/kg wet		9.99		71	30-150		
Surrogate: Decachlorobiphenyl (Sr)	7.91		µg/kg wet		9.99		79	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	10.1		µg/kg wet		9.99		101	30-150		
<b>LCS Dup (1800576-BS1)</b>					Prepared: 16-Jan-18 Analyzed: 25-Jan-18					

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800576 - SW846 3546</b>										
<b>LCS Dup (1800576-BSD1)</b>					Prepared: 16-Jan-18 Analyzed: 25-Jan-18					
alpha-BHC	19.3		µg/kg wet	4.96	24.8		78	40-140	14	30
alpha-BHC [2C]	21.3		µg/kg wet	4.96	24.8		86	40-140	14	30
beta-BHC	21.2		µg/kg wet	4.96	24.8		86	40-140	16	30
beta-BHC [2C]	22.3		µg/kg wet	4.96	24.8		90	40-140	13	30
delta-BHC	20.0		µg/kg wet	4.96	24.8		81	40-140	16	30
delta-BHC [2C]	21.6		µg/kg wet	4.96	24.8		87	40-140	12	30
gamma-BHC (Lindane)	20.4		µg/kg wet	2.98	24.8		82	40-140	15	30
gamma-BHC (Lindane) [2C]	21.9		µg/kg wet	2.98	24.8		88	40-140	13	30
Heptachlor	20.8		µg/kg wet	4.96	24.8		84	40-140	15	30
Heptachlor [2C]	21.3		µg/kg wet	4.96	24.8		86	40-140	13	30
Aldrin	20.6		µg/kg wet	4.96	24.8		83	40-140	15	30
Aldrin [2C]	21.6		µg/kg wet	4.96	24.8		87	40-140	13	30
Heptachlor epoxide	20.3		µg/kg wet	4.96	24.8		82	40-140	15	30
Heptachlor epoxide [2C]	21.5		µg/kg wet	4.96	24.8		87	40-140	12	30
Endosulfan I	24.0		µg/kg wet	4.96	24.8		97	40-140	13	30
Endosulfan I [2C]	23.6		µg/kg wet	4.96	24.8		95	40-140	12	30
Dieldrin	20.2		µg/kg wet	4.96	24.8		82	40-140	14	30
Dieldrin [2C]	23.0		µg/kg wet	4.96	24.8		93	40-140	12	30
4,4'-DDE (p,p')	18.9		µg/kg wet	4.96	24.8		76	40-140	14	30
4,4'-DDE (p,p') [2C]	22.8		µg/kg wet	4.96	24.8		92	40-140	12	30
Endrin	24.8		µg/kg wet	7.94	24.8		100	40-140	14	30
Endrin [2C]	27.2		µg/kg wet	7.94	24.8		110	40-140	12	30
Endosulfan II	19.8		µg/kg wet	7.94	24.8		80	40-140	12	30
Endosulfan II [2C]	22.9		µg/kg wet	7.94	24.8		92	40-140	12	30
4,4'-DDD (p,p')	18.8		µg/kg wet	7.94	24.8		76	40-140	13	30
4,4'-DDD (p,p') [2C]	23.8		µg/kg wet	7.94	24.8		96	40-140	12	30
Endosulfan sulfate	19.9		µg/kg wet	7.94	24.8		80	40-140	11	30
Endosulfan sulfate [2C]	24.0		µg/kg wet	7.94	24.8		97	40-140	12	30
4,4'-DDT (p,p')	18.8		µg/kg wet	7.94	24.8		76	40-140	12	30
4,4'-DDT (p,p') [2C]	22.6		µg/kg wet	7.94	24.8		91	40-140	11	30
Methoxychlor	20.7		µg/kg wet	7.94	24.8		84	40-140	12	30
Methoxychlor [2C]	24.3		µg/kg wet	7.94	24.8		98	40-140	11	30
Endrin ketone	17.6		µg/kg wet	7.94	24.8		71	40-140	12	30
Endrin ketone [2C]	21.1		µg/kg wet	7.94	24.8		85	40-140	12	30
Endrin aldehyde	24.2		µg/kg wet	7.94	24.8		98	40-140	12	30
Endrin aldehyde [2C]	27.8		µg/kg wet	7.94	24.8		112	40-140	12	30
alpha-Chlordane	20.7		µg/kg wet	4.96	24.8		83	40-140	12	30
alpha-Chlordane [2C]	22.2		µg/kg wet	4.96	24.8		89	40-140	12	30
Chlordane (gamma)(trans)	21.0		µg/kg wet	4.96	24.8		85	40-140	13	30
Chlordane (gamma)(trans) [2C]	22.5		µg/kg wet	4.96	24.8		91	40-140	13	30
Alachlor	27.1		µg/kg wet	4.96	24.8		109	40-140	16	30
Alachlor [2C]	27.9		µg/kg wet	4.96	24.8		113	40-140	13	30
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	7.42		µg/kg wet		9.92		75	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	7.63		µg/kg wet		9.92		77	30-150		
Surrogate: Decachlorobiphenyl (Sr)	8.42		µg/kg wet		9.92		85	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	11.0		µg/kg wet		9.92		111	30-150		
<b>Duplicate (1800576-DUP1)</b>				<b>Source: SC43071-19</b>		<b>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</b>				
alpha-BHC	< 5.13	U	µg/kg dry	5.13		BRL				30
alpha-BHC [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800576 - SW846 3546</b>										
<b><u>Duplicate (1800576-DUP1)</u></b>				<b><u>Source: SC43071-19</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</u></b>				
beta-BHC	< 5.13	U	µg/kg dry	5.13		BRL				30
beta-BHC [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
delta-BHC	< 5.13	U	µg/kg dry	5.13		BRL				30
delta-BHC [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
gamma-BHC (Lindane)	< 3.08	U	µg/kg dry	3.08		BRL				30
gamma-BHC (Lindane) [2C]	< 3.08	U	µg/kg dry	3.08		BRL				30
Heptachlor	< 5.13	U	µg/kg dry	5.13		BRL				30
Heptachlor [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Aldrin	< 5.13	U	µg/kg dry	5.13		BRL				30
Aldrin [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Heptachlor epoxide	< 5.13	U	µg/kg dry	5.13		BRL				30
Heptachlor epoxide [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Endosulfan I	< 5.13	U	µg/kg dry	5.13		BRL				30
Endosulfan I [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Dieldrin	< 5.13	U	µg/kg dry	5.13		BRL				30
Dieldrin [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
4,4'-DDE (p,p')	< 5.13	U	µg/kg dry	5.13		BRL				30
4,4'-DDE (p,p') [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Endrin	< 8.21	U	µg/kg dry	8.21		BRL				30
Endrin [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
Endosulfan II	< 8.21	U	µg/kg dry	8.21		BRL				30
Endosulfan II [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
4,4'-DDD (p,p')	< 8.21	U	µg/kg dry	8.21		BRL				30
4,4'-DDD (p,p') [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
Endosulfan sulfate	< 8.21	U	µg/kg dry	8.21		BRL				30
Endosulfan sulfate [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
4,4'-DDT (p,p')	< 8.21	U	µg/kg dry	8.21		BRL				30
4,4'-DDT (p,p') [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
Methoxychlor	< 8.21	U	µg/kg dry	8.21		BRL				30
Methoxychlor [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
Endrin ketone	< 8.21	U	µg/kg dry	8.21		BRL				30
Endrin ketone [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
Endrin aldehyde	< 8.21	U	µg/kg dry	8.21		BRL				30
Endrin aldehyde [2C]	< 8.21	U	µg/kg dry	8.21		BRL				30
alpha-Chlordane	< 5.13	U	µg/kg dry	5.13		BRL				30
alpha-Chlordane [2C]	2.21	J	µg/kg dry	5.13		1.98			11	30
Chlordane (gamma)(trans)	< 5.13	U	µg/kg dry	5.13		BRL				30
Chlordane (gamma)(trans) [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Toxaphene	< 103	U	µg/kg dry	103		BRL				30
Toxaphene [2C]	< 103	U	µg/kg dry	103		BRL				30
Chlordane	< 20.5	U	µg/kg dry	20.5		BRL				30
Chlordane [2C]	< 20.5	U	µg/kg dry	20.5		BRL				30
Alachlor	< 5.13	U	µg/kg dry	5.13		BRL				30
Alachlor [2C]	< 5.13	U	µg/kg dry	5.13		BRL				30
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	7.74		µg/kg dry		10.3		75	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	7.82		µg/kg dry		10.3		76	30-150		
Surrogate: Decachlorobiphenyl (Sr)	10.3		µg/kg dry		10.3		101	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	10.8		µg/kg dry		10.3		105	30-150		
<b><u>Matrix Spike (1800576-MS1)</u></b>				<b><u>Source: SC43071-19</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</u></b>				

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800576 - SW846 3546</b>										
<b><u>Matrix Spike (1800576-MS1)</u></b>				<b><u>Source: SC43071-19</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</u></b>				
alpha-BHC	19.7		µg/kg dry	5.20	26.0	BRL	76	30-150		
alpha-BHC [2C]	21.2		µg/kg dry	5.20	26.0	BRL	82	30-150		
beta-BHC	29.6		µg/kg dry	5.20	26.0	BRL	114	30-150		
beta-BHC [2C]	30.6		µg/kg dry	5.20	26.0	BRL	118	30-150		
delta-BHC	27.5		µg/kg dry	5.20	26.0	BRL	106	30-150		
delta-BHC [2C]	28.7		µg/kg dry	5.20	26.0	BRL	110	30-150		
gamma-BHC (Lindane)	24.0		µg/kg dry	3.12	26.0	BRL	92	30-150		
gamma-BHC (Lindane) [2C]	24.3		µg/kg dry	3.12	26.0	BRL	94	30-150		
Heptachlor	24.6		µg/kg dry	5.20	26.0	BRL	95	30-150		
Heptachlor [2C]	23.6		µg/kg dry	5.20	26.0	BRL	91	30-150		
Aldrin	24.2		µg/kg dry	5.20	26.0	BRL	93	30-150		
Aldrin [2C]	23.7		µg/kg dry	5.20	26.0	BRL	91	30-150		
Heptachlor epoxide	27.8		µg/kg dry	5.20	26.0	BRL	107	30-150		
Heptachlor epoxide [2C]	28.3		µg/kg dry	5.20	26.0	BRL	109	30-150		
Endosulfan I	33.5		µg/kg dry	5.20	26.0	BRL	129	30-150		
Endosulfan I [2C]	28.7		µg/kg dry	5.20	26.0	BRL	110	30-150		
Dieldrin	29.2		µg/kg dry	5.20	26.0	BRL	112	30-150		
Dieldrin [2C]	28.0		µg/kg dry	5.20	26.0	BRL	108	30-150		
4,4'-DDE (p,p')	27.2		µg/kg dry	5.20	26.0	BRL	105	30-150		
4,4'-DDE (p,p') [2C]	27.2		µg/kg dry	5.20	26.0	BRL	105	30-150		
Endrin	36.2		µg/kg dry	8.32	26.0	BRL	139	30-150		
Endrin [2C]	32.7		µg/kg dry	8.32	26.0	BRL	126	30-150		
Endosulfan II	29.6		µg/kg dry	8.32	26.0	BRL	114	30-150		
Endosulfan II [2C]	27.4		µg/kg dry	8.32	26.0	BRL	106	30-150		
4,4'-DDD (p,p')	28.3		µg/kg dry	8.32	26.0	BRL	109	30-150		
4,4'-DDD (p,p') [2C]	28.1		µg/kg dry	8.32	26.0	BRL	108	30-150		
Endosulfan sulfate	30.8		µg/kg dry	8.32	26.0	BRL	119	30-150		
Endosulfan sulfate [2C]	28.4		µg/kg dry	8.32	26.0	BRL	109	30-150		
4,4'-DDT (p,p')	29.3		µg/kg dry	8.32	26.0	BRL	113	30-150		
4,4'-DDT (p,p') [2C]	26.3		µg/kg dry	8.32	26.0	BRL	101	30-150		
Methoxychlor	33.3		µg/kg dry	8.32	26.0	BRL	128	30-150		
Methoxychlor [2C]	27.2		µg/kg dry	8.32	26.0	BRL	105	30-150		
Endrin ketone	27.5		µg/kg dry	8.32	26.0	BRL	106	30-150		
Endrin ketone [2C]	24.5		µg/kg dry	8.32	26.0	BRL	94	30-150		
Endrin aldehyde	33.4		µg/kg dry	8.32	26.0	BRL	128	30-150		
Endrin aldehyde [2C]	30.9		µg/kg dry	8.32	26.0	BRL	119	30-150		
alpha-Chlordane	30.1		µg/kg dry	5.20	26.0	BRL	116	30-150		
alpha-Chlordane [2C]	27.3		µg/kg dry	5.20	26.0	1.98	98	30-150		
Chlordane (gamma)(trans)	29.9		µg/kg dry	5.20	26.0	BRL	115	30-150		
Chlordane (gamma)(trans) [2C]	26.3		µg/kg dry	5.20	26.0	BRL	101	30-150		
Alachlor	34.9		µg/kg dry	5.20	26.0	BRL	134	30-150		
Alachlor [2C]	45.4	QM7	µg/kg dry	5.20	26.0	BRL	175	30-150		
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Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	8.44		µg/kg dry		10.4		81	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	8.31		µg/kg dry		10.4		80	30-150		
Surrogate: Decachlorobiphenyl (Sr)	11.6		µg/kg dry		10.4		112	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	9.78		µg/kg dry		10.4		94	30-150		
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<b><u>Matrix Spike Dup (1800576-MSD1)</u></b>				<b><u>Source: SC43071-19</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</u></b>				
alpha-BHC	15.6		µg/kg dry	5.17	25.9	BRL	60	30-150	23	30
alpha-BHC [2C]	17.8		µg/kg dry	5.17	25.9	BRL	69	30-150	18	30

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800576 - SW846 3546</b>										
<b>Matrix Spike Dup (1800576-MSD1)</b>				<b>Source: SC43071-19</b>		<b>Prepared: 16-Jan-18 Analyzed: 25-Jan-18</b>				
beta-BHC	22.2		µg/kg dry	5.17	25.9	BRL	86	30-150	29	30
beta-BHC [2C]	25.7		µg/kg dry	5.17	25.9	BRL	99	30-150	17	30
delta-BHC	20.8		µg/kg dry	5.17	25.9	BRL	80	30-150	28	30
delta-BHC [2C]	25.0		µg/kg dry	5.17	25.9	BRL	97	30-150	14	30
gamma-BHC (Lindane)	18.3		µg/kg dry	3.10	25.9	BRL	71	30-150	27	30
gamma-BHC (Lindane) [2C]	20.5		µg/kg dry	3.10	25.9	BRL	79	30-150	17	30
Heptachlor	17.7	QR2	µg/kg dry	5.17	25.9	BRL	69	30-150	32	30
Heptachlor [2C]	19.8		µg/kg dry	5.17	25.9	BRL	77	30-150	17	30
Aldrin	17.3	QR2	µg/kg dry	5.17	25.9	BRL	67	30-150	33	30
Aldrin [2C]	20.2		µg/kg dry	5.17	25.9	BRL	78	30-150	16	30
Heptachlor epoxide	20.5		µg/kg dry	5.17	25.9	BRL	79	30-150	30	30
Heptachlor epoxide [2C]	22.9		µg/kg dry	5.17	25.9	BRL	89	30-150	21	30
Endosulfan I	24.7		µg/kg dry	5.17	25.9	BRL	95	30-150	30	30
Endosulfan I [2C]	25.3		µg/kg dry	5.17	25.9	BRL	98	30-150	13	30
Dieldrin	21.4	QR2	µg/kg dry	5.17	25.9	BRL	83	30-150	31	30
Dieldrin [2C]	25.0		µg/kg dry	5.17	25.9	BRL	97	30-150	11	30
4,4'-DDE (p,p')	19.9	QR2	µg/kg dry	5.17	25.9	BRL	77	30-150	31	30
4,4'-DDE (p,p') [2C]	24.7		µg/kg dry	5.17	25.9	BRL	95	30-150	10	30
Endrin	26.0	QR2	µg/kg dry	8.28	25.9	BRL	101	30-150	33	30
Endrin [2C]	30.0		µg/kg dry	8.28	25.9	BRL	116	30-150	9	30
Endosulfan II	22.4		µg/kg dry	8.28	25.9	BRL	86	30-150	28	30
Endosulfan II [2C]	24.9		µg/kg dry	8.28	25.9	BRL	96	30-150	10	30
4,4'-DDD (p,p')	20.8	QR2	µg/kg dry	8.28	25.9	BRL	80	30-150	31	30
4,4'-DDD (p,p') [2C]	25.7		µg/kg dry	8.28	25.9	BRL	99	30-150	9	30
Endosulfan sulfate	23.7		µg/kg dry	8.28	25.9	BRL	92	30-150	26	30
Endosulfan sulfate [2C]	25.9		µg/kg dry	8.28	25.9	BRL	100	30-150	9	30
4,4'-DDT (p,p')	21.0	QR2	µg/kg dry	8.28	25.9	BRL	81	30-150	33	30
4,4'-DDT (p,p') [2C]	25.4		µg/kg dry	8.28	25.9	BRL	98	30-150	3	30
Methoxychlor	25.0		µg/kg dry	8.28	25.9	BRL	97	30-150	29	30
Methoxychlor [2C]	26.9		µg/kg dry	8.28	25.9	BRL	104	30-150	1	30
Endrin ketone	21.0		µg/kg dry	8.28	25.9	BRL	81	30-150	27	30
Endrin ketone [2C]	22.8		µg/kg dry	8.28	25.9	BRL	88	30-150	7	30
Endrin aldehyde	25.4		µg/kg dry	8.28	25.9	BRL	98	30-150	27	30
Endrin aldehyde [2C]	27.7		µg/kg dry	8.28	25.9	BRL	107	30-150	11	30
alpha-Chlordane	22.1	QR2	µg/kg dry	5.17	25.9	BRL	85	30-150	31	30
alpha-Chlordane [2C]	24.5		µg/kg dry	5.17	25.9	1.98	87	30-150	11	30
Chlordane (gamma)(trans)	21.8	QR2	µg/kg dry	5.17	25.9	BRL	84	30-150	31	30
Chlordane (gamma)(trans) [2C]	24.3		µg/kg dry	5.17	25.9	BRL	94	30-150	8	30
Alachlor	27.1		µg/kg dry	5.17	25.9	BRL	105	30-150	25	30
Alachlor [2C]	39.0	QM7	µg/kg dry	5.17	25.9	BRL	151	30-150	15	30
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	5.78		µg/kg dry		10.3		56	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	6.26		µg/kg dry		10.3		61	30-150		
Surrogate: Decachlorobiphenyl (Sr)	8.06		µg/kg dry		10.3		78	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	9.30		µg/kg dry		10.3		90	30-150		

# **Total Metals by EPA 6000/7000 Series Methods - Quality Control**

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1800473 - SW846 3050B</b>										
<b><u>Blank (1800473-BLK1)</u></b>					<u>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</u>					
Manganese	< 0.997	U	mg/kg wet	0.997						
Sodium	< 24.9	U	mg/kg wet	24.9						
Chromium	<b>0.169</b>	J	mg/kg wet	0.997						
Magnesium	< 4.98	U	mg/kg wet	4.98						
Copper	< 0.997	U	mg/kg wet	0.997						
Cadmium	< 0.498	U	mg/kg wet	0.498						
Beryllium	< 0.498	U	mg/kg wet	0.498						
Calcium	< 24.9	U	mg/kg wet	24.9						
Zinc	< 0.997	U	mg/kg wet	0.997						
Iron	< 498	U	mg/kg wet	498						
Arsenic	< 1.50	U	mg/kg wet	1.50						
Aluminum	< 4.98	U	mg/kg wet	4.98						
Lead	< 1.50	U	mg/kg wet	1.50						
Vanadium	< 1.50	U	mg/kg wet	1.50						
Nickel	< 0.997	U	mg/kg wet	0.997						
Silver	< 1.50	U	mg/kg wet	1.50						
Thallium	< 2.99	U	mg/kg wet	2.99						
Barium	< 0.997	U	mg/kg wet	0.997						
<b><u>Duplicate (1800473-DUP1)</u></b>					<u>Source: SC43071-01</u>	<u>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</u>				
Sodium	<b>104</b>		mg/kg dry	25.8		101			2	20
Manganese	<b>152</b>		mg/kg dry	1.03		157			3	20
Magnesium	<b>1390</b>	QR6	mg/kg dry	5.16		2050			38	20
Iron	<b>9460</b>	R06	mg/kg dry	516		9080			4	20
Copper	<b>12.0</b>		mg/kg dry	1.03		11.9			1	20
Chromium	<b>11.4</b>	QR6	mg/kg dry	1.03		8.99			23	20
Nickel	<b>7.75</b>		mg/kg dry	1.03		7.36			5	20
Cadmium	<b>0.732</b>		mg/kg dry	0.516		0.708			3	20
Lead	<b>17.1</b>	QR6	mg/kg dry	1.55		21.2			21	20
Thallium	< 3.10	U	mg/kg dry	3.10		BRL				20
Vanadium	<b>15.7</b>		mg/kg dry	1.55		15.1			4	20
Zinc	<b>23.8</b>		mg/kg dry	1.03		22.5			6	20
Calcium	<b>1440</b>	QR6	mg/kg dry	25.8		2820			65	20
Beryllium	<b>0.283</b>	J	mg/kg dry	0.516		0.277			2	20
Arsenic	<b>1.96</b>		mg/kg dry	1.55		1.91			3	20
Aluminum	<b>6960</b>		mg/kg dry	5.16		5700			20	20
Silver	< 1.55	U	mg/kg dry	1.55		BRL				20
Barium	<b>38.2</b>	QR6	mg/kg dry	1.03		27.9			31	20
<b><u>Matrix Spike (1800473-MS1)</u></b>					<u>Source: SC43071-01</u>	<u>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</u>				
Manganese	<b>277</b>		mg/kg dry	1.03	129	157	93	75-125		
Sodium	<b>824</b>		mg/kg dry	25.8	646	101	112	75-125		
Aluminum	<b>8390</b>	QM7	mg/kg dry	5.17	129	5700	2080	75-125		
Magnesium	<b>1950</b>	QM2	mg/kg dry	5.17	129	2050	-76	75-125		
Chromium	<b>128</b>		mg/kg dry	1.03	129	8.99	92	75-125		
Vanadium	<b>130</b>		mg/kg dry	1.55	129	15.1	89	75-125		
Cadmium	<b>103</b>		mg/kg dry	0.517	129	0.708	79	75-125		
Calcium	<b>2720</b>	QM4X	mg/kg dry	25.8	646	2820	-16	75-125		
Copper	<b>135</b>		mg/kg dry	1.03	129	11.9	95	75-125		
Iron	<b>9270</b>	QM2	mg/kg dry	517	129	9080	141	75-125		
Nickel	<b>112</b>		mg/kg dry	1.03	129	7.36	81	75-125		
Lead	<b>121</b>		mg/kg dry	1.55	129	21.2	77	75-125		

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# Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 6010C</b>										
<b>Batch 1800473 - SW846 3050B</b>										
<b>Matrix Spike (1800473-MS1)</b>			<b>Source: SC43071-01</b>		<b>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</b>					
Beryllium	120		mg/kg dry	0.517	129	0.277	92	75-125		
Arsenic	108		mg/kg dry	1.55	129	1.91	82	75-125		
Thallium	115		mg/kg dry	3.10	129	BRL	89	75-125		
Zinc	132		mg/kg dry	1.03	129	22.5	85	75-125		
Silver	113		mg/kg dry	1.55	129	BRL	87	75-125		
Barium	155		mg/kg dry	1.03	129	27.9	99	75-125		
<b>Matrix Spike Dup (1800473-MSD1)</b>			<b>Source: SC43071-01</b>		<b>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</b>					
Manganese	287		mg/kg dry	1.04	130	157	100	75-125	4	20
Sodium	885		mg/kg dry	25.9	648	101	121	75-125	7	20
Silver	98.9		mg/kg dry	1.56	130	BRL	76	75-125	13	20
Cadmium	112		mg/kg dry	0.519	130	0.708	85	75-125	8	20
Iron	9040	QM2	mg/kg dry	519	130	9080	-36	75-125	3	20
Copper	143		mg/kg dry	1.04	130	11.9	101	75-125	6	20
Nickel	119		mg/kg dry	1.04	130	7.36	86	75-125	7	20
Chromium	138		mg/kg dry	1.04	130	8.99	100	75-125	7	20
Magnesium	1940	QM2	mg/kg dry	5.19	130	2050	-81	75-125	0.3	20
Calcium	2780	QM4X	mg/kg dry	25.9	648	2820	-6	75-125	2	20
Beryllium	131		mg/kg dry	0.519	130	0.277	101	75-125	9	20
Aluminum	8460	QM7	mg/kg dry	5.19	130	5700	2130	75-125	0.9	20
Lead	130		mg/kg dry	1.56	130	21.2	84	75-125	8	20
Thallium	125		mg/kg dry	3.11	130	BRL	96	75-125	8	20
Zinc	142		mg/kg dry	1.04	130	22.5	92	75-125	7	20
Vanadium	140		mg/kg dry	1.56	130	15.1	97	75-125	8	20
Arsenic	116		mg/kg dry	1.56	130	1.91	88	75-125	7	20
Barium	161		mg/kg dry	1.04	130	27.9	102	75-125	3	20
<b>Reference (1800473-SRM1)</b>			<b>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</b>							
Sodium	95.5		mg/kg wet	25.0	109		88	72.2-127.8		
Manganese	100		mg/kg wet	1.00	112		90	82-118		
Arsenic	64.5		mg/kg wet	1.50	74.1		87	83-117		
Zinc	83.6		mg/kg wet	1.00	95.3		88	79.9-120.1		
Silver	18.6		mg/kg wet	1.50	20.5		91	79.6-120.4		
Aluminum	3600		mg/kg wet	5.00	4030		89	47.4-152.5		
Beryllium	27.0		mg/kg wet	0.500	26.9		100	82.2-117.2		
Calcium	2130		mg/kg wet	25.0	2310		92	80.8-119		
Cadmium	80.6		mg/kg wet	0.500	97.3		83	82.4-117.6		
Chromium	39.7		mg/kg wet	1.00	41.6		95	81.8-118.2		
Copper	83.0		mg/kg wet	1.00	86.2		96	83.6-116.4		
Iron	5660		mg/kg wet	500	7110		80	60.4-139.7		
Magnesium	1010		mg/kg wet	5.00	1130		89	75.4-125		
Nickel	58.0		mg/kg wet	1.00	69.0		84	82.5-118.2		
Lead	41.1		mg/kg wet	1.50	46.5		88	82.8-117		
Vanadium	38.5		mg/kg wet	1.50	43.6		88	77.6-122.4		
Thallium	73.2		mg/kg wet	3.00	77.1		95	81-119		

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**Total Metals by EPA 6000/7000 Series Methods - Quality Control**

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1800473 - SW846 3050B</b>										
<b><u>Reference (1800473-SRM1)</u></b>					<u>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</u>					
Barium	143		mg/kg wet	1.00	158		91	82.2-117.8		
<b><u>Reference (1800473-SRM2)</u></b>					<u>Prepared: 16-Jan-18 Analyzed: 24-Jan-18</u>					
Manganese	98.6		mg/kg wet	1.00	111		89	82-118		
Sodium	97.0		mg/kg wet	25.0	108		90	72.2-127.8		
Vanadium	38.8		mg/kg wet	1.50	43.4		89	77.6-122.4		
Copper	82.6		mg/kg wet	1.00	85.8		96	83.6-116.4		
Lead	40.9		mg/kg wet	1.50	46.3		88	82.8-117		
Zinc	83.8		mg/kg wet	1.00	94.8		88	79.9-120.1		
Thallium	74.1		mg/kg wet	3.00	76.7		97	81-119		
Nickel	58.0		mg/kg wet	1.00	68.7		84	82.5-118.2		
Magnesium	1040		mg/kg wet	5.00	1120		92	75.4-125		
Iron	5740		mg/kg wet	500	7070		81	60.4-139.7		
Chromium	40.0		mg/kg wet	1.00	41.4		97	81.8-118.2		
Cadmium	80.0		mg/kg wet	0.500	96.8		83	82.4-117.6		
Calcium	2220		mg/kg wet	25.0	2300		97	80.8-119		
Beryllium	26.9		mg/kg wet	0.500	26.8		100	82.2-117.2		
Arsenic	64.4		mg/kg wet	1.50	73.7		87	83-117		
Aluminum	3760		mg/kg wet	5.00	4010		94	47.4-152.5		
Silver	19.3		mg/kg wet	1.50	20.4		94	79.6-120.4		
Barium	146		mg/kg wet	1.00	158		93	82.2-117.8		
<b>Batch 1801087 - SW846 3050B</b>										
<b><u>Blank (1801087-BLK1)</u></b>					<u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u>					
Potassium	< 49.6	U	mg/kg wet	49.6						
Selenium	< 1.49	U	mg/kg wet	1.49						
Cobalt	< 0.993	U	mg/kg wet	0.993						
Antimony	< 4.96	U	mg/kg wet	4.96						
<b><u>Duplicate (1801087-DUP1)</u></b>					<b><u>Source: SC43071-01</u></b>	<u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u>				
Potassium	384	QR6	mg/kg dry	51.9		278			32	20
Antimony	< 5.19	U	mg/kg dry	5.19		BRL				20
Cobalt	3.21	QR8	mg/kg dry	1.04		2.49			25	20
Selenium	< 1.56	U	mg/kg dry	1.56		BRL				20
<b><u>Matrix Spike (1801087-MS1)</u></b>					<b><u>Source: SC43071-01</u></b>	<u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u>				
Potassium	1630		mg/kg dry	52.0	1300	278	104	75-125		
Antimony	114		mg/kg dry	5.20	130	BRL	88	75-125		
Selenium	117		mg/kg dry	1.56	130	BRL	90	75-125		
Cobalt	118		mg/kg dry	1.04	130	2.49	89	75-125		
<b><u>Matrix Spike Dup (1801087-MSD1)</u></b>					<b><u>Source: SC43071-01</u></b>	<u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u>				
Potassium	1620		mg/kg dry	51.7	1290	278	104	75-125	0.4	20
Selenium	123		mg/kg dry	1.55	129	BRL	95	75-125	5	20
Cobalt	124		mg/kg dry	1.03	129	2.49	94	75-125	5	20
Antimony	119		mg/kg dry	5.17	129	BRL	92	75-125	4	20

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# **Total Metals by EPA 6000/7000 Series Methods - Quality Control**

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1801087 - SW846 3050B</b>										
<b><u>Post Spike (1801087-PS1)</u></b>										
				<b><u>Source: SC43071-01</u></b>				<b><u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u></b>		
Potassium	1440		mg/kg dry	52.3	1310	278	89	80-120		
Antimony	118		mg/kg dry	5.23	131	BRL	90	80-120		
Selenium	120		mg/kg dry	1.57	131	BRL	92	80-120		
Cobalt	120		mg/kg dry	1.05	131	2.49	90	80-120		
<b><u>Reference (1801087-SRM1)</u></b>								<b><u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u></b>		
Potassium	750		mg/kg wet	50.0	1000		75	69.5-130. 5		
Selenium	91.5		mg/kg wet	1.50	93.8		98	79.1-121. 4		
Antimony	46.9		mg/kg wet	5.00	32.7		144	25-212		
Cobalt	39.0		mg/kg wet	1.00	40.8		95	83.4-116. 6		
<b><u>Reference (1801087-SRM2)</u></b>								<b><u>Prepared: 26-Jan-18 Analyzed: 29-Jan-18</u></b>		
Potassium	716		mg/kg wet	50.0	1000		71	69.5-130. 5		
Antimony	40.9		mg/kg wet	5.00	32.7		125	25-212		
Cobalt	36.9		mg/kg wet	1.00	40.8		90	83.4-116. 6		
Selenium	86.2		mg/kg wet	1.50	93.9		92	79.1-121. 4		
<b><u>SW846 7471B</u></b>										
<b>Batch 1800474 - EPA200/SW7000 Series</b>										
<b><u>Blank (1800474-BLK1)</u></b>								<b><u>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</u></b>		
Mercury	< 0.0283	U	mg/kg wet	0.0283						
<b><u>Duplicate (1800474-DUP1)</u></b>								<b><u>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</u></b>		
Mercury	0.0286	QR8, J	mg/kg dry	0.0291			0.0232		21	20
<b><u>Matrix Spike (1800474-MS1)</u></b>								<b><u>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</u></b>		
Mercury	0.206		mg/kg dry	0.0273	0.189	0.0232	97	75-125		
<b><u>Matrix Spike Dup (1800474-MSD1)</u></b>								<b><u>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</u></b>		
Mercury	0.209		mg/kg dry	0.0275	0.191	0.0232	97	75-125	1	20
<b><u>Post Spike (1800474-PS1)</u></b>								<b><u>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</u></b>		
Mercury	0.221		mg/kg dry	0.0290	0.202	0.0232	98	80-120		
<b><u>Reference (1800474-SRM1)</u></b>								<b><u>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</u></b>		
Mercury	5.86	D	mg/kg wet	0.600	6.09		96	66.9-133. 1		

# General Chemistry Parameters - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SM2540 G (11) Mod.</b>										
<b>Batch 1800484 - General Preparation</b>										
<b>Duplicate (1800484-DUP1)</b>						<b>Source: SC43071-02</b>		<b>Prepared &amp; Analyzed: 12-Jan-18</b>		
% Solids	91.5		%			91.1			0.4	5
<b>Duplicate (1800484-DUP2)</b>						<b>Source: SC43071-01</b>		<b>Prepared &amp; Analyzed: 12-Jan-18</b>		
% Solids	95.3		%			95.1			0.2	5
<b>SW846 9012B</b>										
<b>Batch 1800661 - General Preparation</b>										
<b>Blank (1800661-BLK1)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	< 0.500	U	mg/kg wet	0.500						
<b>Blank (1800661-BLK2)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	< 0.500	U	mg/kg wet	0.500						
<b>LCS (1800661-BS1)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	44.0		mg/kg wet	0.500	40.0		110	90-110		
<b>LCS (1800661-BS2)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	23.0	QC3	mg/kg wet	0.500	20.0		115	90-110		
<b>LCS (1800661-BS3)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	43.1		mg/kg wet	0.500	40.0		108	90-110		
<b>LCS (1800661-BS4)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	0.649	QC3	mg/kg wet	0.500	20.0		3	90-110		
<b>Duplicate (1800661-DUP1)</b>						<b>Source: SC43071-09</b>		<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	< 0.369	U	mg/kg dry	0.369		BRL				35
<b>Matrix Spike (1800661-MS1)</b>						<b>Source: SC43071-09</b>		<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	8.10		mg/kg dry	0.401	8.02	BRL	101	90-110		
<b>Matrix Spike Dup (1800661-MSD1)</b>						<b>Source: SC43071-09</b>		<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	9.00		mg/kg dry	0.452	9.03	BRL	100	90-110	10	35
<b>Reference (1800661-SRM1)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	79.9		mg/kg wet	1.35	65.2		122	39.4-183		
<b>Batch 1800670 - General Preparation</b>										
<b>Blank (1800670-BLK1)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	< 0.500	U	mg/kg wet	0.500						
<b>Blank (1800670-BLK2)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	< 0.500	U	mg/kg wet	0.500						
<b>LCS (1800670-BS1)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	42.0		mg/kg wet	0.500	40.0		105	90-110		
<b>LCS (1800670-BS2)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	21.1		mg/kg wet	0.500	20.0		106	90-110		
<b>LCS (1800670-BS3)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	47.3	QC3	mg/kg wet	0.500	40.0		118	90-110		
<b>LCS (1800670-BS4)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	21.6		mg/kg wet	0.500	20.0		108	90-110		
<b>Duplicate (1800670-DUP1)</b>						<b>Source: SC43071-10</b>		<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	< 0.305	U	mg/kg dry	0.305		BRL				35
<b>Matrix Spike (1800670-MS1)</b>						<b>Source: SC43071-10</b>		<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	6.55		mg/kg dry	0.336	6.72	BRL	97	90-110		
<b>Matrix Spike Dup (1800670-MSD1)</b>						<b>Source: SC43071-10</b>		<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	7.87	QM7	mg/kg dry	0.348	6.96	BRL	113	90-110	18	35
<b>Reference (1800670-SRM1)</b>								<b>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</b>		
Cyanide (total)	50.0		mg/kg wet	1.75	65.2		77	39.4-183		

This laboratory report is not valid without an authorized signature on the cover page.

## Pesticides - Pesticide Breakdown Report

Analyte(s)	Column	% Breakdown	Limit
<b>Batch S816206</b>			
<b><u>Performance Mix (S816206-PEM1)</u></b>			
4,4'-DDT (p,p')	1	4.9	15.0
Endrin	1	2.4	15.0
4,4'-DDT (p,p')	2	1.9	15.0
Endrin	2	4.7	15.0
<b><u>Performance Mix (S816206-PEM2)</u></b>			
4,4'-DDT (p,p')	1	5.7	15.0
Endrin	1	3.7	15.0
4,4'-DDT (p,p')	2	3.2	15.0
Endrin	2	6.4	15.0
<b><u>Performance Mix (S816206-PEM3)</u></b>			
4,4'-DDT (p,p')	1	6.4	15.0
Endrin	1	5.8	15.0
4,4'-DDT (p,p')	2	4.5	15.0
Endrin	2	7.9	15.0

**The following list indicates the date and time low-level VOC soil/sediment samples were placed in the freezer at the lab:**

SC43071-01	<i>SB-8 (0-2')</i>	1/12/2018 11:05 AM
SC43071-02	<i>SB-8 (15-17')</i>	1/12/2018 11:05 AM
SC43071-03	<i>SB-6 (0-2')</i>	1/12/2018 11:05 AM
SC43071-04	<i>SB-6 (15-17')</i>	1/12/2018 11:05 AM
SC43071-05	<i>SB-7 (0-2')</i>	1/12/2018 11:05 AM
SC43071-06	<i>SB-7 (15-17')</i>	1/12/2018 11:05 AM
SC43071-07	<i>SB-1 (0-2')</i>	1/12/2018 11:05 AM
SC43071-08	<i>SB-1 (15-17')</i>	1/12/2018 11:05 AM
SC43071-09	<i>SB-3 (0-2')</i>	1/12/2018 11:05 AM
SC43071-10	<i>SB-3 (15-17')</i>	1/12/2018 11:05 AM
SC43071-11	<i>SB-2 (0-2')</i>	1/12/2018 11:05 AM
SC43071-12	<i>SB-2 (15-17')</i>	1/12/2018 11:05 AM
SC43071-13	<i>SB-4 (0-2')</i>	1/12/2018 11:05 AM
SC43071-14	<i>SB-4 (15-17')</i>	1/12/2018 11:05 AM
SC43071-16	<i>SB-5 (0-2')</i>	1/12/2018 11:05 AM
SC43071-17	<i>SB-5 (12-14')</i>	1/12/2018 11:05 AM
SC43071-18	<i>SB-5 (15-17')</i>	1/12/2018 11:05 AM
SC43071-19	<i>DUP-011118</i>	1/12/2018 11:05 AM

## Notes and Definitions

D	Data reported from a dilution
J	Detected above the Method Detection Limit but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
P	Difference between the two GC columns is greater than 40%.
QC2	Analyte out of acceptance range in QC spike but no reportable concentration present in sample.
QC3	The spike recovery is outside acceptable limits for the LCS. The batch was accepted based upon the MS and/or MSD meeting the LCS limits criteria.
QM2	The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.
QM4X	The spike recovery was outside of QC acceptance limits for the MS, MSD and/or PS due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.
QM7	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.
QM9	The spike recovery for this QC sample is outside the established control limits. The sample results for the QC batch were accepted based on LCS/LCSD or SRM recoveries within the control limits.
QR2	The RPD result exceeded the QC control limits; however, both percent recoveries were acceptable. Sample results for the QC batch were accepted based on percent recoveries and completeness of QC data.
QR6	The RPD exceeded the QC control limits; however precision is demonstrated with acceptable RPD values for MS/MSD.
QR8	Analyses are not controlled on RPD values from sample concentrations that are less than 5 times the reporting level. The batch is accepted based upon the difference between the sample and duplicate is less than or equal to the reporting limit.
QR9	RPD out of acceptance range. The batch is accepted based upon LCS and/or LCSD recovery.
R01	The Reporting Limit has been raised to account for matrix interference.
R06	MRL raised to correlate to batch QC reporting limits.
S04	The surrogate recovery for this sample is outside of established control limits due to a sample matrix effect.
U	Analyte included in the analysis, but not detected at or above the MDL.
VOC8	Reporting limits reflect SW846 5035A High Level extraction technique due to interference and/or QC issues using SW846 5035A Low Level extraction technique.
dry	Sample results reported on a dry weight basis
NR	Not Reported
RPD	Relative Percent Difference
[2C]	Indicates concentration was reported from the secondary, confirmation column.

Laboratory Control Sample (LCS): A known matrix spiked with compound(s) representative of the target analytes, which is used to document laboratory performance.

Matrix Duplicate: An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.

Matrix Spike: An aliquot of a sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

Method Blank: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

Method Detection Limit (MDL): The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

Reportable Detection Limit (RDL): The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. For many analytes the RDL analyte concentration is selected as the lowest non-zero standard in the calibration curve. While the RDL is approximately 5 to 10 times the MDL, the RDL for each sample takes into account the sample volume/weight, extract/digestate volume, cleanup procedures and, if applicable, dry weight correction. Sample RDLs are highly matrix-dependent.

Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. These compounds are spiked into all blanks, standards, and samples prior to analysis. Percent recoveries are calculated for each surrogate.

Continuing Calibration Verification: The calibration relationship established during the initial calibration must be verified at periodic intervals. Concentrations, intervals, and criteria are method specific.





Spectrum Analytical

CHAIN OF CUSTODY RECORD

Page 1 of 2

Special Handling:

- ☒ Standard TAT - 7 to 10 business days
- ☐ Rush TAT / Date Needed: \_\_\_\_\_
- All TATs subject to laboratory approval
- Min. 24-hr notification needed for rushes
- Samples disposed after 30 days unless otherwise instructed.

Report To: NELSON ABRAMS  
AECOM CORP.  
125 Broad St.  
New York City, NY

Invoice To: SAME

Project No: RAN 4200

Site Name: ROSENBERG, N.Y.

Location: ROSENBERG, N.Y. State: NY

Telephone #: \_\_\_\_\_  
Project Mgr: NELSON ABRAMS

P.O. No.: RAN 4200  
60542719 Quote #:

F=Field Filtered 1=Na<sub>2</sub>SO<sub>3</sub> 2=HCl 3=H<sub>2</sub>SO<sub>4</sub> 4=HNO<sub>3</sub> 5=NaOH 6=Ascorbic Acid  
7=CH<sub>3</sub>OH 8=NaHSO<sub>4</sub> 9=Deionized Water 10=H<sub>3</sub>PO<sub>4</sub> 11=NONE 12=

DW=Drinking Water GW=Groundwater SW=Surface Water WW=Waste Water

O=Oil SO=Soil SL=Sludge A=Indoor/Ambient Air SG=Soil Gas

X1= X2= X3=

G= Grab

C=Composite

Lab ID:	Sample ID:	Date:	Time:	Type	Matrix
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SC43071-1 SB-8 (0-2') 1/9/18 11:15 C SO

02 SB-8 (15-17') 12:05 C SO

03 SB-6 (0-2') 14:20 C SO

04 SB-6 (15-17') 15:15 C SO

05 SB-7 (0-2') 10:15 C SO

06 SB-7 (15-17') 11:20 C SO

07 SB-1 (0-2') 14:30 C SO

08 SB-1 (15-17') 15:00 C SO

09 SB-3 (0-2') 16:05 C SO

10 SB-3 (15-17') 16:30 C SO

Relinquished by: John Lange (AECOM) Received by: J. J. Muller

Containers

# of VOA Vials	# of Amber Glass	# of Clear Glass	# of Plastic
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List Preservative Code below:

Analysis

VOC 8260	VOC 8260	822, 8260, 8270	CU, PEST, METALS
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Check if chlorinated

MA DEP MCP CAM Report? ☐ Yes ☐ No  
CT DPH RCP Report? ☐ Yes ☐ No  
☐ Standard ☐ No QC  
☐ ASP A\* ☐ ASP B\*  
☐ NJ Reduced\* ☐ NJ Full\*  
☐ Tier II\* ☐ Tier IV\*  
Other: \_\_\_\_\_  
State-specific reporting standards: \_\_\_\_\_

QA/QC Reporting Notes:

\* additional charges may apply

Temp °C Observed 1.0

EDD format: ☐ E-mail to: \_\_\_\_\_

Condition upon receipt: ☐ Ambient ☒ Iced

Condition upon receipt: ☐ Custody Seals: ☐ Present ☒ Intact ☐ Broken

Condition upon receipt: ☐ Ambient ☒ Iced

Condition upon receipt: ☐ Custody Seals: ☐ Present ☒ Intact ☐ Broken



Spectrum Analytical

## CHAIN OF CUSTODY RECORD

Page 2 of 2

Special Handling:

- ☒ Standard TAT - 7 to 10 business days  
☐ Rush TAT / Date Needed: \_\_\_\_\_

All TATs subject to laboratory approval  
Min. 24-hr notification needed for rushes  
Samples disposed after 30 days unless otherwise instructed.

Report To: <u>Nelson Adams</u>		Invoice To: <u>SumS</u>		Project No: <u>RAW 9260</u>	
<u>AECOM CORP.</u>		Site Name: <u>Rosedale, NY</u>		State: _____	
<u>125 Broad St.</u>		Location: _____		Sampler(s): _____	
<u>New York, N.Y.</u>		P.O. No.: <u>60540777</u>		Quote #: _____	
Telephone #: _____		Project Mgr: <u>Nelson Adams</u>		Date: _____	
F=Field Filtered 1=Na <sub>2</sub> SO <sub>3</sub> 2=HCl 3=H <sub>2</sub> SO <sub>4</sub> 4=HNO <sub>3</sub> 5=NaOH 6=Ascorbic Acid 7=CH <sub>3</sub> OH 8=NaHSO <sub>4</sub> 9=Deionized Water 10=H <sub>2</sub> PO <sub>4</sub> 11= <u>None</u> 12= _____		List Preservative Code below:		QA/QC Reporting Notes: * additional charges may apply	
DW=Drinking Water GW=Groundwater SW=Surface Water WW=Waste Water O=Oil SO=Soil SL=Sludge A=Indoor/Ambient Air SG=Soil Gas X1= _____ X2= _____ X3= _____		Containers		Analysis	
G=Grab C=Composite		Type		Matrix	
Lab ID: <u>SCY3071-14</u>		Sample ID: <u>S3-2(0-2')</u>		Date: <u>1/11/18</u>	
Time: <u>10:40</u>		Type		Matrix	
12 <u>S3-2(15-17')</u>		10:40		C 50 3 2 3	
13 <u>S3-4(0-2')</u>		13:17		C 50 3 2 3	
14 <u>S3-4(15-17')</u>		13:40		C 50 3 2 3	
15 <u>FB</u>		16:00		C 50 3 2 3	
16 <u>S3-5(0-2')</u>		14:30		C 50 3 2 3	
17 <u>S3-5(12-14')</u>		15:05		C 50 3 2 3	
18 <u>S3-5(15-17')</u>		15:15		C 50 3 2 3	
Relinquished by: <u>John Camp (AECOM)</u>		Received by: <u>Dr. Shmida</u>		Date: <u>1/13/18</u>	
Time: <u>11:05</u>		Temp °C: <u>1.0</u>		Observed: <u>1.0</u>	
Condition upon receipt: <input type="checkbox"/> Ambient <input checked="" type="checkbox"/> Iced <input type="checkbox"/> Refrigerated <input type="checkbox"/> DI VOA Frozen <input type="checkbox"/> Soil Jar Frozen		Custody Seals: <input checked="" type="checkbox"/> Present <input type="checkbox"/> Intact <input type="checkbox"/> Broken		E-mail to: _____	



Spectrum Analytical

CHAIN OF CUSTODY RECORD

Special Handling:

- ☒ Standard TAT - 7 to 10 business days  
☐ Rush TAT - Date Needed: \_\_\_\_\_  
All TATs subject to laboratory approval  
Min. 24-hr notification needed for rushes  
Samples disposed after 30 days unless otherwise instructed

Report To: Nelson Adams

Invoice To: Smus

Project No: RAW 9260

Site Name: Rosendale, NY

Location: \_\_\_\_\_ State: \_\_\_\_\_

Sample(s): \_\_\_\_\_

Telephone #: 212-1377-8180

Project Mgr: Nelson Adams

P.O. No.: 60540777

Quote #: \_\_\_\_\_

F=Field Filtered 1=Na<sub>2</sub>SO<sub>3</sub> 2=HCl 3=H<sub>2</sub>SO<sub>4</sub> 4=HNO<sub>3</sub> 5=NaOH 6=Ascorbic Acid  
7=CH<sub>3</sub>OH 8=NaHSO<sub>4</sub> 9=Deionized Water 10=H<sub>2</sub>O 11= None 12= \_\_\_\_\_

DW=Drinking Water GW=Groundwater SW=Surface Water WW=Waste Water

O=Oil SO=Soil SL=Sludge A=Indoor/Ambient Air SG=Soil Gas

X1= \_\_\_\_\_ X2= \_\_\_\_\_ X3= \_\_\_\_\_

G=Grab

C=Composite

Lab ID:	Sample ID:	Date:	Time:	Type	Matrix
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SC43071-14  
12 S3-2(0-2') 1/11/18 10:10 C SO

13 S3-4(0-2') 13/17 13:17 C SO

14 S3-4(15-17) 13/17 13:40 C SO

15 S3-5(0-2') 14/18 14:30 C SO

16 S3-5(12-14) 15/15 15:05 C SO

17 S3-5(15-17) 15/15 15:15 C SO

18 DDP-011118 1/11/18 C SO

19 DDP-011118 1/11/18 C SO

Relinquished by: John C. (Adams)

Received by: Dr. [Signature]

Date: 1/2/18 Time: 11:05

Temp °C: 1.0

Observed: 1.0

Corrected: 0

Condition upon receipt: ☒ Present ☒ Intact ☐ Broken

Custody Seals: ☒ Present ☒ Intact ☐ Broken

Ambient ☒ Iced ☐ Refrigerated ☐ DI VOA Frozen ☐ Soil Jar Frozen

List Preservative Code below:

Analysis

Check if chlorinated

QA/QC Reporting Notes:

\* additional charges may apply

MA DEP MCP CAM Report? ☐ Yes ☐ No  
CT DPH RCP Report? ☐ Yes ☐ No

Standard ☐ No QC

ASP A\* ☐ ASP B\* ☐

NJ Reduced\* ☐ NJ Full\* ☐

Tier II\* ☐ Tier IV\* ☐

Other: \_\_\_\_\_  
State-specific reporting standards: \_\_\_\_\_

Ref: Date: 29Dec17 SHIPPING: 0.00  
Dep: Wgt: 30.00 LBS SPECIAL: 0.00  
DV: 0.00 HANDLING: 0.00  
TOTAL: 0.00

Svcs: PRIORITY OVERNIGHT Master 4200 2859 9900  
TRK: 4200 2859 9965

ORIGIN ID:EHTA (631) 624-1989  
ATTN: JOHN GRESPO - AECOM ENV.

4 DASKAMS LANE, UNIT 304

NORWALK, CT 06851  
UNITED STATES US

SHIP DATE: 29DEC17  
ACTWGT: 30.00 LB MAN  
CAD: 0654830/CAFE3108

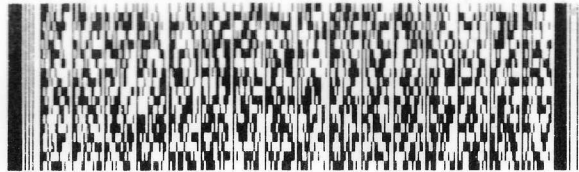
TO **ROBERT BRISTOL**  
**EUROFINS SPECTRUM ANALYTICAL, INC.**  
**11 ALMGREN DRIVE**

**AGAWAM MA 01001**

(413) 789-9018

RMA: #43373

RMA: 



**FedEx**  
Express



**FedEx**

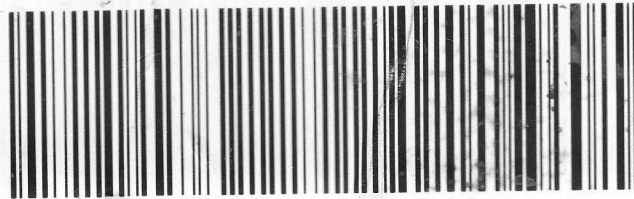
TRK# 4200 2859 9965  
0221

**FRI - 12 JAN 10:30A**  
**PRIORITY OVERNIGHT**

**EB EHTA**

**01001**

**MA-US BD**



#484529 01/11 549J1/BD40/104C

RT **746** 3 **E**  
ST **17** 10:30 9965  
01.12



Ref:   
Dep:

Date: 29Dec17  
Wgt: 30.00 LBS

SHIPPING: 0.00  
SPECIAL: 0.00  
HANDLING: 0.00  
TOTAL: 0.00

Svcs: PRIORITY OVERNIGHT Master 4200 2859 9900  
TRCK: 4200 2859 9954

ORIGIN ID:EHTA (631) 624-1989  
ATTN: JOHN GRESPO - AECOM ENV.

SHIP DATE: 29DEC17  
ACTWGT: 30.00 LB MAN  
CAO: 0654830/CAFE3108

4 DASKAMS LANE, UNIT 304

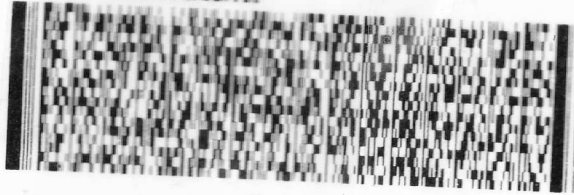
NORWALK, CT 06851  
UNITED STATES US

TO ROBERT BRISTOL  
EUROFINS SPECTRUM ANALYTICAL, INC.  
11 ALMGREN DRIVE

AGAWAM MA 01001

(413) 789-9018  
RMA: #43373

RMA: 



FedEx  
Express



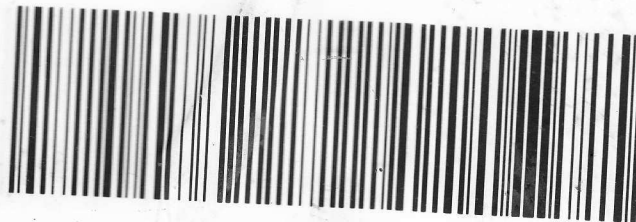
FedEx

TRK# 4200 2859 9954  
0221

FRI - 12 JAN 10:30A  
PRIORITY OVERNIGHT

EB EHTA

01001  
MA-US BDI



#484529 01/11 549J1/BD40/104C

## Batch Summary

### **1800473**

#### Total Metals by EPA 6000/7000 Series Methods

1800473-BLK1  
1800473-DUP1  
1800473-MS1  
1800473-MSD1  
1800473-SRM1  
1800473-SRM2  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

### **1800474**

#### Total Metals by EPA 6000/7000 Series Methods

1800474-BLK1  
1800474-DUP1  
1800474-MS1  
1800474-MSD1  
1800474-PS1  
1800474-SRM1  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

### **1800475**

#### General Chemistry Parameters

SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

### **1800478**

#### Semivolatile Organic Compounds by GCMS

1800478-BLK1  
1800478-BS1  
1800478-BSD1  
1800478-DUP1  
1800478-MS1  
1800478-MSD1  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))

### **1800484**

#### General Chemistry Parameters

1800484-DUP1  
1800484-DUP2  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))

**1800575****Semivolatile Organic Compounds by GC**

1800575-BLK1  
1800575-BS1  
1800575-BSD1  
1800575-DUP1  
1800575-MS1  
1800575-MSD1  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

**1800576****Pesticides**

1800576-BLK1  
1800576-BS1  
1800576-BSD1  
1800576-DUP1  
1800576-MS1  
1800576-MSD1  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

**1800643****Semivolatile Organic Compounds by GCMS**

1800643-BLK1  
1800643-BS1  
1800643-BSD1  
1800643-DUP1  
1800643-MS1  
1800643-MSD1  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

**1800661****General Chemistry Parameters**

1800661-BLK1  
1800661-BLK2  
1800661-BS1  
1800661-BS2  
1800661-BS3  
1800661-BS4  
1800661-DUP1  
1800661-MS1  
1800661-MSD1  
1800661-SRM1  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))

**1800670****General Chemistry Parameters**

1800670-BLK1  
1800670-BLK2  
1800670-BS1  
1800670-BS2  
1800670-BS3  
1800670-BS4  
1800670-DUP1  
1800670-MS1  
1800670-MSD1  
1800670-SRM1  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

**1800741****Volatile Organic Compounds**

1800741-BLK1  
1800741-BS1  
1800741-BSD1  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))

**1800813****Volatile Organic Compounds**

1800813-BLK1  
1800813-BS1  
1800813-BSD1  
SC43071-15 (TB)  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)

**1800822****Volatile Organic Compounds**

1800822-BLK1  
1800822-BS1  
1800822-BSD1  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))

SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))

**1801087****Total Metals by EPA 6000/7000 Series Methods**

1801087-BLK1  
1801087-DUP1  
1801087-MS1  
1801087-MSD1  
1801087-PS1  
1801087-SRM1  
1801087-SRM2  
SC43071-01 (SB-8 (0-2'))  
SC43071-02 (SB-8 (15-17'))  
SC43071-03 (SB-6 (0-2'))  
SC43071-04 (SB-6 (15-17'))  
SC43071-05 (SB-7 (0-2'))  
SC43071-06 (SB-7 (15-17'))  
SC43071-07 (SB-1 (0-2'))  
SC43071-08 (SB-1 (15-17'))  
SC43071-09 (SB-3 (0-2'))  
SC43071-10 (SB-3 (15-17'))  
SC43071-11 (SB-2 (0-2'))  
SC43071-12 (SB-2 (15-17'))  
SC43071-13 (SB-4 (0-2'))  
SC43071-14 (SB-4 (15-17'))  
SC43071-16 (SB-5 (0-2'))  
SC43071-17 (SB-5 (12-14'))  
SC43071-18 (SB-5 (15-17'))  
SC43071-19 (DUP-011118)



**S710445****Semivolatile Organic Compounds by GC**

S710445-CAL1  
S710445-CAL2  
S710445-CAL3  
S710445-CAL4  
S710445-CAL5  
S710445-CAL6  
S710445-CAL7  
S710445-CAL8  
S710445-CAL9  
S710445-CALA  
S710445-CALB  
S710445-CALC  
S710445-CALD  
S710445-CALE  
S710445-CALF  
S710445-CALG  
S710445-CALH  
S710445-CALI  
S710445-CALJ  
S710445-CALK  
S710445-CALL  
S710445-CALM  
S710445-CALN  
S710445-CALO  
S710445-CALP  
S710445-CALQ  
S710445-CALR  
S710445-CALS  
S710445-CALT  
S710445-CALU  
S710445-ICV1  
S710445-ICV2  
S710445-ICV3  
S710445-ICV4  
S710445-ICV5  
S710445-ICV6  
S710445-LCV1  
S710445-LCV2  
S710445-LCV3  
S710445-LCV4  
S710445-LCV5  
S710445-LCV6

**S711008****Semivolatile Organic Compounds by GCMS**

S711008-CAL1  
S711008-CAL2  
S711008-CAL3  
S711008-CAL4  
S711008-CAL5  
S711008-CAL6  
S711008-CAL7  
S711008-CAL8

S711008-CAL9  
S711008-CALA  
S711008-ICV1  
S711008-LCV1  
S711008-LCV2  
S711008-TUN1

**S815988****Semivolatile Organic Compounds by GCMS**

S815988-CCV1  
S815988-TUN1

**S815994****Volatile Organic Compounds**

S815994-CAL1  
S815994-CAL2  
S815994-CAL3  
S815994-CAL4  
S815994-CAL5  
S815994-CAL6  
S815994-CAL7  
S815994-CAL8  
S815994-CAL9  
S815994-ICV1  
S815994-LCV1  
S815994-LCV2  
S815994-LCV3  
S815994-TUN1

**S815997****Semivolatile Organic Compounds by GCMS**

S815997-CCV1  
S815997-TUN1

**S816015****Semivolatile Organic Compounds by GCMS**

S816015-CCV1  
S816015-TUN1

**S816021****Semivolatile Organic Compounds by GC**

S816021-CCV1  
S816021-CCV2  
S816021-CCV3  
S816021-IBL1  
S816021-IBL2  
S816021-IBL3

**S816022****Semivolatile Organic Compounds by GCMS**

S816022-CCV1  
S816022-TUN1

**S816033****General Chemistry Parameters**

S816033-CAL1  
S816033-CAL2  
S816033-CAL3  
S816033-CAL4  
S816033-CAL5  
S816033-CAL6  
S816033-CAL7  
S816033-ICB1  
S816033-ICV1

**S816034****General Chemistry Parameters**

S816034-CCB1  
S816034-CCB2  
S816034-CCB3  
S816034-CCV1  
S816034-CCV2  
S816034-CCV3  
S816034-CRL1  
S816034-CRL2  
S816034-CRL3  
S816034-HCV1  
S816034-LCV1

**S816036****General Chemistry Parameters**

S816036-CCB1  
S816036-CCB2  
S816036-CCB3  
S816036-CCB4  
S816036-CCB5  
S816036-CCV1  
S816036-CCV2  
S816036-CCV3  
S816036-CCV4  
S816036-CCV5  
S816036-CRL1  
S816036-CRL2  
S816036-CRL3  
S816036-CRL4  
S816036-CRL5  
S816036-HCV1  
S816036-LCV1

**S816046****Volatile Organic Compounds**

S816046-CCV1  
S816046-TUN1

**S816061****Volatile Organic Compounds**

S816061-CAL1

S816061-CAL2  
S816061-CAL3  
S816061-CAL4  
S816061-CAL5  
S816061-CAL6  
S816061-CAL7  
S816061-CAL8  
S816061-CAL9  
S816061-ICV1  
S816061-LCV1  
S816061-TUN1

**S816067****Pesticides**

S816067-CAL1  
S816067-CAL2  
S816067-CAL3  
S816067-CAL4  
S816067-CAL5  
S816067-CAL6  
S816067-CAL7  
S816067-CAL8  
S816067-CAL9  
S816067-CALA  
S816067-CALB  
S816067-CALC  
S816067-CALD  
S816067-CALE  
S816067-CALF  
S816067-ICV1  
S816067-ICV2  
S816067-ICV3  
S816067-LCV1  
S816067-LCV2  
S816067-LCV3

**S816080****Volatile Organic Compounds**

S816080-CCV1  
S816080-TUN1

**S816085****Volatile Organic Compounds**

S816085-CCV1  
S816085-TUN1

**S816110****Semivolatile Organic Compounds by GC**

S816110-CCV1  
S816110-CCV2  
S816110-CCV3  
S816110-CCV4  
S816110-CCV5  
S816110-IBL1  
S816110-IBL2  
S816110-IBL3

**S816206****Pesticides**

S816206-CCV1  
S816206-CCV2  
S816206-CCV3  
S816206-CCV4  
S816206-CCV5  
S816206-CCV6  
S816206-CCV7  
S816206-CCV8  
S816206-CCV9  
S816206-IBL1  
S816206-IBL2  
S816206-IBL3  
S816206-PEM1  
S816206-PEM2  
S816206-PEM3

Report Date:  
29-Jan-18 17:51

## Laboratory Report SC43112

AECOM Environment  
125 Broad St  
, 15th Floor  
New York, NY 10005

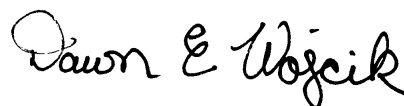
Project: 116th Police Precinct, Rosedale, NY  
Project #: [none]

I attest that the information contained within the report has been reviewed for accuracy and checked against the quality control requirements for each method. These results relate only to the sample(s) as received.  
All applicable NELAC requirements have been met.

Massachusetts # M-MA138/MA1110  
Connecticut # PH-0777  
Florida # E87936  
Maine # MA138  
New Hampshire # 2972/2538  
New Jersey # MA011  
New York # 11393  
Pennsylvania # 68-04426/68-02924  
Rhode Island # LAO00348  
USDA # P330-15-00375  
Vermont # VT-11393



Authorized by:  
Dawn Wojcik  
Laboratory Director



Eurofins Spectrum Analytical holds primary NELAC certification in the State of New York for the analytes as indicated with an X in the "Cert." column within this report. Please note that the State of New York does not offer certification for all analytes. Please refer to our website for specific certification holdings in each state.

Please note that this report contains 104 pages of analytical data plus Chain of Custody document(s). When the Laboratory Report is indicated as revised, this report supersedes any previously dated reports for the laboratory ID(s) referenced above. Where this report identifies subcontracted analyses, copies of the subcontractor's test report are available upon request. This report may not be reproduced, except in full, without written approval from Eurofins Spectrum Analytical, Inc.

*Eurofins Spectrum Analytical, Inc. is a NELAC accredited laboratory organization and meets NELAC testing standards. Use of the NELAC logo however does not insure that Eurofins Spectrum Analytical, Inc. is currently accredited for the specific method or analyte indicated. Please refer to our Quality web page at [www.spectrum-analytical.com](http://www.spectrum-analytical.com) for a full listing of our current certifications and fields of accreditation. States in which Eurofins Spectrum Analytical, Inc. holds NELAC certification are New York, New Hampshire, New Jersey, Pennsylvania and Florida. All analytical work for Volatile Organic and Air analysis are transferred to and conducted at our 830 Silver Street location (PA-68-04426).*

*Please contact the Laboratory or Technical Director at 800-789-9115 with any questions regarding the data contained in this laboratory report.*

## Sample Summary

**Work Order:** SC43112  
**Project:** 116th Police Precinct, Rosedale, NY  
**Project Number:** [none]

<u>Laboratory ID</u>	<u>Client Sample ID</u>	<u>Matrix</u>	<u>Date Sampled</u>	<u>Date Received</u>
SC43112-01	GW-3	Ground Water	10-Jan-18 09:25	15-Jan-18 10:55
SC43112-02	GW-2	Ground Water	10-Jan-18 11:55	15-Jan-18 10:55
SC43112-03	GW-1	Ground Water	12-Jan-18 09:45	15-Jan-18 10:55
SC43112-04	DUP011218	Ground Water	12-Jan-18 08:00	15-Jan-18 10:55
SC43112-05	FB011218	Ground Water	12-Jan-18 12:05	15-Jan-18 10:55
SC43112-06	TB	Aqueous	12-Jan-18 00:00	15-Jan-18 10:55

## CASE NARRATIVE:

Data has been reported to the RDL. This report includes estimated concentrations detected below the RDL and above the MDL (J-Flag).

All non-detects and all results below the detection limit are reported as "<" (less than) the detection limit in this report.

The samples were received 2.0 degrees Celsius, please refer to the Chain of Custody for details specific to temperature upon receipt. An infrared thermometer with a tolerance of +/- 1.0 degrees Celsius was used immediately upon receipt of the samples.

If a Matrix Spike (MS), Matrix Spike Duplicate (MSD) or Duplicate (DUP) was not requested on the Chain of Custody, method criteria may have been fulfilled with a source sample not of this Sample Delivery Group. If method or program required MS/MSD/Dup were not performed, sufficient sample was not provided to the laboratory.

See below for any non-conformances and issues relating to quality control samples and/or sample analysis/matrix.

## EPA 335.4 / SW846 9012B

### Spikes:

1801015-MSD1      *Source: SC43112-03*

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The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Cyanide (total)

## SW846 6010C

### Laboratory Control Samples:

1800619 BS/BSD

---

Beryllium percent recoveries (115/122) are outside individual acceptance criteria (85-115), but within overall method allowances. All reported results of the following samples are considered to have a potentially high bias:

DUP011218  
FB011218  
GW-1  
GW-2  
GW-3

1800621 BS/BSD

---

Beryllium percent recoveries (131/129) are outside individual acceptance criteria (85-115), but within overall method allowances. All reported results of the following samples are considered to have a potentially high bias:

DUP011218  
FB011218  
GW-1  
GW-2  
GW-3

### Spikes:

1800621-MS1      *Source: SC43112-03*

---

Analyte out of acceptance range in QC spike but no reportable concentration present in sample.

Beryllium

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Magnesium

1800621-MSD1      *Source: SC43112-03*

---

## **SW846 6010C**

### **Spikes:**

1800621-MSD1      *Source: SC43112-03*

---

Analyte out of acceptance range in QC spike but no reportable concentration present in sample.

Beryllium

1801097-MS1      *Source: SC43112-03*

---

The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.

Sodium

1801097-MSD1      *Source: SC43112-03*

---

The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.

Sodium

1801097-PS1      *Source: SC43112-03*

---

The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.

Sodium

### **Duplicates:**

1800619-DUP1      *Source: SC43112-03*

---

Analyses are not controlled on RPD values from sample concentrations that are less than 5 times the reporting level. The batch is accepted based upon the difference between the sample and duplicate is less than or equal to the reporting limit.

Arsenic

1800621-DUP1      *Source: SC43112-03*

---

Analyses are not controlled on RPD values from sample concentrations that are less than 5 times the reporting level. The batch is accepted based upon the difference between the sample and duplicate is less than or equal to the reporting limit.

Zinc

The RPD exceeded the QC control limits; however precision is demonstrated with acceptable RPD values for MS/MSD.

Iron

## **SW846 8081B**

### **Spikes:**

1800578-MSD1      *Source: SC43112-03*

---

The RPD result exceeded the QC control limits; however, both percent recoveries were acceptable. Sample results for the QC batch were accepted based on percent recoveries and completeness of QC data.

4,4'-DDT (p,p')  
Endosulfan sulfate  
Endrin aldehyde  
Endrin ketone  
Methoxychlor

### **Samples:**

SC43112-01      *GW-3*

---

## **SW846 8081B**

### **Samples:**

SC43112-01                      *GW-3*

---

Surrogate outside acceptable method limits. Sample was re-extracted.

Decachlorobiphenyl (Sr)  
Decachlorobiphenyl (Sr) [2C]

SC43112-01RE1                      *GW-3*

---

Sample was originally analyzed within the recommended method holding time; however, QC materials for the sample run were out of control. As a result, the sample was immediately re-analyzed (outside the holding time).

SC43112-03                      *GW-1*

---

Difference between the two GC columns is greater than 40%.

alpha-Chlordane

SC43112-04                      *DUP011218*

---

Difference between the two GC columns is greater than 40%.

alpha-Chlordane

## **SW846 8082A**

### **Samples:**

SC43112-01                      *GW-3*

---

Surrogate outside method acceptable limits. Sample re-extracted.

Decachlorobiphenyl (Sr)  
Decachlorobiphenyl (Sr) [2C]

SC43112-01RE1                      *GW-3*

---

Sample was originally analyzed within the recommended method holding time; however, QC materials for the sample run were out of control. As a result, the sample was immediately re-analyzed (outside the holding time).

## **SW846 8260C**

### **Calibration:**

1801052

---

Analyte quantified by quadratic equation type calibration.

1,1,1,2-Tetrachloroethane  
1,2-Dibromo-3-chloropropane  
Bromodichloromethane  
Bromoform  
Carbon tetrachloride  
cis-1,3-Dichloropropene  
Dibromochloromethane  
Naphthalene  
trans-1,3-Dichloropropene  
trans-1,4-Dichloro-2-butene  
Vinyl chloride



## **SW846 8260C**

### **Calibration:**

1801052

---

This affected the following samples:

1800715-BLK1  
1800715-BS1  
1800715-BSD1  
1800715-MS1  
1800715-MSD1  
DUP011218  
FB011218  
GW-1  
GW-2  
GW-3  
S815896-ICV1  
S816026-CCV1  
TB

### **Samples:**

S816026-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

1,1-Dichloroethane (20.1%)  
1,2,4-Trimethylbenzene (23.0%)  
1,3,5-Trimethylbenzene (22.5%)  
1,3-Dichlorobenzene (20.7%)  
2-Chlorotoluene (22.3%)  
4-Chlorotoluene (21.5%)  
Bromobenzene (20.9%)  
Bromomethane (23.2%)  
Ethylbenzene (21.1%)  
o-Xylene (22.3%)  
Styrene (23.2%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

Vinyl chloride (21.2%)

This affected the following samples:

1800715-BLK1  
1800715-BS1  
1800715-BSD1  
1800715-MS1  
1800715-MSD1  
DUP011218  
FB011218  
GW-1  
GW-2  
GW-3  
TB

## **SW846 8270D**

### **Calibration:**

1801047

---

## **SW846 8270D**

### **Calibration:**

1801047

---

Analyte quantified by quadratic equation type calibration.

2,4-Dinitrophenol  
2,4-Dinitrotoluene  
2,6-Dinitrotoluene  
3-Nitroaniline  
4,6-Dinitro-2-methylphenol  
4-Nitrophenol  
Benzidine  
Benzoic acid  
Carbazole  
Pentachlorophenol

This affected the following samples:

1800581-BLK1  
1800581-BS1  
1800581-BSD1  
1800581-MS1  
1800581-MSD1  
1800974-BLK1  
1800974-BS1  
1800974-BSD1  
DUP011218  
FB011218  
GW-1  
GW-2  
GW-3  
S815859-ICV1  
S816135-CCV1  
S816213-CCV1

### **Laboratory Control Samples:**

1800974 BS/BSD

---

Aniline percent recoveries (32/30) are outside individual acceptance criteria (40-140), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

FB011218

Benzidine percent recoveries (26/18) are outside individual acceptance criteria (40-140), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

FB011218

Phenol percent recoveries (28/27) are outside individual acceptance criteria (30-130), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

FB011218

Pyridine percent recoveries (33/30) are outside individual acceptance criteria (40-140), but within overall method allowances. All reported results of the following samples are considered to have a potentially low bias:

FB011218

1800974 BSD

---

Benzidine RPD 36% (20%) is outside individual acceptance criteria.

1800974-BS1

---

## **SW846 8270D**

### **Laboratory Control Samples:**

1800974-BS1

---

Analyte is found in the associated blank as well as in the sample (CLP B-flag).

Di-n-octyl phthalate

1800974-BSD1

---

Analyte is found in the associated blank as well as in the sample (CLP B-flag).

Di-n-octyl phthalate

### **Spikes:**

1800581-MS1

*Source: SC43112-03*

---

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Aniline

Benzidine

N-Nitrosodimethylamine

Phenol

Pyridine

1800581-MSD1

*Source: SC43112-03*

---

The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.

Aniline

Benzidine

N-Nitrosodimethylamine

Phenol

Pyridine

### **Samples:**

S816135-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

4-Chloroaniline (-24.7%)

Aniline (-35.6%)

Benzo (b) fluoranthene (21.4%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

2,4-Dinitrophenol (26.0%)

4,6-Dinitro-2-methylphenol (22.9%)

Benzidine (22.0%)

This affected the following samples:

1800581-BLK1

1800581-BS1

1800581-BSD1

1800581-MS1

1800581-MSD1

DUP011218

FB011218

GW-1

GW-2

GW-3

S816213-CCV1

---

## **SW846 8270D**

### **Samples:**

S816213-CCV1

---

Analyte percent difference is outside individual acceptance criteria (20), but within overall method allowances.

4-Nitroaniline (23.8%)

Aniline (-37.1%)

Benzo (b) fluoranthene (21.5%)

Bis(2-chloroethyl)ether (23.3%)

Analyte percent drift is outside individual acceptance criteria (20), but within overall method allowances.

2,4-Dinitrophenol (25.9%)

4,6-Dinitro-2-methylphenol (25.2%)

Benzidine (-69.8%)

This affected the following samples:

1800974-BLK1

1800974-BS1

1800974-BSD1

FB011218

SC43112-05

*FB011218*

---

**Samples:**

SC43112-05

FB011218

This flag indicates the concentration for this analyte is an estimated value due to exceeding the calibration range or interferences resulting in a biased final concentration.

1,2,4,5-Tetrachlorobenzene  
1,2,4-Trichlorobenzene  
1,2-Dichlorobenzene  
1,3-Dichlorobenzene  
1,4-Dichlorobenzene  
1-Methylnaphthalene  
2,4,5-Trichlorophenol  
2,4,6-Trichlorophenol  
2,4-Dichlorophenol  
2,4-Dimethylphenol  
2,4-Dinitrophenol  
2,4-Dinitrotoluene  
2,6-Dinitrotoluene  
2-Chloronaphthalene  
2-Chlorophenol  
2-Methylnaphthalene  
2-Methylphenol  
2-Nitroaniline  
2-Nitrophenol  
3 & 4-Methylphenol  
3,3'-Dichlorobenzidine  
3-Nitroaniline  
4,6-Dinitro-2-methylphenol  
4-Bromophenyl phenyl ether  
4-Chloro-3-methylphenol  
4-Chloroaniline  
4-Chlorophenyl phenyl ether  
4-Nitroaniline  
4-Nitrophenol  
Acenaphthene  
Acenaphthylene  
Aniline  
Anthracene  
Azobenzene/Diphenyldiazene  
Benzidine  
Benzo (a) anthracene  
Benzo (a) pyrene  
Benzo (b) fluoranthene  
Benzo (g,h,i) perylene  
Benzo (k) fluoranthene  
Benzoic acid  
Benzyl alcohol  
Bis(2-chloroethoxy)methane  
Bis(2-chloroethyl)ether  
Bis(2-chloroisopropyl)ether  
Bis(2-ethylhexyl)phthalate  
Butyl benzyl phthalate  
Carbazole  
Chrysene  
Dibenzo (a,h) anthracene  
Dibenzofuran  
Diethyl phthalate  
Dimethyl phthalate  
Di-n-butyl phthalate  
Di-n-octyl phthalate

**Samples:**

SC43112-05

FB011218

---

This flag indicates the concentration for this analyte is an estimated value due to exceeding the calibration range or interferences resulting in a biased final concentration.

Fluoranthene  
Fluorene  
Hexachlorobenzene  
Hexachlorobutadiene  
Hexachlorocyclopentadiene  
Hexachloroethane  
Indeno (1,2,3-cd) pyrene  
Isophorone  
Naphthalene  
Nitrobenzene  
N-Nitrosodimethylamine  
N-Nitrosodi-n-propylamine  
N-Nitrosodiphenylamine  
Pentachloronitrobenzene  
Pentachlorophenol  
Phenanthrene  
Phenol  
Pyrene  
Pyridine

SC43112-05RE1

FB011218

---

Analyte is found in the associated blank as well as in the sample (CLP B-flag).

Di-n-octyl phthalate

Sample was originally analyzed within the recommended method holding time; however, QC materials for the sample run were out of control. As a result, the sample was immediately re-analyzed (outside the holding time).

## Sample Acceptance Check Form

Client: AECOM Environment - NY, NY  
Project: 116th Police Precinct, Rosedale, NY / [none]  
Work Order: SC43112  
Sample(s) received on: 1/15/2018

*The following outlines the condition of samples for the attached Chain of Custody upon receipt.*

	<u>Yes</u>	<u>No</u>	<u>N/A</u>
Were custody seals present?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were custody seals intact?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples received at a temperature of $\leq 6^{\circ}\text{C}$ ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples cooled on ice upon transfer to laboratory representative?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were sample containers received intact?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples properly labeled (labels affixed to sample containers and include sample ID, site location, and/or project number and the collection date)?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples accompanied by a Chain of Custody document?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does Chain of Custody document include proper, full, and complete documentation, which shall include sample ID, site location, and/or project number, date and time of collection, collector's name, preservation type, sample matrix and any special remarks concerning the sample?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Did sample container labels agree with Chain of Custody document?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Were samples received within method-specific holding times?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Summary of Hits

**Lab ID:** SC43112-01

**Client ID:** GW-3

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	0.241		0.0250	mg/l	SW846 6010C
Arsenic	0.0014	J	0.0040	mg/l	SW846 6010C
Barium	0.0277		0.0050	mg/l	SW846 6010C
Barium (dissolved)	0.0270		0.0050	mg/l	SW846 6010C
Calcium	17.9		0.100	mg/l	SW846 6010C
Calcium (dissolved)	18.3		0.100	mg/l	SW846 6010C
Cobalt	0.0028	J	0.0050	mg/l	SW846 6010C
Cobalt (dissolved)	0.0032	J	0.0050	mg/l	SW846 6010C
Iron	0.649		0.0300	mg/l	SW846 6010C
Iron (dissolved)	0.228		0.0150	mg/l	SW846 6010C
Magnesium	2.74		0.0100	mg/l	SW846 6010C
Magnesium (dissolved)	2.74		0.0100	mg/l	SW846 6010C
Manganese	1.75		0.0020	mg/l	SW846 6010C
Manganese (dissolved)	1.93		0.0020	mg/l	SW846 6010C
Nickel	0.0049	J	0.0050	mg/l	SW846 6010C
Nickel (dissolved)	0.0050		0.0050	mg/l	SW846 6010C
Potassium	3.40		0.500	mg/l	SW846 6010C
Potassium (dissolved)	3.55		0.500	mg/l	SW846 6010C
Sodium	67.5		0.250	mg/l	SW846 6010C
Sodium (dissolved)	73.7		0.250	mg/l	SW846 6010C
Vanadium	0.0012	J	0.0050	mg/l	SW846 6010C
Zinc	0.0040	J	0.0050	mg/l	SW846 6010C
Zinc (dissolved)	0.0035	J	0.0050	mg/l	SW846 6010C
Dieldrin [2C]	0.060		0.019	µg/l	SW846 8081B
Acetone	1.46	J	10.0	µg/l	SW846 8260C
Chloroform	0.48	J	1.00	µg/l	SW846 8260C
Bis(2-ethylhexyl)phthalate	0.835	J	4.85	µg/l	SW846 8270D

**Lab ID:** SC43112-01RE1

**Client ID:** GW-3

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Dieldrin	0.019		0.019	µg/l	SW846 8081B



Lab ID: SC43112-02

Client ID: GW-2

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	0.364		0.0250	mg/l	SW846 6010C
Arsenic	0.0022	J	0.0040	mg/l	SW846 6010C
Arsenic (dissolved)	0.0022	J	0.0040	mg/l	SW846 6010C
Barium	0.0817		0.0050	mg/l	SW846 6010C
Barium (dissolved)	0.0908		0.0050	mg/l	SW846 6010C
Calcium	36.6		0.100	mg/l	SW846 6010C
Calcium (dissolved)	40.8		0.100	mg/l	SW846 6010C
Chromium	0.0012	J	0.0050	mg/l	SW846 6010C
Cobalt	0.0046	J	0.0050	mg/l	SW846 6010C
Cobalt (dissolved)	0.0051		0.0050	mg/l	SW846 6010C
Iron	1.13		0.0300	mg/l	SW846 6010C
Iron (dissolved)	0.150		0.0150	mg/l	SW846 6010C
Magnesium	6.70		0.0100	mg/l	SW846 6010C
Magnesium (dissolved)	7.10		0.0100	mg/l	SW846 6010C
Manganese	4.08		0.0020	mg/l	SW846 6010C
Manganese (dissolved)	4.70		0.0020	mg/l	SW846 6010C
Nickel	0.0070		0.0050	mg/l	SW846 6010C
Nickel (dissolved)	0.0066		0.0050	mg/l	SW846 6010C
Potassium	6.60		0.500	mg/l	SW846 6010C
Potassium (dissolved)	7.30		0.500	mg/l	SW846 6010C
Sodium	182		0.250	mg/l	SW846 6010C
Sodium (dissolved)	187		0.250	mg/l	SW846 6010C
Vanadium	0.0019	J	0.0050	mg/l	SW846 6010C
Vanadium (dissolved)	0.0012	J	0.0050	mg/l	SW846 6010C
Zinc	0.0125		0.0050	mg/l	SW846 6010C
Zinc (dissolved)	0.0114		0.0050	mg/l	SW846 6010C
Acetone	3.51	J	10.0	µg/l	SW846 8260C
Chloroform	1.29		1.00	µg/l	SW846 8260C
Bis(2-ethylhexyl)phthalate	1.17	J	4.81	µg/l	SW846 8270D
Di-n-octyl phthalate	2.88	J	4.81	µg/l	SW846 8270D

Lab ID: SC43112-03

Client ID: GW-1

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Aluminum	0.0113	J	0.0250	mg/l	SW846 6010C
Arsenic	0.0016	J	0.0040	mg/l	SW846 6010C
Barium	0.0394		0.0050	mg/l	SW846 6010C
Barium (dissolved)	0.0423		0.0050	mg/l	SW846 6010C
Calcium	25.5		0.100	mg/l	SW846 6010C
Calcium (dissolved)	26.7		0.100	mg/l	SW846 6010C
Cobalt	0.0041	J	0.0050	mg/l	SW846 6010C
Cobalt (dissolved)	0.0040	J	0.0050	mg/l	SW846 6010C
Copper (dissolved)	0.0026	J	0.0050	mg/l	SW846 6010C
Iron	0.296		0.0300	mg/l	SW846 6010C
Iron (dissolved)	0.331		0.0150	mg/l	SW846 6010C
Magnesium	4.58		0.0100	mg/l	SW846 6010C
Magnesium (dissolved)	4.84		0.0100	mg/l	SW846 6010C
Manganese	2.11		0.0020	mg/l	SW846 6010C
Manganese (dissolved)	2.06		0.0020	mg/l	SW846 6010C
Nickel	0.0038	J	0.0050	mg/l	SW846 6010C
Nickel (dissolved)	0.0040	J	0.0050	mg/l	SW846 6010C
Potassium	3.52		0.500	mg/l	SW846 6010C
Potassium (dissolved)	3.83		0.500	mg/l	SW846 6010C
Sodium	94.6		0.250	mg/l	SW846 6010C
Sodium (dissolved)	100		0.250	mg/l	SW846 6010C
Zinc	0.0016	J	0.0050	mg/l	SW846 6010C
Zinc (dissolved)	0.0039	J	0.0050	mg/l	SW846 6010C
alpha-Chlordane	0.085	P	0.019	µg/l	SW846 8081B
Chlordane	0.692		0.061	µg/l	SW846 8081B
Chlordane (gamma)(trans)	0.073		0.019	µg/l	SW846 8081B
Dieldrin	0.129		0.019	µg/l	SW846 8081B
Acetone	1.82	J	10.0	µg/l	SW846 8260C

Lab ID: SC43112-04

Client ID: DUP011218

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Arsenic	0.0022	J	0.0040	mg/l	SW846 6010C
Barium	0.0393		0.0050	mg/l	SW846 6010C
Barium (dissolved)	0.0409		0.0050	mg/l	SW846 6010C
Calcium	25.5		0.100	mg/l	SW846 6010C
Calcium (dissolved)	25.8		0.100	mg/l	SW846 6010C
Cobalt	0.0038	J	0.0050	mg/l	SW846 6010C
Cobalt (dissolved)	0.0046	J	0.0050	mg/l	SW846 6010C
Iron	0.303		0.0300	mg/l	SW846 6010C
Iron (dissolved)	0.275		0.0150	mg/l	SW846 6010C
Magnesium	4.56		0.0100	mg/l	SW846 6010C
Magnesium (dissolved)	4.62		0.0100	mg/l	SW846 6010C
Manganese	2.05		0.0020	mg/l	SW846 6010C
Manganese (dissolved)	2.24		0.0020	mg/l	SW846 6010C
Nickel	0.0036	J	0.0050	mg/l	SW846 6010C
Nickel (dissolved)	0.0038	J	0.0050	mg/l	SW846 6010C
Potassium	3.55		0.500	mg/l	SW846 6010C
Potassium (dissolved)	3.73		0.500	mg/l	SW846 6010C
Sodium	94.2		0.250	mg/l	SW846 6010C
Sodium (dissolved)	97.0		0.250	mg/l	SW846 6010C
Zinc	0.0076		0.0050	mg/l	SW846 6010C
Zinc (dissolved)	0.0022	J	0.0050	mg/l	SW846 6010C
alpha-Chlordane	0.082	P	0.019	µg/l	SW846 8081B
Chlordane	0.575		0.061	µg/l	SW846 8081B
Chlordane (gamma)(trans)	0.072		0.019	µg/l	SW846 8081B
Dieldrin [2C]	0.105		0.019	µg/l	SW846 8081B
Acetone	1.90	J	10.0	µg/l	SW846 8260C

Lab ID: SC43112-05

Client ID: FB011218

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Calcium	0.0436	J	0.100	mg/l	SW846 6010C
Calcium (dissolved)	0.0338	J	0.100	mg/l	SW846 6010C
Iron (dissolved)	0.0058	J	0.0150	mg/l	SW846 6010C
Magnesium	0.0058	J	0.0100	mg/l	SW846 6010C
Magnesium (dissolved)	0.0067	J	0.0100	mg/l	SW846 6010C
Sodium	0.117	J	0.250	mg/l	SW846 6010C
Sodium (dissolved)	0.148	J	0.250	mg/l	SW846 6010C
Zinc	0.0019	J	0.0050	mg/l	SW846 6010C

Lab ID: SC43112-05RE1

Client ID: FB011218

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Di-n-octyl phthalate	1.67	J, B	4.67	µg/l	SW846 8270D

**Lab ID:** SC43112-06

**Client ID:** TB

Parameter	Result	Flag	Reporting Limit	Units	Analytical Method
Acetone	0.94	J	10.0	µg/l	SW846 8260C

*Please note that because there are no reporting limits associated with hazardous waste characterizations or micro analyses, this summary does not include hits from these analyses if included in this work order.*

Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
Volatile Organic Compounds by SW846 8260													
Prepared by method SW846 5030 Water MS													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00	0.53	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
67-64-1	Acetone	1.46	J	µg/l	10.0	0.80	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
71-43-2	Benzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 0.50	U	µg/l	0.50	0.42	1	"	"	"	"	"	X
75-25-2	Bromoform	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 2.00	U	µg/l	2.00	0.90	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 2.00	U	µg/l	2.00	1.07	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 1.00	U	µg/l	1.00	0.41	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 2.00	U	µg/l	2.00	0.41	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 1.00	U	µg/l	1.00	0.44	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 1.00	U	µg/l	1.00	0.25	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 2.00	U	µg/l	2.00	0.59	1	"	"	"	"	"	X
67-66-3	Chloroform	0.48	J	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 2.00	U	µg/l	2.00	0.37	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00	0.86	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 0.50	U	µg/l	0.50	0.32	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50	0.20	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.27	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00	0.58	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 1.00	U	µg/l	1.00	0.69	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 1.00	U	µg/l	1.00	0.21	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 1.00	U	µg/l	1.00	0.58	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.36	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.35	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 2.00	U	µg/l	2.00	0.53	1	"	"	"	"	"	X

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Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
98-82-8	Isopropylbenzene	< 1.00	U	µg/l	1.00	0.36	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
99-87-6	4-Isopropyltoluene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.24	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00	0.52	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 2.00	U	µg/l	2.00	0.66	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 1.00	U	µg/l	1.00	0.35	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
100-42-5	Styrene	< 1.00	U	µg/l	1.00	0.40	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50	0.33	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 1.00	U	µg/l	1.00	0.57	1	"	"	"	"	"	X
108-88-3	Toluene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00	0.51	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 1.00	U	µg/l	1.00	0.50	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.36	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.43	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 1.00	U	µg/l	1.00	0.47	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 2.00	U	µg/l	2.00	0.38	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 2.00	U	µg/l	2.00	1.06	1	"	"	"	"	"	
60-29-7	Ethyl ether	< 1.00	U	µg/l	1.00	0.37	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0	5.90	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 20.0	U	µg/l	20.0	11.4	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 5.00	U	µg/l	5.00	0.82	1	"	"	"	"	"	X
64-17-5	Ethanol	< 200	U	µg/l	200	30.9	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	98		70-130 %		"	"	"	"	"
2037-26-5	Toluene-d8	101		70-130 %		"	"	"	"	"
17060-07-0	1,2-Dichloroethane-d4	99		70-130 %		"	"	"	"	"
1868-53-7	Dibromofluoromethane	103		70-130 %		"	"	"	"	"

Semivolatile Organic Compounds by GCMSSemivolatile Organic CompoundsPrepared by method SW846 3510C

83-32-9	Acenaphthene	< 4.85	U	µg/l	4.85	0.671	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
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Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
208-96-8	Acenaphthylene	< 4.85	U	µg/l	4.85	0.663	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
62-53-3	Aniline	< 4.85	U	µg/l	4.85	1.72	1	"	"	"	"	"	X
120-12-7	Anthracene	< 4.85	U	µg/l	4.85	0.590	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 4.85	U	µg/l	4.85	0.726	1	"	"	"	"	"	
92-87-5	Benzidine	< 4.85	U	µg/l	4.85	1.11	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 4.85	U	µg/l	4.85	0.520	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 4.85	U	µg/l	4.85	0.546	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 4.85	U	µg/l	4.85	0.424	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 4.85	U	µg/l	4.85	0.515	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 4.85	U	µg/l	4.85	0.466	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 4.85	U	µg/l	4.85	0.512	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 4.85	U	µg/l	4.85	0.757	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 4.85	U	µg/l	4.85	0.647	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 4.85	U	µg/l	4.85	0.713	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 4.85	U	µg/l	4.85	0.755	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	0.835	J	µg/l	4.85	0.619	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 4.85	U	µg/l	4.85	0.584	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 4.85	U	µg/l	4.85	0.425	1	"	"	"	"	"	X
86-74-8	Carbazole	< 4.85	U	µg/l	4.85	1.51	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 4.85	U	µg/l	4.85	0.486	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 4.85	U	µg/l	4.85	1.09	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 4.85	U	µg/l	4.85	0.573	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 4.85	U	µg/l	4.85	0.726	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 4.85	U	µg/l	4.85	0.585	1	"	"	"	"	"	X
218-01-9	Chrysene	< 4.85	U	µg/l	4.85	0.517	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 4.85	U	µg/l	4.85	0.437	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 4.85	U	µg/l	4.85	0.718	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.85	U	µg/l	4.85	0.546	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.85	U	µg/l	4.85	0.628	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.85	U	µg/l	4.85	0.596	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 4.85	U	µg/l	4.85	1.93	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 4.85	U	µg/l	4.85	0.515	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 4.85	U	µg/l	4.85	0.605	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 4.85	U	µg/l	4.85	0.736	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 4.85	U	µg/l	4.85	0.634	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 4.85	U	µg/l	4.85	0.444	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 4.85	U	µg/l	4.85	0.310	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 4.85	U	µg/l	4.85	0.545	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 4.85	U	µg/l	4.85	0.653	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 4.85	U	µg/l	4.85	0.576	1	"	"	"	"	"	X
117-84-0	Di-n-octyl phthalate	< 4.85	U	µg/l	4.85	0.394	1	"	"	"	"	"	X
206-44-0	Fluoranthene	< 4.85	U	µg/l	4.85	0.619	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

86-73-7	Fluorene	< 4.85	U	µg/l	4.85	0.594	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
118-74-1	Hexachlorobenzene	< 4.85	U	µg/l	4.85	0.554	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 4.85	U	µg/l	4.85	0.377	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 4.85	U	µg/l	4.85	1.01	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 4.85	U	µg/l	4.85	0.620	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 4.85	U	µg/l	4.85	0.563	1	"	"	"	"	"	X
78-59-1	Isophorone	< 4.85	U	µg/l	4.85	0.569	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 4.85	U	µg/l	4.85	0.557	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 4.85	U	µg/l	4.85	0.646	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 9.71	U	µg/l	9.71	0.597	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.85	U	µg/l	4.85	0.665	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 4.85	U	µg/l	4.85	0.588	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 4.85	U	µg/l	4.85	0.527	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 4.85	U	µg/l	4.85	0.363	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 4.85	U	µg/l	4.85	0.670	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 4.85	U	µg/l	4.85	0.451	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 19.4	U	µg/l	19.4	0.814	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 4.85	U	µg/l	4.85	0.653	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 4.85	U	µg/l	4.85	0.561	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 4.85	U	µg/l	4.85	0.632	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 19.4	U	µg/l	19.4	0.362	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 4.85	U	µg/l	4.85	0.569	1	"	"	"	"	"	X
108-95-2	Phenol	< 4.85	U	µg/l	4.85	0.626	1	"	"	"	"	"	X
129-00-0	Pyrene	< 4.85	U	µg/l	4.85	0.592	1	"	"	"	"	"	X
110-86-1	Pyridine	< 4.85	U	µg/l	4.85	0.795	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.85	U	µg/l	4.85	0.667	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 4.85	U	µg/l	4.85	0.712	1	"	"	"	"	"	X
95-95-4	2,4,5-Trichlorophenol	< 4.85	U	µg/l	4.85	0.505	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 4.85	U	µg/l	4.85	0.503	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 4.85	U	µg/l	4.85	0.676	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 4.85	U	µg/l	4.85	0.704	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	55			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	32			15-110 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	56			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	24			15-110 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	81			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	64			15-110 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3510C

12674-11-2	Aroclor-1016	< 0.192	U	µg/l	0.192	0.100	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
11104-28-2	Aroclor-1221	< 0.192	U	µg/l	0.192	0.111	1	"	"	"	"	"	X
11141-16-5	Aroclor-1232	< 0.192	U	µg/l	0.192	0.107	1	"	"	"	"	"	X

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Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

53469-21-9	Aroclor-1242	< 0.192	U	µg/l	0.192	0.103	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
12672-29-6	Aroclor-1248	< 0.192	U	µg/l	0.192	0.131	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 0.192	U	µg/l	0.192	0.112	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 0.192	U	µg/l	0.192	0.0818	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 0.192	U	µg/l	0.192	0.0862	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 0.192	U	µg/l	0.192	0.0880	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	75			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	80			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	760	Z-2a		30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	770	Z-2a		30-150 %			"	"	"	"	"	

Re-analysis of Polychlorinated Biphenyls

HT5

Prepared by method SW846 3510C

12674-11-2	Aroclor-1016	< 0.190	U	µg/l	0.190	0.0990	1	SW846 8082A	19-Jan-18	23-Jan-18	AM	1800739	X
11104-28-2	Aroclor-1221	< 0.190	U	µg/l	0.190	0.110	1	"	"	"	"	"	X
11141-16-5	Aroclor-1232	< 0.190	U	µg/l	0.190	0.106	1	"	"	"	"	"	X
53469-21-9	Aroclor-1242	< 0.190	U	µg/l	0.190	0.102	1	"	"	"	"	"	X
12672-29-6	Aroclor-1248	< 0.190	U	µg/l	0.190	0.130	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 0.190	U	µg/l	0.190	0.110	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 0.190	U	µg/l	0.190	0.0810	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 0.190	U	µg/l	0.190	0.0853	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 0.190	U	µg/l	0.190	0.0871	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	60			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	65			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	90			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	110			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3510C

319-84-6	alpha-BHC	< 0.019	U	µg/l	0.019	0.011	1	SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	X
319-85-7	beta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 0.019	U	µg/l	0.019	0.019	1	"	"	"	"	"	X
309-00-2	Aldrin	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
60-57-1	Dieldrin [2C]	0.060		µg/l	0.019	0.018	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
72-20-8	Endrin	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X

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Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Pesticides</b>													
<u>Organochlorine Pesticides</u>													
33213-65-9	Endosulfan II	< 0.038	U	µg/l	0.038	0.019	1	SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	X
72-54-8	4,4'-DDD (p,p')	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 0.481	U	µg/l	0.481	0.315	1	"	"	"	"	"	X
57-74-9	Chlordane	< 0.063	U	µg/l	0.063	0.049	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	
<u>Surrogate recoveries:</u>													
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	111			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	109			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	695	Z-2		30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	642	Z-2		30-150 %			"	"	"	"	"	
<u>Re-analysis of Organochlorine Pesticides</u>													
<u>Prepared by method SW846 3510C</u>													
319-84-6	alpha-BHC	< 0.019	U	µg/l	0.019	0.011	1	SW846 8081B	19-Jan-18	20-Jan-18	SM	1800753	X
319-85-7	beta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 0.019	U	µg/l	0.019	0.019	1	"	"	"	"	"	X
309-00-2	Aldrin	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
60-57-1	Dieldrin	0.019		µg/l	0.019	0.016	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
72-20-8	Endrin	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 0.038	U	µg/l	0.038	0.016	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 0.476	U	µg/l	0.476	0.312	1	"	"	"	"	"	X
57-74-9	Chlordane	< 0.062	U	µg/l	0.062	0.049	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	
<u>Surrogate recoveries:</u>													

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Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
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**Pesticides**

Re-analysis of Organochlorine Pesticides

HT5

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	74			30-150 %			SW846 8081B	19-Jan-18	20-Jan-18	SM	1800753	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	76			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	83			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	92			30-150 %			"	"	"	"	"	

**Total Metals by EPA 200/6000 Series Methods**

Prepared by method General Prep-Metal

Preservation	Field Preserved; pH<2 confirmed			N/A			1	EPA 200/6000 methods	16-Jan-18		JS	1800630	
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**Total Metals by EPA 6000/7000 Series Methods**

Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	18-Jan-18	24-Jan-18	SJR/T	1800619	X
7429-90-5	Aluminum	0.241		mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.0014	J	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0277		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	17.9		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X
7440-48-4	Cobalt	0.0028	J	mg/l	0.0050	0.0008	1	"	"	"	"	"	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.649		mg/l	0.0300	0.0089	1	"	26-Jan-18	28-Jan-18	"	1801155	X
7440-09-7	Potassium	3.40		mg/l	0.500	0.0600	1	"	18-Jan-18	25-Jan-18	"	1801089	X
7439-95-4	Magnesium	2.74		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800619	X
7439-96-5	Manganese	1.75		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	67.5		mg/l	0.250	0.0392	1	"	"	"	"	"	X
7440-02-0	Nickel	0.0049	J	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	"	"	"	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	"	"	"	X
7440-62-2	Vanadium	0.0012	J	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0040	J	mg/l	0.0050	0.0016	1	"	"	"	"	"	X

**Total Metals by EPA 200 Series Methods**

7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	18-Jan-18	23-Jan-18	ABW	1800620	X
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**Soluble Metals by EPA 200/6000 Series Methods**

Prepared by method General Prep-Metal

Filtration	Field Filtered			N/A			1	EPA 200.7/3005A/6010			JS	1800631	
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**Soluble Metals by EPA 6000/7000 Series Methods**

Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	17-Jan-18	24-Jan-18	SJR/T	1800621	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X

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Sample Identification

GW-3

SC43112-01

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 09:25

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Soluble Metals by EPA 6000/7000 Series Methods</b>													
7440-38-2	Arsenic	< 0.0040	U	mg/l	0.0040	0.0014	1	SW846 6010C	17-Jan-18	24-Jan-18	SJR/T	1800621	X
7440-39-3	Barium	0.0270		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	18.3		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X
7440-48-4	Cobalt	0.0032	J	mg/l	0.0050	0.0008	1	"	"	25-Jan-18	"	1801097	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.228		mg/l	0.0150	0.0045	1	"	"	"	"	"	X
7440-09-7	Potassium	3.55		mg/l	0.500	0.0600	1	"	"	25-Jan-18	"	1801097	X
7439-95-4	Magnesium	2.74		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800621	X
7439-96-5	Manganese	1.93		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	73.7		mg/l	0.250	0.0392	1	"	"	25-Jan-18	"	1801097	X
7440-02-0	Nickel	0.0050		mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	25-Jan-18	"	1801097	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	24-Jan-18	"	1800621	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0035	J	mg/l	0.0050	0.0016	1	"	"	"	"	"	X
<b>Soluble Metals by EPA 200 Series Methods</b>													
7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	17-Jan-18	18-Jan-18	ABW	1800622	X
<b>General Chemistry Parameters</b>													
57-12-5	Cyanide (total)	< 0.00500	U	mg/l	0.00500	0.00474	1	EPA 335.4 / SW846 9012B	24-Jan-18	24-Jan-18	RLT	1801015	X

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Sample Identification

GW-2

SC43112-02

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 11:55

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5030 Water MS</u>													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00	0.53	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
67-64-1	Acetone	3.51	J	µg/l	10.0	0.80	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
71-43-2	Benzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 0.50	U	µg/l	0.50	0.42	1	"	"	"	"	"	X
75-25-2	Bromoform	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 2.00	U	µg/l	2.00	0.90	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 2.00	U	µg/l	2.00	1.07	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 1.00	U	µg/l	1.00	0.41	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 2.00	U	µg/l	2.00	0.41	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 1.00	U	µg/l	1.00	0.44	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 1.00	U	µg/l	1.00	0.25	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 2.00	U	µg/l	2.00	0.59	1	"	"	"	"	"	X
67-66-3	Chloroform	1.29		µg/l	1.00	0.33	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 2.00	U	µg/l	2.00	0.37	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00	0.86	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 0.50	U	µg/l	0.50	0.32	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50	0.20	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.27	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00	0.58	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 1.00	U	µg/l	1.00	0.69	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 1.00	U	µg/l	1.00	0.21	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 1.00	U	µg/l	1.00	0.58	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.36	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.35	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 2.00	U	µg/l	2.00	0.53	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

GW-2

SC43112-02

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 11:55

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
98-82-8	Isopropylbenzene	< 1.00	U	µg/l	1.00	0.36	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
99-87-6	4-Isopropyltoluene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.24	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00	0.52	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 2.00	U	µg/l	2.00	0.66	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 1.00	U	µg/l	1.00	0.35	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
100-42-5	Styrene	< 1.00	U	µg/l	1.00	0.40	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50	0.33	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 1.00	U	µg/l	1.00	0.57	1	"	"	"	"	"	X
108-88-3	Toluene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00	0.51	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 1.00	U	µg/l	1.00	0.50	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.36	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.43	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 1.00	U	µg/l	1.00	0.47	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 2.00	U	µg/l	2.00	0.38	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 2.00	U	µg/l	2.00	1.06	1	"	"	"	"	"	
60-29-7	Ethyl ether	< 1.00	U	µg/l	1.00	0.37	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0	5.90	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 20.0	U	µg/l	20.0	11.4	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 5.00	U	µg/l	5.00	0.82	1	"	"	"	"	"	X
64-17-5	Ethanol	< 200	U	µg/l	200	30.9	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	98			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	101			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	100			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	103			70-130 %		"	"	"	"	"	"	

Semivolatile Organic Compounds by GCMSSemivolatile Organic CompoundsPrepared by method SW846 3510C

83-32-9	Acenaphthene	< 4.81	U	µg/l	4.81	0.664	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
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## Sample Identification

GW-2

SC43112-02

## Client Project #

[none]

## Matrix

Ground Water

## Collection Date/Time

10-Jan-18 11:55

## Received

15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Semivolatile Organic Compounds by GCMS</b>													
<b>Semivolatile Organic Compounds</b>													
208-96-8	Acenaphthylene	< 4.81	U	µg/l	4.81	0.657	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
62-53-3	Aniline	< 4.81	U	µg/l	4.81	1.70	1	"	"	"	"	"	X
120-12-7	Anthracene	< 4.81	U	µg/l	4.81	0.585	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 4.81	U	µg/l	4.81	0.719	1	"	"	"	"	"	
92-87-5	Benzidine	< 4.81	U	µg/l	4.81	1.10	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 4.81	U	µg/l	4.81	0.515	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 4.81	U	µg/l	4.81	0.540	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 4.81	U	µg/l	4.81	0.420	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 4.81	U	µg/l	4.81	0.510	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 4.81	U	µg/l	4.81	0.462	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 4.81	U	µg/l	4.81	0.507	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 4.81	U	µg/l	4.81	0.750	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 4.81	U	µg/l	4.81	0.640	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 4.81	U	µg/l	4.81	0.706	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 4.81	U	µg/l	4.81	0.748	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	1.17	J	µg/l	4.81	0.613	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 4.81	U	µg/l	4.81	0.579	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 4.81	U	µg/l	4.81	0.421	1	"	"	"	"	"	X
86-74-8	Carbazole	< 4.81	U	µg/l	4.81	1.50	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 4.81	U	µg/l	4.81	0.482	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 4.81	U	µg/l	4.81	1.08	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 4.81	U	µg/l	4.81	0.567	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 4.81	U	µg/l	4.81	0.719	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 4.81	U	µg/l	4.81	0.580	1	"	"	"	"	"	X
218-01-9	Chrysene	< 4.81	U	µg/l	4.81	0.512	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 4.81	U	µg/l	4.81	0.433	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 4.81	U	µg/l	4.81	0.712	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.81	U	µg/l	4.81	0.540	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.81	U	µg/l	4.81	0.622	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.81	U	µg/l	4.81	0.590	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 4.81	U	µg/l	4.81	1.91	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 4.81	U	µg/l	4.81	0.510	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 4.81	U	µg/l	4.81	0.599	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 4.81	U	µg/l	4.81	0.729	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 4.81	U	µg/l	4.81	0.628	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 4.81	U	µg/l	4.81	0.439	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 4.81	U	µg/l	4.81	0.307	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 4.81	U	µg/l	4.81	0.539	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 4.81	U	µg/l	4.81	0.647	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 4.81	U	µg/l	4.81	0.570	1	"	"	"	"	"	X
117-84-0	Di-n-octyl phthalate	2.88	J	µg/l	4.81	0.390	1	"	"	"	"	"	X
206-44-0	Fluoranthene	< 4.81	U	µg/l	4.81	0.613	1	"	"	"	"	"	X

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Sample Identification

GW-2

SC43112-02

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 11:55

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

86-73-7	Fluorene	< 4.81	U	µg/l	4.81	0.588	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
118-74-1	Hexachlorobenzene	< 4.81	U	µg/l	4.81	0.549	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 4.81	U	µg/l	4.81	0.373	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 4.81	U	µg/l	4.81	0.996	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 4.81	U	µg/l	4.81	0.614	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 4.81	U	µg/l	4.81	0.558	1	"	"	"	"	"	X
78-59-1	Isophorone	< 4.81	U	µg/l	4.81	0.563	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 4.81	U	µg/l	4.81	0.552	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 4.81	U	µg/l	4.81	0.639	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 9.62	U	µg/l	9.62	0.591	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.81	U	µg/l	4.81	0.659	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 4.81	U	µg/l	4.81	0.583	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 4.81	U	µg/l	4.81	0.522	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 4.81	U	µg/l	4.81	0.360	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 4.81	U	µg/l	4.81	0.663	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 4.81	U	µg/l	4.81	0.447	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 19.2	U	µg/l	19.2	0.806	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 4.81	U	µg/l	4.81	0.647	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 4.81	U	µg/l	4.81	0.556	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 4.81	U	µg/l	4.81	0.626	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 19.2	U	µg/l	19.2	0.359	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 4.81	U	µg/l	4.81	0.563	1	"	"	"	"	"	X
108-95-2	Phenol	< 4.81	U	µg/l	4.81	0.620	1	"	"	"	"	"	X
129-00-0	Pyrene	< 4.81	U	µg/l	4.81	0.587	1	"	"	"	"	"	X
110-86-1	Pyridine	< 4.81	U	µg/l	4.81	0.788	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.81	U	µg/l	4.81	0.661	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 4.81	U	µg/l	4.81	0.705	1	"	"	"	"	"	X
95-95-4	2,4,5-Trichlorophenol	< 4.81	U	µg/l	4.81	0.500	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 4.81	U	µg/l	4.81	0.498	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 4.81	U	µg/l	4.81	0.669	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 4.81	U	µg/l	4.81	0.697	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	46			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	33			15-110 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	48			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	22			15-110 %			"	"	"	"	"	
1718-51-0	Terphenyl-d14	80			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	65			15-110 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3510C

12674-11-2	Aroclor-1016	< 0.189	U	µg/l	0.189	0.0981	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
11104-28-2	Aroclor-1221	< 0.189	U	µg/l	0.189	0.108	1	"	"	"	"	"	X
11141-16-5	Aroclor-1232	< 0.189	U	µg/l	0.189	0.105	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*



Sample Identification

GW-2

SC43112-02

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 11:55

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

53469-21-9	Aroclor-1242	< 0.189	U	µg/l	0.189	0.101	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
12672-29-6	Aroclor-1248	< 0.189	U	µg/l	0.189	0.128	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 0.189	U	µg/l	0.189	0.109	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 0.189	U	µg/l	0.189	0.0803	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 0.189	U	µg/l	0.189	0.0845	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 0.189	U	µg/l	0.189	0.0863	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	60			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	70			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	105			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	115			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3510C

319-84-6	alpha-BHC	< 0.019	U	µg/l	0.019	0.011	1	SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	X
319-85-7	beta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	X
309-00-2	Aldrin	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
72-20-8	Endrin	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 0.038	U	µg/l	0.038	0.016	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 0.472	U	µg/l	0.472	0.309	1	"	"	"	"	"	X
57-74-9	Chlordane	< 0.061	U	µg/l	0.061	0.048	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	107			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	111			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	131			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

GW-2

SC43112-02

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 11:55

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr) [2C]	126			30-150 %			SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	
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**Total Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Preservation	Field Preserved; pH<2 confirmed		N/A			1	EPA 200/6000 methods	16-Jan-18		JS	1800630	
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**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	18-Jan-18	24-Jan-18	SJR/T	1800619	X
7429-90-5	Aluminum	0.364		mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.0022	J	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0817		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	36.6		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X
7440-48-4	Cobalt	0.0046	J	mg/l	0.0050	0.0008	1	"	"	"	"	"	X
7440-47-3	Chromium	0.0012	J	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	1.13		mg/l	0.0300	0.0089	1	"	26-Jan-18	28-Jan-18	"	1801155	X
7440-09-7	Potassium	6.60		mg/l	0.500	0.0600	1	"	18-Jan-18	25-Jan-18	"	1801089	X
7439-95-4	Magnesium	6.70		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800619	X
7439-96-5	Manganese	4.08		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	182		mg/l	0.250	0.0392	1	"	"	"	"	"	X
7440-02-0	Nickel	0.0070		mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	"	"	"	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	"	"	"	X
7440-62-2	Vanadium	0.0019	J	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0125		mg/l	0.0050	0.0016	1	"	"	"	"	"	X

**Total Metals by EPA 200 Series Methods**

7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	18-Jan-18	23-Jan-18	ABW	1800620	X
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**Soluble Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Filtration	Field Filtered		N/A			1	EPA 200.7/3005A/6010			JS	1800631	
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**Soluble Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	17-Jan-18	24-Jan-18	SJR/T	1800621	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.0022	J	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0908		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	40.8		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X

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Sample Identification

GW-2

SC43112-02

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

10-Jan-18 11:55

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Soluble Metals by EPA 6000/7000 Series Methods</b>													
7440-48-4	Cobalt	0.0051		mg/l	0.0050	0.0008	1	SW846 6010C	17-Jan-18	25-Jan-18	SJR/T	1801097	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.150		mg/l	0.0150	0.0045	1	"	"	"	"	"	X
7440-09-7	Potassium	7.30		mg/l	0.500	0.0600	1	"	"	25-Jan-18	"	1801097	X
7439-95-4	Magnesium	7.10		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800621	X
7439-96-5	Manganese	4.70		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	187		mg/l	0.250	0.0392	1	"	"	25-Jan-18	"	1801097	X
7440-02-0	Nickel	0.0066		mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	25-Jan-18	"	1801097	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	24-Jan-18	"	1800621	X
7440-62-2	Vanadium	0.0012	J	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0114		mg/l	0.0050	0.0016	1	"	"	"	"	"	X
<b>Soluble Metals by EPA 200 Series Methods</b>													
7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	17-Jan-18	18-Jan-18	ABW	1800622	X
<b>General Chemistry Parameters</b>													
57-12-5	Cyanide (total)	< 0.00500	U	mg/l	0.00500	0.00474	1	EPA 335.4 / SW846 9012B	24-Jan-18	24-Jan-18	RLT	1801015	X

Sample Identification

GW-1

SC43112-03

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 09:45

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
Volatile Organic Compounds by SW846 8260													
Prepared by method SW846 5030 Water MS													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00	0.53	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
67-64-1	Acetone	1.82	J	µg/l	10.0	0.80	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
71-43-2	Benzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 0.50	U	µg/l	0.50	0.42	1	"	"	"	"	"	X
75-25-2	Bromoform	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 2.00	U	µg/l	2.00	0.90	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 2.00	U	µg/l	2.00	1.07	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 1.00	U	µg/l	1.00	0.41	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 2.00	U	µg/l	2.00	0.41	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 1.00	U	µg/l	1.00	0.44	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 1.00	U	µg/l	1.00	0.25	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 2.00	U	µg/l	2.00	0.59	1	"	"	"	"	"	X
67-66-3	Chloroform	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 2.00	U	µg/l	2.00	0.37	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00	0.86	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 0.50	U	µg/l	0.50	0.32	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50	0.20	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.27	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00	0.58	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 1.00	U	µg/l	1.00	0.69	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 1.00	U	µg/l	1.00	0.21	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 1.00	U	µg/l	1.00	0.58	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.36	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.35	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 2.00	U	µg/l	2.00	0.53	1	"	"	"	"	"	X

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Sample Identification

GW-1

SC43112-03

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 09:45

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
98-82-8	Isopropylbenzene	< 1.00	U	µg/l	1.00	0.36	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
99-87-6	4-Isopropyltoluene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.24	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00	0.52	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 2.00	U	µg/l	2.00	0.66	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 1.00	U	µg/l	1.00	0.35	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
100-42-5	Styrene	< 1.00	U	µg/l	1.00	0.40	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50	0.33	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 1.00	U	µg/l	1.00	0.57	1	"	"	"	"	"	X
108-88-3	Toluene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00	0.51	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 1.00	U	µg/l	1.00	0.50	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.36	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.43	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 1.00	U	µg/l	1.00	0.47	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 2.00	U	µg/l	2.00	0.38	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 2.00	U	µg/l	2.00	1.06	1	"	"	"	"	"	
60-29-7	Ethyl ether	< 1.00	U	µg/l	1.00	0.37	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0	5.90	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 20.0	U	µg/l	20.0	11.4	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 5.00	U	µg/l	5.00	0.82	1	"	"	"	"	"	X
64-17-5	Ethanol	< 200	U	µg/l	200	30.9	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	98			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	101			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	100			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	103			70-130 %		"	"	"	"	"	"	

Semivolatile Organic Compounds by GCMSSemivolatile Organic CompoundsPrepared by method SW846 3510C

83-32-9	Acenaphthene	< 4.72	U	µg/l	4.72	0.652	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
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Sample Identification

GW-1

SC43112-03

Client Project #

[none]

Matrix

Ground Water

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12-Jan-18 09:45

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15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
208-96-8	Acenaphthylene	< 4.72	U	µg/l	4.72	0.644	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
62-53-3	Aniline	< 4.72	U	µg/l	4.72	1.67	1	"	"	"	"	"	X
120-12-7	Anthracene	< 4.72	U	µg/l	4.72	0.574	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 4.72	U	µg/l	4.72	0.706	1	"	"	"	"	"	
92-87-5	Benzidine	< 4.72	U	µg/l	4.72	1.08	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 4.72	U	µg/l	4.72	0.506	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 4.72	U	µg/l	4.72	0.530	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 4.72	U	µg/l	4.72	0.412	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 4.72	U	µg/l	4.72	0.500	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 4.72	U	µg/l	4.72	0.453	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 4.72	U	µg/l	4.72	0.497	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 4.72	U	µg/l	4.72	0.736	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 4.72	U	µg/l	4.72	0.628	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 4.72	U	µg/l	4.72	0.692	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 4.72	U	µg/l	4.72	0.734	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 4.72	U	µg/l	4.72	0.602	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 4.72	U	µg/l	4.72	0.568	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 4.72	U	µg/l	4.72	0.413	1	"	"	"	"	"	X
86-74-8	Carbazole	< 4.72	U	µg/l	4.72	1.47	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 4.72	U	µg/l	4.72	0.473	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 4.72	U	µg/l	4.72	1.06	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 4.72	U	µg/l	4.72	0.557	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 4.72	U	µg/l	4.72	0.706	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 4.72	U	µg/l	4.72	0.569	1	"	"	"	"	"	X
218-01-9	Chrysene	< 4.72	U	µg/l	4.72	0.502	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 4.72	U	µg/l	4.72	0.425	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 4.72	U	µg/l	4.72	0.698	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.72	U	µg/l	4.72	0.530	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.72	U	µg/l	4.72	0.610	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.72	U	µg/l	4.72	0.579	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 4.72	U	µg/l	4.72	1.88	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 4.72	U	µg/l	4.72	0.500	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 4.72	U	µg/l	4.72	0.588	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 4.72	U	µg/l	4.72	0.715	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 4.72	U	µg/l	4.72	0.616	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 4.72	U	µg/l	4.72	0.431	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 4.72	U	µg/l	4.72	0.301	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 4.72	U	µg/l	4.72	0.529	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 4.72	U	µg/l	4.72	0.635	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 4.72	U	µg/l	4.72	0.559	1	"	"	"	"	"	X
117-84-0	Di-n-octyl phthalate	< 4.72	U	µg/l	4.72	0.383	1	"	"	"	"	"	X
206-44-0	Fluoranthene	< 4.72	U	µg/l	4.72	0.602	1	"	"	"	"	"	X

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SC43112-03

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Matrix

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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

86-73-7	Fluorene	< 4.72	U	µg/l	4.72	0.577	1	SW846 8270D	16-Jan-18	22-Jan-18	MSL	1800581	X
118-74-1	Hexachlorobenzene	< 4.72	U	µg/l	4.72	0.539	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 4.72	U	µg/l	4.72	0.366	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 4.72	U	µg/l	4.72	0.977	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 4.72	U	µg/l	4.72	0.603	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 4.72	U	µg/l	4.72	0.547	1	"	"	"	"	"	X
78-59-1	Isophorone	< 4.72	U	µg/l	4.72	0.553	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 4.72	U	µg/l	4.72	0.542	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 4.72	U	µg/l	4.72	0.627	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 9.43	U	µg/l	9.43	0.580	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.72	U	µg/l	4.72	0.646	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 4.72	U	µg/l	4.72	0.572	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 4.72	U	µg/l	4.72	0.512	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 4.72	U	µg/l	4.72	0.353	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 4.72	U	µg/l	4.72	0.651	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 4.72	U	µg/l	4.72	0.439	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 18.9	U	µg/l	18.9	0.791	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 4.72	U	µg/l	4.72	0.635	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 4.72	U	µg/l	4.72	0.545	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 4.72	U	µg/l	4.72	0.614	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 18.9	U	µg/l	18.9	0.352	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 4.72	U	µg/l	4.72	0.553	1	"	"	"	"	"	X
108-95-2	Phenol	< 4.72	U	µg/l	4.72	0.608	1	"	"	"	"	"	X
129-00-0	Pyrene	< 4.72	U	µg/l	4.72	0.575	1	"	"	"	"	"	X
110-86-1	Pyridine	< 4.72	U	µg/l	4.72	0.773	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.72	U	µg/l	4.72	0.648	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 4.72	U	µg/l	4.72	0.692	1	"	"	"	"	"	X
95-95-4	2,4,5-Trichlorophenol	< 4.72	U	µg/l	4.72	0.491	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 4.72	U	µg/l	4.72	0.489	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 4.72	U	µg/l	4.72	0.657	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 4.72	U	µg/l	4.72	0.684	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	40			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	28			15-110 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	42			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	20			15-110 %			"	"	"	"	"	
1718-51-0	Terphenyl-dl4	67			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	56			15-110 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3510C

12674-11-2	Aroclor-1016	< 0.187	U	µg/l	0.187	0.0972	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
11104-28-2	Aroclor-1221	< 0.187	U	µg/l	0.187	0.107	1	"	"	"	"	"	X
11141-16-5	Aroclor-1232	< 0.187	U	µg/l	0.187	0.104	1	"	"	"	"	"	X

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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

53469-21-9	Aroclor-1242	< 0.187	U	µg/l	0.187	0.100	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
12672-29-6	Aroclor-1248	< 0.187	U	µg/l	0.187	0.127	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 0.187	U	µg/l	0.187	0.108	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 0.187	U	µg/l	0.187	0.0795	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 0.187	U	µg/l	0.187	0.0837	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 0.187	U	µg/l	0.187	0.0855	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	65			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	80			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	120			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	140			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3510C

319-84-6	alpha-BHC	< 0.019	U	µg/l	0.019	0.011	1	SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	X
319-85-7	beta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	X
309-00-2	Aldrin	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
60-57-1	Dieldrin	0.129		µg/l	0.019	0.016	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
72-20-8	Endrin	< 0.037	U	µg/l	0.037	0.018	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 0.037	U	µg/l	0.037	0.019	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 0.037	U	µg/l	0.037	0.017	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 0.037	U	µg/l	0.037	0.019	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 0.037	U	µg/l	0.037	0.017	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 0.037	U	µg/l	0.037	0.017	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 0.037	U	µg/l	0.037	0.016	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 0.037	U	µg/l	0.037	0.018	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	0.085	P	µg/l	0.019	0.014	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	0.073		µg/l	0.019	0.015	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 0.467	U	µg/l	0.467	0.307	1	"	"	"	"	"	X
57-74-9	Chlordane	0.692		µg/l	0.061	0.048	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	117			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	124			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	149			30-150 %			"	"	"	"	"	

This laboratory report is not valid without an authorized signature on the cover page.



Sample Identification

GW-1

SC43112-03

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 09:45

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr) [2C]	139			30-150 %			SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	
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**Total Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Preservation	Field Preserved; pH<2 confirmed		N/A			1	EPA 200/6000 methods	16-Jan-18		JS	1800630	
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**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	18-Jan-18	24-Jan-18	SJR/T	1800619	X
7429-90-5	Aluminum	0.0113	J	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.0016	J	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0394		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	25.5		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X
7440-48-4	Cobalt	0.0041	J	mg/l	0.0050	0.0008	1	"	"	"	"	"	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.296		mg/l	0.0300	0.0089	1	"	26-Jan-18	28-Jan-18	"	1801155	X
7440-09-7	Potassium	3.52		mg/l	0.500	0.0600	1	"	18-Jan-18	25-Jan-18	"	1801089	X
7439-95-4	Magnesium	4.58		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800619	X
7439-96-5	Manganese	2.11		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	94.6		mg/l	0.250	0.0392	1	"	"	"	"	"	X
7440-02-0	Nickel	0.0038	J	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	"	"	"	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	"	"	"	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0016	J	mg/l	0.0050	0.0016	1	"	"	"	"	"	X

**Total Metals by EPA 200 Series Methods**

7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	18-Jan-18	23-Jan-18	ABW	1800620	X
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**Soluble Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Filtration	Field Filtered		N/A			1	EPA 200.7/3005A/601 0			JS	1800631	
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**Soluble Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	17-Jan-18	24-Jan-18	SJR/T	1800621	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	< 0.0040	U	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0423		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	26.7		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

GW-1

SC43112-03

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 09:45

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Soluble Metals by EPA 6000/7000 Series Methods</b>													
7440-48-4	Cobalt	0.0040	J	mg/l	0.0050	0.0008	1	SW846 6010C	17-Jan-18	25-Jan-18	SJR/T	1801097	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7440-50-8	Copper	0.0026	J	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.331		mg/l	0.0150	0.0045	1	"	"	"	"	"	X
7440-09-7	Potassium	3.83		mg/l	0.500	0.0600	1	"	"	25-Jan-18	"	1801097	X
7439-95-4	Magnesium	4.84		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800621	X
7439-96-5	Manganese	2.06		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	100		mg/l	0.250	0.0392	1	"	"	25-Jan-18	"	1801097	X
7440-02-0	Nickel	0.0040	J	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	25-Jan-18	"	1801097	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	24-Jan-18	"	1800621	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0039	J	mg/l	0.0050	0.0016	1	"	"	"	"	"	X
<b>Soluble Metals by EPA 200 Series Methods</b>													
7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	17-Jan-18	18-Jan-18	ABW	1800622	X
<b>General Chemistry Parameters</b>													
57-12-5	Cyanide (total)	< 0.00500	U	mg/l	0.00500	0.00474	1	EPA 335.4 / SW846 9012B	24-Jan-18	24-Jan-18	RLT	1801015	X

Sample Identification

DUP011218

SC43112-04

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 08:00

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5030 Water MS</u>													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00	0.53	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
67-64-1	Acetone	1.90	J	µg/l	10.0	0.80	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
71-43-2	Benzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 0.50	U	µg/l	0.50	0.42	1	"	"	"	"	"	X
75-25-2	Bromoform	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 2.00	U	µg/l	2.00	0.90	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 2.00	U	µg/l	2.00	1.07	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 1.00	U	µg/l	1.00	0.41	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 2.00	U	µg/l	2.00	0.41	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 1.00	U	µg/l	1.00	0.44	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 1.00	U	µg/l	1.00	0.25	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 2.00	U	µg/l	2.00	0.59	1	"	"	"	"	"	X
67-66-3	Chloroform	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 2.00	U	µg/l	2.00	0.37	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00	0.86	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 0.50	U	µg/l	0.50	0.32	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50	0.20	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.27	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00	0.58	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 1.00	U	µg/l	1.00	0.69	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 1.00	U	µg/l	1.00	0.21	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 1.00	U	µg/l	1.00	0.58	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.36	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.35	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 2.00	U	µg/l	2.00	0.53	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

DUP011218

SC43112-04

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 08:00

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
98-82-8	Isopropylbenzene	< 1.00	U	µg/l	1.00	0.36	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
99-87-6	4-Isopropyltoluene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.24	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00	0.52	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 2.00	U	µg/l	2.00	0.66	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 1.00	U	µg/l	1.00	0.35	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
100-42-5	Styrene	< 1.00	U	µg/l	1.00	0.40	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50	0.33	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 1.00	U	µg/l	1.00	0.57	1	"	"	"	"	"	X
108-88-3	Toluene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	
71-55-6	1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00	0.51	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 1.00	U	µg/l	1.00	0.50	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.36	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.43	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 1.00	U	µg/l	1.00	0.47	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 2.00	U	µg/l	2.00	0.38	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 2.00	U	µg/l	2.00	1.06	1	"	"	"	"	"	
60-29-7	Ethyl ether	< 1.00	U	µg/l	1.00	0.37	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0	5.90	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 20.0	U	µg/l	20.0	11.4	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 5.00	U	µg/l	5.00	0.82	1	"	"	"	"	"	X
64-17-5	Ethanol	< 200	U	µg/l	200	30.9	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	99			70-130 %		"	"	"	"	"	"	
2037-26-5	Toluene-d8	101			70-130 %		"	"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	100			70-130 %		"	"	"	"	"	"	
1868-53-7	Dibromofluoromethane	103			70-130 %		"	"	"	"	"	"	

Semivolatile Organic Compounds by GCMSSemivolatile Organic CompoundsPrepared by method SW846 3510C

83-32-9	Acenaphthene	< 4.72	U	µg/l	4.72	0.652	1	SW846 8270D	16-Jan-18	23-Jan-18	MSL	1800581	X
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Sample Identification

DUP011218

SC43112-04

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 08:00

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Semivolatile Organic Compounds by GCMS</b>													
<u>Semivolatile Organic Compounds</u>													
208-96-8	Acenaphthylene	< 4.72	U	µg/l	4.72	0.644	1	SW846 8270D	16-Jan-18	23-Jan-18	MSL	1800581	X
62-53-3	Aniline	< 4.72	U	µg/l	4.72	1.67	1	"	"	"	"	"	X
120-12-7	Anthracene	< 4.72	U	µg/l	4.72	0.574	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 4.72	U	µg/l	4.72	0.706	1	"	"	"	"	"	
92-87-5	Benzidine	< 4.72	U	µg/l	4.72	1.08	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 4.72	U	µg/l	4.72	0.506	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 4.72	U	µg/l	4.72	0.530	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 4.72	U	µg/l	4.72	0.412	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 4.72	U	µg/l	4.72	0.500	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 4.72	U	µg/l	4.72	0.453	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 4.72	U	µg/l	4.72	0.497	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 4.72	U	µg/l	4.72	0.736	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 4.72	U	µg/l	4.72	0.628	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 4.72	U	µg/l	4.72	0.692	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 4.72	U	µg/l	4.72	0.734	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 4.72	U	µg/l	4.72	0.602	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 4.72	U	µg/l	4.72	0.568	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 4.72	U	µg/l	4.72	0.413	1	"	"	"	"	"	X
86-74-8	Carbazole	< 4.72	U	µg/l	4.72	1.47	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 4.72	U	µg/l	4.72	0.473	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 4.72	U	µg/l	4.72	1.06	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 4.72	U	µg/l	4.72	0.557	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 4.72	U	µg/l	4.72	0.706	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 4.72	U	µg/l	4.72	0.569	1	"	"	"	"	"	X
218-01-9	Chrysene	< 4.72	U	µg/l	4.72	0.502	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 4.72	U	µg/l	4.72	0.425	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 4.72	U	µg/l	4.72	0.698	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.72	U	µg/l	4.72	0.530	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.72	U	µg/l	4.72	0.610	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.72	U	µg/l	4.72	0.579	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 4.72	U	µg/l	4.72	1.88	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 4.72	U	µg/l	4.72	0.500	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 4.72	U	µg/l	4.72	0.588	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 4.72	U	µg/l	4.72	0.715	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 4.72	U	µg/l	4.72	0.616	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 4.72	U	µg/l	4.72	0.431	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 4.72	U	µg/l	4.72	0.301	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 4.72	U	µg/l	4.72	0.529	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 4.72	U	µg/l	4.72	0.635	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 4.72	U	µg/l	4.72	0.559	1	"	"	"	"	"	X
117-84-0	Di-n-octyl phthalate	< 4.72	U	µg/l	4.72	0.383	1	"	"	"	"	"	X
206-44-0	Fluoranthene	< 4.72	U	µg/l	4.72	0.602	1	"	"	"	"	"	X

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SC43112-04

Client Project #

[none]

Matrix

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<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

86-73-7	Fluorene	< 4.72	U	µg/l	4.72	0.577	1	SW846 8270D	16-Jan-18	23-Jan-18	MSL	1800581	X
118-74-1	Hexachlorobenzene	< 4.72	U	µg/l	4.72	0.539	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 4.72	U	µg/l	4.72	0.366	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 4.72	U	µg/l	4.72	0.977	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 4.72	U	µg/l	4.72	0.603	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 4.72	U	µg/l	4.72	0.547	1	"	"	"	"	"	X
78-59-1	Isophorone	< 4.72	U	µg/l	4.72	0.553	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 4.72	U	µg/l	4.72	0.542	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 4.72	U	µg/l	4.72	0.627	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 9.43	U	µg/l	9.43	0.580	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.72	U	µg/l	4.72	0.646	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 4.72	U	µg/l	4.72	0.572	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 4.72	U	µg/l	4.72	0.512	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 4.72	U	µg/l	4.72	0.353	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 4.72	U	µg/l	4.72	0.651	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 4.72	U	µg/l	4.72	0.439	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 18.9	U	µg/l	18.9	0.791	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 4.72	U	µg/l	4.72	0.635	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 4.72	U	µg/l	4.72	0.545	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 4.72	U	µg/l	4.72	0.614	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 18.9	U	µg/l	18.9	0.352	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 4.72	U	µg/l	4.72	0.553	1	"	"	"	"	"	X
108-95-2	Phenol	< 4.72	U	µg/l	4.72	0.608	1	"	"	"	"	"	X
129-00-0	Pyrene	< 4.72	U	µg/l	4.72	0.575	1	"	"	"	"	"	X
110-86-1	Pyridine	< 4.72	U	µg/l	4.72	0.773	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.72	U	µg/l	4.72	0.648	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 4.72	U	µg/l	4.72	0.692	1	"	"	"	"	"	X
95-95-4	2,4,5-Trichlorophenol	< 4.72	U	µg/l	4.72	0.491	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 4.72	U	µg/l	4.72	0.489	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 4.72	U	µg/l	4.72	0.657	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 4.72	U	µg/l	4.72	0.684	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	33			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	22			15-110 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	34			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	16			15-110 %			"	"	"	"	"	
1718-51-0	Terphenyl-d14	64			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	50			15-110 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3510C

12674-11-2	Aroclor-1016	< 0.189	U	µg/l	0.189	0.0981	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
11104-28-2	Aroclor-1221	< 0.189	U	µg/l	0.189	0.108	1	"	"	"	"	"	X
11141-16-5	Aroclor-1232	< 0.189	U	µg/l	0.189	0.105	1	"	"	"	"	"	X

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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

53469-21-9	Aroclor-1242	< 0.189	U	µg/l	0.189	0.101	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
12672-29-6	Aroclor-1248	< 0.189	U	µg/l	0.189	0.128	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 0.189	U	µg/l	0.189	0.109	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 0.189	U	µg/l	0.189	0.0803	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 0.189	U	µg/l	0.189	0.0845	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 0.189	U	µg/l	0.189	0.0863	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	65			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	75			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	115			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	125			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3510C

319-84-6	alpha-BHC	< 0.019	U	µg/l	0.019	0.011	1	SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	X
319-85-7	beta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	X
309-00-2	Aldrin	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
60-57-1	Dieldrin [2C]	0.105		µg/l	0.019	0.018	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
72-20-8	Endrin	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 0.038	U	µg/l	0.038	0.019	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 0.038	U	µg/l	0.038	0.017	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 0.038	U	µg/l	0.038	0.016	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 0.038	U	µg/l	0.038	0.018	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	0.082	P	µg/l	0.019	0.015	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	0.072		µg/l	0.019	0.015	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 0.472	U	µg/l	0.472	0.309	1	"	"	"	"	"	X
57-74-9	Chlordane	0.575		µg/l	0.061	0.048	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	103			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	105			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	136			30-150 %			"	"	"	"	"	

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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr) [2C]	117			30-150 %			SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	
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**Total Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Preservation	Field Preserved; pH<2 confirmed		N/A			1	EPA 200/6000 methods	16-Jan-18		JS	1800630	
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**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	18-Jan-18	24-Jan-18	SJR/T	1800619	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	0.0022	J	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0393		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	25.5		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X
7440-48-4	Cobalt	0.0038	J	mg/l	0.0050	0.0008	1	"	"	"	"	"	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.303		mg/l	0.0300	0.0089	1	"	26-Jan-18	28-Jan-18	"	1801155	X
7440-09-7	Potassium	3.55		mg/l	0.500	0.0600	1	"	18-Jan-18	25-Jan-18	"	1801089	X
7439-95-4	Magnesium	4.56		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800619	X
7439-96-5	Manganese	2.05		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	94.2		mg/l	0.250	0.0392	1	"	"	"	"	"	X
7440-02-0	Nickel	0.0036	J	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	"	"	"	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	"	"	"	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0076		mg/l	0.0050	0.0016	1	"	"	"	"	"	X

**Total Metals by EPA 200 Series Methods**

7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	18-Jan-18	23-Jan-18	ABW	1800620	X
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**Soluble Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Filtration	Field Filtered		N/A			1	EPA 200.7/3005A/6010			JS	1800631	
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**Soluble Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	17-Jan-18	24-Jan-18	SJR/T	1800621	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	< 0.0040	U	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	0.0409		mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	25.8		mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*



Sample Identification**DUP011218**

SC43112-04

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 08:00

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Soluble Metals by EPA 6000/7000 Series Methods</b>													
7440-48-4	Cobalt	0.0046	J	mg/l	0.0050	0.0008	1	SW846 6010C	17-Jan-18	25-Jan-18	SJR/T	1801097	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.275		mg/l	0.0150	0.0045	1	"	"	"	"	"	X
7440-09-7	Potassium	3.73		mg/l	0.500	0.0600	1	"	"	25-Jan-18	"	1801097	X
7439-95-4	Magnesium	4.62		mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800621	X
7439-96-5	Manganese	2.24		mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	97.0		mg/l	0.250	0.0392	1	"	"	25-Jan-18	"	1801097	X
7440-02-0	Nickel	0.0038	J	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	25-Jan-18	"	1801097	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	24-Jan-18	"	1800621	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0022	J	mg/l	0.0050	0.0016	1	"	"	"	"	"	X
<b>Soluble Metals by EPA 200 Series Methods</b>													
7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	17-Jan-18	18-Jan-18	ABW	1800622	X
<b>General Chemistry Parameters</b>													
57-12-5	Cyanide (total)	< 0.00500	U	mg/l	0.00500	0.00474	1	EPA 335.4 / SW846 9012B	24-Jan-18	24-Jan-18	RLT	1801015	X

Sample Identification

<b>FB011218</b>	<u>Client Project #</u>	<u>Matrix</u>	<u>Collection Date/Time</u>	<u>Received</u>
SC43112-05	[none]	Ground Water	12-Jan-18 12:05	15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
<u>Prepared by method SW846 5030 Water MS</u>													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00	0.53	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
67-64-1	Acetone	< 10.0	U	µg/l	10.0	0.80	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
71-43-2	Benzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 0.50	U	µg/l	0.50	0.42	1	"	"	"	"	"	X
75-25-2	Bromoform	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 2.00	U	µg/l	2.00	0.90	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 2.00	U	µg/l	2.00	1.07	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 1.00	U	µg/l	1.00	0.41	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 2.00	U	µg/l	2.00	0.41	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 1.00	U	µg/l	1.00	0.44	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 1.00	U	µg/l	1.00	0.25	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 2.00	U	µg/l	2.00	0.59	1	"	"	"	"	"	X
67-66-3	Chloroform	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 2.00	U	µg/l	2.00	0.37	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00	0.86	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 0.50	U	µg/l	0.50	0.32	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50	0.20	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.27	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00	0.58	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 1.00	U	µg/l	1.00	0.69	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 1.00	U	µg/l	1.00	0.21	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 1.00	U	µg/l	1.00	0.58	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.36	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.35	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 2.00	U	µg/l	2.00	0.53	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

<b>FB011218</b>	<u>Client Project #</u>	<u>Matrix</u>	<u>Collection Date/Time</u>	<u>Received</u>
SC43112-05	[none]	Ground Water	12-Jan-18 12:05	15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
<u>Volatile Organic Compounds by SW846 8260</u>													
98-82-8	Isopropylbenzene	< 1.00	U	µg/l	1.00	0.36	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
99-87-6	4-Isopropyltoluene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.24	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00	0.52	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 2.00	U	µg/l	2.00	0.66	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 1.00	U	µg/l	1.00	0.35	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
100-42-5	Styrene	< 1.00	U	µg/l	1.00	0.40	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50	0.33	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 1.00	U	µg/l	1.00	0.57	1	"	"	"	"	"	X
108-88-3	Toluene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00	0.51	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 1.00	U	µg/l	1.00	0.50	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.36	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.43	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 1.00	U	µg/l	1.00	0.47	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 2.00	U	µg/l	2.00	0.38	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 2.00	U	µg/l	2.00	1.06	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 1.00	U	µg/l	1.00	0.37	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0	5.90	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 20.0	U	µg/l	20.0	11.4	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 5.00	U	µg/l	5.00	0.82	1	"	"	"	"	"	X
64-17-5	Ethanol	< 200	U	µg/l	200	30.9	1	"	"	"	"	"	X

Surrogate recoveries:

460-00-4	4-Bromofluorobenzene	98		70-130 %	"	"	"	"	"
2037-26-5	Toluene-d8	101		70-130 %	"	"	"	"	"
17060-07-0	1,2-Dichloroethane-d4	100		70-130 %	"	"	"	"	"
1868-53-7	Dibromofluoromethane	103		70-130 %	"	"	"	"	"

Semivolatile Organic Compounds by GCMSSemivolatile Organic CompoundsPrepared by method SW846 3510C

83-32-9	Acenaphthene	< 4.72	E, U	µg/l	4.72	0.652	1	SW846 8270D	16-Jan-18	23-Jan-18	MSL	1800581	X
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*This laboratory report is not valid without an authorized signature on the cover page.*

## Sample Identification

FB011218  
SC43112-05

Client Project #  
[none]

Matrix  
Ground Water

Collection Date/Time  
12-Jan-18 12:05

Received  
15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
<b>Semivolatile Organic Compounds by GCMS</b>													
<b>Semivolatile Organic Compounds</b>													
208-96-8	Acenaphthylene	< 4.72	E, U	µg/l	4.72	0.644	1	SW846 8270D	16-Jan-18	23-Jan-18	MSL	1800581	X
62-53-3	Aniline	< 4.72	E, U	µg/l	4.72	1.67	1	"	"	"	"	"	X
120-12-7	Anthracene	< 4.72	E, U	µg/l	4.72	0.574	1	"	"	"	"	"	X
103-33-3	Azobenzene/Diphenyldiazene	< 4.72	E, U	µg/l	4.72	0.706	1	"	"	"	"	"	X
92-87-5	Benzidine	< 4.72	E, U	µg/l	4.72	1.08	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 4.72	E, U	µg/l	4.72	0.506	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 4.72	E, U	µg/l	4.72	0.530	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 4.72	E, U	µg/l	4.72	0.412	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 4.72	E, U	µg/l	4.72	0.500	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 4.72	E, U	µg/l	4.72	0.453	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 4.72	E, U	µg/l	4.72	0.497	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 4.72	E, U	µg/l	4.72	0.736	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 4.72	E, U	µg/l	4.72	0.628	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 4.72	E, U	µg/l	4.72	0.692	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 4.72	E, U	µg/l	4.72	0.734	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 4.72	E, U	µg/l	4.72	0.602	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 4.72	E, U	µg/l	4.72	0.568	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 4.72	E, U	µg/l	4.72	0.413	1	"	"	"	"	"	X
86-74-8	Carbazole	< 4.72	E, U	µg/l	4.72	1.47	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 4.72	E, U	µg/l	4.72	0.473	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 4.72	E, U	µg/l	4.72	1.06	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 4.72	E, U	µg/l	4.72	0.557	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 4.72	E, U	µg/l	4.72	0.706	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 4.72	E, U	µg/l	4.72	0.569	1	"	"	"	"	"	X
218-01-9	Chrysene	< 4.72	E, U	µg/l	4.72	0.502	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 4.72	E, U	µg/l	4.72	0.425	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 4.72	E, U	µg/l	4.72	0.698	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.72	E, U	µg/l	4.72	0.530	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.72	E, U	µg/l	4.72	0.610	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.72	E, U	µg/l	4.72	0.579	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 4.72	E, U	µg/l	4.72	1.88	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 4.72	E, U	µg/l	4.72	0.500	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 4.72	E, U	µg/l	4.72	0.588	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 4.72	E, U	µg/l	4.72	0.715	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 4.72	E, U	µg/l	4.72	0.616	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 4.72	E, U	µg/l	4.72	0.431	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 4.72	E, U	µg/l	4.72	0.301	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 4.72	E, U	µg/l	4.72	0.529	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 4.72	E, U	µg/l	4.72	0.635	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 4.72	E, U	µg/l	4.72	0.559	1	"	"	"	"	"	X
117-84-0	Di-n-octyl phthalate	< 4.72	E, U	µg/l	4.72	0.383	1	"	"	"	"	"	X
206-44-0	Fluoranthene	< 4.72	E, U	µg/l	4.72	0.602	1	"	"	"	"	"	X

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Sample Identification

<b>FB011218</b>	<u>Client Project #</u>	<u>Matrix</u>	<u>Collection Date/Time</u>	<u>Received</u>
SC43112-05	[none]	Ground Water	12-Jan-18 12:05	15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
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**Semivolatile Organic Compounds by GCMS**Semivolatile Organic Compounds

86-73-7	Fluorene	< 4.72	E, U	µg/l	4.72	0.577	1	SW846 8270D	16-Jan-18	23-Jan-18	MSL	1800581	X
118-74-1	Hexachlorobenzene	< 4.72	E, U	µg/l	4.72	0.539	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 4.72	E, U	µg/l	4.72	0.366	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 4.72	E, U	µg/l	4.72	0.977	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 4.72	E, U	µg/l	4.72	0.603	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 4.72	E, U	µg/l	4.72	0.547	1	"	"	"	"	"	X
78-59-1	Isophorone	< 4.72	E, U	µg/l	4.72	0.553	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 4.72	E, U	µg/l	4.72	0.542	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 4.72	E, U	µg/l	4.72	0.627	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 9.43	E, U	µg/l	9.43	0.580	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.72	E, U	µg/l	4.72	0.646	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 4.72	E, U	µg/l	4.72	0.572	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 4.72	E, U	µg/l	4.72	0.512	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 4.72	E, U	µg/l	4.72	0.353	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 4.72	E, U	µg/l	4.72	0.651	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 4.72	E, U	µg/l	4.72	0.439	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 18.9	E, U	µg/l	18.9	0.791	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 4.72	E, U	µg/l	4.72	0.635	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 4.72	E, U	µg/l	4.72	0.545	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 4.72	E, U	µg/l	4.72	0.614	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 18.9	E, U	µg/l	18.9	0.352	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 4.72	E, U	µg/l	4.72	0.553	1	"	"	"	"	"	X
108-95-2	Phenol	< 4.72	E, U	µg/l	4.72	0.608	1	"	"	"	"	"	X
129-00-0	Pyrene	< 4.72	E, U	µg/l	4.72	0.575	1	"	"	"	"	"	X
110-86-1	Pyridine	< 4.72	E, U	µg/l	4.72	0.773	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.72	E, U	µg/l	4.72	0.648	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 4.72	E, U	µg/l	4.72	0.692	1	"	"	"	"	"	X
95-95-4	2,4,5-Trichlorophenol	< 4.72	E, U	µg/l	4.72	0.491	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 4.72	E, U	µg/l	4.72	0.489	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 4.72	E, U	µg/l	4.72	0.657	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzen e	< 4.72	E, U	µg/l	4.72	0.684	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	29			30-130 %		"	"	"	"	"	"
367-12-4	2-Fluorophenol	17			15-110 %		"	"	"	"	"	"
4165-60-0	Nitrobenzene-d5	25			30-130 %		"	"	"	"	"	"
4165-62-2	Phenol-d5	13			15-110 %		"	"	"	"	"	"
1718-51-0	Terphenyl-dl4	60			30-130 %		"	"	"	"	"	"
118-79-6	2,4,6-Tribromophenol	49			15-110 %		"	"	"	"	"	"

Re-analysis of Semivolatile Organic Compounds

HT5

Prepared by method SW846 3510C

83-32-9	Acenaphthene	< 4.67	U	µg/l	4.67	0.646	1	SW846 8270D	24-Jan-18	25-Jan-18	MSL	1800974	X
208-96-8	Acenaphthylene	< 4.67	U	µg/l	4.67	0.638	1	"	"	"	"	"	X
62-53-3	Aniline	< 4.67	U	µg/l	4.67	1.65	1	"	"	"	"	"	X

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## Sample Identification

FB011218  
SC43112-05

Client Project #  
[none]

Matrix  
Ground Water

Collection Date/Time  
12-Jan-18 12:05

Received  
15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
Semivolatile Organic Compounds by GCMS													
Re-analysis of Semivolatile Organic Compounds			HT5										
120-12-7	Anthracene	< 4.67	U	µg/l	4.67	0.568	1	SW846 8270D	24-Jan-18	25-Jan-18	MSL	1800974	X
103-33-3	Azobenzene/Diphenyldiazene	< 4.67	U	µg/l	4.67	0.699	1	"	"	"	"	"	
92-87-5	Benzidine	< 4.67	U	µg/l	4.67	1.07	1	"	"	"	"	"	X
56-55-3	Benzo (a) anthracene	< 4.67	U	µg/l	4.67	0.501	1	"	"	"	"	"	X
50-32-8	Benzo (a) pyrene	< 4.67	U	µg/l	4.67	0.525	1	"	"	"	"	"	X
205-99-2	Benzo (b) fluoranthene	< 4.67	U	µg/l	4.67	0.408	1	"	"	"	"	"	X
191-24-2	Benzo (g,h,i) perylene	< 4.67	U	µg/l	4.67	0.495	1	"	"	"	"	"	X
207-08-9	Benzo (k) fluoranthene	< 4.67	U	µg/l	4.67	0.449	1	"	"	"	"	"	X
65-85-0	Benzoic acid	< 4.67	U	µg/l	4.67	0.493	1	"	"	"	"	"	X
100-51-6	Benzyl alcohol	< 4.67	U	µg/l	4.67	0.729	1	"	"	"	"	"	X
111-91-1	Bis(2-chloroethoxy)methane	< 4.67	U	µg/l	4.67	0.622	1	"	"	"	"	"	X
111-44-4	Bis(2-chloroethyl)ether	< 4.67	U	µg/l	4.67	0.686	1	"	"	"	"	"	X
108-60-1	Bis(2-chloroisopropyl)ether	< 4.67	U	µg/l	4.67	0.727	1	"	"	"	"	"	X
117-81-7	Bis(2-ethylhexyl)phthalate	< 4.67	U	µg/l	4.67	0.596	1	"	"	"	"	"	X
101-55-3	4-Bromophenyl phenyl ether	< 4.67	U	µg/l	4.67	0.563	1	"	"	"	"	"	X
85-68-7	Butyl benzyl phthalate	< 4.67	U	µg/l	4.67	0.409	1	"	"	"	"	"	X
86-74-8	Carbazole	< 4.67	U	µg/l	4.67	1.46	1	"	"	"	"	"	X
59-50-7	4-Chloro-3-methylphenol	< 4.67	U	µg/l	4.67	0.468	1	"	"	"	"	"	X
106-47-8	4-Chloroaniline	< 4.67	U	µg/l	4.67	1.05	1	"	"	"	"	"	X
91-58-7	2-Chloronaphthalene	< 4.67	U	µg/l	4.67	0.551	1	"	"	"	"	"	X
95-57-8	2-Chlorophenol	< 4.67	U	µg/l	4.67	0.699	1	"	"	"	"	"	X
7005-72-3	4-Chlorophenyl phenyl ether	< 4.67	U	µg/l	4.67	0.564	1	"	"	"	"	"	X
218-01-9	Chrysene	< 4.67	U	µg/l	4.67	0.497	1	"	"	"	"	"	X
53-70-3	Dibenzo (a,h) anthracene	< 4.67	U	µg/l	4.67	0.421	1	"	"	"	"	"	X
132-64-9	Dibenzofuran	< 4.67	U	µg/l	4.67	0.692	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 4.67	U	µg/l	4.67	0.525	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 4.67	U	µg/l	4.67	0.605	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 4.67	U	µg/l	4.67	0.574	1	"	"	"	"	"	X
91-94-1	3,3'-Dichlorobenzidine	< 4.67	U	µg/l	4.67	1.86	1	"	"	"	"	"	X
120-83-2	2,4-Dichlorophenol	< 4.67	U	µg/l	4.67	0.495	1	"	"	"	"	"	X
84-66-2	Diethyl phthalate	< 4.67	U	µg/l	4.67	0.582	1	"	"	"	"	"	X
131-11-3	Dimethyl phthalate	< 4.67	U	µg/l	4.67	0.708	1	"	"	"	"	"	X
105-67-9	2,4-Dimethylphenol	< 4.67	U	µg/l	4.67	0.610	1	"	"	"	"	"	X
84-74-2	Di-n-butyl phthalate	< 4.67	U	µg/l	4.67	0.427	1	"	"	"	"	"	X
534-52-1	4,6-Dinitro-2-methylphenol	< 4.67	U	µg/l	4.67	0.298	1	"	"	"	"	"	X
51-28-5	2,4-Dinitrophenol	< 4.67	U	µg/l	4.67	0.524	1	"	"	"	"	"	X
121-14-2	2,4-Dinitrotoluene	< 4.67	U	µg/l	4.67	0.629	1	"	"	"	"	"	X
606-20-2	2,6-Dinitrotoluene	< 4.67	U	µg/l	4.67	0.554	1	"	"	"	"	"	X
117-84-0	Di-n-octyl phthalate	1.67	J, B	µg/l	4.67	0.379	1	"	"	"	"	"	X
206-44-0	Fluoranthene	< 4.67	U	µg/l	4.67	0.596	1	"	"	"	"	"	X
86-73-7	Fluorene	< 4.67	U	µg/l	4.67	0.572	1	"	"	"	"	"	X

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Sample Identification

<b>FB011218</b>	<u>Client Project #</u>	<u>Matrix</u>	<u>Collection Date/Time</u>	<u>Received</u>
SC43112-05	[none]	Ground Water	12-Jan-18 12:05	15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
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**Semivolatile Organic Compounds by GCMS**Re-analysis of Semivolatile Organic Compounds

HT5

118-74-1	Hexachlorobenzene	< 4.67	U	µg/l	4.67	0.534	1	SW846 8270D	24-Jan-18	25-Jan-18	MSL	1800974	X
87-68-3	Hexachlorobutadiene	< 4.67	U	µg/l	4.67	0.363	1	"	"	"	"	"	X
77-47-4	Hexachlorocyclopentadiene	< 4.67	U	µg/l	4.67	0.968	1	"	"	"	"	"	X
67-72-1	Hexachloroethane	< 4.67	U	µg/l	4.67	0.597	1	"	"	"	"	"	X
193-39-5	Indeno (1,2,3-cd) pyrene	< 4.67	U	µg/l	4.67	0.542	1	"	"	"	"	"	X
78-59-1	Isophorone	< 4.67	U	µg/l	4.67	0.548	1	"	"	"	"	"	X
91-57-6	2-Methylnaphthalene	< 4.67	U	µg/l	4.67	0.536	1	"	"	"	"	"	X
95-48-7	2-Methylphenol	< 4.67	U	µg/l	4.67	0.621	1	"	"	"	"	"	X
108-39-4, 106-44-5	3 & 4-Methylphenol	< 9.35	U	µg/l	9.35	0.575	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 4.67	U	µg/l	4.67	0.640	1	"	"	"	"	"	X
88-74-4	2-Nitroaniline	< 4.67	U	µg/l	4.67	0.566	1	"	"	"	"	"	X
99-09-2	3-Nitroaniline	< 4.67	U	µg/l	4.67	0.507	1	"	"	"	"	"	X
100-01-6	4-Nitroaniline	< 4.67	U	µg/l	4.67	0.350	1	"	"	"	"	"	X
98-95-3	Nitrobenzene	< 4.67	U	µg/l	4.67	0.645	1	"	"	"	"	"	X
88-75-5	2-Nitrophenol	< 4.67	U	µg/l	4.67	0.435	1	"	"	"	"	"	X
100-02-7	4-Nitrophenol	< 18.7	U	µg/l	18.7	0.783	1	"	"	"	"	"	X
62-75-9	N-Nitrosodimethylamine	< 4.67	U	µg/l	4.67	0.629	1	"	"	"	"	"	X
621-64-7	N-Nitrosodi-n-propylamine	< 4.67	U	µg/l	4.67	0.540	1	"	"	"	"	"	X
86-30-6	N-Nitrosodiphenylamine	< 4.67	U	µg/l	4.67	0.608	1	"	"	"	"	"	X
87-86-5	Pentachlorophenol	< 18.7	U	µg/l	18.7	0.349	1	"	"	"	"	"	X
85-01-8	Phenanthrene	< 4.67	U	µg/l	4.67	0.548	1	"	"	"	"	"	X
108-95-2	Phenol	< 4.67	U	µg/l	4.67	0.603	1	"	"	"	"	"	X
129-00-0	Pyrene	< 4.67	U	µg/l	4.67	0.570	1	"	"	"	"	"	X
110-86-1	Pyridine	< 4.67	U	µg/l	4.67	0.765	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 4.67	U	µg/l	4.67	0.642	1	"	"	"	"	"	X
90-12-0	1-Methylnaphthalene	< 4.67	U	µg/l	4.67	0.685	1	"	"	"	"	"	
95-95-4	2,4,5-Trichlorophenol	< 4.67	U	µg/l	4.67	0.486	1	"	"	"	"	"	X
88-06-2	2,4,6-Trichlorophenol	< 4.67	U	µg/l	4.67	0.484	1	"	"	"	"	"	X
82-68-8	Pentachloronitrobenzene	< 4.67	U	µg/l	4.67	0.650	1	"	"	"	"	"	X
95-94-3	1,2,4,5-Tetrachlorobenzene	< 4.67	U	µg/l	4.67	0.678	1	"	"	"	"	"	X

Surrogate recoveries:

321-60-8	2-Fluorobiphenyl	41			30-130 %			"	"	"	"	"	
367-12-4	2-Fluorophenol	29			15-110 %			"	"	"	"	"	
4165-60-0	Nitrobenzene-d5	45			30-130 %			"	"	"	"	"	
4165-62-2	Phenol-d5	18			15-110 %			"	"	"	"	"	
1718-51-0	Terphenyl-d14	65			30-130 %			"	"	"	"	"	
118-79-6	2,4,6-Tribromophenol	51			15-110 %			"	"	"	"	"	

**Semivolatile Organic Compounds by GC**Polychlorinated BiphenylsPrepared by method SW846 3510C

12674-11-2	Aroclor-1016	< 0.187	U	µg/l	0.187	0.0972	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
11104-28-2	Aroclor-1221	< 0.187	U	µg/l	0.187	0.107	1	"	"	"	"	"	X
11141-16-5	Aroclor-1232	< 0.187	U	µg/l	0.187	0.104	1	"	"	"	"	"	X

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Sample Identification

<b>FB011218</b>	<u>Client Project #</u>	<u>Matrix</u>	<u>Collection Date/Time</u>	<u>Received</u>
SC43112-05	[none]	Ground Water	12-Jan-18 12:05	15-Jan-18

CAS No.	Analyte(s)	Result	Flag	Units	*RDL	MDL	Dilution	Method Ref.	Prepared	Analyzed	Analyst	Batch	Cert.
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**Semivolatile Organic Compounds by GC**Polychlorinated Biphenyls

53469-21-9	Aroclor-1242	< 0.187	U	µg/l	0.187	0.100	1	SW846 8082A	16-Jan-18	16-Jan-18	AM	1800579	X
12672-29-6	Aroclor-1248	< 0.187	U	µg/l	0.187	0.127	1	"	"	"	"	"	X
11097-69-1	Aroclor-1254	< 0.187	U	µg/l	0.187	0.108	1	"	"	"	"	"	X
11096-82-5	Aroclor-1260	< 0.187	U	µg/l	0.187	0.0795	1	"	"	"	"	"	X
37324-23-5	Aroclor-1262	< 0.187	U	µg/l	0.187	0.0837	1	"	"	"	"	"	X
11100-14-4	Aroclor-1268	< 0.187	U	µg/l	0.187	0.0855	1	"	"	"	"	"	X

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	65			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	75			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	80			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr) [2C]	90			30-150 %			"	"	"	"	"	

**Pesticides**Organochlorine PesticidesPrepared by method SW846 3510C

319-84-6	alpha-BHC	< 0.019	U	µg/l	0.019	0.011	1	SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	X
319-85-7	beta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
319-86-8	delta-BHC	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
58-89-9	gamma-BHC (Lindane)	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
76-44-8	Heptachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	X
309-00-2	Aldrin	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
1024-57-3	Heptachlor epoxide	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
959-98-8	Endosulfan I	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
60-57-1	Dieldrin	< 0.019	U	µg/l	0.019	0.016	1	"	"	"	"	"	X
72-55-9	4,4'-DDE (p,p')	< 0.019	U	µg/l	0.019	0.017	1	"	"	"	"	"	X
72-20-8	Endrin	< 0.037	U	µg/l	0.037	0.018	1	"	"	"	"	"	X
33213-65-9	Endosulfan II	< 0.037	U	µg/l	0.037	0.019	1	"	"	"	"	"	X
72-54-8	4,4'-DDD (p,p')	< 0.037	U	µg/l	0.037	0.017	1	"	"	"	"	"	X
1031-07-8	Endosulfan sulfate	< 0.037	U	µg/l	0.037	0.019	1	"	"	"	"	"	X
50-29-3	4,4'-DDT (p,p')	< 0.037	U	µg/l	0.037	0.017	1	"	"	"	"	"	X
72-43-5	Methoxychlor	< 0.037	U	µg/l	0.037	0.017	1	"	"	"	"	"	X
53494-70-5	Endrin ketone	< 0.037	U	µg/l	0.037	0.016	1	"	"	"	"	"	X
7421-93-4	Endrin aldehyde	< 0.037	U	µg/l	0.037	0.018	1	"	"	"	"	"	X
5103-71-9	alpha-Chlordane	< 0.019	U	µg/l	0.019	0.014	1	"	"	"	"	"	X
5103-74-2	Chlordane (gamma)(trans)	< 0.019	U	µg/l	0.019	0.015	1	"	"	"	"	"	X
8001-35-2	Toxaphene	< 0.467	U	µg/l	0.467	0.307	1	"	"	"	"	"	X
57-74-9	Chlordane	< 0.061	U	µg/l	0.061	0.048	1	"	"	"	"	"	X
15972-60-8	Alachlor	< 0.019	U	µg/l	0.019	0.018	1	"	"	"	"	"	

Surrogate recoveries:

10386-84-2	4,4-DB-Octafluorobiphenyl (Sr)	104			30-150 %			"	"	"	"	"	
10386-84-2	4,4-DB-Octafluorobiphenyl (Sr) [2C]	102			30-150 %			"	"	"	"	"	
2051-24-3	Decachlorobiphenyl (Sr)	104			30-150 %			"	"	"	"	"	

*This laboratory report is not valid without an authorized signature on the cover page.*



Sample Identification

FB011218

SC43112-05

Client Project #

[none]

Matrix

Ground Water

Collection Date/Time

12-Jan-18 12:05

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
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**Pesticides**Organochlorine Pesticides

2051-24-3	Decachlorobiphenyl (Sr) [2C]	90			30-150 %			SW846 8081B	16-Jan-18	19-Jan-18	SM	1800578	
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**Total Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Preservation	Field Preserved; pH<2 confirmed		N/A			1	EPA 200/6000 methods	16-Jan-18		JS	1800630	
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**Total Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	18-Jan-18	24-Jan-18	SJR/T	1800619	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	< 0.0040	U	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	< 0.0050	U	mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	0.0436	J	mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X
7440-48-4	Cobalt	< 0.0050	U	mg/l	0.0050	0.0008	1	"	"	"	"	"	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	< 0.0300	U	mg/l	0.0300	0.0089	1	"	26-Jan-18	28-Jan-18	"	1801155	X
7440-09-7	Potassium	< 0.500	U	mg/l	0.500	0.0600	1	"	18-Jan-18	25-Jan-18	"	1801089	X
7439-95-4	Magnesium	0.0058	J	mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800619	X
7439-96-5	Manganese	< 0.0020	U	mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	0.117	J	mg/l	0.250	0.0392	1	"	"	"	"	"	X
7440-02-0	Nickel	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	"	"	"	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	"	"	"	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	"	"	"	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	0.0019	J	mg/l	0.0050	0.0016	1	"	"	"	"	"	X

**Total Metals by EPA 200 Series Methods**

7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	18-Jan-18	23-Jan-18	ABW	1800620	X
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**Soluble Metals by EPA 200/6000 Series Methods**Prepared by method General Prep-Metal

	Filtration	Field Filtered		N/A			1	EPA 200.7/3005A/601 0			JS	1800631	
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**Soluble Metals by EPA 6000/7000 Series Methods**Prepared by method SW846 3005A

7440-22-4	Silver	< 0.0050	U	mg/l	0.0050	0.0006	1	SW846 6010C	17-Jan-18	24-Jan-18	SJR/T	1800621	X
7429-90-5	Aluminum	< 0.0250	U	mg/l	0.0250	0.0103	1	"	"	"	"	"	X
7440-38-2	Arsenic	< 0.0040	U	mg/l	0.0040	0.0014	1	"	"	"	"	"	X
7440-39-3	Barium	< 0.0050	U	mg/l	0.0050	0.0007	1	"	"	"	"	"	X
7440-41-7	Beryllium	< 0.0020	U	mg/l	0.0020	0.0003	1	"	"	"	"	"	X
7440-70-2	Calcium	0.0338	J	mg/l	0.100	0.0071	1	"	"	"	"	"	X
7440-43-9	Cadmium	< 0.0025	U	mg/l	0.0025	0.0004	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

<b>FB011218</b>	<u>Client Project #</u>	<u>Matrix</u>	<u>Collection Date/Time</u>	<u>Received</u>
SC43112-05	[none]	Ground Water	12-Jan-18 12:05	15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Soluble Metals by EPA 6000/7000 Series Methods</b>													
7440-48-4	Cobalt	< 0.0050	U	mg/l	0.0050	0.0008	1	SW846 6010C	17-Jan-18	25-Jan-18	SJR/T	1801097	X
7440-47-3	Chromium	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7440-50-8	Copper	< 0.0050	U	mg/l	0.0050	0.0023	1	"	"	"	"	"	X
7439-89-6	Iron	0.0058	J	mg/l	0.0150	0.0045	1	"	"	"	"	"	X
7440-09-7	Potassium	< 0.500	U	mg/l	0.500	0.0600	1	"	"	25-Jan-18	"	1801097	X
7439-95-4	Magnesium	0.0067	J	mg/l	0.0100	0.0044	1	"	"	24-Jan-18	"	1800621	X
7439-96-5	Manganese	< 0.0020	U	mg/l	0.0020	0.0019	1	"	"	"	"	"	X
7440-23-5	Sodium	0.148	J	mg/l	0.250	0.0392	1	"	"	25-Jan-18	"	1801097	X
7440-02-0	Nickel	< 0.0050	U	mg/l	0.0050	0.0009	1	"	"	24-Jan-18	"	1800621	X
7439-92-1	Lead	< 0.0075	U	mg/l	0.0075	0.0062	1	"	"	"	"	"	X
7440-36-0	Antimony	< 0.0060	U	mg/l	0.0060	0.0016	1	"	"	25-Jan-18	"	1801097	X
7782-49-2	Selenium	< 0.0150	U	mg/l	0.0150	0.0042	1	"	"	"	"	"	X
7440-28-0	Thallium	< 0.0050	U	mg/l	0.0050	0.0021	1	"	"	24-Jan-18	"	1800621	X
7440-62-2	Vanadium	< 0.0050	U	mg/l	0.0050	0.0011	1	"	"	"	"	"	X
7440-66-6	Zinc	< 0.0050	U	mg/l	0.0050	0.0016	1	"	"	"	"	"	X
<b>Soluble Metals by EPA 200 Series Methods</b>													
7439-97-6	Mercury	< 0.00020	U	mg/l	0.00020	0.00013	1	EPA 245.1/7470A	17-Jan-18	18-Jan-18	ABW	1800622	X
<b>General Chemistry Parameters</b>													
57-12-5	Cyanide (total)	< 0.00500	U	mg/l	0.00500	0.00474	1	EPA 335.4 / SW846 9012B	24-Jan-18	24-Jan-18	RLT	1801015	X

Sample Identification

TB

SC43112-06

Client Project #

[none]

Matrix

Aqueous

Collection Date/Time

12-Jan-18 00:00

Received

15-Jan-18

<u>CAS No.</u>	<u>Analyte(s)</u>	<u>Result</u>	<u>Flag</u>	<u>Units</u>	<u>*RDL</u>	<u>MDL</u>	<u>Dilution</u>	<u>Method Ref.</u>	<u>Prepared</u>	<u>Analyzed</u>	<u>Analyst</u>	<u>Batch</u>	<u>Cert.</u>
<b>Volatile Organic Compounds</b>													
Volatile Organic Compounds by SW846 8260													
Prepared by method SW846 5030 Water MS													
76-13-1	1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00	0.53	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
67-64-1	Acetone	0.94	J	µg/l	10.0	0.80	1	"	"	"	"	"	X
107-13-1	Acrylonitrile	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
71-43-2	Benzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
108-86-1	Bromobenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-97-5	Bromochloromethane	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
75-27-4	Bromodichloromethane	< 0.50	U	µg/l	0.50	0.42	1	"	"	"	"	"	X
75-25-2	Bromoform	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
74-83-9	Bromomethane	< 2.00	U	µg/l	2.00	0.90	1	"	"	"	"	"	X
78-93-3	2-Butanone (MEK)	< 2.00	U	µg/l	2.00	1.07	1	"	"	"	"	"	X
104-51-8	n-Butylbenzene	< 1.00	U	µg/l	1.00	0.41	1	"	"	"	"	"	X
135-98-8	sec-Butylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
98-06-6	tert-Butylbenzene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
75-15-0	Carbon disulfide	< 2.00	U	µg/l	2.00	0.41	1	"	"	"	"	"	X
56-23-5	Carbon tetrachloride	< 1.00	U	µg/l	1.00	0.44	1	"	"	"	"	"	X
108-90-7	Chlorobenzene	< 1.00	U	µg/l	1.00	0.25	1	"	"	"	"	"	X
75-00-3	Chloroethane	< 2.00	U	µg/l	2.00	0.59	1	"	"	"	"	"	X
67-66-3	Chloroform	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
74-87-3	Chloromethane	< 2.00	U	µg/l	2.00	0.37	1	"	"	"	"	"	X
95-49-8	2-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
106-43-4	4-Chlorotoluene	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
96-12-8	1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00	0.86	1	"	"	"	"	"	X
124-48-1	Dibromochloromethane	< 0.50	U	µg/l	0.50	0.32	1	"	"	"	"	"	X
106-93-4	1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50	0.20	1	"	"	"	"	"	X
74-95-3	Dibromomethane	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
95-50-1	1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
541-73-1	1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.31	1	"	"	"	"	"	X
106-46-7	1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00	0.27	1	"	"	"	"	"	X
75-71-8	Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00	0.58	1	"	"	"	"	"	X
75-34-3	1,1-Dichloroethane	< 1.00	U	µg/l	1.00	0.32	1	"	"	"	"	"	X
107-06-2	1,2-Dichloroethane	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
75-35-4	1,1-Dichloroethene	< 1.00	U	µg/l	1.00	0.69	1	"	"	"	"	"	X
156-59-2	cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
156-60-5	trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
78-87-5	1,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
142-28-9	1,3-Dichloropropane	< 1.00	U	µg/l	1.00	0.21	1	"	"	"	"	"	X
594-20-7	2,2-Dichloropropane	< 1.00	U	µg/l	1.00	0.42	1	"	"	"	"	"	X
563-58-6	1,1-Dichloropropene	< 1.00	U	µg/l	1.00	0.58	1	"	"	"	"	"	X
10061-01-5	cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.36	1	"	"	"	"	"	X
10061-02-6	trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50	0.35	1	"	"	"	"	"	X
100-41-4	Ethylbenzene	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
87-68-3	Hexachlorobutadiene	< 0.50	U	µg/l	0.50	0.47	1	"	"	"	"	"	X
591-78-6	2-Hexanone (MBK)	< 2.00	U	µg/l	2.00	0.53	1	"	"	"	"	"	X

*This laboratory report is not valid without an authorized signature on the cover page.*

Sample Identification

TB

SC43112-06

Client Project #

[none]

Matrix

Aqueous

Collection Date/Time

12-Jan-18 00:00

Received

15-Jan-18

<i>CAS No.</i>	<i>Analyte(s)</i>	<i>Result</i>	<i>Flag</i>	<i>Units</i>	<i>*RDL</i>	<i>MDL</i>	<i>Dilution</i>	<i>Method Ref.</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Analyst</i>	<i>Batch</i>	<i>Cert.</i>
<b>Volatile Organic Compounds</b>													
Volatile Organic Compounds by SW846 8260													
98-82-8	Isopropylbenzene	< 1.00	U	µg/l	1.00	0.36	1	SW846 8260C	18-Jan-18	19-Jan-18	GMA	1800715	X
99-87-6	4-Isopropyltoluene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
1634-04-4	Methyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.24	1	"	"	"	"	"	X
108-10-1	4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00	0.52	1	"	"	"	"	"	X
75-09-2	Methylene chloride	< 2.00	U	µg/l	2.00	0.66	1	"	"	"	"	"	X
91-20-3	Naphthalene	< 1.00	U	µg/l	1.00	0.35	1	"	"	"	"	"	X
103-65-1	n-Propylbenzene	< 1.00	U	µg/l	1.00	0.34	1	"	"	"	"	"	X
100-42-5	Styrene	< 1.00	U	µg/l	1.00	0.40	1	"	"	"	"	"	X
630-20-6	1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
79-34-5	1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50	0.33	1	"	"	"	"	"	X
127-18-4	Tetrachloroethene	< 1.00	U	µg/l	1.00	0.57	1	"	"	"	"	"	X
108-88-3	Toluene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
87-61-6	1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
120-82-1	1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.38	1	"	"	"	"	"	X
108-70-3	1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00	0.30	1	"	"	"	"	"	X
71-55-6	1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00	0.51	1	"	"	"	"	"	X
79-00-5	1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
79-01-6	Trichloroethene	< 1.00	U	µg/l	1.00	0.50	1	"	"	"	"	"	X
75-69-4	Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
96-18-4	1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
95-63-6	1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.36	1	"	"	"	"	"	X
108-67-8	1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00	0.43	1	"	"	"	"	"	X
75-01-4	Vinyl chloride	< 1.00	U	µg/l	1.00	0.47	1	"	"	"	"	"	X
179601-23-1	m,p-Xylene	< 2.00	U	µg/l	2.00	0.38	1	"	"	"	"	"	X
95-47-6	o-Xylene	< 1.00	U	µg/l	1.00	0.28	1	"	"	"	"	"	X
109-99-9	Tetrahydrofuran	< 2.00	U	µg/l	2.00	1.06	1	"	"	"	"	"	X
60-29-7	Ethyl ether	< 1.00	U	µg/l	1.00	0.37	1	"	"	"	"	"	X
994-05-8	Tert-amyl methyl ether	< 1.00	U	µg/l	1.00	0.49	1	"	"	"	"	"	X
637-92-3	Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00	0.33	1	"	"	"	"	"	X
108-20-3	Di-isopropyl ether	< 1.00	U	µg/l	1.00	0.29	1	"	"	"	"	"	X
75-65-0	Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0	5.90	1	"	"	"	"	"	X
123-91-1	1,4-Dioxane	< 20.0	U	µg/l	20.0	11.4	1	"	"	"	"	"	X
110-57-6	trans-1,4-Dichloro-2-buten e	< 5.00	U	µg/l	5.00	0.82	1	"	"	"	"	"	X
64-17-5	Ethanol	< 200	U	µg/l	200	30.9	1	"	"	"	"	"	X

*Surrogate recoveries:*

460-00-4	4-Bromofluorobenzene	98			70-130 %			"	"	"	"	"	
2037-26-5	Toluene-d8	101			70-130 %			"	"	"	"	"	
17060-07-0	1,2-Dichloroethane-d4	101			70-130 %			"	"	"	"	"	
1868-53-7	Dibromofluoromethane	103			70-130 %			"	"	"	"	"	

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b>Blank (1800715-BLK1)</b>					<u>Prepared &amp; Analyzed: 18-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	< 1.00	U	µg/l	1.00						
Acetone	< 10.0	U	µg/l	10.0						
Acrylonitrile	< 0.50	U	µg/l	0.50						
Benzene	< 1.00	U	µg/l	1.00						
Bromobenzene	< 1.00	U	µg/l	1.00						
Bromochloromethane	< 1.00	U	µg/l	1.00						
Bromodichloromethane	< 0.50	U	µg/l	0.50						
Bromoform	< 1.00	U	µg/l	1.00						
Bromomethane	< 2.00	U	µg/l	2.00						
2-Butanone (MEK)	< 2.00	U	µg/l	2.00						
n-Butylbenzene	< 1.00	U	µg/l	1.00						
sec-Butylbenzene	< 1.00	U	µg/l	1.00						
tert-Butylbenzene	< 1.00	U	µg/l	1.00						
Carbon disulfide	< 2.00	U	µg/l	2.00						
Carbon tetrachloride	< 1.00	U	µg/l	1.00						
Chlorobenzene	< 1.00	U	µg/l	1.00						
Chloroethane	< 2.00	U	µg/l	2.00						
Chloroform	< 1.00	U	µg/l	1.00						
Chloromethane	< 2.00	U	µg/l	2.00						
2-Chlorotoluene	< 1.00	U	µg/l	1.00						
4-Chlorotoluene	< 1.00	U	µg/l	1.00						
1,2-Dibromo-3-chloropropane	< 2.00	U	µg/l	2.00						
Dibromochloromethane	< 0.50	U	µg/l	0.50						
1,2-Dibromoethane (EDB)	< 0.50	U	µg/l	0.50						
Dibromomethane	< 1.00	U	µg/l	1.00						
1,2-Dichlorobenzene	< 1.00	U	µg/l	1.00						
1,3-Dichlorobenzene	< 1.00	U	µg/l	1.00						
1,4-Dichlorobenzene	< 1.00	U	µg/l	1.00						
Dichlorodifluoromethane (Freon12)	< 2.00	U	µg/l	2.00						
1,1-Dichloroethane	< 1.00	U	µg/l	1.00						
1,2-Dichloroethane	< 1.00	U	µg/l	1.00						
1,1-Dichloroethene	< 1.00	U	µg/l	1.00						
cis-1,2-Dichloroethene	< 1.00	U	µg/l	1.00						
trans-1,2-Dichloroethene	< 1.00	U	µg/l	1.00						
1,2-Dichloropropane	< 1.00	U	µg/l	1.00						
1,3-Dichloropropane	< 1.00	U	µg/l	1.00						
2,2-Dichloropropane	< 1.00	U	µg/l	1.00						
1,1-Dichloropropene	< 1.00	U	µg/l	1.00						
cis-1,3-Dichloropropene	< 0.50	U	µg/l	0.50						
trans-1,3-Dichloropropene	< 0.50	U	µg/l	0.50						
Ethylbenzene	< 1.00	U	µg/l	1.00						
Hexachlorobutadiene	< 0.50	U	µg/l	0.50						
2-Hexanone (MBK)	< 2.00	U	µg/l	2.00						
Isopropylbenzene	< 1.00	U	µg/l	1.00						
4-Isopropyltoluene	< 1.00	U	µg/l	1.00						
Methyl tert-butyl ether	< 1.00	U	µg/l	1.00						
4-Methyl-2-pentanone (MIBK)	< 2.00	U	µg/l	2.00						
Methylene chloride	< 2.00	U	µg/l	2.00						
Naphthalene	< 1.00	U	µg/l	1.00						
n-Propylbenzene	< 1.00	U	µg/l	1.00						

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b>Blank (1800715-BLK1)</b>					<u>Prepared &amp; Analyzed: 18-Jan-18</u>					
Styrene	< 1.00	U	µg/l	1.00						
1,1,1,2-Tetrachloroethane	< 1.00	U	µg/l	1.00						
1,1,2,2-Tetrachloroethane	< 0.50	U	µg/l	0.50						
Tetrachloroethene	< 1.00	U	µg/l	1.00						
Toluene	< 1.00	U	µg/l	1.00						
1,2,3-Trichlorobenzene	< 1.00	U	µg/l	1.00						
1,2,4-Trichlorobenzene	< 1.00	U	µg/l	1.00						
1,3,5-Trichlorobenzene	< 1.00	U	µg/l	1.00						
1,1,1-Trichloroethane	< 1.00	U	µg/l	1.00						
1,1,2-Trichloroethane	< 1.00	U	µg/l	1.00						
Trichloroethene	< 1.00	U	µg/l	1.00						
Trichlorofluoromethane (Freon 11)	< 1.00	U	µg/l	1.00						
1,2,3-Trichloropropane	< 1.00	U	µg/l	1.00						
1,2,4-Trimethylbenzene	< 1.00	U	µg/l	1.00						
1,3,5-Trimethylbenzene	< 1.00	U	µg/l	1.00						
Vinyl chloride	< 1.00	U	µg/l	1.00						
m,p-Xylene	< 2.00	U	µg/l	2.00						
o-Xylene	< 1.00	U	µg/l	1.00						
Tetrahydrofuran	< 2.00	U	µg/l	2.00						
Ethyl ether	< 1.00	U	µg/l	1.00						
Tert-amyl methyl ether	< 1.00	U	µg/l	1.00						
Ethyl tert-butyl ether	< 1.00	U	µg/l	1.00						
Di-isopropyl ether	< 1.00	U	µg/l	1.00						
Tert-Butanol / butyl alcohol	< 10.0	U	µg/l	10.0						
1,4-Dioxane	< 20.0	U	µg/l	20.0						
trans-1,4-Dichloro-2-butene	< 5.00	U	µg/l	5.00						
Ethanol	< 200	U	µg/l	200						
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Surrogate: 4-Bromofluorobenzene	49.1		µg/l		50.0		98	70-130		
Surrogate: Toluene-d8	49.9		µg/l		50.0		100	70-130		
Surrogate: 1,2-Dichloroethane-d4	49.8		µg/l		50.0		100	70-130		
Surrogate: Dibromofluoromethane	51.0		µg/l		50.0		102	70-130		
<b>LCS (1800715-BS1)</b>					<u>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	21.4		µg/l		20.0		107	70-130		
Acetone	19.7		µg/l		20.0		98	70-130		
Acrylonitrile	22.4		µg/l		20.0		112	70-130		
Benzene	23.0		µg/l		20.0		115	70-130		
Bromobenzene	23.9		µg/l		20.0		119	70-130		
Bromochloromethane	23.9		µg/l		20.0		120	70-130		
Bromodichloromethane	21.6		µg/l		20.0		108	70-130		
Bromoform	22.7		µg/l		20.0		113	70-130		
Bromomethane	24.5		µg/l		20.0		122	70-130		
2-Butanone (MEK)	20.7		µg/l		20.0		104	70-130		
n-Butylbenzene	22.9		µg/l		20.0		115	70-130		
sec-Butylbenzene	23.5		µg/l		20.0		118	70-130		
tert-Butylbenzene	23.4		µg/l		20.0		117	70-130		
Carbon disulfide	22.2		µg/l		20.0		111	70-130		
Carbon tetrachloride	21.9		µg/l		20.0		110	70-130		
Chlorobenzene	23.1		µg/l		20.0		115	70-130		
Chloroethane	21.8		µg/l		20.0		109	70-130		
Chloroform	22.4		µg/l		20.0		112	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b><u>LCS (1800715-BS1)</u></b>	<b>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</b>									
Chloromethane	20.1		µg/l		20.0		100	70-130		
2-Chlorotoluene	24.2		µg/l		20.0		121	70-130		
4-Chlorotoluene	24.2		µg/l		20.0		121	70-130		
1,2-Dibromo-3-chloropropane	21.5		µg/l		20.0		107	70-130		
Dibromochloromethane	22.2		µg/l		20.0		111	70-130		
1,2-Dibromoethane (EDB)	21.6		µg/l		20.0		108	70-130		
Dibromomethane	23.6		µg/l		20.0		118	70-130		
1,2-Dichlorobenzene	23.1		µg/l		20.0		115	70-130		
1,3-Dichlorobenzene	23.8		µg/l		20.0		119	70-130		
1,4-Dichlorobenzene	22.3		µg/l		20.0		112	70-130		
Dichlorodifluoromethane (Freon12)	20.6		µg/l		20.0		103	70-130		
1,1-Dichloroethane	23.4		µg/l		20.0		117	70-130		
1,2-Dichloroethane	21.9		µg/l		20.0		109	70-130		
1,1-Dichloroethene	21.8		µg/l		20.0		109	70-130		
cis-1,2-Dichloroethene	22.6		µg/l		20.0		113	70-130		
trans-1,2-Dichloroethene	22.2		µg/l		20.0		111	70-130		
1,2-Dichloropropane	22.8		µg/l		20.0		114	70-130		
1,3-Dichloropropane	22.8		µg/l		20.0		114	70-130		
2,2-Dichloropropane	20.6		µg/l		20.0		103	70-130		
1,1-Dichloropropene	21.6		µg/l		20.0		108	70-130		
cis-1,3-Dichloropropene	21.0		µg/l		20.0		105	70-130		
trans-1,3-Dichloropropene	21.1		µg/l		20.0		106	70-130		
Ethylbenzene	23.7		µg/l		20.0		118	70-130		
Hexachlorobutadiene	23.7		µg/l		20.0		118	70-130		
2-Hexanone (MBK)	21.5		µg/l		20.0		108	70-130		
Isopropylbenzene	23.1		µg/l		20.0		116	70-130		
4-Isopropyltoluene	22.6		µg/l		20.0		113	70-130		
Methyl tert-butyl ether	22.8		µg/l		20.0		114	70-130		
4-Methyl-2-pentanone (MIBK)	21.6		µg/l		20.0		108	70-130		
Methylene chloride	22.5		µg/l		20.0		112	70-130		
Naphthalene	21.5		µg/l		20.0		107	70-130		
n-Propylbenzene	23.1		µg/l		20.0		115	70-130		
Styrene	24.4		µg/l		20.0		122	70-130		
1,1,1,2-Tetrachloroethane	22.2		µg/l		20.0		111	70-130		
1,1,2,2-Tetrachloroethane	23.9		µg/l		20.0		120	70-130		
Tetrachloroethene	22.4		µg/l		20.0		112	70-130		
Toluene	22.9		µg/l		20.0		114	70-130		
1,2,3-Trichlorobenzene	23.4		µg/l		20.0		117	70-130		
1,2,4-Trichlorobenzene	23.0		µg/l		20.0		115	70-130		
1,3,5-Trichlorobenzene	23.4		µg/l		20.0		117	70-130		
1,1,1-Trichloroethane	22.0		µg/l		20.0		110	70-130		
1,1,2-Trichloroethane	23.4		µg/l		20.0		117	70-130		
Trichloroethene	20.8		µg/l		20.0		104	70-130		
Trichlorofluoromethane (Freon 11)	20.9		µg/l		20.0		105	70-130		
1,2,3-Trichloropropane	23.8		µg/l		20.0		119	70-130		
1,2,4-Trimethylbenzene	24.2		µg/l		20.0		121	70-130		
1,3,5-Trimethylbenzene	24.1		µg/l		20.0		120	70-130		
Vinyl chloride	23.1		µg/l		20.0		115	70-130		
m,p-Xylene	23.3		µg/l		20.0		116	70-130		
o-Xylene	24.1		µg/l		20.0		120	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b><u>LCS (1800715-BS1)</u></b>					<u>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</u>					
Tetrahydrofuran	20.5		µg/l		20.0		103	70-130		
Ethyl ether	23.2		µg/l		20.0		116	70-130		
Tert-amyl methyl ether	20.9		µg/l		20.0		105	70-130		
Ethyl tert-butyl ether	21.7		µg/l		20.0		108	70-130		
Di-isopropyl ether	22.0		µg/l		20.0		110	70-130		
Tert-Butanol / butyl alcohol	204		µg/l		200		102	70-130		
1,4-Dioxane	202		µg/l		200		101	70-130		
trans-1,4-Dichloro-2-butene	18.7		µg/l		20.0		93	70-130		
Ethanol	418		µg/l		400		105	70-130		
<i>Surrogate: 4-Bromofluorobenzene</i>	<i>51.2</i>		<i>µg/l</i>		<i>50.0</i>		<i>102</i>	<i>70-130</i>		
<i>Surrogate: Toluene-d8</i>	<i>50.1</i>		<i>µg/l</i>		<i>50.0</i>		<i>100</i>	<i>70-130</i>		
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>48.2</i>		<i>µg/l</i>		<i>50.0</i>		<i>96</i>	<i>70-130</i>		
<i>Surrogate: Dibromofluoromethane</i>	<i>50.7</i>		<i>µg/l</i>		<i>50.0</i>		<i>101</i>	<i>70-130</i>		
<b><u>LCS Dup (1800715-BSD1)</u></b>					<u>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</u>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	20.2		µg/l		20.0		101	70-130	6	20
Acetone	19.9		µg/l		20.0		99	70-130	0.9	20
Acrylonitrile	22.2		µg/l		20.0		111	70-130	1	20
Benzene	22.1		µg/l		20.0		110	70-130	4	20
Bromobenzene	23.2		µg/l		20.0		116	70-130	3	20
Bromochloromethane	23.0		µg/l		20.0		115	70-130	4	20
Bromodichloromethane	21.0		µg/l		20.0		105	70-130	3	20
Bromoform	22.1		µg/l		20.0		110	70-130	3	20
Bromomethane	23.7		µg/l		20.0		118	70-130	3	20
2-Butanone (MEK)	19.8		µg/l		20.0		99	70-130	5	20
n-Butylbenzene	22.3		µg/l		20.0		112	70-130	3	20
sec-Butylbenzene	22.6		µg/l		20.0		113	70-130	4	20
tert-Butylbenzene	22.6		µg/l		20.0		113	70-130	4	20
Carbon disulfide	20.8		µg/l		20.0		104	70-130	6	20
Carbon tetrachloride	20.9		µg/l		20.0		104	70-130	5	20
Chlorobenzene	22.4		µg/l		20.0		112	70-130	3	20
Chloroethane	20.9		µg/l		20.0		104	70-130	4	20
Chloroform	21.6		µg/l		20.0		108	70-130	3	20
Chloromethane	19.0		µg/l		20.0		95	70-130	5	20
2-Chlorotoluene	23.1		µg/l		20.0		116	70-130	4	20
4-Chlorotoluene	23.1		µg/l		20.0		116	70-130	5	20
1,2-Dibromo-3-chloropropane	21.7		µg/l		20.0		109	70-130	1	20
Dibromochloromethane	21.7		µg/l		20.0		109	70-130	2	20
1,2-Dibromoethane (EDB)	21.5		µg/l		20.0		107	70-130	0.5	20
Dibromomethane	23.5		µg/l		20.0		117	70-130	0.6	20
1,2-Dichlorobenzene	22.5		µg/l		20.0		112	70-130	3	20
1,3-Dichlorobenzene	23.0		µg/l		20.0		115	70-130	4	20
1,4-Dichlorobenzene	21.6		µg/l		20.0		108	70-130	3	20
Dichlorodifluoromethane (Freon12)	19.5		µg/l		20.0		98	70-130	6	20
1,1-Dichloroethane	21.5		µg/l		20.0		108	70-130	8	20
1,2-Dichloroethane	21.6		µg/l		20.0		108	70-130	1	20
1,1-Dichloroethene	20.9		µg/l		20.0		104	70-130	4	20
cis-1,2-Dichloroethene	21.9		µg/l		20.0		109	70-130	4	20
trans-1,2-Dichloroethene	21.2		µg/l		20.0		106	70-130	5	20
1,2-Dichloropropane	22.4		µg/l		20.0		112	70-130	2	20
1,3-Dichloropropane	22.2		µg/l		20.0		111	70-130	2	20

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b><u>LCS Dup (1800715-BSD1)</u></b>					<b><u>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</u></b>					
2,2-Dichloropropane	19.4		µg/l		20.0		97	70-130	6	20
1,1-Dichloropropene	20.9		µg/l		20.0		104	70-130	3	20
cis-1,3-Dichloropropene	20.6		µg/l		20.0		103	70-130	2	20
trans-1,3-Dichloropropene	20.8		µg/l		20.0		104	70-130	2	20
Ethylbenzene	22.7		µg/l		20.0		114	70-130	4	20
Hexachlorobutadiene	22.5		µg/l		20.0		113	70-130	5	20
2-Hexanone (MBK)	21.6		µg/l		20.0		108	70-130	0.3	20
Isopropylbenzene	22.3		µg/l		20.0		111	70-130	4	20
4-Isopropyltoluene	21.8		µg/l		20.0		109	70-130	4	20
Methyl tert-butyl ether	21.7		µg/l		20.0		108	70-130	5	20
4-Methyl-2-pentanone (MIBK)	21.4		µg/l		20.0		107	70-130	0.7	20
Methylene chloride	21.9		µg/l		20.0		110	70-130	2	20
Naphthalene	21.4		µg/l		20.0		107	70-130	0.3	20
n-Propylbenzene	22.2		µg/l		20.0		111	70-130	4	20
Styrene	23.6		µg/l		20.0		118	70-130	3	20
1,1,1,2-Tetrachloroethane	21.4		µg/l		20.0		107	70-130	4	20
1,1,2,2-Tetrachloroethane	23.6		µg/l		20.0		118	70-130	2	20
Tetrachloroethene	21.3		µg/l		20.0		107	70-130	5	20
Toluene	21.9		µg/l		20.0		110	70-130	4	20
1,2,3-Trichlorobenzene	22.8		µg/l		20.0		114	70-130	2	20
1,2,4-Trichlorobenzene	22.2		µg/l		20.0		111	70-130	3	20
1,3,5-Trichlorobenzene	22.5		µg/l		20.0		113	70-130	4	20
1,1,1-Trichloroethane	21.3		µg/l		20.0		106	70-130	3	20
1,1,2-Trichloroethane	23.2		µg/l		20.0		116	70-130	0.8	20
Trichloroethene	20.2		µg/l		20.0		101	70-130	3	20
Trichlorofluoromethane (Freon 11)	20.1		µg/l		20.0		101	70-130	4	20
1,2,3-Trichloropropane	23.5		µg/l		20.0		118	70-130	1	20
1,2,4-Trimethylbenzene	23.3		µg/l		20.0		116	70-130	4	20
1,3,5-Trimethylbenzene	23.2		µg/l		20.0		116	70-130	4	20
Vinyl chloride	21.0		µg/l		20.0		105	70-130	9	20
m,p-Xylene	22.4		µg/l		20.0		112	70-130	4	20
o-Xylene	23.0		µg/l		20.0		115	70-130	5	20
Tetrahydrofuran	20.4		µg/l		20.0		102	70-130	0.4	20
Ethyl ether	22.6		µg/l		20.0		113	70-130	3	20
Tert-amyl methyl ether	20.6		µg/l		20.0		103	70-130	2	20
Ethyl tert-butyl ether	21.8		µg/l		20.0		109	70-130	0.5	20
Di-isopropyl ether	21.8		µg/l		20.0		109	70-130	0.8	20
Tert-Butanol / butyl alcohol	202		µg/l		200		101	70-130	0.9	20
1,4-Dioxane	208		µg/l		200		104	70-130	3	20
trans-1,4-Dichloro-2-butene	18.8		µg/l		20.0		94	70-130	0.5	20
Ethanol	409		µg/l		400		102	70-130	2	20
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Surrogate: 4-Bromofluorobenzene	51.1		µg/l		50.0		102	70-130		
Surrogate: Toluene-d8	50.4		µg/l		50.0		101	70-130		
Surrogate: 1,2-Dichloroethane-d4	48.4		µg/l		50.0		97	70-130		
Surrogate: Dibromofluoromethane	51.2		µg/l		50.0		102	70-130		
<b><u>Matrix Spike (1800715-MS1)</u></b>					<b><u>Source: SC43112-03 Prepared: 18-Jan-18 Analyzed: 19-Jan-18</u></b>					
1,1,2-Trichlorotrifluoroethane (Freon 113)	23.1		µg/l		20.0	0.00	115	70-130		
Acetone	20.8		µg/l		20.0	1.82	95	70-130		
Acrylonitrile	22.0		µg/l		20.0	0.00	110	70-130		
Benzene	23.8		µg/l		20.0	0.00	119	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b>Matrix Spike (1800715-MS1)</b>				<b>Source: SC43112-03</b>				<b>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</b>		
Bromobenzene	24.2		µg/l		20.0	0.00	121	70-130		
Bromochloromethane	23.7		µg/l		20.0	0.00	118	70-130		
Bromodichloromethane	22.3		µg/l		20.0	0.00	112	70-130		
Bromoform	22.6		µg/l		20.0	0.00	113	70-130		
Bromomethane	25.1		µg/l		20.0	0.00	125	70-130		
2-Butanone (MEK)	21.0		µg/l		20.0	0.00	105	70-130		
n-Butylbenzene	24.8		µg/l		20.0	0.00	124	70-130		
sec-Butylbenzene	25.1		µg/l		20.0	0.00	125	70-130		
tert-Butylbenzene	25.0		µg/l		20.0	0.00	125	70-130		
Carbon disulfide	22.6		µg/l		20.0	0.00	113	70-130		
Carbon tetrachloride	23.6		µg/l		20.0	0.00	118	70-130		
Chlorobenzene	23.8		µg/l		20.0	0.00	119	70-130		
Chloroethane	22.3		µg/l		20.0	0.00	111	70-130		
Chloroform	23.3		µg/l		20.0	0.27	115	70-130		
Chloromethane	19.8		µg/l		20.0	0.00	99	70-130		
2-Chlorotoluene	25.0		µg/l		20.0	0.00	125	70-130		
4-Chlorotoluene	25.0		µg/l		20.0	0.00	125	70-130		
1,2-Dibromo-3-chloropropane	22.0		µg/l		20.0	0.00	110	70-130		
Dibromochloromethane	22.4		µg/l		20.0	0.00	112	70-130		
1,2-Dibromoethane (EDB)	21.9		µg/l		20.0	0.00	110	70-130		
Dibromomethane	23.8		µg/l		20.0	0.00	119	70-130		
1,2-Dichlorobenzene	23.8		µg/l		20.0	0.00	119	70-130		
1,3-Dichlorobenzene	24.2		µg/l		20.0	0.00	121	70-130		
1,4-Dichlorobenzene	22.9		µg/l		20.0	0.00	114	70-130		
Dichlorodifluoromethane (Freon12)	20.3		µg/l		20.0	0.00	101	70-130		
1,1-Dichloroethane	24.0		µg/l		20.0	0.00	120	70-130		
1,2-Dichloroethane	22.1		µg/l		20.0	0.00	111	70-130		
1,1-Dichloroethene	23.1		µg/l		20.0	0.00	116	70-130		
cis-1,2-Dichloroethene	23.1		µg/l		20.0	0.00	116	70-130		
trans-1,2-Dichloroethene	23.4		µg/l		20.0	0.00	117	70-130		
1,2-Dichloropropane	23.5		µg/l		20.0	0.00	117	70-130		
1,3-Dichloropropane	22.9		µg/l		20.0	0.00	115	70-130		
2,2-Dichloropropane	22.9		µg/l		20.0	0.00	115	70-130		
1,1-Dichloropropene	23.5		µg/l		20.0	0.00	117	70-130		
cis-1,3-Dichloropropene	21.9		µg/l		20.0	0.00	109	70-130		
trans-1,3-Dichloropropene	21.7		µg/l		20.0	0.00	108	70-130		
Ethylbenzene	25.0		µg/l		20.0	0.00	125	70-130		
Hexachlorobutadiene	25.7		µg/l		20.0	0.00	128	70-130		
2-Hexanone (MBK)	22.1		µg/l		20.0	0.00	110	70-130		
Isopropylbenzene	24.4		µg/l		20.0	0.00	122	70-130		
4-Isopropyltoluene	24.0		µg/l		20.0	0.00	120	70-130		
Methyl tert-butyl ether	23.1		µg/l		20.0	0.00	116	70-130		
4-Methyl-2-pentanone (MIBK)	22.0		µg/l		20.0	0.00	110	70-130		
Methylene chloride	22.6		µg/l		20.0	0.00	113	70-130		
Naphthalene	21.9		µg/l		20.0	0.00	109	70-130		
n-Propylbenzene	24.4		µg/l		20.0	0.00	122	70-130		
Styrene	22.4		µg/l		20.0	0.00	112	70-130		
1,1,1,2-Tetrachloroethane	22.6		µg/l		20.0	0.00	113	70-130		
1,1,2,2-Tetrachloroethane	23.8		µg/l		20.0	0.00	119	70-130		
Tetrachloroethene	23.7		µg/l		20.0	0.00	118	70-130		

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b>Matrix Spike (1800715-MS1)</b>				<b>Source: SC43112-03</b>			<b>Prepared: 18-Jan-18</b>	<b>Analyzed: 19-Jan-18</b>		
Toluene	23.7		µg/l		20.0	0.00	118	70-130		
1,2,3-Trichlorobenzene	23.7		µg/l		20.0	0.00	118	70-130		
1,2,4-Trichlorobenzene	23.5		µg/l		20.0	0.00	117	70-130		
1,3,5-Trichlorobenzene	24.1		µg/l		20.0	0.00	120	70-130		
1,1,1-Trichloroethane	23.8		µg/l		20.0	0.00	119	70-130		
1,1,2-Trichloroethane	23.6		µg/l		20.0	0.00	118	70-130		
Trichloroethene	22.0		µg/l		20.0	0.00	110	70-130		
Trichlorofluoromethane (Freon 11)	22.4		µg/l		20.0	0.00	112	70-130		
1,2,3-Trichloropropane	23.6		µg/l		20.0	0.00	118	70-130		
1,2,4-Trimethylbenzene	25.1		µg/l		20.0	0.00	126	70-130		
1,3,5-Trimethylbenzene	25.2		µg/l		20.0	0.00	126	70-130		
Vinyl chloride	24.0		µg/l		20.0	0.00	120	70-130		
m,p-Xylene	24.2		µg/l		20.0	0.00	121	70-130		
o-Xylene	24.8		µg/l		20.0	0.00	124	70-130		
Tetrahydrofuran	20.8		µg/l		20.0	0.00	104	70-130		
Ethyl ether	23.1		µg/l		20.0	0.00	115	70-130		
Tert-amyl methyl ether	20.8		µg/l		20.0	0.00	104	70-130		
Ethyl tert-butyl ether	22.5		µg/l		20.0	0.00	112	70-130		
Di-isopropyl ether	22.7		µg/l		20.0	0.00	113	70-130		
Tert-Butanol / butyl alcohol	206		µg/l		200	0.00	103	70-130		
1,4-Dioxane	210		µg/l		200	0.00	105	70-130		
trans-1,4-Dichloro-2-butene	20.4		µg/l		20.0	0.00	102	70-130		
Ethanol	417		µg/l		400	0.00	104	70-130		
Surrogate: 4-Bromofluorobenzene	51.1		µg/l		50.0		102	70-130		
Surrogate: Toluene-d8	50.4		µg/l		50.0		101	70-130		
Surrogate: 1,2-Dichloroethane-d4	48.6		µg/l		50.0		97	70-130		
Surrogate: Dibromofluoromethane	51.1		µg/l		50.0		102	70-130		
<b>Matrix Spike Dup (1800715-MSD1)</b>				<b>Source: SC43112-03</b>			<b>Prepared: 18-Jan-18</b>	<b>Analyzed: 19-Jan-18</b>		
1,1,2-Trichlorotrifluoroethane (Freon 113)	21.5		µg/l		20.0	0.00	107	70-130	7	20
Acetone	20.7		µg/l		20.0	1.82	94	70-130	0.8	20
Acrylonitrile	22.1		µg/l		20.0	0.00	111	70-130	0.7	20
Benzene	22.3		µg/l		20.0	0.00	111	70-130	7	20
Bromobenzene	22.8		µg/l		20.0	0.00	114	70-130	6	20
Bromochloromethane	23.1		µg/l		20.0	0.00	116	70-130	2	20
Bromodichloromethane	21.0		µg/l		20.0	0.00	105	70-130	6	20
Bromoform	21.8		µg/l		20.0	0.00	109	70-130	4	20
Bromomethane	23.8		µg/l		20.0	0.00	119	70-130	5	20
2-Butanone (MEK)	20.4		µg/l		20.0	0.00	102	70-130	3	20
n-Butylbenzene	23.5		µg/l		20.0	0.00	117	70-130	5	20
sec-Butylbenzene	23.6		µg/l		20.0	0.00	118	70-130	6	20
tert-Butylbenzene	23.7		µg/l		20.0	0.00	118	70-130	6	20
Carbon disulfide	21.2		µg/l		20.0	0.00	106	70-130	6	20
Carbon tetrachloride	22.1		µg/l		20.0	0.00	111	70-130	7	20
Chlorobenzene	22.4		µg/l		20.0	0.00	112	70-130	6	20
Chloroethane	21.0		µg/l		20.0	0.00	105	70-130	6	20
Chloroform	21.8		µg/l		20.0	0.27	108	70-130	6	20
Chloromethane	18.3		µg/l		20.0	0.00	92	70-130	8	20
2-Chlorotoluene	23.4		µg/l		20.0	0.00	117	70-130	6	20
4-Chlorotoluene	23.6		µg/l		20.0	0.00	118	70-130	6	20
1,2-Dibromo-3-chloropropane	21.1		µg/l		20.0	0.00	105	70-130	4	20

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8260C</u></b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b><u>Matrix Spike Dup (1800715-MSD1)</u></b>				<b><u>Source: SC43112-03</u></b>				<b><u>Prepared: 18-Jan-18 Analyzed: 19-Jan-18</u></b>		
Dibromochloromethane	21.4		µg/l		20.0	0.00	107	70-130	5	20
1,2-Dibromoethane (EDB)	21.0		µg/l		20.0	0.00	105	70-130	4	20
Dibromomethane	22.7		µg/l		20.0	0.00	114	70-130	5	20
1,2-Dichlorobenzene	22.6		µg/l		20.0	0.00	113	70-130	5	20
1,3-Dichlorobenzene	23.3		µg/l		20.0	0.00	116	70-130	4	20
1,4-Dichlorobenzene	21.8		µg/l		20.0	0.00	109	70-130	5	20
Dichlorodifluoromethane (Freon12)	18.8		µg/l		20.0	0.00	94	70-130	8	20
1,1-Dichloroethane	22.7		µg/l		20.0	0.00	113	70-130	6	20
1,2-Dichloroethane	21.2		µg/l		20.0	0.00	106	70-130	4	20
1,1-Dichloroethene	21.6		µg/l		20.0	0.00	108	70-130	7	20
cis-1,2-Dichloroethene	21.9		µg/l		20.0	0.00	110	70-130	5	20
trans-1,2-Dichloroethene	22.2		µg/l		20.0	0.00	111	70-130	5	20
1,2-Dichloropropane	22.2		µg/l		20.0	0.00	111	70-130	6	20
1,3-Dichloropropane	22.0		µg/l		20.0	0.00	110	70-130	4	20
2,2-Dichloropropane	21.1		µg/l		20.0	0.00	105	70-130	9	20
1,1-Dichloropropene	21.8		µg/l		20.0	0.00	109	70-130	8	20
cis-1,3-Dichloropropene	20.7		µg/l		20.0	0.00	104	70-130	5	20
trans-1,3-Dichloropropene	20.9		µg/l		20.0	0.00	104	70-130	4	20
Ethylbenzene	23.3		µg/l		20.0	0.00	117	70-130	7	20
Hexachlorobutadiene	24.5		µg/l		20.0	0.00	123	70-130	5	20
2-Hexanone (MBK)	21.3		µg/l		20.0	0.00	106	70-130	4	20
Isopropylbenzene	23.3		µg/l		20.0	0.00	117	70-130	5	20
4-Isopropyltoluene	22.8		µg/l		20.0	0.00	114	70-130	5	20
Methyl tert-butyl ether	22.2		µg/l		20.0	0.00	111	70-130	4	20
4-Methyl-2-pentanone (MIBK)	21.4		µg/l		20.0	0.00	107	70-130	3	20
Methylene chloride	21.4		µg/l		20.0	0.00	107	70-130	5	20
Naphthalene	21.7		µg/l		20.0	0.00	108	70-130	0.8	20
n-Propylbenzene	23.1		µg/l		20.0	0.00	115	70-130	6	20
Styrene	21.1		µg/l		20.0	0.00	106	70-130	6	20
1,1,1,2-Tetrachloroethane	21.4		µg/l		20.0	0.00	107	70-130	6	20
1,1,2,2-Tetrachloroethane	23.1		µg/l		20.0	0.00	115	70-130	3	20
Tetrachloroethene	22.4		µg/l		20.0	0.00	112	70-130	6	20
Toluene	22.5		µg/l		20.0	0.00	113	70-130	5	20
1,2,3-Trichlorobenzene	23.3		µg/l		20.0	0.00	116	70-130	2	20
1,2,4-Trichlorobenzene	22.9		µg/l		20.0	0.00	115	70-130	2	20
1,3,5-Trichlorobenzene	23.2		µg/l		20.0	0.00	116	70-130	4	20
1,1,1-Trichloroethane	22.2		µg/l		20.0	0.00	111	70-130	7	20
1,1,2-Trichloroethane	22.7		µg/l		20.0	0.00	114	70-130	4	20
Trichloroethene	20.6		µg/l		20.0	0.00	103	70-130	7	20
Trichlorofluoromethane (Freon 11)	20.8		µg/l		20.0	0.00	104	70-130	7	20
1,2,3-Trichloropropane	22.8		µg/l		20.0	0.00	114	70-130	4	20
1,2,4-Trimethylbenzene	23.6		µg/l		20.0	0.00	118	70-130	6	20
1,3,5-Trimethylbenzene	23.9		µg/l		20.0	0.00	119	70-130	5	20
Vinyl chloride	21.2		µg/l		20.0	0.00	106	70-130	12	20
m,p-Xylene	23.0		µg/l		20.0	0.00	115	70-130	5	20
o-Xylene	23.5		µg/l		20.0	0.00	117	70-130	5	20
Tetrahydrofuran	20.4		µg/l		20.0	0.00	102	70-130	2	20
Ethyl ether	22.2		µg/l		20.0	0.00	111	70-130	4	20
Tert-amyl methyl ether	20.1		µg/l		20.0	0.00	100	70-130	4	20
Ethyl tert-butyl ether	21.7		µg/l		20.0	0.00	108	70-130	4	20

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# Volatile Organic Compounds - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8260C</b>										
<b>Batch 1800715 - SW846 5030 Water MS</b>										
<b><u>Matrix Spike Dup (1800715-MSD1)</u></b>				<b><u>Source: SC43112-03</u></b>			<b><u>Prepared: 18-Jan-18</u></b>	<b><u>Analyzed: 19-Jan-18</u></b>		
Di-isopropyl ether	21.6		µg/l		20.0	0.00	108	70-130	5	20
Tert-Butanol / butyl alcohol	201		µg/l		200	0.00	100	70-130	2	20
1,4-Dioxane	202		µg/l		200	0.00	101	70-130	4	20
trans-1,4-Dichloro-2-butene	18.9		µg/l		20.0	0.00	94	70-130	8	20
Ethanol	403		µg/l		400	0.00	101	70-130	3	20
<i>Surrogate: 4-Bromofluorobenzene</i>	51.2		µg/l		50.0		102	70-130		
<i>Surrogate: Toluene-d8</i>	50.1		µg/l		50.0		100	70-130		
<i>Surrogate: 1,2-Dichloroethane-d4</i>	48.3		µg/l		50.0		97	70-130		
<i>Surrogate: Dibromofluoromethane</i>	50.7		µg/l		50.0		101	70-130		

# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8270D</u></b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b><u>Blank (1800581-BLK1)</u></b>	<b><u>Prepared: 16-Jan-18 Analyzed: 22-Jan-18</u></b>									
Acenaphthene	< 5.10	U	µg/l	5.10						
Acenaphthylene	< 5.10	U	µg/l	5.10						
Aniline	< 5.10	U	µg/l	5.10						
Anthracene	< 5.10	U	µg/l	5.10						
Azobenzene/Diphenyldiazene	< 5.10	U	µg/l	5.10						
Benzidine	< 5.10	U	µg/l	5.10						
Benzo (a) anthracene	< 5.10	U	µg/l	5.10						
Benzo (a) pyrene	< 5.10	U	µg/l	5.10						
Benzo (b) fluoranthene	< 5.10	U	µg/l	5.10						
Benzo (g,h,i) perylene	< 5.10	U	µg/l	5.10						
Benzo (k) fluoranthene	< 5.10	U	µg/l	5.10						
Benzoic acid	< 5.10	U	µg/l	5.10						
Benzyl alcohol	< 5.10	U	µg/l	5.10						
Bis(2-chloroethoxy)methane	< 5.10	U	µg/l	5.10						
Bis(2-chloroethyl)ether	< 5.10	U	µg/l	5.10						
Bis(2-chloroisopropyl)ether	< 5.10	U	µg/l	5.10						
Bis(2-ethylhexyl)phthalate	< 5.10	U	µg/l	5.10						
4-Bromophenyl phenyl ether	< 5.10	U	µg/l	5.10						
Butyl benzyl phthalate	< 5.10	U	µg/l	5.10						
Carbazole	< 5.10	U	µg/l	5.10						
4-Chloro-3-methylphenol	< 5.10	U	µg/l	5.10						
4-Chloroaniline	< 5.10	U	µg/l	5.10						
2-Chloronaphthalene	< 5.10	U	µg/l	5.10						
2-Chlorophenol	< 5.10	U	µg/l	5.10						
4-Chlorophenyl phenyl ether	< 5.10	U	µg/l	5.10						
Chrysene	< 5.10	U	µg/l	5.10						
Dibenzo (a,h) anthracene	< 5.10	U	µg/l	5.10						
Dibenzofuran	< 5.10	U	µg/l	5.10						
1,2-Dichlorobenzene	< 5.10	U	µg/l	5.10						
1,3-Dichlorobenzene	< 5.10	U	µg/l	5.10						
1,4-Dichlorobenzene	< 5.10	U	µg/l	5.10						
3,3'-Dichlorobenzidine	< 5.10	U	µg/l	5.10						
2,4-Dichlorophenol	< 5.10	U	µg/l	5.10						
Diethyl phthalate	< 5.10	U	µg/l	5.10						
Dimethyl phthalate	< 5.10	U	µg/l	5.10						
2,4-Dimethylphenol	< 5.10	U	µg/l	5.10						
Di-n-butyl phthalate	< 5.10	U	µg/l	5.10						
4,6-Dinitro-2-methylphenol	< 5.10	U	µg/l	5.10						
2,4-Dinitrophenol	< 5.10	U	µg/l	5.10						
2,4-Dinitrotoluene	< 5.10	U	µg/l	5.10						
2,6-Dinitrotoluene	< 5.10	U	µg/l	5.10						
Di-n-octyl phthalate	< 5.10	U	µg/l	5.10						
Fluoranthene	< 5.10	U	µg/l	5.10						
Fluorene	< 5.10	U	µg/l	5.10						
Hexachlorobenzene	< 5.10	U	µg/l	5.10						
Hexachlorobutadiene	< 5.10	U	µg/l	5.10						
Hexachlorocyclopentadiene	< 5.10	U	µg/l	5.10						
Hexachloroethane	< 5.10	U	µg/l	5.10						
Indeno (1,2,3-cd) pyrene	< 5.10	U	µg/l	5.10						
Isophorone	< 5.10	U	µg/l	5.10						

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8270D</u></b>										
<b>Batch 1800581 - SW846 3510C</b>					<b>Prepared: 16-Jan-18 Analyzed: 22-Jan-18</b>					
<b><u>Blank (1800581-BLK1)</u></b>										
2-Methylnaphthalene	< 5.10	U	µg/l	5.10						
2-Methylphenol	< 5.10	U	µg/l	5.10						
3 & 4-Methylphenol	< 10.2	U	µg/l	10.2						
Naphthalene	< 5.10	U	µg/l	5.10						
2-Nitroaniline	< 5.10	U	µg/l	5.10						
3-Nitroaniline	< 5.10	U	µg/l	5.10						
4-Nitroaniline	< 5.10	U	µg/l	5.10						
Nitrobenzene	< 5.10	U	µg/l	5.10						
2-Nitrophenol	< 5.10	U	µg/l	5.10						
4-Nitrophenol	< 20.4	U	µg/l	20.4						
N-Nitrosodimethylamine	< 5.10	U	µg/l	5.10						
N-Nitrosodi-n-propylamine	< 5.10	U	µg/l	5.10						
N-Nitrosodiphenylamine	< 5.10	U	µg/l	5.10						
Pentachlorophenol	< 20.4	U	µg/l	20.4						
Phenanthrene	< 5.10	U	µg/l	5.10						
Phenol	< 5.10	U	µg/l	5.10						
Pyrene	< 5.10	U	µg/l	5.10						
Pyridine	< 5.10	U	µg/l	5.10						
1,2,4-Trichlorobenzene	< 5.10	U	µg/l	5.10						
1-Methylnaphthalene	< 5.10	U	µg/l	5.10						
2,4,5-Trichlorophenol	< 5.10	U	µg/l	5.10						
2,4,6-Trichlorophenol	< 5.10	U	µg/l	5.10						
Pentachloronitrobenzene	< 5.10	U	µg/l	5.10						
1,2,4,5-Tetrachlorobenzene	< 5.10	U	µg/l	5.10						
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Surrogate: 2-Fluorobiphenyl	21.9		µg/l		51.0		43	30-130		
Surrogate: 2-Fluorophenol	13.5		µg/l		51.0		26	15-110		
Surrogate: Nitrobenzene-d5	23.3		µg/l		51.0		46	30-130		
Surrogate: Phenol-d5	10.9		µg/l		51.0		21	15-110		
Surrogate: Terphenyl-d14	34.2		µg/l		51.0		67	30-130		
Surrogate: 2,4,6-Tribromophenol	23.1		µg/l		51.0		45	15-110		
<b><u>LCS (1800581-BS1)</u></b>					<b>Prepared: 16-Jan-18 Analyzed: 22-Jan-18</b>					
Acenaphthene	33.0		µg/l	5.10	51.0		65	40-140		
Acenaphthylene	33.3		µg/l	5.10	51.0		65	40-140		
Aniline	22.2		µg/l	5.10	51.0		44	40-140		
Anthracene	34.6		µg/l	5.10	51.0		68	40-140		
Azobenzene/Diphenyldiazene	32.4		µg/l	5.10	51.0		64	40-140		
Benzidine	24.9		µg/l	5.10	51.0		49	40-140		
Benzo (a) anthracene	36.6		µg/l	5.10	51.0		72	40-140		
Benzo (a) pyrene	38.0		µg/l	5.10	51.0		74	40-140		
Benzo (b) fluoranthene	41.5		µg/l	5.10	51.0		81	40-140		
Benzo (g,h,i) perylene	37.0		µg/l	5.10	51.0		72	40-140		
Benzo (k) fluoranthene	36.2		µg/l	5.10	51.0		71	40-140		
Benzoic acid	26.0		µg/l	5.10	51.0		51	30-130		
Benzyl alcohol	33.8		µg/l	5.10	51.0		66	40-140		
Bis(2-chloroethoxy)methane	25.2		µg/l	5.10	51.0		49	40-140		
Bis(2-chloroethyl)ether	27.6		µg/l	5.10	51.0		54	40-140		
Bis(2-chloroisopropyl)ether	25.9		µg/l	5.10	51.0		51	40-140		
Bis(2-ethylhexyl)phthalate	36.6		µg/l	5.10	51.0		72	40-140		
4-Bromophenyl phenyl ether	33.9		µg/l	5.10	51.0		66	40-140		
Butyl benzyl phthalate	35.1		µg/l	5.10	51.0		69	40-140		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>LCS (1800581-BS1)</b>	Prepared: 16-Jan-18 Analyzed: 22-Jan-18									
Carbazole	50.9		µg/l	5.10	51.0		100	40-140		
4-Chloro-3-methylphenol	34.8		µg/l	5.10	51.0		68	30-130		
4-Chloroaniline	28.2		µg/l	5.10	51.0		55	40-140		
2-Chloronaphthalene	34.6		µg/l	5.10	51.0		68	40-140		
2-Chlorophenol	28.9		µg/l	5.10	51.0		57	30-130		
4-Chlorophenyl phenyl ether	33.4		µg/l	5.10	51.0		66	40-140		
Chrysene	34.6		µg/l	5.10	51.0		68	40-140		
Dibenzo (a,h) anthracene	39.2		µg/l	5.10	51.0		77	40-140		
Dibenzofuran	37.2		µg/l	5.10	51.0		73	40-140		
1,2-Dichlorobenzene	29.1		µg/l	5.10	51.0		57	40-140		
1,3-Dichlorobenzene	28.1		µg/l	5.10	51.0		55	40-140		
1,4-Dichlorobenzene	28.8		µg/l	5.10	51.0		56	40-140		
3,3'-Dichlorobenzidine	43.5		µg/l	5.10	51.0		85	40-140		
2,4-Dichlorophenol	31.3		µg/l	5.10	51.0		61	30-130		
Diethyl phthalate	34.0		µg/l	5.10	51.0		67	40-140		
Dimethyl phthalate	32.7		µg/l	5.10	51.0		64	40-140		
2,4-Dimethylphenol	29.6		µg/l	5.10	51.0		58	30-130		
Di-n-butyl phthalate	32.9		µg/l	5.10	51.0		65	40-140		
4,6-Dinitro-2-methylphenol	45.3		µg/l	5.10	51.0		89	30-130		
2,4-Dinitrophenol	41.9		µg/l	5.10	51.0		82	30-130		
2,4-Dinitrotoluene	45.5		µg/l	5.10	51.0		89	40-140		
2,6-Dinitrotoluene	45.4		µg/l	5.10	51.0		89	40-140		
Di-n-octyl phthalate	38.3		µg/l	5.10	51.0		75	40-140		
Fluoranthene	34.2		µg/l	5.10	51.0		67	40-140		
Fluorene	33.4		µg/l	5.10	51.0		65	40-140		
Hexachlorobenzene	40.9		µg/l	5.10	51.0		80	40-140		
Hexachlorobutadiene	26.9		µg/l	5.10	51.0		53	40-140		
Hexachlorocyclopentadiene	35.6		µg/l	5.10	51.0		70	40-140		
Hexachloroethane	29.5		µg/l	5.10	51.0		58	40-140		
Indeno (1,2,3-cd) pyrene	39.3		µg/l	5.10	51.0		77	40-140		
Isophorone	30.1		µg/l	5.10	51.0		59	40-140		
2-Methylnaphthalene	32.8		µg/l	5.10	51.0		64	40-140		
2-Methylphenol	29.3		µg/l	5.10	51.0		57	30-130		
3 & 4-Methylphenol	29.0		µg/l	10.2	51.0		57	30-130		
Naphthalene	26.8		µg/l	5.10	51.0		52	40-140		
2-Nitroaniline	36.9		µg/l	5.10	51.0		72	40-140		
3-Nitroaniline	42.3		µg/l	5.10	51.0		83	40-140		
4-Nitroaniline	50.6		µg/l	5.10	51.0		99	40-140		
Nitrobenzene	36.4		µg/l	5.10	51.0		71	40-140		
2-Nitrophenol	31.9		µg/l	5.10	51.0		63	30-130		
4-Nitrophenol	26.1		µg/l	20.4	51.0		51	30-130		
N-Nitrosodimethylamine	24.2		µg/l	5.10	51.0		47	40-140		
N-Nitrosodi-n-propylamine	30.6		µg/l	5.10	51.0		60	40-140		
N-Nitrosodiphenylamine	37.2		µg/l	5.10	51.0		73	40-140		
Pentachlorophenol	35.5		µg/l	20.4	51.0		70	30-130		
Phenanthrene	33.2		µg/l	5.10	51.0		65	40-140		
Phenol	18.5		µg/l	5.10	51.0		36	30-130		
Pyrene	35.6		µg/l	5.10	51.0		70	40-140		
Pyridine	23.9		µg/l	5.10	51.0		47	40-140		
1,2,4-Trichlorobenzene	29.5		µg/l	5.10	51.0		58	40-140		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>LCS (1800581-BS1)</b>					Prepared: 16-Jan-18 Analyzed: 22-Jan-18					
1-Methylnaphthalene	28.9		µg/l	5.10	51.0		57	40-140		
2,4,5-Trichlorophenol	37.6		µg/l	5.10	51.0		74	30-130		
2,4,6-Trichlorophenol	33.8		µg/l	5.10	51.0		66	30-130		
Pentachloronitrobenzene	38.0		µg/l	5.10	51.0		74	40-140		
1,2,4,5-Tetrachlorobenzene	28.5		µg/l	5.10	51.0		56	40-140		
Surrogate: 2-Fluorobiphenyl	29.1		µg/l		51.0		57	30-130		
Surrogate: 2-Fluorophenol	22.7		µg/l		51.0		45	15-110		
Surrogate: Nitrobenzene-d5	30.8		µg/l		51.0		60	30-130		
Surrogate: Phenol-d5	18.2		µg/l		51.0		36	15-110		
Surrogate: Terphenyl-d14	37.9		µg/l		51.0		74	30-130		
Surrogate: 2,4,6-Tribromophenol	38.4		µg/l		51.0		75	15-110		
<b>LCS Dup (1800581-BSD1)</b>					Prepared: 16-Jan-18 Analyzed: 22-Jan-18					
Acenaphthene	31.9		µg/l	5.05	50.5		63	40-140	3	20
Acenaphthylene	32.1		µg/l	5.05	50.5		64	40-140	3	20
Aniline	23.7		µg/l	5.05	50.5		47	40-140	6	20
Anthracene	33.4		µg/l	5.05	50.5		66	40-140	4	20
Azobenzene/Diphenyldiazene	31.8		µg/l	5.05	50.5		63	40-140	2	20
Benzidine	25.1		µg/l	5.05	50.5		50	40-140	0.5	20
Benzo (a) anthracene	35.2		µg/l	5.05	50.5		70	40-140	4	20
Benzo (a) pyrene	38.0		µg/l	5.05	50.5		75	40-140	0.1	20
Benzo (b) fluoranthene	41.6		µg/l	5.05	50.5		82	40-140	0.2	20
Benzo (g,h,i) perylene	37.5		µg/l	5.05	50.5		74	40-140	1	20
Benzo (k) fluoranthene	36.9		µg/l	5.05	50.5		73	40-140	2	20
Benzoic acid	25.1		µg/l	5.05	50.5		50	30-130	3	20
Benzyl alcohol	34.2		µg/l	5.05	50.5		68	40-140	1	20
Bis(2-chloroethoxy)methane	25.4		µg/l	5.05	50.5		50	40-140	0.5	20
Bis(2-chloroethyl)ether	27.2		µg/l	5.05	50.5		54	40-140	1	20
Bis(2-chloroisopropyl)ether	26.3		µg/l	5.05	50.5		52	40-140	1	20
Bis(2-ethylhexyl)phthalate	36.0		µg/l	5.05	50.5		71	40-140	2	20
4-Bromophenyl phenyl ether	32.7		µg/l	5.05	50.5		65	40-140	3	20
Butyl benzyl phthalate	34.5		µg/l	5.05	50.5		68	40-140	2	20
Carbazole	51.7		µg/l	5.05	50.5		102	40-140	2	20
4-Chloro-3-methylphenol	33.9		µg/l	5.05	50.5		67	30-130	2	20
4-Chloroaniline	29.5		µg/l	5.05	50.5		58	40-140	4	20
2-Chloronaphthalene	33.5		µg/l	5.05	50.5		66	40-140	3	20
2-Chlorophenol	29.1		µg/l	5.05	50.5		58	30-130	0.7	20
4-Chlorophenyl phenyl ether	32.3		µg/l	5.05	50.5		64	40-140	4	20
Chrysene	34.1		µg/l	5.05	50.5		68	40-140	1	20
Dibenzo (a,h) anthracene	39.5		µg/l	5.05	50.5		78	40-140	0.7	20
Dibenzofuran	35.8		µg/l	5.05	50.5		71	40-140	4	20
1,2-Dichlorobenzene	29.2		µg/l	5.05	50.5		58	40-140	0.4	20
1,3-Dichlorobenzene	28.3		µg/l	5.05	50.5		56	40-140	0.7	20
1,4-Dichlorobenzene	28.3		µg/l	5.05	50.5		56	40-140	2	20
3,3'-Dichlorobenzidine	42.2		µg/l	5.05	50.5		84	40-140	3	20
2,4-Dichlorophenol	30.6		µg/l	5.05	50.5		61	30-130	2	20
Diethyl phthalate	33.0		µg/l	5.05	50.5		65	40-140	3	20
Dimethyl phthalate	31.4		µg/l	5.05	50.5		62	40-140	4	20
2,4-Dimethylphenol	29.2		µg/l	5.05	50.5		58	30-130	1	20
Di-n-butyl phthalate	32.9		µg/l	5.05	50.5		65	40-140	0.06	20
4,6-Dinitro-2-methylphenol	42.9		µg/l	5.05	50.5		85	30-130	6	20

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>LCS Dup (1800581-BSD1)</b>					Prepared: 16-Jan-18 Analyzed: 22-Jan-18					
2,4-Dinitrophenol	40.3		µg/l	5.05	50.5		80	30-130	4	20
2,4-Dinitrotoluene	45.1		µg/l	5.05	50.5		89	40-140	0.9	20
2,6-Dinitrotoluene	44.2		µg/l	5.05	50.5		87	40-140	3	20
Di-n-octyl phthalate	38.4		µg/l	5.05	50.5		76	40-140	0.2	20
Fluoranthene	33.5		µg/l	5.05	50.5		66	40-140	2	20
Fluorene	32.2		µg/l	5.05	50.5		64	40-140	4	20
Hexachlorobenzene	39.5		µg/l	5.05	50.5		78	40-140	4	20
Hexachlorobutadiene	26.8		µg/l	5.05	50.5		53	40-140	0.6	20
Hexachlorocyclopentadiene	34.2		µg/l	5.05	50.5		68	40-140	4	20
Hexachloroethane	29.6		µg/l	5.05	50.5		59	40-140	0.2	20
Indeno (1,2,3-cd) pyrene	38.5		µg/l	5.05	50.5		76	40-140	2	20
Isophorone	30.0		µg/l	5.05	50.5		59	40-140	0.5	20
2-Methylnaphthalene	32.1		µg/l	5.05	50.5		64	40-140	2	20
2-Methylphenol	29.2		µg/l	5.05	50.5		58	30-130	0.4	20
3 & 4-Methylphenol	29.0		µg/l	10.1	50.5		57	30-130	0.04	20
Naphthalene	26.6		µg/l	5.05	50.5		53	40-140	0.4	20
2-Nitroaniline	35.7		µg/l	5.05	50.5		71	40-140	3	20
3-Nitroaniline	41.6		µg/l	5.05	50.5		82	40-140	2	20
4-Nitroaniline	51.1		µg/l	5.05	50.5		101	40-140	1	20
Nitrobenzene	35.7		µg/l	5.05	50.5		71	40-140	2	20
2-Nitrophenol	31.2		µg/l	5.05	50.5		62	30-130	2	20
4-Nitrophenol	25.2		µg/l	20.2	50.5		50	30-130	3	20
N-Nitrosodimethylamine	24.4		µg/l	5.05	50.5		48	40-140	0.8	20
N-Nitrosodi-n-propylamine	30.9		µg/l	5.05	50.5		61	40-140	0.9	20
N-Nitrosodiphenylamine	36.3		µg/l	5.05	50.5		72	40-140	2	20
Pentachlorophenol	34.8		µg/l	20.2	50.5		69	30-130	2	20
Phenanthrene	32.7		µg/l	5.05	50.5		65	40-140	2	20
Phenol	18.8		µg/l	5.05	50.5		37	30-130	2	20
Pyrene	35.0		µg/l	5.05	50.5		69	40-140	2	20
Pyridine	24.0		µg/l	5.05	50.5		48	40-140	0.4	20
1,2,4-Trichlorobenzene	29.2		µg/l	5.05	50.5		58	40-140	1	20
1-Methylnaphthalene	28.1		µg/l	5.05	50.5		56	40-140	3	20
2,4,5-Trichlorophenol	35.9		µg/l	5.05	50.5		71	30-130	5	20
2,4,6-Trichlorophenol	32.7		µg/l	5.05	50.5		65	30-130	3	20
Pentachloronitrobenzene	36.5		µg/l	5.05	50.5		72	40-140	4	20
1,2,4,5-Tetrachlorobenzene	27.7		µg/l	5.05	50.5		55	40-140	3	20
Surrogate: 2-Fluorobiphenyl	28.6		µg/l		50.5		57	30-130		
Surrogate: 2-Fluorophenol	22.7		µg/l		50.5		45	15-110		
Surrogate: Nitrobenzene-d5	30.5		µg/l		50.5		60	30-130		
Surrogate: Phenol-d5	18.5		µg/l		50.5		37	15-110		
Surrogate: Terphenyl-dl4	36.8		µg/l		50.5		73	30-130		
Surrogate: 2,4,6-Tribromophenol	37.3		µg/l		50.5		74	15-110		
<b>Matrix Spike (1800581-MS1)</b>				<b>Source: SC43112-03</b>		Prepared: 16-Jan-18 Analyzed: 23-Jan-18				
Acenaphthene	28.0		µg/l	4.72	47.2	BRL	59	40-140		
Acenaphthylene	28.2		µg/l	4.72	47.2	BRL	60	40-140		
Aniline	16.9	QM7	µg/l	4.72	47.2	BRL	36	40-140		
Anthracene	29.5		µg/l	4.72	47.2	BRL	63	40-140		
Azobenzene/Diphenyldiazene	27.0		µg/l	4.72	47.2	BRL	57	40-140		
Benzidine	6.93	QM7	µg/l	4.72	47.2	BRL	15	40-140		
Benzo (a) anthracene	30.0		µg/l	4.72	47.2	BRL	64	40-140		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>Matrix Spike (1800581-MS1)</b>				<b>Source: SC43112-03</b>			<b>Prepared: 16-Jan-18</b>	<b>Analyzed: 23-Jan-18</b>		
Benzo (a) pyrene	31.7		µg/l	4.72	47.2	BRL	67	40-140		
Benzo (b) fluoranthene	33.9		µg/l	4.72	47.2	BRL	72	40-140		
Benzo (g,h,i) perylene	29.1		µg/l	4.72	47.2	BRL	62	40-140		
Benzo (k) fluoranthene	31.3		µg/l	4.72	47.2	BRL	66	40-140		
Benzoic acid	16.5		µg/l	4.72	47.2	BRL	35	30-130		
Benzyl alcohol	26.7		µg/l	4.72	47.2	BRL	57	40-140		
Bis(2-chloroethoxy)methane	20.9		µg/l	4.72	47.2	BRL	44	40-140		
Bis(2-chloroethyl)ether	20.8		µg/l	4.72	47.2	BRL	44	40-140		
Bis(2-chloroisopropyl)ether	20.7		µg/l	4.72	47.2	BRL	44	40-140		
Bis(2-ethylhexyl)phthalate	29.0		µg/l	4.72	47.2	BRL	62	40-140		
4-Bromophenyl phenyl ether	27.8		µg/l	4.72	47.2	BRL	59	40-140		
Butyl benzyl phthalate	29.0		µg/l	4.72	47.2	BRL	61	40-140		
Carbazole	45.4		µg/l	4.72	47.2	BRL	96	40-140		
4-Chloro-3-methylphenol	28.5		µg/l	4.72	47.2	BRL	60	30-130		
4-Chloroaniline	23.7		µg/l	4.72	47.2	BRL	50	40-140		
2-Chloronaphthalene	30.8		µg/l	4.72	47.2	BRL	65	40-140		
2-Chlorophenol	22.7		µg/l	4.72	47.2	BRL	48	30-130		
4-Chlorophenyl phenyl ether	28.2		µg/l	4.72	47.2	BRL	60	40-140		
Chrysene	28.5		µg/l	4.72	47.2	BRL	60	40-140		
Dibenzo (a,h) anthracene	31.6		µg/l	4.72	47.2	BRL	67	40-140		
Dibenzofuran	32.0		µg/l	4.72	47.2	BRL	68	40-140		
1,2-Dichlorobenzene	25.2		µg/l	4.72	47.2	BRL	53	40-140		
1,3-Dichlorobenzene	23.3		µg/l	4.72	47.2	BRL	49	40-140		
1,4-Dichlorobenzene	24.0		µg/l	4.72	47.2	BRL	51	40-140		
3,3'-Dichlorobenzidine	32.4		µg/l	4.72	47.2	BRL	69	40-140		
2,4-Dichlorophenol	26.4		µg/l	4.72	47.2	BRL	56	30-130		
Diethyl phthalate	28.4		µg/l	4.72	47.2	BRL	60	40-140		
Dimethyl phthalate	27.0		µg/l	4.72	47.2	BRL	57	40-140		
2,4-Dimethylphenol	22.2		µg/l	4.72	47.2	BRL	47	30-130		
Di-n-butyl phthalate	28.1		µg/l	4.72	47.2	BRL	59	40-140		
4,6-Dinitro-2-methylphenol	34.4		µg/l	4.72	47.2	BRL	73	30-130		
2,4-Dinitrophenol	29.3		µg/l	4.72	47.2	BRL	62	30-130		
2,4-Dinitrotoluene	40.4		µg/l	4.72	47.2	BRL	86	40-140		
2,6-Dinitrotoluene	39.9		µg/l	4.72	47.2	BRL	85	40-140		
Di-n-octyl phthalate	31.5		µg/l	4.72	47.2	BRL	67	40-140		
Fluoranthene	29.0		µg/l	4.72	47.2	BRL	61	40-140		
Fluorene	28.1		µg/l	4.72	47.2	BRL	60	40-140		
Hexachlorobenzene	35.2		µg/l	4.72	47.2	BRL	75	40-140		
Hexachlorobutadiene	23.1		µg/l	4.72	47.2	BRL	49	40-140		
Hexachlorocyclopentadiene	27.7		µg/l	4.72	47.2	BRL	59	40-140		
Hexachloroethane	24.9		µg/l	4.72	47.2	BRL	53	40-140		
Indeno (1,2,3-cd) pyrene	30.7		µg/l	4.72	47.2	BRL	65	40-140		
Isophorone	25.3		µg/l	4.72	47.2	BRL	54	30-130		
2-Methylnaphthalene	29.4		µg/l	4.72	47.2	BRL	62	40-140		
2-Methylphenol	22.7		µg/l	4.72	47.2	BRL	48	30-130		
3 & 4-Methylphenol	21.9		µg/l	9.43	47.2	BRL	47	30-130		
Naphthalene	22.6		µg/l	4.72	47.2	BRL	48	40-140		
2-Nitroaniline	30.0		µg/l	4.72	47.2	BRL	64	40-140		
3-Nitroaniline	38.2		µg/l	4.72	47.2	BRL	81	40-140		
4-Nitroaniline	42.1		µg/l	4.72	47.2	BRL	89	40-140		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>Matrix Spike (1800581-MS1)</b>				<b>Source: SC43112-03</b>			<b>Prepared: 16-Jan-18</b>	<b>Analyzed: 23-Jan-18</b>		
Nitrobenzene	32.6		µg/l	4.72	47.2	BRL	69	40-140		
2-Nitrophenol	26.7		µg/l	4.72	47.2	BRL	57	30-130		
4-Nitrophenol	16.8	J	µg/l	18.9	47.2	BRL	36	30-130		
N-Nitrosodimethylamine	16.3	QM7	µg/l	4.72	47.2	BRL	35	40-140		
N-Nitrosodi-n-propylamine	25.7		µg/l	4.72	47.2	BRL	54	40-140		
N-Nitrosodiphenylamine	32.7		µg/l	4.72	47.2	BRL	69	40-140		
Pentachlorophenol	28.3		µg/l	18.9	47.2	BRL	60	30-130		
Phenanthrene	27.8		µg/l	4.72	47.2	BRL	59	40-140		
Phenol	11.3	QM7	µg/l	4.72	47.2	BRL	24	30-130		
Pyrene	30.4		µg/l	4.72	47.2	BRL	64	40-140		
Pyridine	15.3	QM7	µg/l	4.72	47.2	BRL	32	40-140		
1,2,4-Trichlorobenzene	26.2		µg/l	4.72	47.2	BRL	56	40-140		
1-Methylnaphthalene	24.6		µg/l	4.72	47.2	BRL	52	40-140		
2,4,5-Trichlorophenol	31.1		µg/l	4.72	47.2	BRL	66	30-130		
2,4,6-Trichlorophenol	28.5		µg/l	4.72	47.2	BRL	61	30-130		
Pentachloronitrobenzene	32.2		µg/l	4.72	47.2	BRL	68	40-140		
1,2,4,5-Tetrachlorobenzene	24.1		µg/l	4.72	47.2	BRL	51	40-140		
Surrogate: 2-Fluorobiphenyl	25.2		µg/l		47.2		54	30-130		
Surrogate: 2-Fluorophenol	15.1		µg/l		47.2		32	15-110		
Surrogate: Nitrobenzene-d5	25.7		µg/l		47.2		55	30-130		
Surrogate: Phenol-d5	10.5		µg/l		47.2		22	15-110		
Surrogate: Terphenyl-dl4	31.9		µg/l		47.2		68	30-130		
Surrogate: 2,4,6-Tribromophenol	32.0		µg/l		47.2		68	15-110		
<b>Matrix Spike Dup (1800581-MSD1)</b>				<b>Source: SC43112-03</b>			<b>Prepared: 16-Jan-18</b>	<b>Analyzed: 23-Jan-18</b>		
Acenaphthene	26.9		µg/l	4.72	47.2	BRL	57	40-140	4	20
Acenaphthylene	27.1		µg/l	4.72	47.2	BRL	57	40-140	4	20
Aniline	15.6	QM7	µg/l	4.72	47.2	BRL	33	40-140	8	20
Anthracene	27.9		µg/l	4.72	47.2	BRL	59	40-140	6	20
Azobenzene/Diphenyldiazene	25.8		µg/l	4.72	47.2	BRL	55	40-140	5	20
Benzidine	6.63	QM7	µg/l	4.72	47.2	BRL	14	40-140	4	20
Benzo (a) anthracene	29.3		µg/l	4.72	47.2	BRL	62	40-140	2	20
Benzo (a) pyrene	30.2		µg/l	4.72	47.2	BRL	64	40-140	5	20
Benzo (b) fluoranthene	31.7		µg/l	4.72	47.2	BRL	67	40-140	7	20
Benzo (g,h,i) perylene	27.9		µg/l	4.72	47.2	BRL	59	40-140	4	20
Benzo (k) fluoranthene	31.2		µg/l	4.72	47.2	BRL	66	40-140	0.3	20
Benzoic acid	17.7		µg/l	4.72	47.2	BRL	38	30-130	7	20
Benzyl alcohol	25.8		µg/l	4.72	47.2	BRL	55	40-140	3	20
Bis(2-chloroethoxy)methane	20.0		µg/l	4.72	47.2	BRL	42	40-140	4	20
Bis(2-chloroethyl)ether	20.6		µg/l	4.72	47.2	BRL	44	40-140	1	20
Bis(2-chloroisopropyl)ether	19.6		µg/l	4.72	47.2	BRL	42	40-140	6	20
Bis(2-ethylhexyl)phthalate	28.0		µg/l	4.72	47.2	BRL	59	40-140	3	20
4-Bromophenyl phenyl ether	27.4		µg/l	4.72	47.2	BRL	58	40-140	1	20
Butyl benzyl phthalate	27.6		µg/l	4.72	47.2	BRL	59	40-140	5	20
Carbazole	44.1		µg/l	4.72	47.2	BRL	94	40-140	3	20
4-Chloro-3-methylphenol	27.5		µg/l	4.72	47.2	BRL	58	30-130	3	20
4-Chloroaniline	23.8		µg/l	4.72	47.2	BRL	50	40-140	0.4	20
2-Chloronaphthalene	29.4		µg/l	4.72	47.2	BRL	62	40-140	5	20
2-Chlorophenol	22.2		µg/l	4.72	47.2	BRL	47	30-130	2	20
4-Chlorophenyl phenyl ether	27.2		µg/l	4.72	47.2	BRL	58	40-140	4	20
Chrysene	27.9		µg/l	4.72	47.2	BRL	59	40-140	2	20

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>Matrix Spike Dup (1800581-MSD1)</b>				<b>Source: SC43112-03</b>			<b>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</b>			
Dibenzo (a,h) anthracene	30.1		µg/l	4.72	47.2	BRL	64	40-140	5	20
Dibenzofuran	30.9		µg/l	4.72	47.2	BRL	65	40-140	4	20
1,2-Dichlorobenzene	24.2		µg/l	4.72	47.2	BRL	51	40-140	4	20
1,3-Dichlorobenzene	22.7		µg/l	4.72	47.2	BRL	48	40-140	3	20
1,4-Dichlorobenzene	23.3		µg/l	4.72	47.2	BRL	49	40-140	3	20
3,3'-Dichlorobenzidine	31.2		µg/l	4.72	47.2	BRL	66	40-140	4	20
2,4-Dichlorophenol	25.6		µg/l	4.72	47.2	BRL	54	30-130	3	20
Diethyl phthalate	27.2		µg/l	4.72	47.2	BRL	58	40-140	4	20
Dimethyl phthalate	25.9		µg/l	4.72	47.2	BRL	55	40-140	4	20
2,4-Dimethylphenol	21.9		µg/l	4.72	47.2	BRL	46	30-130	1	20
Di-n-butyl phthalate	27.1		µg/l	4.72	47.2	BRL	58	40-140	3	20
4,6-Dinitro-2-methylphenol	34.7		µg/l	4.72	47.2	BRL	74	30-130	0.8	20
2,4-Dinitrophenol	30.4		µg/l	4.72	47.2	BRL	65	30-130	4	20
2,4-Dinitrotoluene	39.9		µg/l	4.72	47.2	BRL	85	40-140	1	20
2,6-Dinitrotoluene	38.2		µg/l	4.72	47.2	BRL	81	40-140	5	20
Di-n-octyl phthalate	29.8		µg/l	4.72	47.2	BRL	63	40-140	6	20
Fluoranthene	28.3		µg/l	4.72	47.2	BRL	60	40-140	2	20
Fluorene	26.9		µg/l	4.72	47.2	BRL	57	40-140	4	20
Hexachlorobenzene	34.0		µg/l	4.72	47.2	BRL	72	40-140	4	20
Hexachlorobutadiene	22.3		µg/l	4.72	47.2	BRL	47	40-140	3	20
Hexachlorocyclopentadiene	27.2		µg/l	4.72	47.2	BRL	58	40-140	2	20
Hexachloroethane	24.1		µg/l	4.72	47.2	BRL	51	40-140	3	20
Indeno (1,2,3-cd) pyrene	29.5		µg/l	4.72	47.2	BRL	63	40-140	4	20
Isophorone	24.3		µg/l	4.72	47.2	BRL	51	30-130	4	20
2-Methylnaphthalene	28.4		µg/l	4.72	47.2	BRL	60	40-140	4	20
2-Methylphenol	22.1		µg/l	4.72	47.2	BRL	47	30-130	2	20
3 & 4-Methylphenol	21.3		µg/l	9.43	47.2	BRL	45	30-130	3	20
Naphthalene	21.5		µg/l	4.72	47.2	BRL	46	40-140	5	20
2-Nitroaniline	29.1		µg/l	4.72	47.2	BRL	62	40-140	3	20
3-Nitroaniline	37.7		µg/l	4.72	47.2	BRL	80	40-140	1	20
4-Nitroaniline	41.1		µg/l	4.72	47.2	BRL	87	40-140	2	20
Nitrobenzene	31.8		µg/l	4.72	47.2	BRL	67	40-140	3	20
2-Nitrophenol	26.2		µg/l	4.72	47.2	BRL	56	30-130	2	20
4-Nitrophenol	17.0	J	µg/l	18.9	47.2	BRL	36	30-130	1	20
N-Nitrosodimethylamine	15.9	QM7	µg/l	4.72	47.2	BRL	34	40-140	3	20
N-Nitrosodi-n-propylamine	25.0		µg/l	4.72	47.2	BRL	53	40-140	3	20
N-Nitrosodiphenylamine	30.7		µg/l	4.72	47.2	BRL	65	40-140	7	20
Pentachlorophenol	28.2		µg/l	18.9	47.2	BRL	60	30-130	0.4	20
Phenanthrene	26.5		µg/l	4.72	47.2	BRL	56	40-140	5	20
Phenol	11.0	QM7	µg/l	4.72	47.2	BRL	23	30-130	2	20
Pyrene	28.6		µg/l	4.72	47.2	BRL	61	40-140	6	20
Pyridine	14.9	QM7	µg/l	4.72	47.2	BRL	32	40-140	3	20
1,2,4-Trichlorobenzene	25.2		µg/l	4.72	47.2	BRL	54	40-140	4	20
1-Methylnaphthalene	23.4		µg/l	4.72	47.2	BRL	50	40-140	5	20
2,4,5-Trichlorophenol	30.6		µg/l	4.72	47.2	BRL	65	30-130	2	20
2,4,6-Trichlorophenol	27.6		µg/l	4.72	47.2	BRL	58	30-130	3	20
Pentachloronitrobenzene	31.3		µg/l	4.72	47.2	BRL	66	40-140	3	20
1,2,4,5-Tetrachlorobenzene	23.3		µg/l	4.72	47.2	BRL	49	40-140	3	20
Surrogate: 2-Fluorobiphenyl	24.5		µg/l		47.2		52	30-130		
Surrogate: 2-Fluorophenol	15.0		µg/l		47.2		32	15-110		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800581 - SW846 3510C</b>										
<b>Matrix Spike Dup (1800581-MSD1)</b>	<b>Source: SC43112-03</b>				<b>Prepared: 16-Jan-18 Analyzed: 23-Jan-18</b>					
Surrogate: Nitrobenzene-d5	25.2		µg/l		47.2		53	30-130		
Surrogate: Phenol-d5	10.5		µg/l		47.2		22	15-110		
Surrogate: Terphenyl-dl4	30.8		µg/l		47.2		65	30-130		
Surrogate: 2,4,6-Tribromophenol	31.6		µg/l		47.2		67	15-110		
<b>Batch 1800974 - SW846 3510C</b>										
<b>Blank (1800974-BLK1)</b>	<b>Prepared: 24-Jan-18 Analyzed: 25-Jan-18</b>									
Acenaphthene	< 5.15	U	µg/l	5.15						
Acenaphthylene	< 5.15	U	µg/l	5.15						
Aniline	< 5.15	U	µg/l	5.15						
Anthracene	< 5.15	U	µg/l	5.15						
Azobenzene/Diphenyldiazene	< 5.15	U	µg/l	5.15						
Benzidine	< 5.15	U	µg/l	5.15						
Benzo (a) anthracene	< 5.15	U	µg/l	5.15						
Benzo (a) pyrene	< 5.15	U	µg/l	5.15						
Benzo (b) fluoranthene	< 5.15	U	µg/l	5.15						
Benzo (g,h,i) perylene	< 5.15	U	µg/l	5.15						
Benzo (k) fluoranthene	< 5.15	U	µg/l	5.15						
Benzoic acid	< 5.15	U	µg/l	5.15						
Benzyl alcohol	< 5.15	U	µg/l	5.15						
Bis(2-chloroethoxy)methane	< 5.15	U	µg/l	5.15						
Bis(2-chloroethyl)ether	< 5.15	U	µg/l	5.15						
Bis(2-chloroisopropyl)ether	< 5.15	U	µg/l	5.15						
Bis(2-ethylhexyl)phthalate	< 5.15	U	µg/l	5.15						
4-Bromophenyl phenyl ether	< 5.15	U	µg/l	5.15						
Butyl benzyl phthalate	< 5.15	U	µg/l	5.15						
Carbazole	< 5.15	U	µg/l	5.15						
4-Chloro-3-methylphenol	< 5.15	U	µg/l	5.15						
4-Chloroaniline	< 5.15	U	µg/l	5.15						
2-Chloronaphthalene	< 5.15	U	µg/l	5.15						
2-Chlorophenol	< 5.15	U	µg/l	5.15						
4-Chlorophenyl phenyl ether	< 5.15	U	µg/l	5.15						
Chrysene	< 5.15	U	µg/l	5.15						
Dibenzo (a,h) anthracene	< 5.15	U	µg/l	5.15						
Dibenzofuran	< 5.15	U	µg/l	5.15						
1,2-Dichlorobenzene	< 5.15	U	µg/l	5.15						
1,3-Dichlorobenzene	< 5.15	U	µg/l	5.15						
1,4-Dichlorobenzene	< 5.15	U	µg/l	5.15						
3,3'-Dichlorobenzidine	< 5.15	U	µg/l	5.15						
2,4-Dichlorophenol	< 5.15	U	µg/l	5.15						
Diethyl phthalate	< 5.15	U	µg/l	5.15						
Dimethyl phthalate	< 5.15	U	µg/l	5.15						
2,4-Dimethylphenol	< 5.15	U	µg/l	5.15						
Di-n-butyl phthalate	< 5.15	U	µg/l	5.15						
4,6-Dinitro-2-methylphenol	< 5.15	U	µg/l	5.15						
2,4-Dinitrophenol	< 5.15	U	µg/l	5.15						
2,4-Dinitrotoluene	< 5.15	U	µg/l	5.15						
2,6-Dinitrotoluene	< 5.15	U	µg/l	5.15						
Di-n-octyl phthalate	5.94		µg/l	5.15						
Fluoranthene	< 5.15	U	µg/l	5.15						
Fluorene	< 5.15	U	µg/l	5.15						

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8270D</u></b>										
<b>Batch 1800974 - SW846 3510C</b>										
<b><u>Blank (1800974-BLK1)</u></b>	<b><u>Prepared: 24-Jan-18 Analyzed: 25-Jan-18</u></b>									
Hexachlorobenzene	< 5.15	U	µg/l	5.15						
Hexachlorobutadiene	< 5.15	U	µg/l	5.15						
Hexachlorocyclopentadiene	< 5.15	U	µg/l	5.15						
Hexachloroethane	< 5.15	U	µg/l	5.15						
Indeno (1,2,3-cd) pyrene	< 5.15	U	µg/l	5.15						
Isophorone	< 5.15	U	µg/l	5.15						
2-Methylnaphthalene	< 5.15	U	µg/l	5.15						
2-Methylphenol	< 5.15	U	µg/l	5.15						
3 & 4-Methylphenol	< 10.3	U	µg/l	10.3						
Naphthalene	< 5.15	U	µg/l	5.15						
2-Nitroaniline	< 5.15	U	µg/l	5.15						
3-Nitroaniline	< 5.15	U	µg/l	5.15						
4-Nitroaniline	< 5.15	U	µg/l	5.15						
Nitrobenzene	< 5.15	U	µg/l	5.15						
2-Nitrophenol	< 5.15	U	µg/l	5.15						
4-Nitrophenol	< 20.6	U	µg/l	20.6						
N-Nitrosodimethylamine	< 5.15	U	µg/l	5.15						
N-Nitrosodi-n-propylamine	< 5.15	U	µg/l	5.15						
N-Nitrosodiphenylamine	< 5.15	U	µg/l	5.15						
Pentachlorophenol	< 20.6	U	µg/l	20.6						
Phenanthrene	< 5.15	U	µg/l	5.15						
Phenol	< 5.15	U	µg/l	5.15						
Pyrene	< 5.15	U	µg/l	5.15						
Pyridine	< 5.15	U	µg/l	5.15						
1,2,4-Trichlorobenzene	< 5.15	U	µg/l	5.15						
1-Methylnaphthalene	< 5.15	U	µg/l	5.15						
2,4,5-Trichlorophenol	< 5.15	U	µg/l	5.15						
2,4,6-Trichlorophenol	< 5.15	U	µg/l	5.15						
Pentachloronitrobenzene	< 5.15	U	µg/l	5.15						
1,2,4,5-Tetrachlorobenzene	< 5.15	U	µg/l	5.15						
Surrogate: 2-Fluorobiphenyl	20.8		µg/l		51.5		40	30-130		
Surrogate: 2-Fluorophenol	15.4		µg/l		51.5		30	15-110		
Surrogate: Nitrobenzene-d5	22.2		µg/l		51.5		43	30-130		
Surrogate: Phenol-d5	10.4		µg/l		51.5		20	15-110		
Surrogate: Terphenyl-dl4	33.7		µg/l		51.5		65	30-130		
Surrogate: 2,4,6-Tribromophenol	25.2		µg/l		51.5		49	15-110		
<b><u>LCS (1800974-BS1)</u></b>	<b><u>Prepared: 24-Jan-18 Analyzed: 25-Jan-18</u></b>									
Acenaphthene	32.7		µg/l	5.10	51.0		64	40-140		
Acenaphthylene	32.3		µg/l	5.10	51.0		63	40-140		
Aniline	16.2	QC2	µg/l	5.10	51.0		32	40-140		
Anthracene	32.8		µg/l	5.10	51.0		64	40-140		
Azobenzene/Diphenyldiazene	31.6		µg/l	5.10	51.0		62	40-140		
Benzidine	13.4	QC2	µg/l	5.10	51.0		26	40-140		
Benzo (a) anthracene	35.7		µg/l	5.10	51.0		70	40-140		
Benzo (a) pyrene	36.3		µg/l	5.10	51.0		71	40-140		
Benzo (b) fluoranthene	37.3		µg/l	5.10	51.0		73	40-140		
Benzo (g,h,i) perylene	34.5		µg/l	5.10	51.0		68	40-140		
Benzo (k) fluoranthene	37.5		µg/l	5.10	51.0		73	40-140		
Benzoic acid	21.7		µg/l	5.10	51.0		43	30-130		
Benzyl alcohol	32.6		µg/l	5.10	51.0		64	40-140		

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# Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800974 - SW846 3510C</b>										
<b>LCS (1800974-BS1)</b>	Prepared: 24-Jan-18 Analyzed: 25-Jan-18									
Bis(2-chloroethoxy)methane	25.7		µg/l	5.10	51.0		50	40-140		
Bis(2-chloroethyl)ether	28.2		µg/l	5.10	51.0		55	40-140		
Bis(2-chloroisopropyl)ether	27.8		µg/l	5.10	51.0		55	40-140		
Bis(2-ethylhexyl)phthalate	35.6		µg/l	5.10	51.0		70	40-140		
4-Bromophenyl phenyl ether	32.4		µg/l	5.10	51.0		64	40-140		
Butyl benzyl phthalate	34.9		µg/l	5.10	51.0		68	40-140		
Carbazole	52.6		µg/l	5.10	51.0		103	40-140		
4-Chloro-3-methylphenol	33.7		µg/l	5.10	51.0		66	30-130		
4-Chloroaniline	26.0		µg/l	5.10	51.0		51	40-140		
2-Chloronaphthalene	37.2		µg/l	5.10	51.0		73	40-140		
2-Chlorophenol	30.5		µg/l	5.10	51.0		60	30-130		
4-Chlorophenyl phenyl ether	31.7		µg/l	5.10	51.0		62	40-140		
Chrysene	33.8		µg/l	5.10	51.0		66	40-140		
Dibenzo (a,h) anthracene	36.9		µg/l	5.10	51.0		72	40-140		
Dibenzofuran	37.2		µg/l	5.10	51.0		73	40-140		
1,2-Dichlorobenzene	33.8		µg/l	5.10	51.0		66	40-140		
1,3-Dichlorobenzene	32.7		µg/l	5.10	51.0		64	40-140		
1,4-Dichlorobenzene	33.3		µg/l	5.10	51.0		65	40-140		
3,3'-Dichlorobenzidine	46.5		µg/l	5.10	51.0		91	40-140		
2,4-Dichlorophenol	32.2		µg/l	5.10	51.0		63	30-130		
Diethyl phthalate	32.7		µg/l	5.10	51.0		64	40-140		
Dimethyl phthalate	30.8		µg/l	5.10	51.0		60	40-140		
2,4-Dimethylphenol	28.1		µg/l	5.10	51.0		55	30-130		
Di-n-butyl phthalate	32.9		µg/l	5.10	51.0		64	40-140		
4,6-Dinitro-2-methylphenol	42.3		µg/l	5.10	51.0		83	30-130		
2,4-Dinitrophenol	35.6		µg/l	5.10	51.0		70	30-130		
2,4-Dinitrotoluene	46.2		µg/l	5.10	51.0		91	40-140		
2,6-Dinitrotoluene	45.6		µg/l	5.10	51.0		89	40-140		
Di-n-octyl phthalate	36.9	B	µg/l	5.10	51.0		72	40-140		
Fluoranthene	33.6		µg/l	5.10	51.0		66	40-140		
Fluorene	32.2		µg/l	5.10	51.0		63	40-140		
Hexachlorobenzene	39.0		µg/l	5.10	51.0		76	40-140		
Hexachlorobutadiene	29.0		µg/l	5.10	51.0		57	40-140		
Hexachlorocyclopentadiene	31.1		µg/l	5.10	51.0		61	40-140		
Hexachloroethane	33.4		µg/l	5.10	51.0		66	40-140		
Indeno (1,2,3-cd) pyrene	34.8		µg/l	5.10	51.0		68	40-140		
Isophorone	31.6		µg/l	5.10	51.0		62	40-140		
2-Methylnaphthalene	39.3		µg/l	5.10	51.0		77	40-140		
2-Methylphenol	28.9		µg/l	5.10	51.0		57	30-130		
3 & 4-Methylphenol	26.5		µg/l	10.2	51.0		52	30-130		
Naphthalene	29.3		µg/l	5.10	51.0		58	40-140		
2-Nitroaniline	36.3		µg/l	5.10	51.0		71	40-140		
3-Nitroaniline	45.9		µg/l	5.10	51.0		90	40-140		
4-Nitroaniline	59.1		µg/l	5.10	51.0		116	40-140		
Nitrobenzene	41.7		µg/l	5.10	51.0		82	40-140		
2-Nitrophenol	33.7		µg/l	5.10	51.0		66	30-130		
4-Nitrophenol	20.9		µg/l	20.4	51.0		41	30-130		
N-Nitrosodimethylamine	22.6		µg/l	5.10	51.0		44	40-140		
N-Nitrosodi-n-propylamine	31.7		µg/l	5.10	51.0		62	40-140		
N-Nitrosodiphenylamine	37.3		µg/l	5.10	51.0		73	40-140		

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800974 - SW846 3510C</b>										
<b>LCS (1800974-BS1)</b>					Prepared: 24-Jan-18 Analyzed: 25-Jan-18					
Pentachlorophenol	28.9		µg/l	20.4	51.0		57	30-130		
Phenanthrene	32.0		µg/l	5.10	51.0		63	40-140		
Phenol	14.4	QC2	µg/l	5.10	51.0		28	30-130		
Pyrene	35.3		µg/l	5.10	51.0		69	40-140		
Pyridine	16.9	QC2	µg/l	5.10	51.0		33	40-140		
1,2,4-Trichlorobenzene	34.5		µg/l	5.10	51.0		68	40-140		
1-Methylnaphthalene	30.7		µg/l	5.10	51.0		60	40-140		
2,4,5-Trichlorophenol	35.9		µg/l	5.10	51.0		70	30-130		
2,4,6-Trichlorophenol	31.9		µg/l	5.10	51.0		63	30-130		
Pentachloronitrobenzene	35.2		µg/l	5.10	51.0		69	40-140		
1,2,4,5-Tetrachlorobenzene	30.1		µg/l	5.10	51.0		59	40-140		
Surrogate: 2-Fluorobiphenyl	30.7		µg/l		51.0		60	30-130		
Surrogate: 2-Fluorophenol	22.0		µg/l		51.0		43	15-110		
Surrogate: Nitrobenzene-d5	34.0		µg/l		51.0		67	30-130		
Surrogate: Phenol-d5	14.0		µg/l		51.0		27	15-110		
Surrogate: Terphenyl-d14	37.1		µg/l		51.0		73	30-130		
Surrogate: 2,4,6-Tribromophenol	35.4		µg/l		51.0		69	15-110		
<b>LCS Dup (1800974-BSD1)</b>					Prepared: 24-Jan-18 Analyzed: 25-Jan-18					
Acenaphthene	31.2		µg/l	5.10	51.0		61	40-140	4	20
Acenaphthylene	30.9		µg/l	5.10	51.0		61	40-140	5	20
Aniline	15.1	QC2	µg/l	5.10	51.0		30	40-140	7	20
Anthracene	31.6		µg/l	5.10	51.0		62	40-140	4	20
Azobenzene/Diphenyldiazene	31.3		µg/l	5.10	51.0		61	40-140	0.8	20
Benzidine	9.32	QC2, QR5	µg/l	5.10	51.0		18	40-140	36	20
Benzo (a) anthracene	33.8		µg/l	5.10	51.0		66	40-140	5	20
Benzo (a) pyrene	34.0		µg/l	5.10	51.0		67	40-140	6	20
Benzo (b) fluoranthene	32.7		µg/l	5.10	51.0		64	40-140	13	20
Benzo (g,h,i) perylene	31.7		µg/l	5.10	51.0		62	40-140	8	20
Benzo (k) fluoranthene	39.0		µg/l	5.10	51.0		76	40-140	4	20
Benzoic acid	20.8		µg/l	5.10	51.0		41	30-130	4	20
Benzyl alcohol	31.4		µg/l	5.10	51.0		62	40-140	4	20
Bis(2-chloroethoxy)methane	24.6		µg/l	5.10	51.0		48	40-140	4	20
Bis(2-chloroethyl)ether	27.2		µg/l	5.10	51.0		53	40-140	4	20
Bis(2-chloroisopropyl)ether	26.6		µg/l	5.10	51.0		52	40-140	4	20
Bis(2-ethylhexyl)phthalate	34.3		µg/l	5.10	51.0		67	40-140	4	20
4-Bromophenyl phenyl ether	30.9		µg/l	5.10	51.0		61	40-140	5	20
Butyl benzyl phthalate	34.2		µg/l	5.10	51.0		67	40-140	2	20
Carbazole	51.8		µg/l	5.10	51.0		102	40-140	2	20
4-Chloro-3-methylphenol	32.3		µg/l	5.10	51.0		63	30-130	4	20
4-Chloroaniline	25.9		µg/l	5.10	51.0		51	40-140	0.4	20
2-Chloronaphthalene	35.6		µg/l	5.10	51.0		70	40-140	4	20
2-Chlorophenol	28.9		µg/l	5.10	51.0		57	30-130	5	20
4-Chlorophenyl phenyl ether	30.2		µg/l	5.10	51.0		59	40-140	5	20
Chrysene	33.4		µg/l	5.10	51.0		65	40-140	1	20
Dibenzo (a,h) anthracene	34.5		µg/l	5.10	51.0		68	40-140	7	20
Dibenzofuran	35.9		µg/l	5.10	51.0		70	40-140	4	20
1,2-Dichlorobenzene	32.3		µg/l	5.10	51.0		63	40-140	5	20
1,3-Dichlorobenzene	30.8		µg/l	5.10	51.0		60	40-140	6	20
1,4-Dichlorobenzene	31.5		µg/l	5.10	51.0		62	40-140	6	20

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## Semivolatile Organic Compounds by GCMS - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8270D</b>										
<b>Batch 1800974 - SW846 3510C</b>										
<b>LCS Dup (1800974-BSD1)</b>					Prepared: 24-Jan-18 Analyzed: 25-Jan-18					
3,3'-Dichlorobenzidine	44.5		µg/l	5.10	51.0		87	40-140	4	20
2,4-Dichlorophenol	31.1		µg/l	5.10	51.0		61	30-130	3	20
Diethyl phthalate	31.5		µg/l	5.10	51.0		62	40-140	4	20
Dimethyl phthalate	29.7		µg/l	5.10	51.0		58	40-140	4	20
2,4-Dimethylphenol	26.8		µg/l	5.10	51.0		53	30-130	5	20
Di-n-butyl phthalate	32.3		µg/l	5.10	51.0		63	40-140	2	20
4,6-Dinitro-2-methylphenol	40.9		µg/l	5.10	51.0		80	30-130	3	20
2,4-Dinitrophenol	34.5		µg/l	5.10	51.0		68	30-130	3	20
2,4-Dinitrotoluene	45.2		µg/l	5.10	51.0		88	40-140	2	20
2,6-Dinitrotoluene	43.5		µg/l	5.10	51.0		85	40-140	5	20
Di-n-octyl phthalate	35.8	B	µg/l	5.10	51.0		70	40-140	3	20
Fluoranthene	33.0		µg/l	5.10	51.0		65	40-140	2	20
Fluorene	30.9		µg/l	5.10	51.0		60	40-140	4	20
Hexachlorobenzene	37.9		µg/l	5.10	51.0		74	40-140	3	20
Hexachlorobutadiene	28.6		µg/l	5.10	51.0		56	40-140	1	20
Hexachlorocyclopentadiene	28.7		µg/l	5.10	51.0		56	40-140	8	20
Hexachloroethane	32.6		µg/l	5.10	51.0		64	40-140	2	20
Indeno (1,2,3-cd) pyrene	31.5		µg/l	5.10	51.0		62	40-140	10	20
Isophorone	30.0		µg/l	5.10	51.0		59	40-140	5	20
2-Methylnaphthalene	37.7		µg/l	5.10	51.0		74	40-140	4	20
2-Methylphenol	27.4		µg/l	5.10	51.0		54	30-130	5	20
3 & 4-Methylphenol	26.4		µg/l	10.2	51.0		52	30-130	0.4	20
Naphthalene	27.6		µg/l	5.10	51.0		54	40-140	6	20
2-Nitroaniline	34.9		µg/l	5.10	51.0		68	40-140	4	20
3-Nitroaniline	44.6		µg/l	5.10	51.0		87	40-140	3	20
4-Nitroaniline	57.0		µg/l	5.10	51.0		112	40-140	4	20
Nitrobenzene	39.2		µg/l	5.10	51.0		77	40-140	6	20
2-Nitrophenol	32.6		µg/l	5.10	51.0		64	30-130	3	20
4-Nitrophenol	20.7		µg/l	20.4	51.0		41	30-130	0.9	20
N-Nitrosodimethylamine	21.4		µg/l	5.10	51.0		42	40-140	5	20
N-Nitrosodi-n-propylamine	30.6		µg/l	5.10	51.0		60	40-140	4	20
N-Nitrosodiphenylamine	36.3		µg/l	5.10	51.0		71	40-140	3	20
Pentachlorophenol	27.9		µg/l	20.4	51.0		55	30-130	3	20
Phenanthrene	31.1		µg/l	5.10	51.0		61	40-140	3	20
Phenol	14.0	QC2	µg/l	5.10	51.0		27	30-130	3	20
Pyrene	34.0		µg/l	5.10	51.0		67	40-140	4	20
Pyridine	15.2	QC2	µg/l	5.10	51.0		30	40-140	11	20
1,2,4-Trichlorobenzene	33.1		µg/l	5.10	51.0		65	40-140	4	20
1-Methylnaphthalene	29.1		µg/l	5.10	51.0		57	40-140	6	20
2,4,5-Trichlorophenol	34.4		µg/l	5.10	51.0		67	30-130	4	20
2,4,6-Trichlorophenol	30.7		µg/l	5.10	51.0		60	30-130	4	20
Pentachloronitrobenzene	34.8		µg/l	5.10	51.0		68	40-140	1	20
1,2,4,5-Tetrachlorobenzene	28.6		µg/l	5.10	51.0		56	40-140	5	20
Surrogate: 2-Fluorobiphenyl	28.9		µg/l		51.0		57	30-130		
Surrogate: 2-Fluorophenol	20.3		µg/l		51.0		40	15-110		
Surrogate: Nitrobenzene-d5	31.4		µg/l		51.0		62	30-130		
Surrogate: Phenol-d5	13.4		µg/l		51.0		26	15-110		
Surrogate: Terphenyl-dl4	35.5		µg/l		51.0		70	30-130		
Surrogate: 2,4,6-Tribromophenol	34.2		µg/l		51.0		67	15-110		

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## Semivolatile Organic Compounds by GC - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8082A</b>										
Batch 1800579 - SW846 3510C										
<b>Blank (1800579-BLK1)</b>					Prepared & Analyzed: 16-Jan-18					
Aroclor-1016	< 0.200	U	µg/l	0.200						
Aroclor-1016 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1221	< 0.200	U	µg/l	0.200						
Aroclor-1221 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1232	< 0.200	U	µg/l	0.200						
Aroclor-1232 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1242	< 0.200	U	µg/l	0.200						
Aroclor-1242 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1248	< 0.200	U	µg/l	0.200						
Aroclor-1248 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1254	< 0.200	U	µg/l	0.200						
Aroclor-1254 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1260	< 0.200	U	µg/l	0.200						
Aroclor-1260 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1262	< 0.200	U	µg/l	0.200						
Aroclor-1262 [2C]	< 0.200	U	µg/l	0.200						
Aroclor-1268	< 0.200	U	µg/l	0.200						
Aroclor-1268 [2C]	< 0.200	U	µg/l	0.200						
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.140		µg/l		0.200		70	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.150		µg/l		0.200		75	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.210		µg/l		0.200		105	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.230		µg/l		0.200		115	30-150		
<b>LCS (1800579-BS1)</b>					Prepared & Analyzed: 16-Jan-18					
Aroclor-1016	1.40		µg/l	0.202	2.53		56	40-140		
Aroclor-1016 [2C]	1.41		µg/l	0.202	2.53		56	40-140		
Aroclor-1260	1.54		µg/l	0.202	2.53		61	40-140		
Aroclor-1260 [2C]	1.52		µg/l	0.202	2.53		60	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.131		µg/l		0.202		65	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.141		µg/l		0.202		70	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.182		µg/l		0.202		90	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.192		µg/l		0.202		95	30-150		
<b>LCS Dup (1800579-BSD1)</b>					Prepared & Analyzed: 16-Jan-18					
Aroclor-1016	1.49		µg/l	0.204	2.55		58	40-140	6	20
Aroclor-1016 [2C]	1.51		µg/l	0.204	2.55		59	40-140	7	20
Aroclor-1260	1.62		µg/l	0.204	2.55		64	40-140	6	20
Aroclor-1260 [2C]	1.62		µg/l	0.204	2.55		64	40-140	7	20
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.153		µg/l		0.204		75	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.163		µg/l		0.204		80	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.204		µg/l		0.204		100	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.235		µg/l		0.204		115	30-150		
<b>Matrix Spike (1800579-MS1)</b>					Source: SC43112-03 Prepared & Analyzed: 16-Jan-18					
Aroclor-1016	3.09		µg/l	0.370	4.63	BRL	67	40-140		
Aroclor-1016 [2C]	3.07		µg/l	0.370	4.63	BRL	66	40-140		
Aroclor-1260	3.33		µg/l	0.370	4.63	BRL	72	40-140		
Aroclor-1260 [2C]	3.35		µg/l	0.370	4.63	BRL	72	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.278		µg/l		0.370		75	30-150		

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## Semivolatile Organic Compounds by GC - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8082A</b>										
Batch 1800579 - SW846 3510C										
<b>Matrix Spike (1800579-MS1)</b>			<b>Source: SC43112-03</b>			<b>Prepared &amp; Analyzed: 16-Jan-18</b>				
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.296		µg/l		0.370		80	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.444		µg/l		0.370		120	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.500		µg/l		0.370		135	30-150		
<b>Matrix Spike Dup (1800579-MSD1)</b>			<b>Source: SC43112-03</b>			<b>Prepared &amp; Analyzed: 16-Jan-18</b>				
Aroclor-1016	3.00		µg/l	0.385	4.81	BRL	62	40-140	3	20
Aroclor-1016 [2C]	2.98		µg/l	0.385	4.81	BRL	62	40-140	3	20
Aroclor-1260	3.37		µg/l	0.385	4.81	BRL	70	40-140	1	20
Aroclor-1260 [2C]	3.25		µg/l	0.385	4.81	BRL	68	40-140	3	20
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.308		µg/l		0.385		80	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.308		µg/l		0.385		80	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.442		µg/l		0.385		115	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.481		µg/l		0.385		125	30-150		
Batch 1800739 - SW846 3510C										
<b>Blank (1800739-BLK1)</b>			<b>Prepared: 19-Jan-18 Analyzed: 23-Jan-18</b>							
Aroclor-1016	< 0.204	U	µg/l	0.204						
Aroclor-1016 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1221	< 0.204	U	µg/l	0.204						
Aroclor-1221 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1232	< 0.204	U	µg/l	0.204						
Aroclor-1232 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1242	< 0.204	U	µg/l	0.204						
Aroclor-1242 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1248	< 0.204	U	µg/l	0.204						
Aroclor-1248 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1254	< 0.204	U	µg/l	0.204						
Aroclor-1254 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1260	< 0.204	U	µg/l	0.204						
Aroclor-1260 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1262	< 0.204	U	µg/l	0.204						
Aroclor-1262 [2C]	< 0.204	U	µg/l	0.204						
Aroclor-1268	< 0.204	U	µg/l	0.204						
Aroclor-1268 [2C]	< 0.204	U	µg/l	0.204						
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.122		µg/l		0.204		60	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.133		µg/l		0.204		65	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.153		µg/l		0.204		75	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.173		µg/l		0.204		85	30-150		
<b>LCS (1800739-BS1)</b>			<b>Prepared: 19-Jan-18 Analyzed: 23-Jan-18</b>							
Aroclor-1016	1.73		µg/l	0.202	2.53		68	40-140		
Aroclor-1016 [2C]	1.78		µg/l	0.202	2.53		70	40-140		
Aroclor-1260	1.81		µg/l	0.202	2.53		72	40-140		
Aroclor-1260 [2C]	1.81		µg/l	0.202	2.53		72	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.121		µg/l		0.202		60	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.131		µg/l		0.202		65	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.111		µg/l		0.202		55	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.121		µg/l		0.202		60	30-150		
<b>LCS Dup (1800739-BSD1)</b>			<b>Prepared: 19-Jan-18 Analyzed: 23-Jan-18</b>							

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# Semivolatile Organic Compounds by GC - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8082A</u></b>										
<b>Batch 1800739 - SW846 3510C</b>										
<b><u>LCS Dup (1800739-BSD1)</u></b>					<u>Prepared: 19-Jan-18 Analyzed: 23-Jan-18</u>					
Aroclor-1016	1.78		µg/l	0.204	2.55		70	40-140	3	20
Aroclor-1016 [2C]	1.80		µg/l	0.204	2.55		70	40-140	1	20
Aroclor-1260	1.71		µg/l	0.204	2.55		67	40-140	5	20
Aroclor-1260 [2C]	1.86		µg/l	0.204	2.55		73	40-140	3	20
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.133		µg/l		0.204		65	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.143		µg/l		0.204		70	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.133		µg/l		0.204		65	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.184		µg/l		0.204		90	30-150		

# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800578 - SW846 3510C</b>										
<b><u>Blank (1800578-BLK1)</u></b>	<b><u>Prepared: 16-Jan-18 Analyzed: 19-Jan-18</u></b>									
alpha-BHC	< 0.020	U	µg/l	0.020						
alpha-BHC [2C]	< 0.020	U	µg/l	0.020						
beta-BHC	< 0.020	U	µg/l	0.020						
beta-BHC [2C]	< 0.020	U	µg/l	0.020						
delta-BHC	< 0.020	U	µg/l	0.020						
delta-BHC [2C]	< 0.020	U	µg/l	0.020						
gamma-BHC (Lindane)	< 0.020	U	µg/l	0.020						
gamma-BHC (Lindane) [2C]	< 0.020	U	µg/l	0.020						
Heptachlor	< 0.020	U	µg/l	0.020						
Heptachlor [2C]	< 0.020	U	µg/l	0.020						
Aldrin	< 0.020	U	µg/l	0.020						
Aldrin [2C]	< 0.020	U	µg/l	0.020						
Heptachlor epoxide	< 0.020	U	µg/l	0.020						
Heptachlor epoxide [2C]	< 0.020	U	µg/l	0.020						
Endosulfan I	< 0.020	U	µg/l	0.020						
Endosulfan I [2C]	< 0.020	U	µg/l	0.020						
Dieldrin	< 0.020	U	µg/l	0.020						
Dieldrin [2C]	< 0.020	U	µg/l	0.020						
4,4'-DDE (p,p')	< 0.020	U	µg/l	0.020						
4,4'-DDE (p,p') [2C]	< 0.020	U	µg/l	0.020						
Endrin	< 0.040	U	µg/l	0.040						
Endrin [2C]	< 0.040	U	µg/l	0.040						
Endosulfan II	< 0.040	U	µg/l	0.040						
Endosulfan II [2C]	< 0.040	U	µg/l	0.040						
4,4'-DDD (p,p')	< 0.040	U	µg/l	0.040						
4,4'-DDD (p,p') [2C]	< 0.040	U	µg/l	0.040						
Endosulfan sulfate	< 0.040	U	µg/l	0.040						
Endosulfan sulfate [2C]	< 0.040	U	µg/l	0.040						
4,4'-DDT (p,p')	< 0.040	U	µg/l	0.040						
4,4'-DDT (p,p') [2C]	< 0.040	U	µg/l	0.040						
Methoxychlor	< 0.040	U	µg/l	0.040						
Methoxychlor [2C]	< 0.040	U	µg/l	0.040						
Endrin ketone	< 0.040	U	µg/l	0.040						
Endrin ketone [2C]	< 0.040	U	µg/l	0.040						
Endrin aldehyde	< 0.040	U	µg/l	0.040						
Endrin aldehyde [2C]	< 0.040	U	µg/l	0.040						
alpha-Chlordane	< 0.020	U	µg/l	0.020						
alpha-Chlordane [2C]	< 0.020	U	µg/l	0.020						
Chlordane (gamma)(trans)	< 0.020	U	µg/l	0.020						
Chlordane (gamma)(trans) [2C]	< 0.020	U	µg/l	0.020						
Toxaphene	< 0.505	U	µg/l	0.505						
Toxaphene [2C]	< 0.505	U	µg/l	0.505						
Chlordane	< 0.066	U	µg/l	0.066						
Chlordane [2C]	< 0.066	U	µg/l	0.066						
Alachlor	< 0.020	U	µg/l	0.020						
Alachlor [2C]	< 0.020	U	µg/l	0.020						
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.148		µg/l		0.202		73	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.149		µg/l		0.202		74	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.170		µg/l		0.202		84	30-150		

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800578 - SW846 3510C</b>										
<b>Blank (1800578-BLK1)</b>					Prepared: 16-Jan-18 Analyzed: 19-Jan-18					
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.174		µg/l		0.202		86	30-150		
<b>LCS (1800578-BS1)</b>					Prepared: 16-Jan-18 Analyzed: 19-Jan-18					
alpha-BHC	0.368		µg/l	0.020	0.510		72	40-140		
alpha-BHC [2C]	0.364		µg/l	0.020	0.510		71	40-140		
beta-BHC	0.350		µg/l	0.020	0.510		69	40-140		
beta-BHC [2C]	0.343		µg/l	0.020	0.510		67	40-140		
delta-BHC	0.351		µg/l	0.020	0.510		69	40-140		
delta-BHC [2C]	0.356		µg/l	0.020	0.510		70	40-140		
gamma-BHC (Lindane)	0.372		µg/l	0.020	0.510		73	40-140		
gamma-BHC (Lindane) [2C]	0.367		µg/l	0.020	0.510		72	40-140		
Heptachlor	0.345		µg/l	0.020	0.510		68	40-140		
Heptachlor [2C]	0.358		µg/l	0.020	0.510		70	40-140		
Aldrin	0.350		µg/l	0.020	0.510		69	40-140		
Aldrin [2C]	0.353		µg/l	0.020	0.510		69	40-140		
Heptachlor epoxide	0.334		µg/l	0.020	0.510		65	40-140		
Heptachlor epoxide [2C]	0.343		µg/l	0.020	0.510		67	40-140		
Endosulfan I	0.359		µg/l	0.020	0.510		70	40-140		
Endosulfan I [2C]	0.370		µg/l	0.020	0.510		73	40-140		
Dieldrin	0.333		µg/l	0.020	0.510		65	40-140		
Dieldrin [2C]	0.344		µg/l	0.020	0.510		67	40-140		
4,4'-DDE (p,p')	0.333		µg/l	0.020	0.510		65	40-140		
4,4'-DDE (p,p') [2C]	0.344		µg/l	0.020	0.510		67	40-140		
Endrin	0.407		µg/l	0.041	0.510		80	40-140		
Endrin [2C]	0.437		µg/l	0.041	0.510		86	40-140		
Endosulfan II	0.325		µg/l	0.041	0.510		64	40-140		
Endosulfan II [2C]	0.340		µg/l	0.041	0.510		67	40-140		
4,4'-DDD (p,p')	0.344		µg/l	0.041	0.510		67	40-140		
4,4'-DDD (p,p') [2C]	0.340		µg/l	0.041	0.510		67	40-140		
Endosulfan sulfate	0.342		µg/l	0.041	0.510		67	40-140		
Endosulfan sulfate [2C]	0.343		µg/l	0.041	0.510		67	40-140		
4,4'-DDT (p,p')	0.365		µg/l	0.041	0.510		71	40-140		
4,4'-DDT (p,p') [2C]	0.379		µg/l	0.041	0.510		74	40-140		
Methoxychlor	0.347		µg/l	0.041	0.510		68	40-140		
Methoxychlor [2C]	0.367		µg/l	0.041	0.510		72	40-140		
Endrin ketone	0.292		µg/l	0.041	0.510		57	40-140		
Endrin ketone [2C]	0.307		µg/l	0.041	0.510		60	40-140		
Endrin aldehyde	0.345		µg/l	0.041	0.510		68	40-140		
Endrin aldehyde [2C]	0.361		µg/l	0.041	0.510		71	40-140		
alpha-Chlordane	0.336		µg/l	0.020	0.510		66	40-140		
alpha-Chlordane [2C]	0.341		µg/l	0.020	0.510		67	40-140		
Chlordane (gamma)(trans)	0.339		µg/l	0.020	0.510		66	40-140		
Chlordane (gamma)(trans) [2C]	0.346		µg/l	0.020	0.510		68	40-140		
Alachlor	0.396		µg/l	0.020	0.510		78	40-140		
Alachlor [2C]	0.405		µg/l	0.020	0.510		79	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.144		µg/l		0.204		70	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.146		µg/l		0.204		72	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.160		µg/l		0.204		78	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.163		µg/l		0.204		80	30-150		
<b>LCS Dup (1800578-BS1)</b>					Prepared: 16-Jan-18 Analyzed: 19-Jan-18					

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800578 - SW846 3510C</b>										
<b><u>LCS Dup (1800578-BSD1)</u></b>					Prepared: 16-Jan-18 Analyzed: 19-Jan-18					
alpha-BHC	0.430		µg/l	0.020	0.510		84	40-140	16	20
alpha-BHC [2C]	0.415		µg/l	0.020	0.510		81	40-140	13	20
beta-BHC	0.409		µg/l	0.020	0.510		80	40-140	16	20
beta-BHC [2C]	0.402		µg/l	0.020	0.510		79	40-140	16	20
delta-BHC	0.413		µg/l	0.020	0.510		81	40-140	16	20
delta-BHC [2C]	0.416		µg/l	0.020	0.510		81	40-140	16	20
gamma-BHC (Lindane)	0.436		µg/l	0.020	0.510		86	40-140	16	20
gamma-BHC (Lindane) [2C]	0.421		µg/l	0.020	0.510		82	40-140	14	20
Heptachlor	0.404		µg/l	0.020	0.510		79	40-140	16	20
Heptachlor [2C]	0.411		µg/l	0.020	0.510		81	40-140	14	20
Aldrin	0.412		µg/l	0.020	0.510		81	40-140	16	20
Aldrin [2C]	0.405		µg/l	0.020	0.510		79	40-140	14	20
Heptachlor epoxide	0.393		µg/l	0.020	0.510		77	40-140	16	20
Heptachlor epoxide [2C]	0.400		µg/l	0.020	0.510		78	40-140	15	20
Endosulfan I	0.424		µg/l	0.020	0.510		83	40-140	17	20
Endosulfan I [2C]	0.436		µg/l	0.020	0.510		85	40-140	16	20
Dieldrin	0.392		µg/l	0.020	0.510		77	40-140	16	20
Dieldrin [2C]	0.409		µg/l	0.020	0.510		80	40-140	17	20
4,4'-DDE (p,p')	0.395		µg/l	0.020	0.510		77	40-140	17	20
4,4'-DDE (p,p') [2C]	0.408		µg/l	0.020	0.510		80	40-140	17	20
Endrin	0.478		µg/l	0.041	0.510		94	40-140	16	20
Endrin [2C]	0.520		µg/l	0.041	0.510		102	40-140	17	20
Endosulfan II	0.382		µg/l	0.041	0.510		75	40-140	16	20
Endosulfan II [2C]	0.411		µg/l	0.041	0.510		81	40-140	19	20
4,4'-DDD (p,p')	0.405		µg/l	0.041	0.510		79	40-140	16	20
4,4'-DDD (p,p') [2C]	0.410		µg/l	0.041	0.510		80	40-140	19	20
Endosulfan sulfate	0.404		µg/l	0.041	0.510		79	40-140	17	20
Endosulfan sulfate [2C]	0.418		µg/l	0.041	0.510		82	40-140	20	20
4,4'-DDT (p,p')	0.432		µg/l	0.041	0.510		85	40-140	17	20
4,4'-DDT (p,p') [2C]	0.453		µg/l	0.041	0.510		89	40-140	18	20
Methoxychlor	0.412		µg/l	0.041	0.510		81	40-140	17	20
Methoxychlor [2C]	0.446		µg/l	0.041	0.510		88	40-140	19	20
Endrin ketone	0.346		µg/l	0.041	0.510		68	40-140	17	20
Endrin ketone [2C]	0.372		µg/l	0.041	0.510		73	40-140	19	20
Endrin aldehyde	0.409		µg/l	0.041	0.510		80	40-140	17	20
Endrin aldehyde [2C]	0.440		µg/l	0.041	0.510		86	40-140	20	20
alpha-Chlordane	0.398		µg/l	0.020	0.510		78	40-140	17	20
alpha-Chlordane [2C]	0.403		µg/l	0.020	0.510		79	40-140	17	20
Chlordane (gamma)(trans)	0.399		µg/l	0.020	0.510		78	40-140	16	20
Chlordane (gamma)(trans) [2C]	0.409		µg/l	0.020	0.510		80	40-140	16	20
Alachlor	0.464		µg/l	0.020	0.510		91	40-140	16	20
Alachlor [2C]	0.481		µg/l	0.020	0.510		94	40-140	17	20
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.156		µg/l		0.204		76	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.156		µg/l		0.204		77	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.180		µg/l		0.204		88	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.192		µg/l		0.204		94	30-150		
<b><u>Matrix Spike (1800578-MS1)</u></b>					<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 19-Jan-18</u></b>			
alpha-BHC	0.572		µg/l	0.036	0.909	BRL	63	30-150		
alpha-BHC [2C]	0.588		µg/l	0.036	0.909	BRL	65	30-150		

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800578 - SW846 3510C</b>										
<b><u>Matrix Spike (1800578-MS1)</u></b>				<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 19-Jan-18</u></b>				
beta-BHC	0.653		µg/l	0.036	0.909	BRL	72	30-150		
beta-BHC [2C]	0.649		µg/l	0.036	0.909	BRL	71	30-150		
delta-BHC	0.648		µg/l	0.036	0.909	BRL	71	30-150		
delta-BHC [2C]	0.659		µg/l	0.036	0.909	BRL	72	30-150		
gamma-BHC (Lindane)	0.624		µg/l	0.036	0.909	BRL	69	30-150		
gamma-BHC (Lindane) [2C]	0.614		µg/l	0.036	0.909	BRL	68	30-150		
Heptachlor	0.580		µg/l	0.036	0.909	BRL	64	30-150		
Heptachlor [2C]	0.583		µg/l	0.036	0.909	BRL	64	30-150		
Aldrin	0.564		µg/l	0.036	0.909	BRL	62	30-150		
Aldrin [2C]	0.567		µg/l	0.036	0.909	BRL	62	30-150		
Heptachlor epoxide	0.649		µg/l	0.036	0.909	BRL	71	30-150		
Heptachlor epoxide [2C]	0.661		µg/l	0.036	0.909	BRL	73	30-150		
Endosulfan I	0.710		µg/l	0.036	0.909	BRL	78	30-150		
Endosulfan I [2C]	0.755		µg/l	0.036	0.909	BRL	83	30-150		
Dieldrin	0.737		µg/l	0.036	0.909	0.129	67	30-150		
Dieldrin [2C]	0.780		µg/l	0.036	0.909	0.132	71	30-150		
4,4'-DDE (p,p')	0.627		µg/l	0.036	0.909	BRL	69	30-150		
4,4'-DDE (p,p') [2C]	0.658		µg/l	0.036	0.909	BRL	72	30-150		
Endrin	0.781		µg/l	0.073	0.909	BRL	86	30-150		
Endrin [2C]	0.853		µg/l	0.073	0.909	BRL	94	30-150		
Endosulfan II	0.661		µg/l	0.073	0.909	BRL	73	30-150		
Endosulfan II [2C]	0.703		µg/l	0.073	0.909	BRL	77	30-150		
4,4'-DDD (p,p')	0.692		µg/l	0.073	0.909	BRL	76	30-150		
4,4'-DDD (p,p') [2C]	0.709		µg/l	0.073	0.909	BRL	78	30-150		
Endosulfan sulfate	0.678		µg/l	0.073	0.909	BRL	75	30-150		
Endosulfan sulfate [2C]	0.710		µg/l	0.073	0.909	BRL	78	30-150		
4,4'-DDT (p,p')	0.737		µg/l	0.073	0.909	BRL	81	30-150		
4,4'-DDT (p,p') [2C]	0.809		µg/l	0.073	0.909	BRL	89	30-150		
Methoxychlor	0.713		µg/l	0.073	0.909	BRL	78	30-150		
Methoxychlor [2C]	0.762		µg/l	0.073	0.909	BRL	84	30-150		
Endrin ketone	0.603		µg/l	0.073	0.909	BRL	66	30-150		
Endrin ketone [2C]	0.652		µg/l	0.073	0.909	BRL	72	30-150		
Endrin aldehyde	0.747		µg/l	0.073	0.909	BRL	82	30-150		
Endrin aldehyde [2C]	0.773		µg/l	0.073	0.909	BRL	85	30-150		
alpha-Chlordane	0.710		µg/l	0.036	0.909	0.085	69	30-150		
alpha-Chlordane [2C]	0.849		µg/l	0.036	0.909	0.243	67	30-150		
Chlordane (gamma)(trans)	0.689		µg/l	0.036	0.909	0.073	68	30-150		
Chlordane (gamma)(trans) [2C]	0.745		µg/l	0.036	0.909	0.087	72	30-150		
Alachlor	0.776		µg/l	0.036	0.909	BRL	85	30-150		
Alachlor [2C]	1.01		µg/l	0.036	0.909	BRL	111	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.386		µg/l		0.364		106	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.399		µg/l		0.364		110	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.461		µg/l		0.364		127	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.455		µg/l		0.364		125	30-150		
<b><u>Matrix Spike Dup (1800578-MSD1)</u></b>				<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 19-Jan-18</u></b>				
alpha-BHC	0.649		µg/l	0.041	1.02	BRL	64	30-150	13	20
alpha-BHC [2C]	0.656		µg/l	0.041	1.02	BRL	64	30-150	11	20
beta-BHC	0.747		µg/l	0.041	1.02	BRL	73	30-150	14	20
beta-BHC [2C]	0.740		µg/l	0.041	1.02	BRL	72	30-150	13	20

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800578 - SW846 3510C</b>										
<b><u>Matrix Spike Dup (1800578-MSD1)</u></b>				<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 16-Jan-18 Analyzed: 19-Jan-18</u></b>				
delta-BHC	0.765		µg/l	0.041	1.02	BRL	75	30-150	17	20
delta-BHC [2C]	0.769		µg/l	0.041	1.02	BRL	75	30-150	16	20
gamma-BHC (Lindane)	0.716		µg/l	0.041	1.02	BRL	70	30-150	14	20
gamma-BHC (Lindane) [2C]	0.693		µg/l	0.041	1.02	BRL	68	30-150	12	20
Heptachlor	0.671		µg/l	0.041	1.02	BRL	66	30-150	14	20
Heptachlor [2C]	0.667		µg/l	0.041	1.02	BRL	65	30-150	14	20
Aldrin	0.649		µg/l	0.041	1.02	BRL	64	30-150	14	20
Aldrin [2C]	0.649		µg/l	0.041	1.02	BRL	64	30-150	13	20
Heptachlor epoxide	0.742		µg/l	0.041	1.02	BRL	73	30-150	13	20
Heptachlor epoxide [2C]	0.763		µg/l	0.041	1.02	BRL	75	30-150	14	20
Endosulfan I	0.831		µg/l	0.041	1.02	BRL	81	30-150	16	20
Endosulfan I [2C]	0.880		µg/l	0.041	1.02	BRL	86	30-150	15	20
Dieldrin	0.874		µg/l	0.041	1.02	0.129	73	30-150	17	20
Dieldrin [2C]	0.885		µg/l	0.041	1.02	0.132	74	30-150	13	20
4,4'-DDE (p,p')	0.757		µg/l	0.041	1.02	BRL	74	30-150	19	20
4,4'-DDE (p,p') [2C]	0.777		µg/l	0.041	1.02	BRL	76	30-150	17	20
Endrin	0.938		µg/l	0.082	1.02	BRL	92	30-150	18	20
Endrin [2C]	0.955		µg/l	0.082	1.02	BRL	94	30-150	11	20
Endosulfan II	0.805		µg/l	0.082	1.02	BRL	79	30-150	20	20
Endosulfan II [2C]	0.804		µg/l	0.082	1.02	BRL	79	30-150	13	20
4,4'-DDD (p,p')	0.849		µg/l	0.082	1.02	BRL	83	30-150	20	20
4,4'-DDD (p,p') [2C]	0.813		µg/l	0.082	1.02	BRL	80	30-150	14	20
Endosulfan sulfate	0.844	QR2	µg/l	0.082	1.02	BRL	83	30-150	22	20
Endosulfan sulfate [2C]	0.824		µg/l	0.082	1.02	BRL	81	30-150	15	20
4,4'-DDT (p,p')	0.914	QR2	µg/l	0.082	1.02	BRL	90	30-150	21	20
4,4'-DDT (p,p') [2C]	0.902		µg/l	0.082	1.02	BRL	88	30-150	11	20
Methoxychlor	0.920	QR2	µg/l	0.082	1.02	BRL	90	30-150	25	20
Methoxychlor [2C]	0.909		µg/l	0.082	1.02	BRL	89	30-150	18	20
Endrin ketone	0.768	QR2	µg/l	0.082	1.02	BRL	75	30-150	24	20
Endrin ketone [2C]	0.754		µg/l	0.082	1.02	BRL	74	30-150	15	20
Endrin aldehyde	0.931	QR2	µg/l	0.082	1.02	BRL	91	30-150	22	20
Endrin aldehyde [2C]	0.896		µg/l	0.082	1.02	BRL	88	30-150	15	20
alpha-Chlordane	0.823		µg/l	0.041	1.02	0.085	72	30-150	15	20
alpha-Chlordane [2C]	0.980		µg/l	0.041	1.02	0.243	72	30-150	14	20
Chlordane (gamma)(trans)	0.784		µg/l	0.041	1.02	0.073	70	30-150	13	20
Chlordane (gamma)(trans) [2C]	0.867		µg/l	0.041	1.02	0.087	76	30-150	15	20
Alachlor	0.901		µg/l	0.041	1.02	BRL	88	30-150	15	20
Alachlor [2C]	1.15		µg/l	0.041	1.02	BRL	113	30-150	13	20
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.463		µg/l		0.408		113	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.473		µg/l		0.408		116	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.608		µg/l		0.408		149	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.588		µg/l		0.408		144	30-150		
<b>Batch 1800753 - SW846 3510C</b>										
<b><u>Blank (1800753-BLK1)</u></b>						<b><u>Prepared: 19-Jan-18 Analyzed: 20-Jan-18</u></b>				
alpha-BHC	< 0.020	U	µg/l	0.020						
alpha-BHC [2C]	< 0.020	U	µg/l	0.020						
beta-BHC	< 0.020	U	µg/l	0.020						
beta-BHC [2C]	< 0.020	U	µg/l	0.020						
delta-BHC	< 0.020	U	µg/l	0.020						

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800753 - SW846 3510C</b>										
<b><u>Blank (1800753-BLK1)</u></b>	<b><u>Prepared: 19-Jan-18 Analyzed: 20-Jan-18</u></b>									
delta-BHC [2C]	< 0.020	U	µg/l	0.020						
gamma-BHC (Lindane)	< 0.020	U	µg/l	0.020						
gamma-BHC (Lindane) [2C]	< 0.020	U	µg/l	0.020						
Heptachlor	< 0.020	U	µg/l	0.020						
Heptachlor [2C]	< 0.020	U	µg/l	0.020						
Aldrin	< 0.020	U	µg/l	0.020						
Aldrin [2C]	< 0.020	U	µg/l	0.020						
Heptachlor epoxide	< 0.020	U	µg/l	0.020						
Heptachlor epoxide [2C]	< 0.020	U	µg/l	0.020						
Endosulfan I	< 0.020	U	µg/l	0.020						
Endosulfan I [2C]	< 0.020	U	µg/l	0.020						
Dieldrin	< 0.020	U	µg/l	0.020						
Dieldrin [2C]	< 0.020	U	µg/l	0.020						
4,4'-DDE (p,p')	< 0.020	U	µg/l	0.020						
4,4'-DDE (p,p') [2C]	< 0.020	U	µg/l	0.020						
Endrin	< 0.041	U	µg/l	0.041						
Endrin [2C]	< 0.041	U	µg/l	0.041						
Endosulfan II	< 0.041	U	µg/l	0.041						
Endosulfan II [2C]	< 0.041	U	µg/l	0.041						
4,4'-DDD (p,p')	< 0.041	U	µg/l	0.041						
4,4'-DDD (p,p') [2C]	< 0.041	U	µg/l	0.041						
Endosulfan sulfate	< 0.041	U	µg/l	0.041						
Endosulfan sulfate [2C]	< 0.041	U	µg/l	0.041						
4,4'-DDT (p,p')	< 0.041	U	µg/l	0.041						
4,4'-DDT (p,p') [2C]	< 0.041	U	µg/l	0.041						
Methoxychlor	< 0.041	U	µg/l	0.041						
Methoxychlor [2C]	< 0.041	U	µg/l	0.041						
Endrin ketone	< 0.041	U	µg/l	0.041						
Endrin ketone [2C]	< 0.041	U	µg/l	0.041						
Endrin aldehyde	< 0.041	U	µg/l	0.041						
Endrin aldehyde [2C]	< 0.041	U	µg/l	0.041						
alpha-Chlordane	< 0.020	U	µg/l	0.020						
alpha-Chlordane [2C]	< 0.020	U	µg/l	0.020						
Chlordane (gamma)(trans)	< 0.020	U	µg/l	0.020						
Chlordane (gamma)(trans) [2C]	< 0.020	U	µg/l	0.020						
Toxaphene	< 0.510	U	µg/l	0.510						
Toxaphene [2C]	< 0.510	U	µg/l	0.510						
Chlordane	< 0.066	U	µg/l	0.066						
Chlordane [2C]	< 0.066	U	µg/l	0.066						
Alachlor	< 0.020	U	µg/l	0.020						
Alachlor [2C]	< 0.020	U	µg/l	0.020						
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Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.148		µg/l		0.204		73	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.151		µg/l		0.204		74	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.177		µg/l		0.204		87	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.188		µg/l		0.204		92	30-150		
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<b><u>LCS (1800753-BS1)</u></b>	<b><u>Prepared: 19-Jan-18 Analyzed: 20-Jan-18</u></b>									
alpha-BHC	0.375		µg/l	0.020	0.510		74	40-140		
alpha-BHC [2C]	0.370		µg/l	0.020	0.510		73	40-140		
beta-BHC	0.356		µg/l	0.020	0.510		70	40-140		

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 8081B</u></b>										
<b>Batch 1800753 - SW846 3510C</b>										
<b><u>LCS (1800753-BS1)</u></b>					<u>Prepared: 19-Jan-18 Analyzed: 20-Jan-18</u>					
beta-BHC [2C]	0.361		µg/l	0.020	0.510		71	40-140		
delta-BHC	0.363		µg/l	0.020	0.510		71	40-140		
delta-BHC [2C]	0.380		µg/l	0.020	0.510		75	40-140		
gamma-BHC (Lindane)	0.382		µg/l	0.020	0.510		75	40-140		
gamma-BHC (Lindane) [2C]	0.380		µg/l	0.020	0.510		74	40-140		
Heptachlor	0.357		µg/l	0.020	0.510		70	40-140		
Heptachlor [2C]	0.377		µg/l	0.020	0.510		74	40-140		
Aldrin	0.358		µg/l	0.020	0.510		70	40-140		
Aldrin [2C]	0.371		µg/l	0.020	0.510		73	40-140		
Heptachlor epoxide	0.343		µg/l	0.020	0.510		67	40-140		
Heptachlor epoxide [2C]	0.366		µg/l	0.020	0.510		72	40-140		
Endosulfan I	0.368		µg/l	0.020	0.510		72	40-140		
Endosulfan I [2C]	0.398		µg/l	0.020	0.510		78	40-140		
Dieldrin	0.342		µg/l	0.020	0.510		67	40-140		
Dieldrin [2C]	0.373		µg/l	0.020	0.510		73	40-140		
4,4'-DDE (p,p')	0.344		µg/l	0.020	0.510		67	40-140		
4,4'-DDE (p,p') [2C]	0.374		µg/l	0.020	0.510		73	40-140		
Endrin	0.390		µg/l	0.041	0.510		77	40-140		
Endrin [2C]	0.466		µg/l	0.041	0.510		91	40-140		
Endosulfan II	0.331		µg/l	0.041	0.510		65	40-140		
Endosulfan II [2C]	0.370		µg/l	0.041	0.510		72	40-140		
4,4'-DDD (p,p')	0.348		µg/l	0.041	0.510		68	40-140		
4,4'-DDD (p,p') [2C]	0.373		µg/l	0.041	0.510		73	40-140		
Endosulfan sulfate	0.347		µg/l	0.041	0.510		68	40-140		
Endosulfan sulfate [2C]	0.372		µg/l	0.041	0.510		73	40-140		
4,4'-DDT (p,p')	0.386		µg/l	0.041	0.510		76	40-140		
4,4'-DDT (p,p') [2C]	0.426		µg/l	0.041	0.510		83	40-140		
Methoxychlor	0.356		µg/l	0.041	0.510		70	40-140		
Methoxychlor [2C]	0.407		µg/l	0.041	0.510		80	40-140		
Endrin ketone	0.300		µg/l	0.041	0.510		59	40-140		
Endrin ketone [2C]	0.336		µg/l	0.041	0.510		66	40-140		
Endrin aldehyde	0.353		µg/l	0.041	0.510		69	40-140		
Endrin aldehyde [2C]	0.393		µg/l	0.041	0.510		77	40-140		
alpha-Chlordane	0.346		µg/l	0.020	0.510		68	40-140		
alpha-Chlordane [2C]	0.367		µg/l	0.020	0.510		72	40-140		
Chlordane (gamma)(trans)	0.346		µg/l	0.020	0.510		68	40-140		
Chlordane (gamma)(trans) [2C]	0.373		µg/l	0.020	0.510		73	40-140		
Alachlor	0.402		µg/l	0.020	0.510		79	40-140		
Alachlor [2C]	0.434		µg/l	0.020	0.510		85	40-140		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.143		µg/l		0.204		70	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.144		µg/l		0.204		70	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.157		µg/l		0.204		77	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.185		µg/l		0.204		91	30-150		
<b><u>LCS Dup (1800753-BSD1)</u></b>					<u>Prepared: 19-Jan-18 Analyzed: 20-Jan-18</u>					
alpha-BHC	0.437		µg/l	0.020	0.510		86	40-140	15	20
alpha-BHC [2C]	0.429		µg/l	0.020	0.510		84	40-140	15	20
beta-BHC	0.408		µg/l	0.020	0.510		80	40-140	14	20
beta-BHC [2C]	0.411		µg/l	0.020	0.510		81	40-140	13	20
delta-BHC	0.420		µg/l	0.020	0.510		82	40-140	14	20

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# Pesticides - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 8081B</b>										
<b>Batch 1800753 - SW846 3510C</b>										
<b>LCS Dup (1800753-BSD1)</b>					Prepared: 19-Jan-18 Analyzed: 20-Jan-18					
delta-BHC [2C]	0.436		µg/l	0.020	0.510		86	40-140	14	20
gamma-BHC (Lindane)	0.445		µg/l	0.020	0.510		87	40-140	15	20
gamma-BHC (Lindane) [2C]	0.438		µg/l	0.020	0.510		86	40-140	14	20
Heptachlor	0.413		µg/l	0.020	0.510		81	40-140	14	20
Heptachlor [2C]	0.434		µg/l	0.020	0.510		85	40-140	14	20
Aldrin	0.415		µg/l	0.020	0.510		81	40-140	15	20
Aldrin [2C]	0.426		µg/l	0.020	0.510		83	40-140	14	20
Heptachlor epoxide	0.393		µg/l	0.020	0.510		77	40-140	14	20
Heptachlor epoxide [2C]	0.418		µg/l	0.020	0.510		82	40-140	13	20
Endosulfan I	0.423		µg/l	0.020	0.510		83	40-140	14	20
Endosulfan I [2C]	0.454		µg/l	0.020	0.510		89	40-140	13	20
Dieldrin	0.393		µg/l	0.020	0.510		77	40-140	14	20
Dieldrin [2C]	0.428		µg/l	0.020	0.510		84	40-140	14	20
4,4'-DDE (p,p')	0.396		µg/l	0.020	0.510		78	40-140	14	20
4,4'-DDE (p,p') [2C]	0.429		µg/l	0.020	0.510		84	40-140	14	20
Endrin	0.453		µg/l	0.041	0.510		89	40-140	15	20
Endrin [2C]	0.537		µg/l	0.041	0.510		105	40-140	14	20
Endosulfan II	0.381		µg/l	0.041	0.510		75	40-140	14	20
Endosulfan II [2C]	0.425		µg/l	0.041	0.510		83	40-140	14	20
4,4'-DDD (p,p')	0.401		µg/l	0.041	0.510		79	40-140	14	20
4,4'-DDD (p,p') [2C]	0.431		µg/l	0.041	0.510		85	40-140	14	20
Endosulfan sulfate	0.400		µg/l	0.041	0.510		78	40-140	14	20
Endosulfan sulfate [2C]	0.429		µg/l	0.041	0.510		84	40-140	14	20
4,4'-DDT (p,p')	0.444		µg/l	0.041	0.510		87	40-140	14	20
4,4'-DDT (p,p') [2C]	0.495		µg/l	0.041	0.510		97	40-140	15	20
Methoxychlor	0.412		µg/l	0.041	0.510		81	40-140	15	20
Methoxychlor [2C]	0.461		µg/l	0.041	0.510		90	40-140	12	20
Endrin ketone	0.348		µg/l	0.041	0.510		68	40-140	15	20
Endrin ketone [2C]	0.388		µg/l	0.041	0.510		76	40-140	14	20
Endrin aldehyde	0.407		µg/l	0.041	0.510		80	40-140	14	20
Endrin aldehyde [2C]	0.451		µg/l	0.041	0.510		88	40-140	14	20
alpha-Chlordane	0.396		µg/l	0.020	0.510		78	40-140	14	20
alpha-Chlordane [2C]	0.419		µg/l	0.020	0.510		82	40-140	13	20
Chlordane (gamma)(trans)	0.397		µg/l	0.020	0.510		78	40-140	14	20
Chlordane (gamma)(trans) [2C]	0.426		µg/l	0.020	0.510		84	40-140	13	20
Alachlor	0.458		µg/l	0.020	0.510		90	40-140	13	20
Alachlor [2C]	0.491		µg/l	0.020	0.510		96	40-140	12	20
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr)	0.154		µg/l		0.204		76	30-150		
Surrogate: 4,4-DB-Octafluorobiphenyl (Sr) [2C]	0.155		µg/l		0.204		76	30-150		
Surrogate: Decachlorobiphenyl (Sr)	0.172		µg/l		0.204		84	30-150		
Surrogate: Decachlorobiphenyl (Sr) [2C]	0.201		µg/l		0.204		99	30-150		

# Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1800619 - SW846 3005A</b>										
<b><u>Blank (1800619-BLK1)</u></b>					<u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u>					
Manganese	< 0.0020	U	mg/l	0.0020						
Sodium	<b>0.0618</b>	J	mg/l	0.250						
Cobalt	< 0.0050	U	mg/l	0.0050						
Cadmium	< 0.0025	U	mg/l	0.0025						
Calcium	<b>0.0176</b>	J	mg/l	0.100						
Selenium	< 0.0150	U	mg/l	0.0150						
Antimony	< 0.0060	U	mg/l	0.0060						
Beryllium	< 0.0020	U	mg/l	0.0020						
Barium	< 0.0050	U	mg/l	0.0050						
Zinc	<b>0.0040</b>	J	mg/l	0.0050						
Chromium	< 0.0050	U	mg/l	0.0050						
Vanadium	< 0.0050	U	mg/l	0.0050						
Thallium	< 0.0050	U	mg/l	0.0050						
Copper	< 0.0050	U	mg/l	0.0050						
Magnesium	< 0.0100	U	mg/l	0.0100						
Aluminum	< 0.0250	U	mg/l	0.0250						
Silver	< 0.0050	U	mg/l	0.0050						
Lead	< 0.0075	U	mg/l	0.0075						
Nickel	< 0.0050	U	mg/l	0.0050						
Arsenic	< 0.0040	U	mg/l	0.0040						
<b><u>LCS (1800619-BS1)</u></b>					<u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u>					
Sodium	<b>5.88</b>		mg/l	0.250	6.25		94	85-115		
Manganese	<b>1.28</b>		mg/l	0.0020	1.25		103	85-115		
Copper	<b>1.27</b>		mg/l	0.0050	1.25		102	85-115		
Thallium	<b>1.28</b>		mg/l	0.0050	1.25		103	85-115		
Selenium	<b>1.24</b>		mg/l	0.0150	1.25		100	85-115		
Antimony	<b>1.19</b>		mg/l	0.0060	1.25		95	85-115		
Lead	<b>1.25</b>		mg/l	0.0075	1.25		100	85-115		
Zinc	<b>1.29</b>		mg/l	0.0050	1.25		103	85-115		
Silver	<b>1.29</b>		mg/l	0.0050	1.25		103	85-115		
Magnesium	<b>1.27</b>		mg/l	0.0100	1.25		102	85-115		
Vanadium	<b>1.20</b>		mg/l	0.0050	1.25		96	85-115		
Chromium	<b>1.31</b>		mg/l	0.0050	1.25		105	85-115		
Cobalt	<b>1.21</b>		mg/l	0.0050	1.25		97	85-115		
Cadmium	<b>1.24</b>		mg/l	0.0025	1.25		99	85-115		
Calcium	<b>6.62</b>		mg/l	0.100	6.25		106	85-115		
Beryllium	<b>1.44</b>		mg/l	0.0020	1.25		115	85-115		
Barium	<b>1.27</b>		mg/l	0.0050	1.25		101	85-115		
Arsenic	<b>1.22</b>		mg/l	0.0040	1.25		98	85-115		
Aluminum	<b>1.25</b>		mg/l	0.0250	1.25		100	85-115		
Nickel	<b>1.24</b>		mg/l	0.0050	1.25		99	85-115		
<b><u>LCS Dup (1800619-BSD1)</u></b>					<u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u>					
Manganese	<b>1.34</b>		mg/l	0.0020	1.25		107	85-115	5	20
Sodium	<b>5.97</b>		mg/l	0.250	6.25		96	85-115	1	20
Selenium	<b>1.27</b>		mg/l	0.0150	1.25		102	85-115	2	20
Zinc	<b>1.34</b>		mg/l	0.0050	1.25		107	85-115	4	20
Arsenic	<b>1.25</b>		mg/l	0.0040	1.25		100	85-115	2	20
Copper	<b>1.30</b>		mg/l	0.0050	1.25		104	85-115	2	20
Chromium	<b>1.35</b>		mg/l	0.0050	1.25		108	85-115	3	20
Cobalt	<b>1.24</b>		mg/l	0.0050	1.25		99	85-115	3	20

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# Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 6010C</b>										
<b>Batch 1800619 - SW846 3005A</b>										
<b><u>LCS Dup (1800619-BSD1)</u></b>					<b><u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u></b>					
Cadmium	1.28		mg/l	0.0025	1.25		102	85-115	3	20
Calcium	6.88		mg/l	0.100	6.25		110	85-115	4	20
Beryllium	1.52	QC2	mg/l	0.0020	1.25		122	85-115	6	20
Vanadium	1.22		mg/l	0.0050	1.25		98	85-115	2	20
Barium	1.28		mg/l	0.0050	1.25		102	85-115	1	20
Thallium	1.30		mg/l	0.0050	1.25		104	85-115	1	20
Aluminum	1.20		mg/l	0.0250	1.25		96	85-115	4	20
Silver	1.30		mg/l	0.0050	1.25		104	85-115	0.7	20
Magnesium	1.29		mg/l	0.0100	1.25		103	85-115	1	20
Nickel	1.27		mg/l	0.0050	1.25		101	85-115	2	20
Lead	1.28		mg/l	0.0075	1.25		102	85-115	2	20
Antimony	1.20		mg/l	0.0060	1.25		96	85-115	1	20
<b><u>Duplicate (1800619-DUP1)</u></b>					<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u></b>			
Sodium	96.4		mg/l	0.250		94.6			2	20
Manganese	2.13		mg/l	0.0020		2.11			0.7	20
Cadmium	< 0.0025	U	mg/l	0.0025		BRL				20
Magnesium	4.70		mg/l	0.0100		4.58			3	20
Silver	< 0.0050	U	mg/l	0.0050		BRL				20
Aluminum	0.0138	J	mg/l	0.0250		0.0113			20	20
Barium	0.0403		mg/l	0.0050		0.0394			2	20
Calcium	26.0		mg/l	0.100		25.5			2	20
Beryllium	< 0.0020	U	mg/l	0.0020		BRL				20
Chromium	< 0.0050	U	mg/l	0.0050		BRL				20
Copper	< 0.0050	U	mg/l	0.0050		BRL				20
Zinc	0.0018	J	mg/l	0.0050		0.0016			14	20
Nickel	0.0035	J	mg/l	0.0050		0.0038			10	20
Lead	< 0.0075	U	mg/l	0.0075		BRL				20
Antimony	< 0.0060	U	mg/l	0.0060		BRL				20
Selenium	< 0.0150	U	mg/l	0.0150		BRL				20
Thallium	< 0.0050	U	mg/l	0.0050		BRL				20
Vanadium	< 0.0050	U	mg/l	0.0050		BRL				20
Cobalt	0.0041	J	mg/l	0.0050		0.0041			0	20
Arsenic	0.0034	QR8, J	mg/l	0.0040		0.0016			71	20
<b><u>Matrix Spike (1800619-MS1)</u></b>					<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u></b>			
Sodium	100		mg/l	0.250	6.25	94.6	90	75-125		
Manganese	3.19		mg/l	0.0020	1.25	2.11	86	75-125		
Cadmium	1.18		mg/l	0.0025	1.25	BRL	94	75-125		
Selenium	1.20		mg/l	0.0150	1.25	BRL	96	75-125		
Copper	1.21		mg/l	0.0050	1.25	BRL	97	75-125		
Lead	1.15		mg/l	0.0075	1.25	BRL	92	75-125		
Nickel	1.15		mg/l	0.0050	1.25	0.0038	92	75-125		
Magnesium	5.79		mg/l	0.0100	1.25	4.58	97	75-125		
Thallium	1.20		mg/l	0.0050	1.25	BRL	96	75-125		
Cobalt	1.12		mg/l	0.0050	1.25	0.0041	90	75-125		
Antimony	1.13		mg/l	0.0060	1.25	BRL	91	75-125		
Calcium	31.4		mg/l	0.100	6.25	25.5	94	75-125		
Beryllium	1.42		mg/l	0.0020	1.25	BRL	113	75-125		
Barium	1.26		mg/l	0.0050	1.25	0.0394	97	75-125		
Arsenic	1.20		mg/l	0.0040	1.25	0.0016	96	75-125		
Aluminum	1.19		mg/l	0.0250	1.25	0.0113	95	75-125		

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# Total Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1800619 - SW846 3005A</b>										
<b><u>Matrix Spike (1800619-MS1)</u></b>			<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u></b>					
Silver	1.26		mg/l	0.0050	1.25	BRL	101	75-125		
Chromium	1.26		mg/l	0.0050	1.25	BRL	101	75-125		
Zinc	1.24		mg/l	0.0050	1.25	0.0016	99	75-125		
Vanadium	1.17		mg/l	0.0050	1.25	BRL	93	70-130		
<b><u>Matrix Spike Dup (1800619-MSD1)</u></b>			<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u></b>					
Sodium	102		mg/l	0.250	6.25	94.6	116	75-125	2	20
Manganese	3.34		mg/l	0.0020	1.25	2.11	98	75-125	5	20
Antimony	1.18		mg/l	0.0060	1.25	BRL	94	75-125	4	20
Selenium	1.25		mg/l	0.0150	1.25	BRL	100	75-125	4	20
Chromium	1.29		mg/l	0.0050	1.25	BRL	103	75-125	2	20
Magnesium	5.88		mg/l	0.0100	1.25	4.58	104	75-125	1	20
Cobalt	1.18		mg/l	0.0050	1.25	0.0041	94	75-125	5	20
Cadmium	1.23		mg/l	0.0025	1.25	BRL	98	75-125	4	20
Calcium	32.2		mg/l	0.100	6.25	25.5	108	75-125	3	20
Beryllium	1.48		mg/l	0.0020	1.25	BRL	118	75-125	4	20
Barium	1.28		mg/l	0.0050	1.25	0.0394	99	75-125	2	20
Arsenic	1.24		mg/l	0.0040	1.25	0.0016	99	75-125	4	20
Thallium	1.23		mg/l	0.0050	1.25	BRL	98	75-125	2	20
Copper	1.26		mg/l	0.0050	1.25	BRL	101	75-125	4	20
Vanadium	1.19		mg/l	0.0050	1.25	BRL	95	70-130	2	20
Aluminum	1.21		mg/l	0.0250	1.25	0.0113	96	75-125	1	20
Lead	1.19		mg/l	0.0075	1.25	BRL	95	75-125	4	20
Silver	1.26		mg/l	0.0050	1.25	BRL	101	75-125	0.04	20
Zinc	1.28		mg/l	0.0050	1.25	0.0016	102	75-125	3	20
Nickel	1.20		mg/l	0.0050	1.25	0.0038	95	75-125	4	20
<b><u>Post Spike (1800619-PS1)</u></b>			<b><u>Source: SC43112-03</u></b>		<b><u>Prepared: 18-Jan-18 Analyzed: 24-Jan-18</u></b>					
Sodium	94.0	QM9	mg/l	0.250	6.25	94.6	-10	80-120		
Manganese	3.19		mg/l	0.0020	1.25	2.11	86	80-120		
Beryllium	1.47		mg/l	0.0020	1.25	BRL	118	80-120		
Cadmium	1.22		mg/l	0.0025	1.25	BRL	98	80-120		
Cobalt	1.17		mg/l	0.0050	1.25	0.0041	94	80-120		
Chromium	1.28		mg/l	0.0050	1.25	BRL	103	80-120		
Copper	1.27		mg/l	0.0050	1.25	BRL	101	80-120		
Magnesium	5.48	QM9	mg/l	0.0100	1.25	4.58	72	80-120		
Lead	1.20		mg/l	0.0075	1.25	BRL	96	80-120		
Barium	1.26		mg/l	0.0050	1.25	0.0394	98	80-120		
Vanadium	1.18		mg/l	0.0050	1.25	BRL	94	80-120		
Thallium	1.23		mg/l	0.0050	1.25	BRL	98	80-120		
Selenium	1.25		mg/l	0.0150	1.25	BRL	100	80-120		
Antimony	1.19		mg/l	0.0060	1.25	BRL	95	80-120		
Nickel	1.19		mg/l	0.0050	1.25	0.0038	95	80-120		
Aluminum	1.23		mg/l	0.0250	1.25	0.0113	98	80-120		
Silver	1.27		mg/l	0.0050	1.25	BRL	102	80-120		
Calcium	30.1	QM9	mg/l	0.100	6.25	25.5	74	80-120		
Arsenic	1.24		mg/l	0.0040	1.25	0.0016	99	80-120		
Zinc	1.27		mg/l	0.0050	1.25	0.0016	102	80-120		
<b>Batch 1801089 - SW846 3005A</b>										
<b><u>Blank (1801089-BLK1)</u></b>			<b><u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u></b>							
Potassium	0.165	J	mg/l	0.500						
<b><u>LCS (1801089-BS1)</u></b>			<b><u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u></b>							

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**Total Metals by EPA 6000/7000 Series Methods - Quality Control**

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1801089 - SW846 3005A</b>										
<b><u>LCS (1801089-BS1)</u></b>								<u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u>		
Potassium	12.7		mg/l	0.500	12.5		101	85-115		
<b><u>LCS Dup (1801089-BSD1)</u></b>								<u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u>		
Potassium	12.7		mg/l	0.500	12.5		102	85-115	0.6	20
<b><u>Duplicate (1801089-DUP1)</u></b>								<u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u>		
Potassium	3.63		mg/l	0.500		3.52			3	20
<b><u>Matrix Spike (1801089-MS1)</u></b>								<u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u>		
Potassium	16.2		mg/l	0.500	12.5	3.52	101	75-125		
<b><u>Matrix Spike Dup (1801089-MSD1)</u></b>								<u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u>		
Potassium	16.2		mg/l	0.500	12.5	3.52	101	75-125	0.2	20
<b><u>Post Spike (1801089-PS1)</u></b>								<u>Prepared: 18-Jan-18 Analyzed: 25-Jan-18</u>		
Potassium	16.1		mg/l	0.500	12.5	3.52	100	80-120		
<b>Batch 1801155 - SW846 3005A</b>										
<b><u>Blank (1801155-BLK1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	< 0.0300	U	mg/l	0.0300						
<b><u>LCS (1801155-BS1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	2.69		mg/l	0.0300	2.50		107	85-115		
<b><u>LCS Dup (1801155-BSD1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	2.66		mg/l	0.0300	2.50		107	85-115	0.8	20
<b><u>Duplicate (1801155-DUP1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	0.303		mg/l	0.0300		0.296			3	20
<b><u>Matrix Spike (1801155-MS1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	2.98		mg/l	0.0300	2.50	0.296	107	75-125		
<b><u>Matrix Spike Dup (1801155-MSD1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	2.96		mg/l	0.0300	2.50	0.296	107	75-125	0.5	20
<b><u>Post Spike (1801155-PS1)</u></b>								<u>Prepared: 26-Jan-18 Analyzed: 28-Jan-18</u>		
Iron	2.99		mg/l	0.0300	2.50	0.296	108	80-120		

# **Total Metals by EPA 200 Series Methods - Quality Control**

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>EPA 245.1/7470A</u></b>										
<b>Batch 1800620 - EPA200/SW7000 Series</b>										
<b><u>Blank (1800620-BLK1)</u></b>	<u>Prepared: 18-Jan-18 Analyzed: 23-Jan-18</u>									
Mercury	< 0.00020	U	mg/l	0.00020						
<b><u>LCS (1800620-BS1)</u></b>	<u>Prepared: 18-Jan-18 Analyzed: 23-Jan-18</u>									
Mercury	<b>0.00446</b>		mg/l	0.00020	0.00500		89	85-115		
<b><u>Duplicate (1800620-DUP1)</u></b>	<u>Source: SC43112-03 Prepared: 18-Jan-18 Analyzed: 23-Jan-18</u>									
Mercury	< 0.00020	U	mg/l	0.00020		BRL				20
<b><u>Matrix Spike (1800620-MS1)</u></b>	<u>Source: SC43112-03 Prepared: 18-Jan-18 Analyzed: 23-Jan-18</u>									
Mercury	<b>0.00471</b>		mg/l	0.00020	0.00500	BRL	94	80-120		
<b><u>Matrix Spike Dup (1800620-MSD1)</u></b>	<u>Source: SC43112-03 Prepared: 18-Jan-18 Analyzed: 23-Jan-18</u>									
Mercury	<b>0.00474</b>		mg/l	0.00020	0.00500	BRL	95	80-120	0.5	20
<b><u>Post Spike (1800620-PS1)</u></b>	<u>Source: SC43112-03 Prepared: 18-Jan-18 Analyzed: 23-Jan-18</u>									
Mercury	<b>0.00429</b>		mg/l	0.00020	0.00500	BRL	86	85-115		

**Soluble Metals by EPA 6000/7000 Series Methods - Quality Control**

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1800621 - SW846 3005A</b>										
<b><u>Blank (1800621-BLK1)</u></b>					<u>Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u>					
Manganese	< 0.0020	U	mg/l	0.0020						
Iron	<b>0.0071</b>	J	mg/l	0.0150						
Zinc	< 0.0050	U	mg/l	0.0050						
Vanadium	< 0.0050	U	mg/l	0.0050						
Thallium	< 0.0050	U	mg/l	0.0050						
Calcium	< 0.100	U	mg/l	0.100						
Magnesium	< 0.0100	U	mg/l	0.0100						
Copper	< 0.0050	U	mg/l	0.0050						
Chromium	< 0.0050	U	mg/l	0.0050						
Cadmium	< 0.0025	U	mg/l	0.0025						
Arsenic	<b>0.0015</b>	J	mg/l	0.0040						
Aluminum	< 0.0250	U	mg/l	0.0250						
Lead	< 0.0075	U	mg/l	0.0075						
Silver	< 0.0050	U	mg/l	0.0050						
Nickel	< 0.0050	U	mg/l	0.0050						
Beryllium	< 0.0020	U	mg/l	0.0020						
Barium	< 0.0050	U	mg/l	0.0050						
<b><u>LCS (1800621-BS1)</u></b>					<u>Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u>					
Iron	<b>1.38</b>		mg/l	0.0150	1.25		110	85-115		
Manganese	<b>1.38</b>		mg/l	0.0020	1.25		110	85-115		
Calcium	<b>7.01</b>		mg/l	0.100	6.25		112	85-115		
Beryllium	<b>1.64</b>	QC2	mg/l	0.0020	1.25		131	85-115		
Barium	<b>1.31</b>		mg/l	0.0050	1.25		105	85-115		
Aluminum	<b>1.30</b>		mg/l	0.0250	1.25		104	85-115		
Arsenic	<b>1.31</b>		mg/l	0.0040	1.25		105	85-115		
Silver	<b>1.42</b>		mg/l	0.0050	1.25		114	85-115		
Zinc	<b>1.39</b>		mg/l	0.0050	1.25		111	85-115		
Vanadium	<b>1.27</b>		mg/l	0.0050	1.25		101	85-115		
Thallium	<b>1.37</b>		mg/l	0.0050	1.25		110	85-115		
Nickel	<b>1.30</b>		mg/l	0.0050	1.25		104	85-115		
Magnesium	<b>1.31</b>		mg/l	0.0100	1.25		105	85-115		
Copper	<b>1.37</b>		mg/l	0.0050	1.25		110	85-115		
Chromium	<b>1.42</b>		mg/l	0.0050	1.25		114	85-115		
Cadmium	<b>1.30</b>		mg/l	0.0025	1.25		104	85-115		
Lead	<b>1.33</b>		mg/l	0.0075	1.25		106	85-115		
<b><u>LCS Dup (1800621-BSD1)</u></b>					<u>Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u>					
Iron	<b>1.37</b>		mg/l	0.0150	1.25		109	85-115	0.7	20
Manganese	<b>1.35</b>		mg/l	0.0020	1.25		108	85-115	2	20
Chromium	<b>1.42</b>		mg/l	0.0050	1.25		113	85-115	0.6	20
Thallium	<b>1.36</b>		mg/l	0.0050	1.25		109	85-115	0.5	20
Vanadium	<b>1.25</b>		mg/l	0.0050	1.25		100	85-115	1	20
Lead	<b>1.30</b>		mg/l	0.0075	1.25		104	85-115	2	20
Nickel	<b>1.27</b>		mg/l	0.0050	1.25		102	85-115	2	20
Zinc	<b>1.37</b>		mg/l	0.0050	1.25		110	85-115	1	20
Copper	<b>1.34</b>		mg/l	0.0050	1.25		107	85-115	3	20
Cadmium	<b>1.27</b>		mg/l	0.0025	1.25		102	85-115	2	20
Calcium	<b>6.92</b>		mg/l	0.100	6.25		111	85-115	1	20
Beryllium	<b>1.62</b>	QC2	mg/l	0.0020	1.25		129	85-115	1	20
Barium	<b>1.29</b>		mg/l	0.0050	1.25		103	85-115	2	20
Arsenic	<b>1.28</b>		mg/l	0.0040	1.25		102	85-115	3	20

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# Soluble Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 6010C</b>										
<b>Batch 1800621 - SW846 3005A</b>										
<b><u>LCS Dup (1800621-BS1)</u></b>					<b><u>Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u></b>					
Aluminum	1.28		mg/l	0.0250	1.25		102	85-115	1	20
Silver	1.43		mg/l	0.0050	1.25		114	85-115	0.2	20
Magnesium	1.29		mg/l	0.0100	1.25		103	85-115	1	20
<b><u>Duplicate (1800621-DUP1)</u></b>					<b><u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u></b>					
Manganese	2.03		mg/l	0.0020		2.06			1	20
Iron	0.250	QR6	mg/l	0.0150		0.331			28	20
Vanadium	< 0.0050	U	mg/l	0.0050		BRL				20
Silver	< 0.0050	U	mg/l	0.0050		BRL				20
Zinc	0.0028	QR8, J	mg/l	0.0050		0.0039			31	20
Barium	0.0404		mg/l	0.0050		0.0423			5	20
Arsenic	< 0.0040	U	mg/l	0.0040		BRL				20
Aluminum	< 0.0250	U	mg/l	0.0250		BRL				20
Beryllium	< 0.0020	U	mg/l	0.0020		BRL				20
Calcium	26.0		mg/l	0.100		26.7			3	20
Cadmium	< 0.0025	U	mg/l	0.0025		BRL				20
Chromium	< 0.0050	U	mg/l	0.0050		BRL				20
Copper	0.0026	J	mg/l	0.0050		0.0026			0	20
Magnesium	4.65		mg/l	0.0100		4.84			4	20
Nickel	0.0036	J	mg/l	0.0050		0.0040			12	20
Lead	< 0.0075	U	mg/l	0.0075		BRL				20
Thallium	< 0.0050	U	mg/l	0.0050		BRL				20
<b><u>Matrix Spike (1800621-MS1)</u></b>					<b><u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u></b>					
Iron	1.60		mg/l	0.0150	1.25	0.331	102	75-125		
Manganese	3.16		mg/l	0.0020	1.25	2.06	88	75-125		
Zinc	1.32		mg/l	0.0050	1.25	0.0039	106	75-125		
Barium	1.28		mg/l	0.0050	1.25	0.0423	99	75-125		
Beryllium	1.57	QC2	mg/l	0.0020	1.25	BRL	126	75-125		
Calcium	31.7		mg/l	0.100	6.25	26.7	80	75-125		
Cadmium	1.22		mg/l	0.0025	1.25	BRL	97	75-125		
Aluminum	1.25		mg/l	0.0250	1.25	BRL	100	75-125		
Copper	1.29		mg/l	0.0050	1.25	0.0026	103	75-125		
Arsenic	1.28		mg/l	0.0040	1.25	BRL	102	75-125		
Vanadium	1.23		mg/l	0.0050	1.25	BRL	98	75-125		
Thallium	1.29		mg/l	0.0050	1.25	BRL	103	75-125		
Lead	1.21		mg/l	0.0075	1.25	BRL	97	75-125		
Nickel	1.19		mg/l	0.0050	1.25	0.0040	95	75-125		
Magnesium	5.76	QM7	mg/l	0.0100	1.25	4.84	74	75-125		
Chromium	1.37		mg/l	0.0050	1.25	BRL	109	75-125		
Silver	1.42		mg/l	0.0050	1.25	BRL	114	75-125		
<b><u>Matrix Spike Dup (1800621-MSD1)</u></b>					<b><u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 24-Jan-18</u></b>					
Manganese	3.24		mg/l	0.0020	1.25	2.06	95	75-125	3	20
Iron	1.54		mg/l	0.0150	1.25	0.331	97	75-125	4	20
Beryllium	1.59	QC2	mg/l	0.0020	1.25	BRL	128	75-125	1	20
Thallium	1.31		mg/l	0.0050	1.25	BRL	105	75-125	1	20
Lead	1.23		mg/l	0.0075	1.25	BRL	98	75-125	2	20
Nickel	1.21		mg/l	0.0050	1.25	0.0040	97	75-125	1	20
Magnesium	5.90		mg/l	0.0100	1.25	4.84	85	75-125	2	20
Copper	1.32		mg/l	0.0050	1.25	0.0026	105	75-125	2	20
Chromium	1.38		mg/l	0.0050	1.25	BRL	111	75-125	1	20
Cadmium	1.24		mg/l	0.0025	1.25	BRL	99	75-125	2	20

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# Soluble Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>SW846 6010C</b>										
<b>Batch 1800621 - SW846 3005A</b>										
<b>Matrix Spike Dup (1800621-MSD1)</b>				<b>Source: SC43112-03</b>		<b>Prepared: 17-Jan-18 Analyzed: 24-Jan-18</b>				
Calcium	32.5		mg/l	0.100	6.25	26.7	93	75-125	3	20
Vanadium	1.24		mg/l	0.0050	1.25	BRL	99	75-125	1	20
Barium	1.30		mg/l	0.0050	1.25	0.0423	101	75-125	2	20
Arsenic	1.30		mg/l	0.0040	1.25	BRL	104	75-125	2	20
Aluminum	1.27		mg/l	0.0250	1.25	BRL	102	75-125	2	20
Silver	1.43		mg/l	0.0050	1.25	BRL	115	75-125	0.9	20
Zinc	1.34		mg/l	0.0050	1.25	0.0039	107	75-125	1	20
<b>Post Spike (1800621-PS1)</b>				<b>Source: SC43112-03</b>		<b>Prepared: 17-Jan-18 Analyzed: 24-Jan-18</b>				
Manganese	3.31		mg/l	0.0020	1.25	2.06	100	80-120		
Iron	1.46		mg/l	0.0150	1.25	0.331	90	80-120		
Arsenic	1.19		mg/l	0.0040	1.25	BRL	95	80-120		
Lead	1.13		mg/l	0.0075	1.25	BRL	90	80-120		
Nickel	1.11		mg/l	0.0050	1.25	0.0040	88	80-120		
Magnesium	5.70	QM9	mg/l	0.0100	1.25	4.84	68	80-120		
Copper	1.21		mg/l	0.0050	1.25	0.0026	97	80-120		
Chromium	1.26		mg/l	0.0050	1.25	BRL	101	80-120		
Thallium	1.19		mg/l	0.0050	1.25	BRL	95	80-120		
Calcium	31.6	QM9	mg/l	0.100	6.25	26.7	78	80-120		
Silver	1.30		mg/l	0.0050	1.25	BRL	104	80-120		
Zinc	1.22		mg/l	0.0050	1.25	0.0039	97	80-120		
Aluminum	1.16		mg/l	0.0250	1.25	BRL	93	80-120		
Vanadium	1.12		mg/l	0.0050	1.25	BRL	90	80-120		
Barium	1.18		mg/l	0.0050	1.25	0.0423	91	80-120		
Beryllium	1.47		mg/l	0.0020	1.25	BRL	118	80-120		
Cadmium	1.13		mg/l	0.0025	1.25	BRL	90	80-120		
<b>Batch 1801097 - SW846 3005A</b>										
<b>Blank (1801097-BLK1)</b>				<b>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</b>						
Potassium	0.0724	J	mg/l	0.500						
Sodium	0.145	J	mg/l	0.250						
Antimony	< 0.0060	U	mg/l	0.0060						
Selenium	< 0.0150	U	mg/l	0.0150						
Cobalt	< 0.0050	U	mg/l	0.0050						
<b>LCS (1801097-BS1)</b>				<b>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</b>						
Potassium	13.6		mg/l	0.500	12.5		109	85-115		
Sodium	6.59		mg/l	0.250	6.25		105	85-115		
Antimony	1.32		mg/l	0.0060	1.25		106	85-115		
Cobalt	1.34		mg/l	0.0050	1.25		107	85-115		
Selenium	1.37		mg/l	0.0150	1.25		109	85-115		
<b>LCS Dup (1801097-BSD1)</b>				<b>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</b>						
Sodium	6.70		mg/l	0.250	6.25		107	85-115	2	20
Potassium	13.8		mg/l	0.500	12.5		110	85-115	1	20
Antimony	1.34		mg/l	0.0060	1.25		107	85-115	1	20
Cobalt	1.35		mg/l	0.0050	1.25		108	85-115	1	20
Selenium	1.39		mg/l	0.0150	1.25		111	85-115	1	20
<b>Duplicate (1801097-DUP1)</b>				<b>Source: SC43112-03</b>		<b>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</b>				
Sodium	99.0		mg/l	0.250		100			1	20
Potassium	3.76		mg/l	0.500		3.83			2	20
Antimony	< 0.0060	U	mg/l	0.0060		BRL				20
Selenium	< 0.0150	U	mg/l	0.0150		BRL				20
Cobalt	0.0038	J	mg/l	0.0050		0.0040			4	20

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# Soluble Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>SW846 6010C</u></b>										
<b>Batch 1801097 - SW846 3005A</b>										
<b><u>Matrix Spike (1801097-MS1)</u></b>			<b><u>Source: SC43112-03</u></b>			<b><u>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</u></b>				
Potassium	17.4		mg/l	0.500	12.5	3.83	109	75-125		
Sodium	105	QM2	mg/l	0.250	6.25	100	74	75-125		
Cobalt	1.30		mg/l	0.0050	1.25	0.0040	103	75-125		
Antimony	1.31		mg/l	0.0060	1.25	BRL	105	75-125		
Selenium	1.37		mg/l	0.0150	1.25	BRL	110	75-125		
<b><u>Matrix Spike Dup (1801097-MSD1)</u></b>			<b><u>Source: SC43112-03</u></b>			<b><u>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</u></b>				
Sodium	104	QM2	mg/l	0.250	6.25	100	67	75-125	0.4	20
Potassium	17.2		mg/l	0.500	12.5	3.83	107	75-125	1	20
Selenium	1.38		mg/l	0.0150	1.25	BRL	111	75-125	0.6	20
Antimony	1.33		mg/l	0.0060	1.25	BRL	106	75-125	1	20
Cobalt	1.28		mg/l	0.0050	1.25	0.0040	102	75-125	0.9	20
<b><u>Post Spike (1801097-PS1)</u></b>			<b><u>Source: SC43112-03</u></b>			<b><u>Prepared: 17-Jan-18 Analyzed: 25-Jan-18</u></b>				
Potassium	16.0		mg/l	0.500	12.5	3.83	98	80-120		
Sodium	102	QM2	mg/l	0.250	6.25	100	26	80-120		
Cobalt	1.17		mg/l	0.0050	1.25	0.0040	94	80-120		
Antimony	1.22		mg/l	0.0060	1.25	BRL	97	80-120		
Selenium	1.27		mg/l	0.0150	1.25	BRL	101	80-120		

# Soluble Metals by EPA 200 Series Methods - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>EPA 245.1/7470A</u></b>										
<b>Batch 1800622 - EPA200/SW7000 Series</b>										
<b><u>Blank (1800622-BLK1)</u></b>	<u>Prepared: 17-Jan-18 Analyzed: 18-Jan-18</u>									
Mercury	< 0.00020	U	mg/l	0.00020						
<b><u>LCS (1800622-BS1)</u></b>	<u>Prepared: 17-Jan-18 Analyzed: 19-Jan-18</u>									
Mercury	<b>0.00542</b>		mg/l	0.00020	0.00500		108	85-115		
<b><u>Duplicate (1800622-DUP1)</u></b>	<u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 18-Jan-18</u>									
Mercury	< 0.00020	U	mg/l	0.00020		BRL				20
<b><u>Matrix Spike (1800622-MS1)</u></b>	<u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 18-Jan-18</u>									
Mercury	<b>0.00492</b>		mg/l	0.00020	0.00500	BRL	98	80-120		
<b><u>Matrix Spike Dup (1800622-MSD1)</u></b>	<u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 18-Jan-18</u>									
Mercury	<b>0.00538</b>		mg/l	0.00020	0.00500	BRL	108	80-120	9	20
<b><u>Post Spike (1800622-PS1)</u></b>	<u>Source: SC43112-03 Prepared: 17-Jan-18 Analyzed: 18-Jan-18</u>									
Mercury	<b>0.00499</b>		mg/l	0.00020	0.00500	BRL	100	85-115		

# General Chemistry Parameters - Quality Control

Analyte(s)	Result	Flag	Units	*RDL	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b><u>EPA 335.4 / SW846 9012B</u></b>										
<b>Batch 1801015 - General Preparation</b>										
<b><u>Blank (1801015-BLK1)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	< 0.00500	U	mg/l	0.00500						
<b><u>Blank (1801015-BLK2)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	< 0.00500	U	mg/l	0.00500						
<b><u>LCS (1801015-BS1)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.425</b>		mg/l	0.00500	0.400		106	90-110		
<b><u>LCS (1801015-BS2)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.200</b>		mg/l	0.00500	0.200		100	90-110		
<b><u>LCS (1801015-BS3)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.396</b>		mg/l	0.00500	0.400		99	90-110		
<b><u>LCS (1801015-BS4)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.204</b>		mg/l	0.00500	0.200		102	90-110		
<b><u>Duplicate (1801015-DUP1)</u></b>	<u>Source: SC43112-03</u> <u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	< 0.00500	U	mg/l	0.00500		BRL				20
<b><u>Matrix Spike (1801015-MS1)</u></b>	<u>Source: SC43112-03</u> <u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.0976</b>		mg/l	0.00500	0.100	BRL	98	90-110		
<b><u>Matrix Spike Dup (1801015-MSD1)</u></b>	<u>Source: SC43112-03</u> <u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.0838</b>	QM7	mg/l	0.00500	0.100	BRL	84	90-110	15	20
<b><u>Reference (1801015-SRM1)</u></b>	<u>Prepared &amp; Analyzed: 24-Jan-18</u>									
Cyanide (total)	<b>0.289</b>		mg/l	0.00500	0.360		80	76-123		



## Pesticides - Pesticide Breakdown Report

Analyte(s)	Column	% Breakdown	Limit
<b>Batch S816066</b>			
<b><u>Performance Mix (S816066-PEM1)</u></b>			
4,4'-DDT (p,p')	1	1.7	15.0
Endrin	1	2.2	15.0
4,4'-DDT (p,p')	2	2.7	15.0
Endrin	2	4.7	15.0
<b><u>Performance Mix (S816066-PEM2)</u></b>			
4,4'-DDT (p,p')	1	1.8	15.0
Endrin	1	2.4	15.0
4,4'-DDT (p,p')	2	1.8	15.0
Endrin	2	4.2	15.0
<b>Batch S816093</b>			
<b><u>Performance Mix (S816093-PEM1)</u></b>			
4,4'-DDT (p,p')	1	1.7	15.0
Endrin	1	3.5	15.0
4,4'-DDT (p,p')	2	2.6	15.0
Endrin	2	5.6	15.0
<b><u>Performance Mix (S816093-PEM2)</u></b>			
4,4'-DDT (p,p')	1	2.5	15.0
Endrin	1	4.0	15.0
4,4'-DDT (p,p')	2	3.1	15.0
Endrin	2	6.8	15.0

## Notes and Definitions

B	Analyte is found in the associated blank as well as in the sample (CLP B-flag).
E	This flag indicates the concentration for this analyte is an estimated value due to exceeding the calibration range or interferences resulting in a biased final concentration.
HT5	Sample was originally analyzed within the recommended method holding time; however, QC materials for the sample run were out of control. As a result, the sample was immediately re-analyzed (outside the holding time).
J	Detected above the Method Detection Limit but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).
P	Difference between the two GC columns is greater than 40%.
QC2	Analyte out of acceptance range in QC spike but no reportable concentration present in sample.
QM2	The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.
QM7	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.
QM9	The spike recovery for this QC sample is outside the established control limits. The sample results for the QC batch were accepted based on LCS/LCSD or SRM recoveries within the control limits.
QR2	The RPD result exceeded the QC control limits; however, both percent recoveries were acceptable. Sample results for the QC batch were accepted based on percent recoveries and completeness of QC data.
QR5	RPD out of acceptance range.
QR6	The RPD exceeded the QC control limits; however precision is demonstrated with acceptable RPD values for MS/MSD.
QR8	Analyses are not controlled on RPD values from sample concentrations that are less than 5 times the reporting level. The batch is accepted based upon the difference between the sample and duplicate is less than or equal to the reporting limit.
U	Analyte included in the analysis, but not detected at or above the MDL.
Z-2	Surrogate outside acceptable method limits. Sample was re-extracted.
Z-2a	Surrogate outside method acceptable limits. Sample re-extracted.
dry	Sample results reported on a dry weight basis
NR	Not Reported
RPD	Relative Percent Difference
[2C]	Indicates concentration was reported from the secondary, confirmation column.

Laboratory Control Sample (LCS): A known matrix spiked with compound(s) representative of the target analytes, which is used to document laboratory performance.

Matrix Duplicate: An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.

Matrix Spike: An aliquot of a sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

Method Blank: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

Method Detection Limit (MDL): The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

Reportable Detection Limit (RDL): The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. For many analytes the RDL analyte concentration is selected as the lowest non-zero standard in the calibration curve. While the RDL is approximately 5 to 10 times the MDL, the RDL for each sample takes into account the sample volume/weight, extract/digestate volume, cleanup procedures and, if applicable, dry weight correction. Sample RDLs are highly matrix-dependent.

Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. These compounds are spiked into all blanks, standards, and samples prior to analysis. Percent recoveries are calculated for each surrogate.

Continuing Calibration Verification: The calibration relationship established during the initial calibration must be verified at periodic intervals. Concentrations, intervals, and criteria are method specific.



Ref:  
Dep:

Date: 29Dec17  
Wgt: 30.00 LBS  
DV:

SHIPPING: 0.00  
SPECIAL: 0.00  
HANDLING: 0.00  
TOTAL: 0.00

Svc: PRIORITY OVERNIGHT Master 4200 2859 9900  
TRCK 4200 2859 9900

ORIGIN ID: EHTA (631) 624-1989  
ATTN: JOHN GRESPO - AECOM ENV.

4 DASKAMS LANE, UNIT 304

NORWALK, CT 06851  
UNITED STATES US

SHIP DATE: 29DEC17  
ACTWGT: 30.00 LB MAN  
CAD: 0654830/CAFE3108

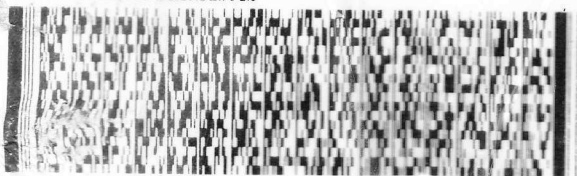
10 ROBERT BRISTOL  
EUROFINS SPECTRUM ANALYTICAL, INC.  
11 ALMGREN DRIVE

AGAWAM MA 01001

(413) 789-9018

RMA: #43373

RMA



FedEx  
Express



FedEx

TRK# 4200 2859 9900  
0221

XO EHTA

SATURDAY 12:00P  
PRIORITY OVERNIGHT

01001

MA-US

BDE



W484529 01/12 549J1/BD40/104C

Ref: Date: 29Dec17 SHIPPING: 0.00  
Dep: Wgt: 30.00 LBS SPECIAL: 0.00  
DV: HANDLING: 0.00  
0.00 TOTAL: 0.00

Sves. PRIORITY OVERNIGHT Master 4200 2859 9900  
TRCK: 4200 2859 9932

ORIGIN ID:EHTA (631) 624-1983  
ATTN: JOHN GRESPO - AECOM ENV.

4 DASKAMS LANE, UNIT 304

NORWALK, CT 06851  
UNITED STATES US

SHIP DATE: 29DEC17  
ACTWGT: 30.00 LB MAN  
CAD: 0654830/CAFE3108

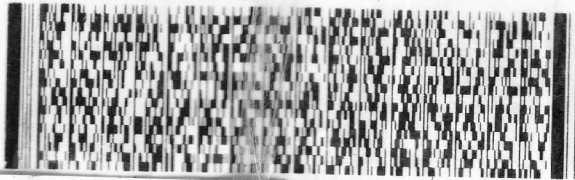
TO ROBERT BRISTOL  
EUROFINS SPECTRUM ANALYTICAL, INC.  
11 ALMGREN DRIVE

AGAWAM MA 01001

(413) 789-9018

RMA: #43373

RMA: 



FedEx  
Express



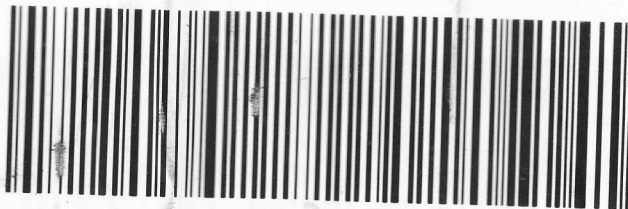
FedEx

TRK# 4200 2859 9932  
0221

SATURDAY 12:00P  
PRIORITY OVERNIGHT

XO EHTA

0100  
MA-US BD



#484529 01/12 549J1/BD40/104C

Ref:  
Dep:

Date: 29Dec17  
Wg: 30.00 LBS

SHIPPING: 0.00  
SPECIAL: 0.00  
HANDLING: 0.00  
TOTAL: 0.00

Master 42002859 9943  
TRACK: 42002859 943

ORIGIN ID: EHTA (631) 624-1989  
ATTN: JOHN GRESPO - AECOM ENV.

4 DASKAMS LANE, UNIT 304

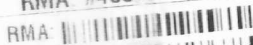
NORWALK, CT 06851  
UNITED STATES US

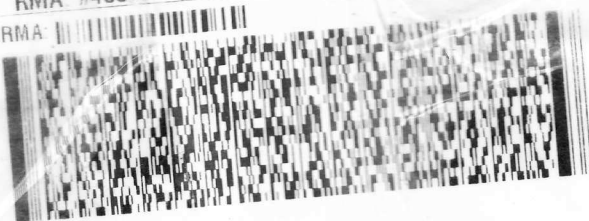
SHIP DATE: 29DEC17  
ACTWGT: 30.00 LB MAN  
CAO: 0654830/CAFE3108

TO ROBERT BRISTOL  
EUROFINS SPECTRUM ANALYTICAL, INC.  
11 ALMGREN DRIVE

AGAWAM MA 01001

(413) 789-9018  
RMA: #43373

RMA: 



FedEx  
Express



FedEx

TRK#  
0221

4200 2859 9943

XO EHTA



SATURDAY 12:00P  
PRIORITY OVERNIGHT

01001

MA-US

BDL

#6097-436 PROB EXP 09/18

## Batch Summary

### **1800578**

#### **Pesticides**

1800578-BLK1  
1800578-BS1  
1800578-BSD1  
1800578-MS1  
1800578-MSD1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

### **1800579**

#### **Semivolatile Organic Compounds by GC**

1800579-BLK1  
1800579-BS1  
1800579-BSD1  
1800579-MS1  
1800579-MSD1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

### **1800581**

#### **Semivolatile Organic Compounds by GCMS**

1800581-BLK1  
1800581-BS1  
1800581-BSD1  
1800581-MS1  
1800581-MSD1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

### **1800619**

#### **Total Metals by EPA 6000/7000 Series Methods**

1800619-BLK1  
1800619-BS1  
1800619-BSD1  
1800619-DUP1  
1800619-MS1  
1800619-MSD1  
1800619-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)

SC43112-05 (FB011218)

### **1800620**

#### **Total Metals by EPA 200 Series Methods**

1800620-BLK1  
1800620-BS1  
1800620-DUP1  
1800620-MS1  
1800620-MSD1  
1800620-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

### **1800621**

#### **Soluble Metals by EPA 6000/7000 Series Methods**

1800621-BLK1  
1800621-BS1  
1800621-BSD1  
1800621-DUP1  
1800621-MS1  
1800621-MSD1  
1800621-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

### **1800622**

#### **Soluble Metals by EPA 200 Series Methods**

1800622-BLK1  
1800622-BS1  
1800622-DUP1  
1800622-MS1  
1800622-MSD1  
1800622-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)



**1800630****Total Metals by EPA 200/6000 Series Methods**

SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

**1800631****Soluble Metals by EPA 200/6000 Series Methods**

SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

**1800715****Volatile Organic Compounds**

1800715-BLK1  
1800715-BS1  
1800715-BSD1  
1800715-MS1  
1800715-MSD1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)  
SC43112-06 (TB)

**1800739****Semivolatile Organic Compounds by GC**

1800739-BLK1  
1800739-BS1  
1800739-BSD1  
SC43112-01RE1 (GW-3)

**1800753****Pesticides**

1800753-BLK1  
1800753-BS1  
1800753-BSD1  
SC43112-01RE1 (GW-3)

**1800974****Semivolatile Organic Compounds by GCMS**

1800974-BLK1  
1800974-BS1  
1800974-BSD1  
SC43112-05RE1 (FB011218)

**1801015****General Chemistry Parameters**

1801015-BLK1

1801015-BLK2  
1801015-BS1  
1801015-BS2  
1801015-BS3  
1801015-BS4  
1801015-DUP1  
1801015-MS1  
1801015-MSD1  
1801015-SRM1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

**1801089****Total Metals by EPA 6000/7000 Series Methods**

1801089-BLK1  
1801089-BS1  
1801089-BSD1  
1801089-DUP1  
1801089-MS1  
1801089-MSD1  
1801089-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

**1801097****Soluble Metals by EPA 6000/7000 Series Methods**

1801097-BLK1  
1801097-BS1  
1801097-BSD1  
1801097-DUP1  
1801097-MS1  
1801097-MSD1  
1801097-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

**1801155****Total Metals by EPA 6000/7000 Series Methods**

1801155-BLK1  
1801155-BS1  
1801155-BSD1  
1801155-DUP1  
1801155-MS1  
1801155-MSD1  
1801155-PS1  
SC43112-01 (GW-3)  
SC43112-02 (GW-2)  
SC43112-03 (GW-1)  
SC43112-04 (DUP011218)  
SC43112-05 (FB011218)

**S710445****Semivolatile Organic Compounds by GC**

S710445-CAL1  
S710445-CAL2  
S710445-CAL3  
S710445-CAL4  
S710445-CAL5  
S710445-CAL6  
S710445-CAL7  
S710445-CAL8  
S710445-CAL9  
S710445-CALA  
S710445-CALB  
S710445-CALC  
S710445-CALD  
S710445-CALE  
S710445-CALF  
S710445-CALG  
S710445-CALH  
S710445-CALI  
S710445-CALJ  
S710445-CALK  
S710445-CALL  
S710445-CALM  
S710445-CALN  
S710445-CALO  
S710445-CALP  
S710445-CALQ  
S710445-CALR  
S710445-CALS  
S710445-CALT  
S710445-CALU  
S710445-ICV1  
S710445-ICV2  
S710445-ICV3  
S710445-ICV4  
S710445-ICV5  
S710445-ICV6  
S710445-LCV1  
S710445-LCV2

S710445-LCV3  
S710445-LCV4  
S710445-LCV5  
S710445-LCV6

**S815859****Semivolatile Organic Compounds by GCMS**

S815859-CAL1  
S815859-CAL2  
S815859-CAL3  
S815859-CAL4  
S815859-CAL5  
S815859-CAL6  
S815859-CAL7  
S815859-CAL8  
S815859-CAL9  
S815859-CALA  
S815859-ICV1  
S815859-LCV1  
S815859-LCV2  
S815859-TUN1

**S815896****Volatile Organic Compounds**

S815896-CAL1  
S815896-CAL2  
S815896-CAL3  
S815896-CAL4  
S815896-CAL5  
S815896-CAL6  
S815896-CAL7  
S815896-CAL8  
S815896-CAL9  
S815896-ICV1  
S815896-LCV1  
S815896-LCV2  
S815896-LCV3  
S815896-TUN1

**S816000****Pesticides**

S816000-CAL1  
S816000-CAL2  
S816000-CAL3  
S816000-CAL4  
S816000-CAL5  
S816000-CAL6  
S816000-CAL7  
S816000-CAL8  
S816000-CAL9  
S816000-CALA  
S816000-CALB  
S816000-CALC  
S816000-CALD  
S816000-CALE  
S816000-CALF  
S816000-ICV1  
S816000-ICV2  
S816000-ICV3  
S816000-LCV1  
S816000-LCV2  
S816000-LCV3

**S816014****Semivolatile Organic Compounds by GC**

S816014-CCV1  
S816014-CCV2  
S816014-CCV3  
S816014-IBL1  
S816014-IBL2

**S816026****Volatile Organic Compounds**

S816026-CCV1  
S816026-TUN1

**S816066****Pesticides**

S816066-CCV1  
S816066-CCV2  
S816066-CCV3  
S816066-CCV4  
S816066-CCV5  
S816066-CCV6  
S816066-IBL1  
S816066-IBL2  
S816066-PEM1  
S816066-PEM2

**S816093****Pesticides**

S816093-CCV1  
S816093-CCV2

S816093-CCV3  
S816093-CCV4  
S816093-CCV5  
S816093-CCV6  
S816093-IBL1  
S816093-IBL2  
S816093-PEM1  
S816093-PEM2

**S816135****Semivolatile Organic Compounds by GCMS**

S816135-CCV1  
S816135-TUN1

**S816145****Semivolatile Organic Compounds by GC**

S816145-CCV1  
S816145-CCV2  
S816145-IBL1  
S816145-IBL2

**S816168****General Chemistry Parameters**

S816168-CAL1  
S816168-CAL2  
S816168-CAL3  
S816168-CAL4  
S816168-CAL5  
S816168-CAL6  
S816168-CAL7  
S816168-ICB1  
S816168-ICV1

**S816169****General Chemistry Parameters**

S816169-CCB1  
S816169-CCB2  
S816169-CCB3  
S816169-CCV1  
S816169-CCV2  
S816169-CCV3  
S816169-CRL1  
S816169-CRL2  
S816169-CRL3  
S816169-HCV1  
S816169-LCV1

**S816213****Semivolatile Organic Compounds by GCMS**

S816213-CCV1  
S816213-TUN1

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

## ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica Burlington

30 Community Drive

Suite 11

South Burlington, VT 05403

Tel: (802)660-1990

TestAmerica Job ID: 200-41898-1

TestAmerica Sample Delivery Group: 200-41898-1

Client Project/Site: Rosedale, New York

For:

AECOM, Inc.

125 Broad Street

16th Floor

New York, New York 10004

Attn: Mr. Nelson Abrams



Authorized for release by:

1/26/2018 11:29:36 AM

Kristine Dusablon, Project Manager II

(802)660-1990

[kris.dusablon@testamericainc.com](mailto:kris.dusablon@testamericainc.com)

### LINKS

Review your project  
results through

TotalAccess

Have a Question?



Visit us at:

[www.testamericainc.com](http://www.testamericainc.com)

The test results in this report meet all 2003 NELAP and 2009 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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## Definitions/Glossary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

### Qualifiers

#### Air - GC/MS VOA

Qualifier	Qualifier Description
U	Indicates the analyte was analyzed for but not detected.
D	Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples.
E	Result exceeded calibration range.

### Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

## Case Narrative

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Job ID: 200-41898-1**

**Laboratory: TestAmerica Burlington**

### Narrative

## CASE NARRATIVE

**Client: AECOM, Inc.**

**Project: Rosedale, New York**

**Report Number: 200-41898-1**

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

### RECEIPT

The samples were received on 01/17/2018; the samples arrived in good condition.

### VOLATILE ORGANIC COMPOUNDS

Samples SV-1 (200-41898-1), SV-2 (200-41898-2), SV-3 (200-41898-3), SV-4 (200-41898-4), AMB-1 (200-41898-5), AMB-2 (200-41898-6), AMB-3 (200-41898-7), AMB-4 (200-41898-8) and DUP-1 (200-41898-9) were analyzed for Volatile Organic Compounds in accordance with EPA Method TO-15. The samples were analyzed on 01/18/2018, 01/19/2018, 01/20/2018, 01/23/2018 and 01/25/2018.

Samples SV-1 (200-41898-1)[5X], SV-2 (200-41898-2)[2X], SV-3 (200-41898-3)[6.06X], SV-4 (200-41898-4)[6.9X], AMB-4 (200-41898-8) [2.5X] and DUP-1 (200-41898-9)[8X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Client Sample ID: SV-1

Lab Sample ID: 200-41898-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	0.90		0.50		ppb v/v	1		TO-15	Total/NA
n-Butane	5.1		0.50		ppb v/v	1		TO-15	Total/NA
Vinyl chloride	0.039		0.035		ppb v/v	1		TO-15	Total/NA
Acetone	41	E	5.0		ppb v/v	1		TO-15	Total/NA
Isopropyl alcohol	110	E	5.0		ppb v/v	1		TO-15	Total/NA
Methylene Chloride	9.6		0.50		ppb v/v	1		TO-15	Total/NA
n-Hexane	0.88		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	2.8		0.50		ppb v/v	1		TO-15	Total/NA
cis-1,2-Dichloroethene	0.13		0.035		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.061		0.035		ppb v/v	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.23		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.31		0.20		ppb v/v	1		TO-15	Total/NA
n-Heptane	0.21		0.20		ppb v/v	1		TO-15	Total/NA
Trichloroethene	0.12		0.035		ppb v/v	1		TO-15	Total/NA
Toluene	0.56		0.20		ppb v/v	1		TO-15	Total/NA
Tetrachloroethene	0.35		0.20		ppb v/v	1		TO-15	Total/NA
1,3-Dichlorobenzene	0.21		0.20		ppb v/v	1		TO-15	Total/NA
n-Butane - DL	5.4	D	2.5		ppb v/v	5		TO-15	Total/NA
Acetone - DL	44	D	25		ppb v/v	5		TO-15	Total/NA
Isopropyl alcohol - DL	110	D	25		ppb v/v	5		TO-15	Total/NA
Methylene Chloride - DL	9.9	D	2.5		ppb v/v	5		TO-15	Total/NA
Methyl Ethyl Ketone - DL	2.8	D	2.5		ppb v/v	5		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	1.9		1.0		ug/m3	1		TO-15	Total/NA
n-Butane	12		1.2		ug/m3	1		TO-15	Total/NA
Vinyl chloride	0.099		0.089		ug/m3	1		TO-15	Total/NA
Acetone	98	E	12		ug/m3	1		TO-15	Total/NA
Isopropyl alcohol	270	E	12		ug/m3	1		TO-15	Total/NA
Methylene Chloride	33		1.7		ug/m3	1		TO-15	Total/NA
n-Hexane	3.1		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	8.1		1.5		ug/m3	1		TO-15	Total/NA
cis-1,2-Dichloroethene	0.50		0.14		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.38		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	1.1		0.93		ug/m3	1		TO-15	Total/NA
Benzene	1.0		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	0.88		0.82		ug/m3	1		TO-15	Total/NA
Trichloroethene	0.64		0.19		ug/m3	1		TO-15	Total/NA
Toluene	2.1		0.75		ug/m3	1		TO-15	Total/NA
Tetrachloroethene	2.3		1.4		ug/m3	1		TO-15	Total/NA
1,3-Dichlorobenzene	1.3		1.2		ug/m3	1		TO-15	Total/NA
n-Butane - DL	13	D	5.9		ug/m3	5		TO-15	Total/NA
Acetone - DL	100	D	59		ug/m3	5		TO-15	Total/NA
Isopropyl alcohol - DL	270	D	61		ug/m3	5		TO-15	Total/NA
Methylene Chloride - DL	34	D	8.7		ug/m3	5		TO-15	Total/NA
Methyl Ethyl Ketone - DL	8.4	D	7.4		ug/m3	5		TO-15	Total/NA

Client Sample ID: SV-2

Lab Sample ID: 200-41898-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	1.8		0.50		ppb v/v	1		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington



# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Client Sample ID: SV-2 (Continued)

Lab Sample ID: 200-41898-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
n-Butane	4.3		0.50		ppb v/v	1			TO-15	Total/NA
Vinyl chloride	0.11		0.035		ppb v/v	1			TO-15	Total/NA
Trichlorofluoromethane	0.21		0.20		ppb v/v	1			TO-15	Total/NA
Acetone	65	E	5.0		ppb v/v	1			TO-15	Total/NA
Isopropyl alcohol	56	E	5.0		ppb v/v	1			TO-15	Total/NA
Methylene Chloride	0.97		0.50		ppb v/v	1			TO-15	Total/NA
n-Hexane	1.8		0.20		ppb v/v	1			TO-15	Total/NA
Methyl Ethyl Ketone	4.2		0.50		ppb v/v	1			TO-15	Total/NA
Cyclohexane	0.69		0.20		ppb v/v	1			TO-15	Total/NA
Carbon tetrachloride	0.062		0.035		ppb v/v	1			TO-15	Total/NA
2,2,4-Trimethylpentane	1.3		0.20		ppb v/v	1			TO-15	Total/NA
Benzene	0.84		0.20		ppb v/v	1			TO-15	Total/NA
n-Heptane	0.90		0.20		ppb v/v	1			TO-15	Total/NA
Methyl methacrylate	3.9		0.50		ppb v/v	1			TO-15	Total/NA
Toluene	3.3		0.20		ppb v/v	1			TO-15	Total/NA
Ethylbenzene	1.2		0.20		ppb v/v	1			TO-15	Total/NA
m,p-Xylene	2.8		0.50		ppb v/v	1			TO-15	Total/NA
Xylene, o-	1.2		0.20		ppb v/v	1			TO-15	Total/NA
Xylene (total)	4.0		0.70		ppb v/v	1			TO-15	Total/NA
4-Ethyltoluene	0.23		0.20		ppb v/v	1			TO-15	Total/NA
1,3,5-Trimethylbenzene	0.22		0.20		ppb v/v	1			TO-15	Total/NA
1,2,4-Trimethylbenzene	0.75		0.20		ppb v/v	1			TO-15	Total/NA
1,3-Dichlorobenzene	0.30		0.20		ppb v/v	1			TO-15	Total/NA
Chloromethane - DL	1.5	D	1.0		ppb v/v	2			TO-15	Total/NA
n-Butane - DL	3.9	D	1.0		ppb v/v	2			TO-15	Total/NA
Vinyl chloride - DL	0.11	D	0.070		ppb v/v	2			TO-15	Total/NA
Acetone - DL	58	D	10		ppb v/v	2			TO-15	Total/NA
Isopropyl alcohol - DL	45	D	10		ppb v/v	2			TO-15	Total/NA
n-Hexane - DL	1.5	D	0.40		ppb v/v	2			TO-15	Total/NA
Methyl Ethyl Ketone - DL	3.4	D	1.0		ppb v/v	2			TO-15	Total/NA
Cyclohexane - DL	0.56	D	0.40		ppb v/v	2			TO-15	Total/NA
2,2,4-Trimethylpentane - DL	1.0	D	0.40		ppb v/v	2			TO-15	Total/NA
Benzene - DL	0.70	D	0.40		ppb v/v	2			TO-15	Total/NA
n-Heptane - DL	0.70	D	0.40		ppb v/v	2			TO-15	Total/NA
Methyl methacrylate - DL	2.9	D	1.0		ppb v/v	2			TO-15	Total/NA
Toluene - DL	2.8	D	0.40		ppb v/v	2			TO-15	Total/NA
Ethylbenzene - DL	0.93	D	0.40		ppb v/v	2			TO-15	Total/NA
m,p-Xylene - DL	2.2	D	1.0		ppb v/v	2			TO-15	Total/NA
Xylene, o- - DL	0.99	D	0.40		ppb v/v	2			TO-15	Total/NA
Xylene (total) - DL	3.2	D	1.4		ppb v/v	2			TO-15	Total/NA
1,2,4-Trimethylbenzene - DL	0.60	D	0.40		ppb v/v	2			TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Chloromethane	3.8		1.0		ug/m3	1			TO-15	Total/NA
n-Butane	10		1.2		ug/m3	1			TO-15	Total/NA
Vinyl chloride	0.28		0.089		ug/m3	1			TO-15	Total/NA
Trichlorofluoromethane	1.2		1.1		ug/m3	1			TO-15	Total/NA
Acetone	150	E	12		ug/m3	1			TO-15	Total/NA
Isopropyl alcohol	140	E	12		ug/m3	1			TO-15	Total/NA
Methylene Chloride	3.4		1.7		ug/m3	1			TO-15	Total/NA
n-Hexane	6.3		0.70		ug/m3	1			TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Client Sample ID: SV-2 (Continued)

## Lab Sample ID: 200-41898-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Methyl Ethyl Ketone	12		1.5		ug/m3	1		TO-15	Total/NA
Cyclohexane	2.4		0.69		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.39		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	5.9		0.93		ug/m3	1		TO-15	Total/NA
Benzene	2.7		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	3.7		0.82		ug/m3	1		TO-15	Total/NA
Methyl methacrylate	16		2.0		ug/m3	1		TO-15	Total/NA
Toluene	12		0.75		ug/m3	1		TO-15	Total/NA
Ethylbenzene	5.2		0.87		ug/m3	1		TO-15	Total/NA
m,p-Xylene	12		2.2		ug/m3	1		TO-15	Total/NA
Xylene, o-	5.3		0.87		ug/m3	1		TO-15	Total/NA
Xylene (total)	17		3.0		ug/m3	1		TO-15	Total/NA
4-Ethyltoluene	1.1		0.98		ug/m3	1		TO-15	Total/NA
1,3,5-Trimethylbenzene	1.1		0.98		ug/m3	1		TO-15	Total/NA
1,2,4-Trimethylbenzene	3.7		0.98		ug/m3	1		TO-15	Total/NA
1,3-Dichlorobenzene	1.8		1.2		ug/m3	1		TO-15	Total/NA
Chloromethane - DL	3.2	D	2.1		ug/m3	2		TO-15	Total/NA
n-Butane - DL	9.4	D	2.4		ug/m3	2		TO-15	Total/NA
Vinyl chloride - DL	0.29	D	0.18		ug/m3	2		TO-15	Total/NA
Acetone - DL	140	D	24		ug/m3	2		TO-15	Total/NA
Isopropyl alcohol - DL	110	D	25		ug/m3	2		TO-15	Total/NA
n-Hexane - DL	5.2	D	1.4		ug/m3	2		TO-15	Total/NA
Methyl Ethyl Ketone - DL	10	D	2.9		ug/m3	2		TO-15	Total/NA
Cyclohexane - DL	1.9	D	1.4		ug/m3	2		TO-15	Total/NA
2,2,4-Trimethylpentane - DL	4.8	D	1.9		ug/m3	2		TO-15	Total/NA
Benzene - DL	2.2	D	1.3		ug/m3	2		TO-15	Total/NA
n-Heptane - DL	2.9	D	1.6		ug/m3	2		TO-15	Total/NA
Methyl methacrylate - DL	12	D	4.1		ug/m3	2		TO-15	Total/NA
Toluene - DL	11	D	1.5		ug/m3	2		TO-15	Total/NA
Ethylbenzene - DL	4.0	D	1.7		ug/m3	2		TO-15	Total/NA
m,p-Xylene - DL	9.5	D	4.3		ug/m3	2		TO-15	Total/NA
Xylene, o- - DL	4.3	D	1.7		ug/m3	2		TO-15	Total/NA
Xylene (total) - DL	14	D	6.1		ug/m3	2		TO-15	Total/NA
1,2,4-Trimethylbenzene - DL	3.0	D	2.0		ug/m3	2		TO-15	Total/NA

## Client Sample ID: SV-3

## Lab Sample ID: 200-41898-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Dichlorodifluoromethane	0.52		0.50		ppb v/v	1		TO-15	Total/NA
Chloromethane	1.4		0.50		ppb v/v	1		TO-15	Total/NA
n-Butane	4.3		0.50		ppb v/v	1		TO-15	Total/NA
Vinyl chloride	0.061		0.035		ppb v/v	1		TO-15	Total/NA
Trichlorofluoromethane	0.20		0.20		ppb v/v	1		TO-15	Total/NA
Acetone	45	E	5.0		ppb v/v	1		TO-15	Total/NA
Isopropyl alcohol	140	E	5.0		ppb v/v	1		TO-15	Total/NA
Methylene Chloride	11		0.50		ppb v/v	1		TO-15	Total/NA
n-Hexane	1.0		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	2.1		0.50		ppb v/v	1		TO-15	Total/NA
Cyclohexane	0.32		0.20		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.057		0.035		ppb v/v	1		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Client Sample ID: SV-3 (Continued)

## Lab Sample ID: 200-41898-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
2,2,4-Trimethylpentane	0.31		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.36		0.20		ppb v/v	1		TO-15	Total/NA
n-Heptane	0.31		0.20		ppb v/v	1		TO-15	Total/NA
Trichloroethene	0.036		0.035		ppb v/v	1		TO-15	Total/NA
Toluene	0.85		0.20		ppb v/v	1		TO-15	Total/NA
n-Butane - DL	4.1	D	3.0		ppb v/v	6.06		TO-15	Total/NA
Acetone - DL	51	D	30		ppb v/v	6.06		TO-15	Total/NA
Isopropyl alcohol - DL	150	D	30		ppb v/v	6.06		TO-15	Total/NA
Methylene Chloride - DL	11	D	3.0		ppb v/v	6.06		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Dichlorodifluoromethane	2.6		2.5		ug/m3	1		TO-15	Total/NA
Chloromethane	3.0		1.0		ug/m3	1		TO-15	Total/NA
n-Butane	10		1.2		ug/m3	1		TO-15	Total/NA
Vinyl chloride	0.16		0.089		ug/m3	1		TO-15	Total/NA
Trichlorofluoromethane	1.1		1.1		ug/m3	1		TO-15	Total/NA
Acetone	110	E	12		ug/m3	1		TO-15	Total/NA
Isopropyl alcohol	350	E	12		ug/m3	1		TO-15	Total/NA
Methylene Chloride	39		1.7		ug/m3	1		TO-15	Total/NA
n-Hexane	3.7		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	6.3		1.5		ug/m3	1		TO-15	Total/NA
Cyclohexane	1.1		0.69		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.36		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	1.4		0.93		ug/m3	1		TO-15	Total/NA
Benzene	1.2		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	1.3		0.82		ug/m3	1		TO-15	Total/NA
Trichloroethene	0.19		0.19		ug/m3	1		TO-15	Total/NA
Toluene	3.2		0.75		ug/m3	1		TO-15	Total/NA
n-Butane - DL	9.7	D	7.2		ug/m3	6.06		TO-15	Total/NA
Acetone - DL	120	D	72		ug/m3	6.06		TO-15	Total/NA
Isopropyl alcohol - DL	360	D	74		ug/m3	6.06		TO-15	Total/NA
Methylene Chloride - DL	37	D	11		ug/m3	6.06		TO-15	Total/NA

## Client Sample ID: SV-4

## Lab Sample ID: 200-41898-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
n-Butane	3.6		0.50		ppb v/v	1		TO-15	Total/NA
Acetone	180	E	5.0		ppb v/v	1		TO-15	Total/NA
n-Hexane	0.76		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	83	E	0.50		ppb v/v	1		TO-15	Total/NA
Tetrahydrofuran	66	E	5.0		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.058		0.035		ppb v/v	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.41		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.89		0.20		ppb v/v	1		TO-15	Total/NA
n-Heptane	0.36		0.20		ppb v/v	1		TO-15	Total/NA
Toluene	1.1		0.20		ppb v/v	1		TO-15	Total/NA
m,p-Xylene	0.60		0.50		ppb v/v	1		TO-15	Total/NA
Xylene, o-	0.20		0.20		ppb v/v	1		TO-15	Total/NA
Xylene (total)	0.80		0.70		ppb v/v	1		TO-15	Total/NA
Acetone - DL	140	D	35		ppb v/v	6.9		TO-15	Total/NA
Methyl Ethyl Ketone - DL	57	D	3.5		ppb v/v	6.9		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Client Sample ID: SV-4 (Continued)

## Lab Sample ID: 200-41898-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Tetrahydrofuran - DL	50	D	35		ppb v/v	6.9		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
n-Butane	8.5		1.2		ug/m3	1		TO-15	Total/NA
Acetone	430	E	12		ug/m3	1		TO-15	Total/NA
n-Hexane	2.7		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	240	E	1.5		ug/m3	1		TO-15	Total/NA
Tetrahydrofuran	190	E	15		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.36		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	1.9		0.93		ug/m3	1		TO-15	Total/NA
Benzene	2.8		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	1.5		0.82		ug/m3	1		TO-15	Total/NA
Toluene	4.0		0.75		ug/m3	1		TO-15	Total/NA
m,p-Xylene	2.6		2.2		ug/m3	1		TO-15	Total/NA
Xylene, o-	0.87		0.87		ug/m3	1		TO-15	Total/NA
Xylene (total)	3.5		3.0		ug/m3	1		TO-15	Total/NA
Acetone - DL	340	D	82		ug/m3	6.9		TO-15	Total/NA
Methyl Ethyl Ketone - DL	170	D	10		ug/m3	6.9		TO-15	Total/NA
Tetrahydrofuran - DL	150	D	100		ug/m3	6.9		TO-15	Total/NA

## Client Sample ID: AMB-1

## Lab Sample ID: 200-41898-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
n-Butane	4.3		0.50		ppb v/v	1		TO-15	Total/NA
Trichlorofluoromethane	0.20		0.20		ppb v/v	1		TO-15	Total/NA
Acetone	9.6		5.0		ppb v/v	1		TO-15	Total/NA
Methylene Chloride	10		0.50		ppb v/v	1		TO-15	Total/NA
n-Hexane	0.99		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	2.3		0.50		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.062		0.035		ppb v/v	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.21		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.31		0.20		ppb v/v	1		TO-15	Total/NA
Toluene	0.45		0.20		ppb v/v	1		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
n-Butane	10		1.2		ug/m3	1		TO-15	Total/NA
Trichlorofluoromethane	1.1		1.1		ug/m3	1		TO-15	Total/NA
Acetone	23		12		ug/m3	1		TO-15	Total/NA
Methylene Chloride	36		1.7		ug/m3	1		TO-15	Total/NA
n-Hexane	3.5		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	6.8		1.5		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.39		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.99		0.93		ug/m3	1		TO-15	Total/NA
Benzene	1.0		0.64		ug/m3	1		TO-15	Total/NA
Toluene	1.7		0.75		ug/m3	1		TO-15	Total/NA

## Client Sample ID: AMB-2

## Lab Sample ID: 200-41898-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	0.52		0.50		ppb v/v	1		TO-15	Total/NA
n-Butane	36		0.50		ppb v/v	1		TO-15	Total/NA
Carbon disulfide	0.81		0.50		ppb v/v	1		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Client Sample ID: AMB-2 (Continued)

## Lab Sample ID: 200-41898-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
n-Hexane	1.2		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	0.56		0.50		ppb v/v	1		TO-15	Total/NA
Cyclohexane	0.36		0.20		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.064		0.035		ppb v/v	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.48		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.74		0.20		ppb v/v	1		TO-15	Total/NA
n-Heptane	0.24		0.20		ppb v/v	1		TO-15	Total/NA
Toluene	1.1		0.20		ppb v/v	1		TO-15	Total/NA
Ethylbenzene	0.29		0.20		ppb v/v	1		TO-15	Total/NA
m,p-Xylene	0.60		0.50		ppb v/v	1		TO-15	Total/NA
Xylene, o-	0.24		0.20		ppb v/v	1		TO-15	Total/NA
Xylene (total)	0.84		0.70		ppb v/v	1		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	1.1		1.0		ug/m3	1		TO-15	Total/NA
n-Butane	86		1.2		ug/m3	1		TO-15	Total/NA
Carbon disulfide	2.5		1.6		ug/m3	1		TO-15	Total/NA
n-Hexane	4.2		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	1.7		1.5		ug/m3	1		TO-15	Total/NA
Cyclohexane	1.2		0.69		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.40		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	2.3		0.93		ug/m3	1		TO-15	Total/NA
Benzene	2.4		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	0.99		0.82		ug/m3	1		TO-15	Total/NA
Toluene	4.1		0.75		ug/m3	1		TO-15	Total/NA
Ethylbenzene	1.3		0.87		ug/m3	1		TO-15	Total/NA
m,p-Xylene	2.6		2.2		ug/m3	1		TO-15	Total/NA
Xylene, o-	1.0		0.87		ug/m3	1		TO-15	Total/NA
Xylene (total)	3.6		3.0		ug/m3	1		TO-15	Total/NA

## Client Sample ID: AMB-3

## Lab Sample ID: 200-41898-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	0.51		0.50		ppb v/v	1		TO-15	Total/NA
n-Butane	5.1		0.50		ppb v/v	1		TO-15	Total/NA
Acetone	6.8		5.0		ppb v/v	1		TO-15	Total/NA
Methylene Chloride	11		0.50		ppb v/v	1		TO-15	Total/NA
n-Hexane	0.86		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	1.0		0.50		ppb v/v	1		TO-15	Total/NA
Cyclohexane	0.20		0.20		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.061		0.035		ppb v/v	1		TO-15	Total/NA
Benzene	0.28		0.20		ppb v/v	1		TO-15	Total/NA
Toluene	0.45		0.20		ppb v/v	1		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	1.0		1.0		ug/m3	1		TO-15	Total/NA
n-Butane	12		1.2		ug/m3	1		TO-15	Total/NA
Acetone	16		12		ug/m3	1		TO-15	Total/NA
Methylene Chloride	40		1.7		ug/m3	1		TO-15	Total/NA
n-Hexane	3.0		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	3.1		1.5		ug/m3	1		TO-15	Total/NA
Cyclohexane	0.68		0.69		ug/m3	1		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Client Sample ID: AMB-3 (Continued)

## Lab Sample ID: 200-41898-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Carbon tetrachloride	0.38		0.22		ug/m3	1		TO-15	Total/NA
Benzene	0.90		0.64		ug/m3	1		TO-15	Total/NA
Toluene	1.7		0.75		ug/m3	1		TO-15	Total/NA

## Client Sample ID: AMB-4

## Lab Sample ID: 200-41898-8

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	0.53		0.50		ppb v/v	1		TO-15	Total/NA
n-Butane	10		0.50		ppb v/v	1		TO-15	Total/NA
Acetone	66	E	5.0		ppb v/v	1		TO-15	Total/NA
Methylene Chloride	5.9		0.50		ppb v/v	1		TO-15	Total/NA
n-Hexane	1.2		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	20		0.50		ppb v/v	1		TO-15	Total/NA
Tetrahydrofuran	14		5.0		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.058		0.035		ppb v/v	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.20		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.42		0.20		ppb v/v	1		TO-15	Total/NA
n-Heptane	0.27		0.20		ppb v/v	1		TO-15	Total/NA
Toluene	0.67		0.20		ppb v/v	1		TO-15	Total/NA
1,2,4-Trimethylbenzene	0.25		0.20		ppb v/v	1		TO-15	Total/NA
n-Butane - DL	11	D	1.3		ppb v/v	2.5		TO-15	Total/NA
Acetone - DL	68	D	13		ppb v/v	2.5		TO-15	Total/NA
Methylene Chloride - DL	6.2	D	1.3		ppb v/v	2.5		TO-15	Total/NA
n-Hexane - DL	1.3	D	0.50		ppb v/v	2.5		TO-15	Total/NA
Methyl Ethyl Ketone - DL	21	D	1.3		ppb v/v	2.5		TO-15	Total/NA
Tetrahydrofuran - DL	15	D	13		ppb v/v	2.5		TO-15	Total/NA
Toluene - DL	0.71	D	0.50		ppb v/v	2.5		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloromethane	1.1		1.0		ug/m3	1		TO-15	Total/NA
n-Butane	24		1.2		ug/m3	1		TO-15	Total/NA
Acetone	160	E	12		ug/m3	1		TO-15	Total/NA
Methylene Chloride	21		1.7		ug/m3	1		TO-15	Total/NA
n-Hexane	4.4		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	60		1.5		ug/m3	1		TO-15	Total/NA
Tetrahydrofuran	43		15		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.37		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.93		0.93		ug/m3	1		TO-15	Total/NA
Benzene	1.4		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	1.1		0.82		ug/m3	1		TO-15	Total/NA
Toluene	2.5		0.75		ug/m3	1		TO-15	Total/NA
1,2,4-Trimethylbenzene	1.2		0.98		ug/m3	1		TO-15	Total/NA
n-Butane - DL	25	D	3.0		ug/m3	2.5		TO-15	Total/NA
Acetone - DL	160	D	30		ug/m3	2.5		TO-15	Total/NA
Methylene Chloride - DL	21	D	4.3		ug/m3	2.5		TO-15	Total/NA
n-Hexane - DL	4.5	D	1.8		ug/m3	2.5		TO-15	Total/NA
Methyl Ethyl Ketone - DL	62	D	3.7		ug/m3	2.5		TO-15	Total/NA
Tetrahydrofuran - DL	43	D	37		ug/m3	2.5		TO-15	Total/NA
Toluene - DL	2.7	D	1.9		ug/m3	2.5		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington

# Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Client Sample ID: DUP-1

Lab Sample ID: 200-41898-9

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Dichlorodifluoromethane	0.59		0.50		ppb v/v	1		TO-15	Total/NA
Chloromethane	1.4		0.50		ppb v/v	1		TO-15	Total/NA
n-Butane	9.0		0.50		ppb v/v	1		TO-15	Total/NA
Vinyl chloride	0.069		0.035		ppb v/v	1		TO-15	Total/NA
Trichlorofluoromethane	0.23		0.20		ppb v/v	1		TO-15	Total/NA
Acetone	77	E	5.0		ppb v/v	1		TO-15	Total/NA
Isopropyl alcohol	200	E	5.0		ppb v/v	1		TO-15	Total/NA
Methylene Chloride	9.8		0.50		ppb v/v	1		TO-15	Total/NA
n-Hexane	1.2		0.20		ppb v/v	1		TO-15	Total/NA
Methyl Ethyl Ketone	8.4		0.50		ppb v/v	1		TO-15	Total/NA
Cyclohexane	0.25		0.20		ppb v/v	1		TO-15	Total/NA
Carbon tetrachloride	0.068		0.035		ppb v/v	1		TO-15	Total/NA
2,2,4-Trimethylpentane	0.35		0.20		ppb v/v	1		TO-15	Total/NA
Benzene	0.48		0.20		ppb v/v	1		TO-15	Total/NA
n-Heptane	0.33		0.20		ppb v/v	1		TO-15	Total/NA
Toluene	0.79		0.20		ppb v/v	1		TO-15	Total/NA
m,p-Xylene	0.54		0.50		ppb v/v	1		TO-15	Total/NA
Xylene, o-	0.21		0.20		ppb v/v	1		TO-15	Total/NA
Xylene (total)	0.75		0.70		ppb v/v	1		TO-15	Total/NA
1,3-Dichlorobenzene	0.45		0.20		ppb v/v	1		TO-15	Total/NA
n-Butane - DL	6.0	D	4.0		ppb v/v	8		TO-15	Total/NA
Acetone - DL	57	D	40		ppb v/v	8		TO-15	Total/NA
Isopropyl alcohol - DL	130	D	40		ppb v/v	8		TO-15	Total/NA
Methylene Chloride - DL	6.7	D	4.0		ppb v/v	8		TO-15	Total/NA
Methyl Ethyl Ketone - DL	5.5	D	4.0		ppb v/v	8		TO-15	Total/NA
Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Dichlorodifluoromethane	2.9		2.5		ug/m3	1		TO-15	Total/NA
Chloromethane	2.9		1.0		ug/m3	1		TO-15	Total/NA
n-Butane	21		1.2		ug/m3	1		TO-15	Total/NA
Vinyl chloride	0.18		0.089		ug/m3	1		TO-15	Total/NA
Trichlorofluoromethane	1.3		1.1		ug/m3	1		TO-15	Total/NA
Acetone	180	E	12		ug/m3	1		TO-15	Total/NA
Isopropyl alcohol	480	E	12		ug/m3	1		TO-15	Total/NA
Methylene Chloride	34		1.7		ug/m3	1		TO-15	Total/NA
n-Hexane	4.1		0.70		ug/m3	1		TO-15	Total/NA
Methyl Ethyl Ketone	25		1.5		ug/m3	1		TO-15	Total/NA
Cyclohexane	0.86		0.69		ug/m3	1		TO-15	Total/NA
Carbon tetrachloride	0.43		0.22		ug/m3	1		TO-15	Total/NA
2,2,4-Trimethylpentane	1.6		0.93		ug/m3	1		TO-15	Total/NA
Benzene	1.5		0.64		ug/m3	1		TO-15	Total/NA
n-Heptane	1.4		0.82		ug/m3	1		TO-15	Total/NA
Toluene	3.0		0.75		ug/m3	1		TO-15	Total/NA
m,p-Xylene	2.3		2.2		ug/m3	1		TO-15	Total/NA
Xylene, o-	0.93		0.87		ug/m3	1		TO-15	Total/NA
Xylene (total)	3.3		3.0		ug/m3	1		TO-15	Total/NA
1,3-Dichlorobenzene	2.7		1.2		ug/m3	1		TO-15	Total/NA
n-Butane - DL	14	D	9.5		ug/m3	8		TO-15	Total/NA
Acetone - DL	140	D	95		ug/m3	8		TO-15	Total/NA
Isopropyl alcohol - DL	320	D	98		ug/m3	8		TO-15	Total/NA
Methylene Chloride - DL	23	D	14		ug/m3	8		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington



## Detection Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1 (Continued)**

**Lab Sample ID: 200-41898-9**

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Methyl Ethyl Ketone - DL	16	D	12		ug/m3	8		TO-15	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-1**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
Freon 22	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>Chloromethane</b>	<b>0.90</b>		0.50		ppb v/v			01/25/18 10:09	1
<b>n-Butane</b>	<b>5.1</b>		0.50		ppb v/v			01/25/18 10:09	1
<b>Vinyl chloride</b>	<b>0.039</b>		0.035		ppb v/v			01/25/18 10:09	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Bromomethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Chloroethane	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Freon TF	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/25/18 10:09	1
<b>Acetone</b>	<b>41</b>	<b>E</b>	5.0		ppb v/v			01/25/18 10:09	1
<b>Isopropyl alcohol</b>	<b>110</b>	<b>E</b>	5.0		ppb v/v			01/25/18 10:09	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
<b>Methylene Chloride</b>	<b>9.6</b>		0.50		ppb v/v			01/25/18 10:09	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/25/18 10:09	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>n-Hexane</b>	<b>0.88</b>		0.20		ppb v/v			01/25/18 10:09	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>Methyl Ethyl Ketone</b>	<b>2.8</b>		0.50		ppb v/v			01/25/18 10:09	1
<b>cis-1,2-Dichloroethene</b>	<b>0.13</b>		0.035		ppb v/v			01/25/18 10:09	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/25/18 10:09	1
Chloroform	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/25/18 10:09	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>Carbon tetrachloride</b>	<b>0.061</b>		0.035		ppb v/v			01/25/18 10:09	1
<b>2,2,4-Trimethylpentane</b>	<b>0.23</b>		0.20		ppb v/v			01/25/18 10:09	1
<b>Benzene</b>	<b>0.31</b>		0.20		ppb v/v			01/25/18 10:09	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>n-Heptane</b>	<b>0.21</b>		0.20		ppb v/v			01/25/18 10:09	1
<b>Trichloroethene</b>	<b>0.12</b>		0.035		ppb v/v			01/25/18 10:09	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/25/18 10:09	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
<b>Toluene</b>	<b>0.56</b>		0.20		ppb v/v			01/25/18 10:09	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>Tetrachloroethene</b>	<b>0.35</b>		0.20		ppb v/v			01/25/18 10:09	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-1**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/25/18 10:09	1
Styrene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Bromoform	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Cumene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
<b>1,3-Dichlorobenzene</b>	<b>0.21</b>		0.20		ppb v/v			01/25/18 10:09	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/25/18 10:09	1
Naphthalene	0.50	U	0.50		ppb v/v			01/25/18 10:09	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/25/18 10:09	1
Freon 22	1.8	U	1.8		ug/m3			01/25/18 10:09	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/25/18 10:09	1
<b>Chloromethane</b>	<b>1.9</b>		1.0		ug/m3			01/25/18 10:09	1
<b>n-Butane</b>	<b>12</b>		1.2		ug/m3			01/25/18 10:09	1
<b>Vinyl chloride</b>	<b>0.099</b>		0.089		ug/m3			01/25/18 10:09	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/25/18 10:09	1
Bromomethane	0.78	U	0.78		ug/m3			01/25/18 10:09	1
Chloroethane	1.3	U	1.3		ug/m3			01/25/18 10:09	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/25/18 10:09	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/25/18 10:09	1
Freon TF	1.5	U	1.5		ug/m3			01/25/18 10:09	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/25/18 10:09	1
<b>Acetone</b>	<b>98</b>	<b>E</b>	12		ug/m3			01/25/18 10:09	1
<b>Isopropyl alcohol</b>	<b>270</b>	<b>E</b>	12		ug/m3			01/25/18 10:09	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/25/18 10:09	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/25/18 10:09	1
<b>Methylene Chloride</b>	<b>33</b>		1.7		ug/m3			01/25/18 10:09	1
tert-Butyl alcohol	15	U	15		ug/m3			01/25/18 10:09	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/25/18 10:09	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/25/18 10:09	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Lab Sample ID: 200-41898-1**

**Date Collected: 01/11/18 17:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>n-Hexane</b>	<b>3.1</b>		0.70		ug/m3			01/25/18 10:09	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/25/18 10:09	1
<b>Methyl Ethyl Ketone</b>	<b>8.1</b>		1.5		ug/m3			01/25/18 10:09	1
<b>cis-1,2-Dichloroethene</b>	<b>0.50</b>		0.14		ug/m3			01/25/18 10:09	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/25/18 10:09	1
Chloroform	0.98	U	0.98		ug/m3			01/25/18 10:09	1
Tetrahydrofuran	15	U	15		ug/m3			01/25/18 10:09	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/25/18 10:09	1
Cyclohexane	0.69	U	0.69		ug/m3			01/25/18 10:09	1
<b>Carbon tetrachloride</b>	<b>0.38</b>		0.22		ug/m3			01/25/18 10:09	1
<b>2,2,4-Trimethylpentane</b>	<b>1.1</b>		0.93		ug/m3			01/25/18 10:09	1
<b>Benzene</b>	<b>1.0</b>		0.64		ug/m3			01/25/18 10:09	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/25/18 10:09	1
<b>n-Heptane</b>	<b>0.88</b>		0.82		ug/m3			01/25/18 10:09	1
<b>Trichloroethene</b>	<b>0.64</b>		0.19		ug/m3			01/25/18 10:09	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/25/18 10:09	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/25/18 10:09	1
1,4-Dioxane	18	U	18		ug/m3			01/25/18 10:09	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/25/18 10:09	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/25/18 10:09	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/25/18 10:09	1
<b>Toluene</b>	<b>2.1</b>		0.75		ug/m3			01/25/18 10:09	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/25/18 10:09	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/25/18 10:09	1
<b>Tetrachloroethene</b>	<b>2.3</b>		1.4		ug/m3			01/25/18 10:09	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/25/18 10:09	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/25/18 10:09	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/25/18 10:09	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/25/18 10:09	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/25/18 10:09	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/25/18 10:09	1
Xylene, o-	0.87	U	0.87		ug/m3			01/25/18 10:09	1
Xylene (total)	3.0	U	3.0		ug/m3			01/25/18 10:09	1
Styrene	0.85	U	0.85		ug/m3			01/25/18 10:09	1
Bromoform	2.1	U	2.1		ug/m3			01/25/18 10:09	1
Cumene	0.98	U	0.98		ug/m3			01/25/18 10:09	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/25/18 10:09	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/25/18 10:09	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/25/18 10:09	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/25/18 10:09	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/25/18 10:09	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/25/18 10:09	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/25/18 10:09	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/25/18 10:09	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/25/18 10:09	1
<b>1,3-Dichlorobenzene</b>	<b>1.3</b>		1.2		ug/m3			01/25/18 10:09	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/25/18 10:09	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/25/18 10:09	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Lab Sample ID: 200-41898-1**

**Date Collected: 01/11/18 17:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
n-Butylbenzene	1.1	U	1.1		ug/m3			01/25/18 10:09	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/25/18 10:09	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/25/18 10:09	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/25/18 10:09	1
Naphthalene	2.6	U	2.6		ug/m3			01/25/18 10:09	1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Freon 22	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
1,2-Dichlorotetrafluoroethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Chloromethane	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
<b>n-Butane</b>	<b>5.4</b>	<b>D</b>	2.5		ppb v/v			01/23/18 17:18	5
Vinyl chloride	0.18	U	0.18		ppb v/v			01/23/18 17:18	5
1,3-Butadiene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Bromomethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Chloroethane	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Bromoethene(Vinyl Bromide)	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Trichlorofluoromethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Freon TF	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,1-Dichloroethene	0.18	U	0.18		ppb v/v			01/23/18 17:18	5
<b>Acetone</b>	<b>44</b>	<b>D</b>	25		ppb v/v			01/23/18 17:18	5
<b>Isopropyl alcohol</b>	<b>110</b>	<b>D</b>	25		ppb v/v			01/23/18 17:18	5
Carbon disulfide	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
3-Chloropropene	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
<b>Methylene Chloride</b>	<b>9.9</b>	<b>D</b>	2.5		ppb v/v			01/23/18 17:18	5
tert-Butyl alcohol	25	U	25		ppb v/v			01/23/18 17:18	5
Methyl tert-butyl ether	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
trans-1,2-Dichloroethene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
n-Hexane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,1-Dichloroethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
<b>Methyl Ethyl Ketone</b>	<b>2.8</b>	<b>D</b>	2.5		ppb v/v			01/23/18 17:18	5
cis-1,2-Dichloroethene	0.18	U	0.18		ppb v/v			01/23/18 17:18	5
1,2-Dichloroethene, Total	2.0	U	2.0		ppb v/v			01/23/18 17:18	5
Chloroform	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Tetrahydrofuran	25	U	25		ppb v/v			01/23/18 17:18	5
1,1,1-Trichloroethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Cyclohexane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Carbon tetrachloride	0.18	U	0.18		ppb v/v			01/23/18 17:18	5
2,2,4-Trimethylpentane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Benzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,2-Dichloroethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
n-Heptane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Trichloroethene	0.18	U	0.18		ppb v/v			01/23/18 17:18	5
Methyl methacrylate	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
1,2-Dichloropropane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,4-Dioxane	25	U	25		ppb v/v			01/23/18 17:18	5
Bromodichloromethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
cis-1,3-Dichloropropene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Lab Sample ID: 200-41898-1**

**Date Collected: 01/11/18 17:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
methyl isobutyl ketone	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Toluene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
trans-1,3-Dichloropropene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,1,2-Trichloroethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Tetrachloroethene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Methyl Butyl Ketone (2-Hexanone)	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Dibromochloromethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,2-Dibromoethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Chlorobenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Ethylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
m,p-Xylene	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Xylene, o-	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Xylene (total)	3.5	U	3.5		ppb v/v			01/23/18 17:18	5
Styrene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Bromoform	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Cumene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,1,2,2-Tetrachloroethane	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
n-Propylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
4-Ethyltoluene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,3,5-Trimethylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
2-Chlorotoluene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
tert-Butylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,2,4-Trimethylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
sec-Butylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
4-Isopropyltoluene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,3-Dichlorobenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,4-Dichlorobenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Benzyl chloride	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
n-Butylbenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,2-Dichlorobenzene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
1,2,4-Trichlorobenzene	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Hexachlorobutadiene	1.0	U	1.0		ppb v/v			01/23/18 17:18	5
Naphthalene	2.5	U	2.5		ppb v/v			01/23/18 17:18	5
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	12	U	12		ug/m3			01/23/18 17:18	5
Freon 22	8.8	U	8.8		ug/m3			01/23/18 17:18	5
1,2-Dichlorotetrafluoroethane	7.0	U	7.0		ug/m3			01/23/18 17:18	5
Chloromethane	5.2	U	5.2		ug/m3			01/23/18 17:18	5
<b>n-Butane</b>	<b>13</b>	<b>D</b>	5.9		ug/m3			01/23/18 17:18	5
Vinyl chloride	0.45	U	0.45		ug/m3			01/23/18 17:18	5
1,3-Butadiene	2.2	U	2.2		ug/m3			01/23/18 17:18	5
Bromomethane	3.9	U	3.9		ug/m3			01/23/18 17:18	5
Chloroethane	6.6	U	6.6		ug/m3			01/23/18 17:18	5
Bromoethene(Vinyl Bromide)	4.4	U	4.4		ug/m3			01/23/18 17:18	5
Trichlorofluoromethane	5.6	U	5.6		ug/m3			01/23/18 17:18	5
Freon TF	7.7	U	7.7		ug/m3			01/23/18 17:18	5
1,1-Dichloroethene	0.69	U	0.69		ug/m3			01/23/18 17:18	5
<b>Acetone</b>	<b>100</b>	<b>D</b>	59		ug/m3			01/23/18 17:18	5

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-1**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>Isopropyl alcohol</b>	<b>270</b>	<b>D</b>	61		ug/m3			01/23/18 17:18	5
Carbon disulfide	7.8	U	7.8		ug/m3			01/23/18 17:18	5
3-Chloropropene	7.8	U	7.8		ug/m3			01/23/18 17:18	5
<b>Methylene Chloride</b>	<b>34</b>	<b>D</b>	8.7		ug/m3			01/23/18 17:18	5
tert-Butyl alcohol	76	U	76		ug/m3			01/23/18 17:18	5
Methyl tert-butyl ether	3.6	U	3.6		ug/m3			01/23/18 17:18	5
trans-1,2-Dichloroethene	4.0	U	4.0		ug/m3			01/23/18 17:18	5
n-Hexane	3.5	U	3.5		ug/m3			01/23/18 17:18	5
1,1-Dichloroethane	4.0	U	4.0		ug/m3			01/23/18 17:18	5
<b>Methyl Ethyl Ketone</b>	<b>8.4</b>	<b>D</b>	7.4		ug/m3			01/23/18 17:18	5
cis-1,2-Dichloroethene	0.69	U	0.69		ug/m3			01/23/18 17:18	5
1,2-Dichloroethene, Total	7.9	U	7.9		ug/m3			01/23/18 17:18	5
Chloroform	4.9	U	4.9		ug/m3			01/23/18 17:18	5
Tetrahydrofuran	74	U	74		ug/m3			01/23/18 17:18	5
1,1,1-Trichloroethane	5.5	U	5.5		ug/m3			01/23/18 17:18	5
Cyclohexane	3.4	U	3.4		ug/m3			01/23/18 17:18	5
Carbon tetrachloride	1.1	U	1.1		ug/m3			01/23/18 17:18	5
2,2,4-Trimethylpentane	4.7	U	4.7		ug/m3			01/23/18 17:18	5
Benzene	3.2	U	3.2		ug/m3			01/23/18 17:18	5
1,2-Dichloroethane	4.0	U	4.0		ug/m3			01/23/18 17:18	5
n-Heptane	4.1	U	4.1		ug/m3			01/23/18 17:18	5
Trichloroethene	0.94	U	0.94		ug/m3			01/23/18 17:18	5
Methyl methacrylate	10	U	10		ug/m3			01/23/18 17:18	5
1,2-Dichloropropane	4.6	U	4.6		ug/m3			01/23/18 17:18	5
1,4-Dioxane	90	U	90		ug/m3			01/23/18 17:18	5
Bromodichloromethane	6.7	U	6.7		ug/m3			01/23/18 17:18	5
cis-1,3-Dichloropropene	4.5	U	4.5		ug/m3			01/23/18 17:18	5
methyl isobutyl ketone	10	U	10		ug/m3			01/23/18 17:18	5
Toluene	3.8	U	3.8		ug/m3			01/23/18 17:18	5
trans-1,3-Dichloropropene	4.5	U	4.5		ug/m3			01/23/18 17:18	5
1,1,2-Trichloroethane	5.5	U	5.5		ug/m3			01/23/18 17:18	5
Tetrachloroethene	6.8	U	6.8		ug/m3			01/23/18 17:18	5
Methyl Butyl Ketone (2-Hexanone)	10	U	10		ug/m3			01/23/18 17:18	5
Dibromochloromethane	8.5	U	8.5		ug/m3			01/23/18 17:18	5
1,2-Dibromoethane	7.7	U	7.7		ug/m3			01/23/18 17:18	5
Chlorobenzene	4.6	U	4.6		ug/m3			01/23/18 17:18	5
Ethylbenzene	4.3	U	4.3		ug/m3			01/23/18 17:18	5
m,p-Xylene	11	U	11		ug/m3			01/23/18 17:18	5
Xylene, o-	4.3	U	4.3		ug/m3			01/23/18 17:18	5
Xylene (total)	15	U	15		ug/m3			01/23/18 17:18	5
Styrene	4.3	U	4.3		ug/m3			01/23/18 17:18	5
Bromoform	10	U	10		ug/m3			01/23/18 17:18	5
Cumene	4.9	U	4.9		ug/m3			01/23/18 17:18	5
1,1,2,2-Tetrachloroethane	6.9	U	6.9		ug/m3			01/23/18 17:18	5
n-Propylbenzene	4.9	U	4.9		ug/m3			01/23/18 17:18	5
4-Ethyltoluene	4.9	U	4.9		ug/m3			01/23/18 17:18	5
1,3,5-Trimethylbenzene	4.9	U	4.9		ug/m3			01/23/18 17:18	5
2-Chlorotoluene	5.2	U	5.2		ug/m3			01/23/18 17:18	5

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-1**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
tert-Butylbenzene	5.5	U	5.5		ug/m3			01/23/18 17:18	5
1,2,4-Trimethylbenzene	4.9	U	4.9		ug/m3			01/23/18 17:18	5
sec-Butylbenzene	5.5	U	5.5		ug/m3			01/23/18 17:18	5
4-Isopropyltoluene	5.5	U	5.5		ug/m3			01/23/18 17:18	5
1,3-Dichlorobenzene	6.0	U	6.0		ug/m3			01/23/18 17:18	5
1,4-Dichlorobenzene	6.0	U	6.0		ug/m3			01/23/18 17:18	5
Benzyl chloride	5.2	U	5.2		ug/m3			01/23/18 17:18	5
n-Butylbenzene	5.5	U	5.5		ug/m3			01/23/18 17:18	5
1,2-Dichlorobenzene	6.0	U	6.0		ug/m3			01/23/18 17:18	5
1,2,4-Trichlorobenzene	19	U	19		ug/m3			01/23/18 17:18	5
Hexachlorobutadiene	11	U	11		ug/m3			01/23/18 17:18	5
Naphthalene	13	U	13		ug/m3			01/23/18 17:18	5

**Client Sample ID: SV-2**

**Date Collected: 01/11/18 17:20**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-2**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
Freon 22	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
<b>Chloromethane</b>	<b>1.8</b>		0.50		ppb v/v			01/19/18 23:56	1
<b>n-Butane</b>	<b>4.3</b>		0.50		ppb v/v			01/19/18 23:56	1
<b>Vinyl chloride</b>	<b>0.11</b>		0.035		ppb v/v			01/19/18 23:56	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Bromomethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Chloroethane	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
<b>Trichlorofluoromethane</b>	<b>0.21</b>		0.20		ppb v/v			01/19/18 23:56	1
Freon TF	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/19/18 23:56	1
<b>Acetone</b>	<b>65</b>	<b>E</b>	5.0		ppb v/v			01/19/18 23:56	1
<b>Isopropyl alcohol</b>	<b>56</b>	<b>E</b>	5.0		ppb v/v			01/19/18 23:56	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
<b>Methylene Chloride</b>	<b>0.97</b>		0.50		ppb v/v			01/19/18 23:56	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/19/18 23:56	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
<b>n-Hexane</b>	<b>1.8</b>		0.20		ppb v/v			01/19/18 23:56	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
<b>Methyl Ethyl Ketone</b>	<b>4.2</b>		0.50		ppb v/v			01/19/18 23:56	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/19/18 23:56	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/19/18 23:56	1
Chloroform	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/19/18 23:56	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-2**

**Lab Sample ID: 200-41898-2**

**Date Collected: 01/11/18 17:20**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cyclohexane	0.69		0.20		ppb v/v			01/19/18 23:56	1
Carbon tetrachloride	0.062		0.035		ppb v/v			01/19/18 23:56	1
2,2,4-Trimethylpentane	1.3		0.20		ppb v/v			01/19/18 23:56	1
Benzene	0.84		0.20		ppb v/v			01/19/18 23:56	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
n-Heptane	0.90		0.20		ppb v/v			01/19/18 23:56	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/19/18 23:56	1
Methyl methacrylate	3.9		0.50		ppb v/v			01/19/18 23:56	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/19/18 23:56	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
Toluene	3.3		0.20		ppb v/v			01/19/18 23:56	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Ethylbenzene	1.2		0.20		ppb v/v			01/19/18 23:56	1
m,p-Xylene	2.8		0.50		ppb v/v			01/19/18 23:56	1
Xylene, o-	1.2		0.20		ppb v/v			01/19/18 23:56	1
Xylene (total)	4.0		0.70		ppb v/v			01/19/18 23:56	1
Styrene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Bromoform	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Cumene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
4-Ethyltoluene	0.23		0.20		ppb v/v			01/19/18 23:56	1
1,3,5-Trimethylbenzene	0.22		0.20		ppb v/v			01/19/18 23:56	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,2,4-Trimethylbenzene	0.75		0.20		ppb v/v			01/19/18 23:56	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,3-Dichlorobenzene	0.30		0.20		ppb v/v			01/19/18 23:56	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/19/18 23:56	1
Naphthalene	0.50	U	0.50		ppb v/v			01/19/18 23:56	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/19/18 23:56	1
Freon 22	1.8	U	1.8		ug/m3			01/19/18 23:56	1

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-2**

**Lab Sample ID: 200-41898-2**

**Date Collected: 01/11/18 17:20**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/19/18 23:56	1
<b>Chloromethane</b>	<b>3.8</b>		1.0		ug/m3			01/19/18 23:56	1
<b>n-Butane</b>	<b>10</b>		1.2		ug/m3			01/19/18 23:56	1
<b>Vinyl chloride</b>	<b>0.28</b>		0.089		ug/m3			01/19/18 23:56	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/19/18 23:56	1
Bromomethane	0.78	U	0.78		ug/m3			01/19/18 23:56	1
Chloroethane	1.3	U	1.3		ug/m3			01/19/18 23:56	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/19/18 23:56	1
<b>Trichlorofluoromethane</b>	<b>1.2</b>		1.1		ug/m3			01/19/18 23:56	1
Freon TF	1.5	U	1.5		ug/m3			01/19/18 23:56	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/19/18 23:56	1
<b>Acetone</b>	<b>150</b>	<b>E</b>	12		ug/m3			01/19/18 23:56	1
<b>Isopropyl alcohol</b>	<b>140</b>	<b>E</b>	12		ug/m3			01/19/18 23:56	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/19/18 23:56	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/19/18 23:56	1
<b>Methylene Chloride</b>	<b>3.4</b>		1.7		ug/m3			01/19/18 23:56	1
tert-Butyl alcohol	15	U	15		ug/m3			01/19/18 23:56	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/19/18 23:56	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/19/18 23:56	1
<b>n-Hexane</b>	<b>6.3</b>		0.70		ug/m3			01/19/18 23:56	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/19/18 23:56	1
<b>Methyl Ethyl Ketone</b>	<b>12</b>		1.5		ug/m3			01/19/18 23:56	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/19/18 23:56	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/19/18 23:56	1
Chloroform	0.98	U	0.98		ug/m3			01/19/18 23:56	1
Tetrahydrofuran	15	U	15		ug/m3			01/19/18 23:56	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/19/18 23:56	1
<b>Cyclohexane</b>	<b>2.4</b>		0.69		ug/m3			01/19/18 23:56	1
<b>Carbon tetrachloride</b>	<b>0.39</b>		0.22		ug/m3			01/19/18 23:56	1
<b>2,2,4-Trimethylpentane</b>	<b>5.9</b>		0.93		ug/m3			01/19/18 23:56	1
<b>Benzene</b>	<b>2.7</b>		0.64		ug/m3			01/19/18 23:56	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/19/18 23:56	1
<b>n-Heptane</b>	<b>3.7</b>		0.82		ug/m3			01/19/18 23:56	1
Trichloroethene	0.19	U	0.19		ug/m3			01/19/18 23:56	1
<b>Methyl methacrylate</b>	<b>16</b>		2.0		ug/m3			01/19/18 23:56	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/19/18 23:56	1
1,4-Dioxane	18	U	18		ug/m3			01/19/18 23:56	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/19/18 23:56	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/19/18 23:56	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/19/18 23:56	1
<b>Toluene</b>	<b>12</b>		0.75		ug/m3			01/19/18 23:56	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/19/18 23:56	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/19/18 23:56	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/19/18 23:56	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/19/18 23:56	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/19/18 23:56	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/19/18 23:56	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/19/18 23:56	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-2**

**Lab Sample ID: 200-41898-2**

**Date Collected: 01/11/18 17:20**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ethylbenzene	5.2		0.87		ug/m3			01/19/18 23:56	1
m,p-Xylene	12		2.2		ug/m3			01/19/18 23:56	1
Xylene, o-	5.3		0.87		ug/m3			01/19/18 23:56	1
Xylene (total)	17		3.0		ug/m3			01/19/18 23:56	1
Styrene	0.85	U	0.85		ug/m3			01/19/18 23:56	1
Bromoform	2.1	U	2.1		ug/m3			01/19/18 23:56	1
Cumene	0.98	U	0.98		ug/m3			01/19/18 23:56	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/19/18 23:56	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/19/18 23:56	1
4-Ethyltoluene	1.1		0.98		ug/m3			01/19/18 23:56	1
1,3,5-Trimethylbenzene	1.1		0.98		ug/m3			01/19/18 23:56	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/19/18 23:56	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/19/18 23:56	1
1,2,4-Trimethylbenzene	3.7		0.98		ug/m3			01/19/18 23:56	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/19/18 23:56	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/19/18 23:56	1
1,3-Dichlorobenzene	1.8		1.2		ug/m3			01/19/18 23:56	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/19/18 23:56	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/19/18 23:56	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/19/18 23:56	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/19/18 23:56	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/19/18 23:56	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/19/18 23:56	1
Naphthalene	2.6	U	2.6		ug/m3			01/19/18 23:56	1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
Freon 22	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
1,2-Dichlorotetrafluoroethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Chloromethane	1.5	D	1.0		ppb v/v			01/23/18 18:08	2
n-Butane	3.9	D	1.0		ppb v/v			01/23/18 18:08	2
Vinyl chloride	0.11	D	0.070		ppb v/v			01/23/18 18:08	2
1,3-Butadiene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Bromomethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Chloroethane	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
Bromoethene(Vinyl Bromide)	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Trichlorofluoromethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Freon TF	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,1-Dichloroethene	0.070	U	0.070		ppb v/v			01/23/18 18:08	2
Acetone	58	D	10		ppb v/v			01/23/18 18:08	2
Isopropyl alcohol	45	D	10		ppb v/v			01/23/18 18:08	2
Carbon disulfide	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
3-Chloropropene	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
Methylene Chloride	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
tert-Butyl alcohol	10	U	10		ppb v/v			01/23/18 18:08	2
Methyl tert-butyl ether	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
trans-1,2-Dichloroethene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
n-Hexane	1.5	D	0.40		ppb v/v			01/23/18 18:08	2

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# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-2**

**Date Collected: 01/11/18 17:20**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-2**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1-Dichloroethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
<b>Methyl Ethyl Ketone</b>	<b>3.4</b>	<b>D</b>	1.0		ppb v/v			01/23/18 18:08	2
cis-1,2-Dichloroethene	0.070	U	0.070		ppb v/v			01/23/18 18:08	2
1,2-Dichloroethene, Total	0.80	U	0.80		ppb v/v			01/23/18 18:08	2
Chloroform	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Tetrahydrofuran	10	U	10		ppb v/v			01/23/18 18:08	2
1,1,1-Trichloroethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
<b>Cyclohexane</b>	<b>0.56</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
Carbon tetrachloride	0.070	U	0.070		ppb v/v			01/23/18 18:08	2
<b>2,2,4-Trimethylpentane</b>	<b>1.0</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
<b>Benzene</b>	<b>0.70</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
1,2-Dichloroethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
<b>n-Heptane</b>	<b>0.70</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
Trichloroethene	0.070	U	0.070		ppb v/v			01/23/18 18:08	2
<b>Methyl methacrylate</b>	<b>2.9</b>	<b>D</b>	1.0		ppb v/v			01/23/18 18:08	2
1,2-Dichloropropane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,4-Dioxane	10	U	10		ppb v/v			01/23/18 18:08	2
Bromodichloromethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
cis-1,3-Dichloropropene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
methyl isobutyl ketone	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
<b>Toluene</b>	<b>2.8</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
trans-1,3-Dichloropropene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,1,2-Trichloroethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Tetrachloroethene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Methyl Butyl Ketone (2-Hexanone)	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
Dibromochloromethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,2-Dibromoethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Chlorobenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
<b>Ethylbenzene</b>	<b>0.93</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
<b>m,p-Xylene</b>	<b>2.2</b>	<b>D</b>	1.0		ppb v/v			01/23/18 18:08	2
<b>Xylene, o-</b>	<b>0.99</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
<b>Xylene (total)</b>	<b>3.2</b>	<b>D</b>	1.4		ppb v/v			01/23/18 18:08	2
Styrene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Bromoform	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Cumene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,1,2,2-Tetrachloroethane	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
n-Propylbenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
4-Ethyltoluene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,3,5-Trimethylbenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
2-Chlorotoluene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
tert-Butylbenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
<b>1,2,4-Trimethylbenzene</b>	<b>0.60</b>	<b>D</b>	0.40		ppb v/v			01/23/18 18:08	2
sec-Butylbenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
4-Isopropyltoluene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,3-Dichlorobenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,4-Dichlorobenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Benzyl chloride	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
n-Butylbenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2

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# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-2**

**Lab Sample ID: 200-41898-2**

**Date Collected: 01/11/18 17:20**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichlorobenzene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
1,2,4-Trichlorobenzene	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
Hexachlorobutadiene	0.40	U	0.40		ppb v/v			01/23/18 18:08	2
Naphthalene	1.0	U	1.0		ppb v/v			01/23/18 18:08	2
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	4.9	U	4.9		ug/m3			01/23/18 18:08	2
Freon 22	3.5	U	3.5		ug/m3			01/23/18 18:08	2
1,2-Dichlorotetrafluoroethane	2.8	U	2.8		ug/m3			01/23/18 18:08	2
<b>Chloromethane</b>	<b>3.2</b>	<b>D</b>	2.1		ug/m3			01/23/18 18:08	2
<b>n-Butane</b>	<b>9.4</b>	<b>D</b>	2.4		ug/m3			01/23/18 18:08	2
<b>Vinyl chloride</b>	<b>0.29</b>	<b>D</b>	0.18		ug/m3			01/23/18 18:08	2
1,3-Butadiene	0.88	U	0.88		ug/m3			01/23/18 18:08	2
Bromomethane	1.6	U	1.6		ug/m3			01/23/18 18:08	2
Chloroethane	2.6	U	2.6		ug/m3			01/23/18 18:08	2
Bromoethene(Vinyl Bromide)	1.7	U	1.7		ug/m3			01/23/18 18:08	2
Trichlorofluoromethane	2.2	U	2.2		ug/m3			01/23/18 18:08	2
Freon TF	3.1	U	3.1		ug/m3			01/23/18 18:08	2
1,1-Dichloroethene	0.28	U	0.28		ug/m3			01/23/18 18:08	2
<b>Acetone</b>	<b>140</b>	<b>D</b>	24		ug/m3			01/23/18 18:08	2
<b>Isopropyl alcohol</b>	<b>110</b>	<b>D</b>	25		ug/m3			01/23/18 18:08	2
Carbon disulfide	3.1	U	3.1		ug/m3			01/23/18 18:08	2
3-Chloropropene	3.1	U	3.1		ug/m3			01/23/18 18:08	2
Methylene Chloride	3.5	U	3.5		ug/m3			01/23/18 18:08	2
tert-Butyl alcohol	30	U	30		ug/m3			01/23/18 18:08	2
Methyl tert-butyl ether	1.4	U	1.4		ug/m3			01/23/18 18:08	2
trans-1,2-Dichloroethene	1.6	U	1.6		ug/m3			01/23/18 18:08	2
<b>n-Hexane</b>	<b>5.2</b>	<b>D</b>	1.4		ug/m3			01/23/18 18:08	2
1,1-Dichloroethane	1.6	U	1.6		ug/m3			01/23/18 18:08	2
<b>Methyl Ethyl Ketone</b>	<b>10</b>	<b>D</b>	2.9		ug/m3			01/23/18 18:08	2
cis-1,2-Dichloroethene	0.28	U	0.28		ug/m3			01/23/18 18:08	2
1,2-Dichloroethene, Total	3.2	U	3.2		ug/m3			01/23/18 18:08	2
Chloroform	2.0	U	2.0		ug/m3			01/23/18 18:08	2
Tetrahydrofuran	29	U	29		ug/m3			01/23/18 18:08	2
1,1,1-Trichloroethane	2.2	U	2.2		ug/m3			01/23/18 18:08	2
<b>Cyclohexane</b>	<b>1.9</b>	<b>D</b>	1.4		ug/m3			01/23/18 18:08	2
Carbon tetrachloride	0.44	U	0.44		ug/m3			01/23/18 18:08	2
<b>2,2,4-Trimethylpentane</b>	<b>4.8</b>	<b>D</b>	1.9		ug/m3			01/23/18 18:08	2
<b>Benzene</b>	<b>2.2</b>	<b>D</b>	1.3		ug/m3			01/23/18 18:08	2
1,2-Dichloroethane	1.6	U	1.6		ug/m3			01/23/18 18:08	2
<b>n-Heptane</b>	<b>2.9</b>	<b>D</b>	1.6		ug/m3			01/23/18 18:08	2
Trichloroethene	0.38	U	0.38		ug/m3			01/23/18 18:08	2
<b>Methyl methacrylate</b>	<b>12</b>	<b>D</b>	4.1		ug/m3			01/23/18 18:08	2
1,2-Dichloropropane	1.8	U	1.8		ug/m3			01/23/18 18:08	2
1,4-Dioxane	36	U	36		ug/m3			01/23/18 18:08	2
Bromodichloromethane	2.7	U	2.7		ug/m3			01/23/18 18:08	2
cis-1,3-Dichloropropene	1.8	U	1.8		ug/m3			01/23/18 18:08	2
methyl isobutyl ketone	4.1	U	4.1		ug/m3			01/23/18 18:08	2
<b>Toluene</b>	<b>11</b>	<b>D</b>	1.5		ug/m3			01/23/18 18:08	2

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-2**

**Date Collected: 01/11/18 17:20**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-2**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
trans-1,3-Dichloropropene	1.8	U	1.8		ug/m3			01/23/18 18:08	2
1,1,2-Trichloroethane	2.2	U	2.2		ug/m3			01/23/18 18:08	2
Tetrachloroethene	2.7	U	2.7		ug/m3			01/23/18 18:08	2
Methyl Butyl Ketone (2-Hexanone)	4.1	U	4.1		ug/m3			01/23/18 18:08	2
Dibromochloromethane	3.4	U	3.4		ug/m3			01/23/18 18:08	2
1,2-Dibromoethane	3.1	U	3.1		ug/m3			01/23/18 18:08	2
Chlorobenzene	1.8	U	1.8		ug/m3			01/23/18 18:08	2
Ethylbenzene	4.0	D	1.7		ug/m3			01/23/18 18:08	2
m,p-Xylene	9.5	D	4.3		ug/m3			01/23/18 18:08	2
Xylene, o-	4.3	D	1.7		ug/m3			01/23/18 18:08	2
Xylene (total)	14	D	6.1		ug/m3			01/23/18 18:08	2
Styrene	1.7	U	1.7		ug/m3			01/23/18 18:08	2
Bromoform	4.1	U	4.1		ug/m3			01/23/18 18:08	2
Cumene	2.0	U	2.0		ug/m3			01/23/18 18:08	2
1,1,2,2-Tetrachloroethane	2.7	U	2.7		ug/m3			01/23/18 18:08	2
n-Propylbenzene	2.0	U	2.0		ug/m3			01/23/18 18:08	2
4-Ethyltoluene	2.0	U	2.0		ug/m3			01/23/18 18:08	2
1,3,5-Trimethylbenzene	2.0	U	2.0		ug/m3			01/23/18 18:08	2
2-Chlorotoluene	2.1	U	2.1		ug/m3			01/23/18 18:08	2
tert-Butylbenzene	2.2	U	2.2		ug/m3			01/23/18 18:08	2
1,2,4-Trimethylbenzene	3.0	D	2.0		ug/m3			01/23/18 18:08	2
sec-Butylbenzene	2.2	U	2.2		ug/m3			01/23/18 18:08	2
4-Isopropyltoluene	2.2	U	2.2		ug/m3			01/23/18 18:08	2
1,3-Dichlorobenzene	2.4	U	2.4		ug/m3			01/23/18 18:08	2
1,4-Dichlorobenzene	2.4	U	2.4		ug/m3			01/23/18 18:08	2
Benzyl chloride	2.1	U	2.1		ug/m3			01/23/18 18:08	2
n-Butylbenzene	2.2	U	2.2		ug/m3			01/23/18 18:08	2
1,2-Dichlorobenzene	2.4	U	2.4		ug/m3			01/23/18 18:08	2
1,2,4-Trichlorobenzene	7.4	U	7.4		ug/m3			01/23/18 18:08	2
Hexachlorobutadiene	4.3	U	4.3		ug/m3			01/23/18 18:08	2
Naphthalene	5.2	U	5.2		ug/m3			01/23/18 18:08	2

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.52		0.50		ppb v/v			01/20/18 00:47	1
Freon 22	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Chloromethane	1.4		0.50		ppb v/v			01/20/18 00:47	1
n-Butane	4.3		0.50		ppb v/v			01/20/18 00:47	1
Vinyl chloride	0.061		0.035		ppb v/v			01/20/18 00:47	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Bromomethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Chloroethane	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/20/18 00:47	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>Trichlorofluoromethane</b>	<b>0.20</b>		0.20		ppb v/v			01/20/18 00:47	1
Freon TF	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/20/18 00:47	1
<b>Acetone</b>	<b>45</b>	<b>E</b>	5.0		ppb v/v			01/20/18 00:47	1
<b>Isopropyl alcohol</b>	<b>140</b>	<b>E</b>	5.0		ppb v/v			01/20/18 00:47	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
<b>Methylene Chloride</b>	<b>11</b>		0.50		ppb v/v			01/20/18 00:47	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/20/18 00:47	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
<b>n-Hexane</b>	<b>1.0</b>		0.20		ppb v/v			01/20/18 00:47	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
<b>Methyl Ethyl Ketone</b>	<b>2.1</b>		0.50		ppb v/v			01/20/18 00:47	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/20/18 00:47	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/20/18 00:47	1
Chloroform	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/20/18 00:47	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
<b>Cyclohexane</b>	<b>0.32</b>		0.20		ppb v/v			01/20/18 00:47	1
<b>Carbon tetrachloride</b>	<b>0.057</b>		0.035		ppb v/v			01/20/18 00:47	1
<b>2,2,4-Trimethylpentane</b>	<b>0.31</b>		0.20		ppb v/v			01/20/18 00:47	1
<b>Benzene</b>	<b>0.36</b>		0.20		ppb v/v			01/20/18 00:47	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
<b>n-Heptane</b>	<b>0.31</b>		0.20		ppb v/v			01/20/18 00:47	1
<b>Trichloroethene</b>	<b>0.036</b>		0.035		ppb v/v			01/20/18 00:47	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/20/18 00:47	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
<b>Toluene</b>	<b>0.85</b>		0.20		ppb v/v			01/20/18 00:47	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/20/18 00:47	1
Styrene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Bromoform	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Cumene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/20/18 00:47	1

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/20/18 00:47	1
Naphthalene	0.50	U	0.50		ppb v/v			01/20/18 00:47	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>Dichlorodifluoromethane</b>	<b>2.6</b>		2.5		ug/m3			01/20/18 00:47	1
Freon 22	1.8	U	1.8		ug/m3			01/20/18 00:47	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/20/18 00:47	1
<b>Chloromethane</b>	<b>3.0</b>		1.0		ug/m3			01/20/18 00:47	1
<b>n-Butane</b>	<b>10</b>		1.2		ug/m3			01/20/18 00:47	1
<b>Vinyl chloride</b>	<b>0.16</b>		0.089		ug/m3			01/20/18 00:47	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/20/18 00:47	1
Bromomethane	0.78	U	0.78		ug/m3			01/20/18 00:47	1
Chloroethane	1.3	U	1.3		ug/m3			01/20/18 00:47	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/20/18 00:47	1
<b>Trichlorofluoromethane</b>	<b>1.1</b>		1.1		ug/m3			01/20/18 00:47	1
Freon TF	1.5	U	1.5		ug/m3			01/20/18 00:47	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/20/18 00:47	1
<b>Acetone</b>	<b>110</b>	<b>E</b>	12		ug/m3			01/20/18 00:47	1
<b>Isopropyl alcohol</b>	<b>350</b>	<b>E</b>	12		ug/m3			01/20/18 00:47	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/20/18 00:47	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/20/18 00:47	1
<b>Methylene Chloride</b>	<b>39</b>		1.7		ug/m3			01/20/18 00:47	1
tert-Butyl alcohol	15	U	15		ug/m3			01/20/18 00:47	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/20/18 00:47	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/20/18 00:47	1
<b>n-Hexane</b>	<b>3.7</b>		0.70		ug/m3			01/20/18 00:47	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/20/18 00:47	1
<b>Methyl Ethyl Ketone</b>	<b>6.3</b>		1.5		ug/m3			01/20/18 00:47	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/20/18 00:47	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/20/18 00:47	1
Chloroform	0.98	U	0.98		ug/m3			01/20/18 00:47	1
Tetrahydrofuran	15	U	15		ug/m3			01/20/18 00:47	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/20/18 00:47	1
<b>Cyclohexane</b>	<b>1.1</b>		0.69		ug/m3			01/20/18 00:47	1
<b>Carbon tetrachloride</b>	<b>0.36</b>		0.22		ug/m3			01/20/18 00:47	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Lab Sample ID: 200-41898-3**

**Date Collected: 01/11/18 16:28**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
2,2,4-Trimethylpentane	1.4		0.93		ug/m3			01/20/18 00:47	1
Benzene	1.2		0.64		ug/m3			01/20/18 00:47	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/20/18 00:47	1
n-Heptane	1.3		0.82		ug/m3			01/20/18 00:47	1
Trichloroethene	0.19		0.19		ug/m3			01/20/18 00:47	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/20/18 00:47	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/20/18 00:47	1
1,4-Dioxane	18	U	18		ug/m3			01/20/18 00:47	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/20/18 00:47	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/20/18 00:47	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/20/18 00:47	1
Toluene	3.2		0.75		ug/m3			01/20/18 00:47	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/20/18 00:47	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/20/18 00:47	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/20/18 00:47	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/20/18 00:47	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/20/18 00:47	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/20/18 00:47	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/20/18 00:47	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/20/18 00:47	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/20/18 00:47	1
Xylene, o-	0.87	U	0.87		ug/m3			01/20/18 00:47	1
Xylene (total)	3.0	U	3.0		ug/m3			01/20/18 00:47	1
Styrene	0.85	U	0.85		ug/m3			01/20/18 00:47	1
Bromoform	2.1	U	2.1		ug/m3			01/20/18 00:47	1
Cumene	0.98	U	0.98		ug/m3			01/20/18 00:47	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/20/18 00:47	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/20/18 00:47	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/20/18 00:47	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/20/18 00:47	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/20/18 00:47	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 00:47	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/20/18 00:47	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 00:47	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/20/18 00:47	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 00:47	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 00:47	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/20/18 00:47	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 00:47	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 00:47	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/20/18 00:47	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/20/18 00:47	1
Naphthalene	2.6	U	2.6		ug/m3			01/20/18 00:47	1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Freon 22	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
1,2-Dichlorotetrafluoroethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloromethane	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
<b>n-Butane</b>	<b>4.1</b>	<b>D</b>	3.0		ppb v/v			01/23/18 18:58	6.06
Vinyl chloride	0.21	U	0.21		ppb v/v			01/23/18 18:58	6.06
1,3-Butadiene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Bromomethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Chloroethane	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Bromoethene(Vinyl Bromide)	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Trichlorofluoromethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Freon TF	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,1-Dichloroethene	0.21	U	0.21		ppb v/v			01/23/18 18:58	6.06
<b>Acetone</b>	<b>51</b>	<b>D</b>	30		ppb v/v			01/23/18 18:58	6.06
<b>Isopropyl alcohol</b>	<b>150</b>	<b>D</b>	30		ppb v/v			01/23/18 18:58	6.06
Carbon disulfide	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
3-Chloropropene	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
<b>Methylene Chloride</b>	<b>11</b>	<b>D</b>	3.0		ppb v/v			01/23/18 18:58	6.06
tert-Butyl alcohol	30	U	30		ppb v/v			01/23/18 18:58	6.06
Methyl tert-butyl ether	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
trans-1,2-Dichloroethene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
n-Hexane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,1-Dichloroethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Methyl Ethyl Ketone	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
cis-1,2-Dichloroethene	0.21	U	0.21		ppb v/v			01/23/18 18:58	6.06
1,2-Dichloroethene, Total	2.4	U	2.4		ppb v/v			01/23/18 18:58	6.06
Chloroform	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Tetrahydrofuran	30	U	30		ppb v/v			01/23/18 18:58	6.06
1,1,1-Trichloroethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Cyclohexane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Carbon tetrachloride	0.21	U	0.21		ppb v/v			01/23/18 18:58	6.06
2,2,4-Trimethylpentane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Benzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,2-Dichloroethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
n-Heptane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Trichloroethene	0.21	U	0.21		ppb v/v			01/23/18 18:58	6.06
Methyl methacrylate	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
1,2-Dichloropropane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,4-Dioxane	30	U	30		ppb v/v			01/23/18 18:58	6.06
Bromodichloromethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
cis-1,3-Dichloropropene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
methyl isobutyl ketone	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Toluene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
trans-1,3-Dichloropropene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,1,2-Trichloroethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Tetrachloroethene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Methyl Butyl Ketone (2-Hexanone)	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Dibromochloromethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,2-Dibromoethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Chlorobenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Ethylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
m,p-Xylene	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Xylene, o-	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Xylene (total)	4.2	U	4.2		ppb v/v			01/23/18 18:58	6.06
Styrene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Bromoform	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Cumene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,1,2,2-Tetrachloroethane	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
n-Propylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
4-Ethyltoluene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,3,5-Trimethylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
2-Chlorotoluene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
tert-Butylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,2,4-Trimethylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
sec-Butylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
4-Isopropyltoluene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,3-Dichlorobenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,4-Dichlorobenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Benzyl chloride	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
n-Butylbenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,2-Dichlorobenzene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
1,2,4-Trichlorobenzene	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Hexachlorobutadiene	1.2	U	1.2		ppb v/v			01/23/18 18:58	6.06
Naphthalene	3.0	U	3.0		ppb v/v			01/23/18 18:58	6.06
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	15	U	15		ug/m3			01/23/18 18:58	6.06
Freon 22	11	U	11		ug/m3			01/23/18 18:58	6.06
1,2-Dichlorotetrafluoroethane	8.5	U	8.5		ug/m3			01/23/18 18:58	6.06
Chloromethane	6.3	U	6.3		ug/m3			01/23/18 18:58	6.06
<b>n-Butane</b>	<b>9.7</b>	<b>D</b>	7.2		ug/m3			01/23/18 18:58	6.06
Vinyl chloride	0.54	U	0.54		ug/m3			01/23/18 18:58	6.06
1,3-Butadiene	2.7	U	2.7		ug/m3			01/23/18 18:58	6.06
Bromomethane	4.7	U	4.7		ug/m3			01/23/18 18:58	6.06
Chloroethane	8.0	U	8.0		ug/m3			01/23/18 18:58	6.06
Bromoethene(Vinyl Bromide)	5.3	U	5.3		ug/m3			01/23/18 18:58	6.06
Trichlorofluoromethane	6.8	U	6.8		ug/m3			01/23/18 18:58	6.06
Freon TF	9.3	U	9.3		ug/m3			01/23/18 18:58	6.06
1,1-Dichloroethene	0.84	U	0.84		ug/m3			01/23/18 18:58	6.06
<b>Acetone</b>	<b>120</b>	<b>D</b>	72		ug/m3			01/23/18 18:58	6.06
<b>Isopropyl alcohol</b>	<b>360</b>	<b>D</b>	74		ug/m3			01/23/18 18:58	6.06
Carbon disulfide	9.4	U	9.4		ug/m3			01/23/18 18:58	6.06
3-Chloropropene	9.5	U	9.5		ug/m3			01/23/18 18:58	6.06
<b>Methylene Chloride</b>	<b>37</b>	<b>D</b>	11		ug/m3			01/23/18 18:58	6.06
tert-Butyl alcohol	92	U	92		ug/m3			01/23/18 18:58	6.06
Methyl tert-butyl ether	4.4	U	4.4		ug/m3			01/23/18 18:58	6.06
trans-1,2-Dichloroethene	4.8	U	4.8		ug/m3			01/23/18 18:58	6.06
n-Hexane	4.3	U	4.3		ug/m3			01/23/18 18:58	6.06
1,1-Dichloroethane	4.9	U	4.9		ug/m3			01/23/18 18:58	6.06
Methyl Ethyl Ketone	8.9	U	8.9		ug/m3			01/23/18 18:58	6.06

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
cis-1,2-Dichloroethene	0.84	U	0.84		ug/m3			01/23/18 18:58	6.06
1,2-Dichloroethene, Total	9.6	U	9.6		ug/m3			01/23/18 18:58	6.06
Chloroform	5.9	U	5.9		ug/m3			01/23/18 18:58	6.06
Tetrahydrofuran	89	U	89		ug/m3			01/23/18 18:58	6.06
1,1,1-Trichloroethane	6.6	U	6.6		ug/m3			01/23/18 18:58	6.06
Cyclohexane	4.2	U	4.2		ug/m3			01/23/18 18:58	6.06
Carbon tetrachloride	1.3	U	1.3		ug/m3			01/23/18 18:58	6.06
2,2,4-Trimethylpentane	5.7	U	5.7		ug/m3			01/23/18 18:58	6.06
Benzene	3.9	U	3.9		ug/m3			01/23/18 18:58	6.06
1,2-Dichloroethane	4.9	U	4.9		ug/m3			01/23/18 18:58	6.06
n-Heptane	5.0	U	5.0		ug/m3			01/23/18 18:58	6.06
Trichloroethene	1.1	U	1.1		ug/m3			01/23/18 18:58	6.06
Methyl methacrylate	12	U	12		ug/m3			01/23/18 18:58	6.06
1,2-Dichloropropane	5.6	U	5.6		ug/m3			01/23/18 18:58	6.06
1,4-Dioxane	110	U	110		ug/m3			01/23/18 18:58	6.06
Bromodichloromethane	8.1	U	8.1		ug/m3			01/23/18 18:58	6.06
cis-1,3-Dichloropropene	5.5	U	5.5		ug/m3			01/23/18 18:58	6.06
methyl isobutyl ketone	12	U	12		ug/m3			01/23/18 18:58	6.06
Toluene	4.6	U	4.6		ug/m3			01/23/18 18:58	6.06
trans-1,3-Dichloropropene	5.5	U	5.5		ug/m3			01/23/18 18:58	6.06
1,1,2-Trichloroethane	6.6	U	6.6		ug/m3			01/23/18 18:58	6.06
Tetrachloroethene	8.2	U	8.2		ug/m3			01/23/18 18:58	6.06
Methyl Butyl Ketone (2-Hexanone)	12	U	12		ug/m3			01/23/18 18:58	6.06
Dibromochloromethane	10	U	10		ug/m3			01/23/18 18:58	6.06
1,2-Dibromoethane	9.3	U	9.3		ug/m3			01/23/18 18:58	6.06
Chlorobenzene	5.6	U	5.6		ug/m3			01/23/18 18:58	6.06
Ethylbenzene	5.3	U	5.3		ug/m3			01/23/18 18:58	6.06
m,p-Xylene	13	U	13		ug/m3			01/23/18 18:58	6.06
Xylene, o-	5.3	U	5.3		ug/m3			01/23/18 18:58	6.06
Xylene (total)	18	U	18		ug/m3			01/23/18 18:58	6.06
Styrene	5.2	U	5.2		ug/m3			01/23/18 18:58	6.06
Bromoform	13	U	13		ug/m3			01/23/18 18:58	6.06
Cumene	6.0	U	6.0		ug/m3			01/23/18 18:58	6.06
1,1,2,2-Tetrachloroethane	8.3	U	8.3		ug/m3			01/23/18 18:58	6.06
n-Propylbenzene	6.0	U	6.0		ug/m3			01/23/18 18:58	6.06
4-Ethyltoluene	6.0	U	6.0		ug/m3			01/23/18 18:58	6.06
1,3,5-Trimethylbenzene	6.0	U	6.0		ug/m3			01/23/18 18:58	6.06
2-Chlorotoluene	6.3	U	6.3		ug/m3			01/23/18 18:58	6.06
tert-Butylbenzene	6.7	U	6.7		ug/m3			01/23/18 18:58	6.06
1,2,4-Trimethylbenzene	6.0	U	6.0		ug/m3			01/23/18 18:58	6.06
sec-Butylbenzene	6.7	U	6.7		ug/m3			01/23/18 18:58	6.06
4-Isopropyltoluene	6.7	U	6.7		ug/m3			01/23/18 18:58	6.06
1,3-Dichlorobenzene	7.3	U	7.3		ug/m3			01/23/18 18:58	6.06
1,4-Dichlorobenzene	7.3	U	7.3		ug/m3			01/23/18 18:58	6.06
Benzyl chloride	6.3	U	6.3		ug/m3			01/23/18 18:58	6.06
n-Butylbenzene	6.7	U	6.7		ug/m3			01/23/18 18:58	6.06
1,2-Dichlorobenzene	7.3	U	7.3		ug/m3			01/23/18 18:58	6.06
1,2,4-Trichlorobenzene	22	U	22		ug/m3			01/23/18 18:58	6.06

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-3**

**Date Collected: 01/11/18 16:28**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-3**

**Matrix: Air**

**Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hexachlorobutadiene	13	U	13		ug/m3			01/23/18 18:58	6.06
Naphthalene	16	U	16		ug/m3			01/23/18 18:58	6.06

**Client Sample ID: SV-4**

**Date Collected: 01/11/18 16:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-4**

**Matrix: Air**

**Method: TO-15 - Volatile Organic Compounds in Ambient Air**

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
Freon 22	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Chloromethane	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
<b>n-Butane</b>	<b>3.6</b>		0.50		ppb v/v			01/20/18 01:37	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/20/18 01:37	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Bromomethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Chloroethane	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Freon TF	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/20/18 01:37	1
<b>Acetone</b>	<b>180</b>	<b>E</b>	5.0		ppb v/v			01/20/18 01:37	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/20/18 01:37	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
Methylene Chloride	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/20/18 01:37	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
<b>n-Hexane</b>	<b>0.76</b>		0.20		ppb v/v			01/20/18 01:37	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
<b>Methyl Ethyl Ketone</b>	<b>83</b>	<b>E</b>	0.50		ppb v/v			01/20/18 01:37	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/20/18 01:37	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/20/18 01:37	1
Chloroform	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
<b>Tetrahydrofuran</b>	<b>66</b>	<b>E</b>	5.0		ppb v/v			01/20/18 01:37	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
<b>Carbon tetrachloride</b>	<b>0.058</b>		0.035		ppb v/v			01/20/18 01:37	1
<b>2,2,4-Trimethylpentane</b>	<b>0.41</b>		0.20		ppb v/v			01/20/18 01:37	1
<b>Benzene</b>	<b>0.89</b>		0.20		ppb v/v			01/20/18 01:37	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
<b>n-Heptane</b>	<b>0.36</b>		0.20		ppb v/v			01/20/18 01:37	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/20/18 01:37	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/20/18 01:37	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-4**

**Date Collected: 01/11/18 16:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-4**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
<b>Toluene</b>	<b>1.1</b>		0.20		ppb v/v			01/20/18 01:37	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
<b>m,p-Xylene</b>	<b>0.60</b>		0.50		ppb v/v			01/20/18 01:37	1
<b>Xylene, o-</b>	<b>0.20</b>		0.20		ppb v/v			01/20/18 01:37	1
<b>Xylene (total)</b>	<b>0.80</b>		0.70		ppb v/v			01/20/18 01:37	1
Styrene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Bromoform	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Cumene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/20/18 01:37	1
Naphthalene	0.50	U	0.50		ppb v/v			01/20/18 01:37	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/20/18 01:37	1
Freon 22	1.8	U	1.8		ug/m3			01/20/18 01:37	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/20/18 01:37	1
Chloromethane	1.0	U	1.0		ug/m3			01/20/18 01:37	1
<b>n-Butane</b>	<b>8.5</b>		1.2		ug/m3			01/20/18 01:37	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/20/18 01:37	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/20/18 01:37	1
Bromomethane	0.78	U	0.78		ug/m3			01/20/18 01:37	1
Chloroethane	1.3	U	1.3		ug/m3			01/20/18 01:37	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/20/18 01:37	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/20/18 01:37	1
Freon TF	1.5	U	1.5		ug/m3			01/20/18 01:37	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-4**

**Lab Sample ID: 200-41898-4**

**Date Collected: 01/11/18 16:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/20/18 01:37	1
<b>Acetone</b>	<b>430</b>	<b>E</b>	12		ug/m3			01/20/18 01:37	1
Isopropyl alcohol	12	U	12		ug/m3			01/20/18 01:37	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/20/18 01:37	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/20/18 01:37	1
Methylene Chloride	1.7	U	1.7		ug/m3			01/20/18 01:37	1
tert-Butyl alcohol	15	U	15		ug/m3			01/20/18 01:37	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/20/18 01:37	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/20/18 01:37	1
<b>n-Hexane</b>	<b>2.7</b>		0.70		ug/m3			01/20/18 01:37	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/20/18 01:37	1
<b>Methyl Ethyl Ketone</b>	<b>240</b>	<b>E</b>	1.5		ug/m3			01/20/18 01:37	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/20/18 01:37	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/20/18 01:37	1
Chloroform	0.98	U	0.98		ug/m3			01/20/18 01:37	1
<b>Tetrahydrofuran</b>	<b>190</b>	<b>E</b>	15		ug/m3			01/20/18 01:37	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/20/18 01:37	1
Cyclohexane	0.69	U	0.69		ug/m3			01/20/18 01:37	1
<b>Carbon tetrachloride</b>	<b>0.36</b>		0.22		ug/m3			01/20/18 01:37	1
<b>2,2,4-Trimethylpentane</b>	<b>1.9</b>		0.93		ug/m3			01/20/18 01:37	1
<b>Benzene</b>	<b>2.8</b>		0.64		ug/m3			01/20/18 01:37	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/20/18 01:37	1
<b>n-Heptane</b>	<b>1.5</b>		0.82		ug/m3			01/20/18 01:37	1
Trichloroethene	0.19	U	0.19		ug/m3			01/20/18 01:37	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/20/18 01:37	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/20/18 01:37	1
1,4-Dioxane	18	U	18		ug/m3			01/20/18 01:37	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/20/18 01:37	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/20/18 01:37	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/20/18 01:37	1
<b>Toluene</b>	<b>4.0</b>		0.75		ug/m3			01/20/18 01:37	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/20/18 01:37	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/20/18 01:37	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/20/18 01:37	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/20/18 01:37	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/20/18 01:37	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/20/18 01:37	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/20/18 01:37	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/20/18 01:37	1
<b>m,p-Xylene</b>	<b>2.6</b>		2.2		ug/m3			01/20/18 01:37	1
<b>Xylene, o-</b>	<b>0.87</b>		0.87		ug/m3			01/20/18 01:37	1
<b>Xylene (total)</b>	<b>3.5</b>		3.0		ug/m3			01/20/18 01:37	1
Styrene	0.85	U	0.85		ug/m3			01/20/18 01:37	1
Bromoform	2.1	U	2.1		ug/m3			01/20/18 01:37	1
Cumene	0.98	U	0.98		ug/m3			01/20/18 01:37	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/20/18 01:37	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/20/18 01:37	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/20/18 01:37	1

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-4**

**Lab Sample ID: 200-41898-4**

**Date Collected: 01/11/18 16:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/20/18 01:37	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/20/18 01:37	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 01:37	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/20/18 01:37	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 01:37	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/20/18 01:37	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 01:37	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 01:37	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/20/18 01:37	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 01:37	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 01:37	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/20/18 01:37	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/20/18 01:37	1
Naphthalene	2.6	U	2.6		ug/m3			01/20/18 01:37	1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Freon 22	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Chloromethane	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
n-Butane	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Vinyl chloride	0.24	U	0.24		ppb v/v			01/23/18 19:48	6.9
1,3-Butadiene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Bromomethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Chloroethane	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Bromoethene(Vinyl Bromide)	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Trichlorofluoromethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Freon TF	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,1-Dichloroethene	0.24	U	0.24		ppb v/v			01/23/18 19:48	6.9
<b>Acetone</b>	<b>140</b>	<b>D</b>	35		ppb v/v			01/23/18 19:48	6.9
Isopropyl alcohol	35	U	35		ppb v/v			01/23/18 19:48	6.9
Carbon disulfide	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
3-Chloropropene	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Methylene Chloride	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
tert-Butyl alcohol	35	U	35		ppb v/v			01/23/18 19:48	6.9
Methyl tert-butyl ether	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
trans-1,2-Dichloroethene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
n-Hexane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,1-Dichloroethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
<b>Methyl Ethyl Ketone</b>	<b>57</b>	<b>D</b>	3.5		ppb v/v			01/23/18 19:48	6.9
cis-1,2-Dichloroethene	0.24	U	0.24		ppb v/v			01/23/18 19:48	6.9
1,2-Dichloroethene, Total	2.8	U	2.8		ppb v/v			01/23/18 19:48	6.9
Chloroform	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
<b>Tetrahydrofuran</b>	<b>50</b>	<b>D</b>	35		ppb v/v			01/23/18 19:48	6.9
1,1,1-Trichloroethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Cyclohexane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Carbon tetrachloride	0.24	U	0.24		ppb v/v			01/23/18 19:48	6.9
2,2,4-Trimethylpentane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-4**

**Lab Sample ID: 200-41898-4**

**Date Collected: 01/11/18 16:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,2-Dichloroethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
n-Heptane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Trichloroethene	0.24	U	0.24		ppb v/v			01/23/18 19:48	6.9
Methyl methacrylate	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
1,2-Dichloropropane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,4-Dioxane	35	U	35		ppb v/v			01/23/18 19:48	6.9
Bromodichloromethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
cis-1,3-Dichloropropene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
methyl isobutyl ketone	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Toluene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
trans-1,3-Dichloropropene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,1,2-Trichloroethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Tetrachloroethene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Methyl Butyl Ketone (2-Hexanone)	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Dibromochloromethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,2-Dibromoethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Chlorobenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Ethylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
m,p-Xylene	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Xylene, o-	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Xylene (total)	4.8	U	4.8		ppb v/v			01/23/18 19:48	6.9
Styrene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Bromoform	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Cumene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
n-Propylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
4-Ethyltoluene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,3,5-Trimethylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
2-Chlorotoluene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
tert-Butylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,2,4-Trimethylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
sec-Butylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
4-Isopropyltoluene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,3-Dichlorobenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,4-Dichlorobenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Benzyl chloride	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
n-Butylbenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,2-Dichlorobenzene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
1,2,4-Trichlorobenzene	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Hexachlorobutadiene	1.4	U	1.4		ppb v/v			01/23/18 19:48	6.9
Naphthalene	3.5	U	3.5		ppb v/v			01/23/18 19:48	6.9
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	17	U	17		ug/m3			01/23/18 19:48	6.9
Freon 22	12	U	12		ug/m3			01/23/18 19:48	6.9
1,2-Dichlorotetrafluoroethane	9.6	U	9.6		ug/m3			01/23/18 19:48	6.9
Chloromethane	7.1	U	7.1		ug/m3			01/23/18 19:48	6.9
n-Butane	8.2	U	8.2		ug/m3			01/23/18 19:48	6.9

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-4**

**Lab Sample ID: 200-41898-4**

**Date Collected: 01/11/18 16:05**

**Matrix: Air**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Vinyl chloride	0.62	U	0.62		ug/m3			01/23/18 19:48	6.9
1,3-Butadiene	3.1	U	3.1		ug/m3			01/23/18 19:48	6.9
Bromomethane	5.4	U	5.4		ug/m3			01/23/18 19:48	6.9
Chloroethane	9.1	U	9.1		ug/m3			01/23/18 19:48	6.9
Bromoethene(Vinyl Bromide)	6.0	U	6.0		ug/m3			01/23/18 19:48	6.9
Trichlorofluoromethane	7.8	U	7.8		ug/m3			01/23/18 19:48	6.9
Freon TF	11	U	11		ug/m3			01/23/18 19:48	6.9
1,1-Dichloroethene	0.96	U	0.96		ug/m3			01/23/18 19:48	6.9
Acetone	340	D	82		ug/m3			01/23/18 19:48	6.9
Isopropyl alcohol	85	U	85		ug/m3			01/23/18 19:48	6.9
Carbon disulfide	11	U	11		ug/m3			01/23/18 19:48	6.9
3-Chloropropene	11	U	11		ug/m3			01/23/18 19:48	6.9
Methylene Chloride	12	U	12		ug/m3			01/23/18 19:48	6.9
tert-Butyl alcohol	100	U	100		ug/m3			01/23/18 19:48	6.9
Methyl tert-butyl ether	5.0	U	5.0		ug/m3			01/23/18 19:48	6.9
trans-1,2-Dichloroethene	5.5	U	5.5		ug/m3			01/23/18 19:48	6.9
n-Hexane	4.9	U	4.9		ug/m3			01/23/18 19:48	6.9
1,1-Dichloroethane	5.6	U	5.6		ug/m3			01/23/18 19:48	6.9
Methyl Ethyl Ketone	170	D	10		ug/m3			01/23/18 19:48	6.9
cis-1,2-Dichloroethene	0.96	U	0.96		ug/m3			01/23/18 19:48	6.9
1,2-Dichloroethene, Total	11	U	11		ug/m3			01/23/18 19:48	6.9
Chloroform	6.7	U	6.7		ug/m3			01/23/18 19:48	6.9
Tetrahydrofuran	150	D	100		ug/m3			01/23/18 19:48	6.9
1,1,1-Trichloroethane	7.5	U	7.5		ug/m3			01/23/18 19:48	6.9
Cyclohexane	4.8	U	4.8		ug/m3			01/23/18 19:48	6.9
Carbon tetrachloride	1.5	U	1.5		ug/m3			01/23/18 19:48	6.9
2,2,4-Trimethylpentane	6.4	U	6.4		ug/m3			01/23/18 19:48	6.9
Benzene	4.4	U	4.4		ug/m3			01/23/18 19:48	6.9
1,2-Dichloroethane	5.6	U	5.6		ug/m3			01/23/18 19:48	6.9
n-Heptane	5.7	U	5.7		ug/m3			01/23/18 19:48	6.9
Trichloroethene	1.3	U	1.3		ug/m3			01/23/18 19:48	6.9
Methyl methacrylate	14	U	14		ug/m3			01/23/18 19:48	6.9
1,2-Dichloropropane	6.4	U	6.4		ug/m3			01/23/18 19:48	6.9
1,4-Dioxane	120	U	120		ug/m3			01/23/18 19:48	6.9
Bromodichloromethane	9.2	U	9.2		ug/m3			01/23/18 19:48	6.9
cis-1,3-Dichloropropene	6.3	U	6.3		ug/m3			01/23/18 19:48	6.9
methyl isobutyl ketone	14	U	14		ug/m3			01/23/18 19:48	6.9
Toluene	5.2	U	5.2		ug/m3			01/23/18 19:48	6.9
trans-1,3-Dichloropropene	6.3	U	6.3		ug/m3			01/23/18 19:48	6.9
1,1,2-Trichloroethane	7.5	U	7.5		ug/m3			01/23/18 19:48	6.9
Tetrachloroethene	9.4	U	9.4		ug/m3			01/23/18 19:48	6.9
Methyl Butyl Ketone (2-Hexanone)	14	U	14		ug/m3			01/23/18 19:48	6.9
Dibromochloromethane	12	U	12		ug/m3			01/23/18 19:48	6.9
1,2-Dibromoethane	11	U	11		ug/m3			01/23/18 19:48	6.9
Chlorobenzene	6.4	U	6.4		ug/m3			01/23/18 19:48	6.9
Ethylbenzene	6.0	U	6.0		ug/m3			01/23/18 19:48	6.9
m,p-Xylene	15	U	15		ug/m3			01/23/18 19:48	6.9
Xylene, o-	6.0	U	6.0		ug/m3			01/23/18 19:48	6.9

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: SV-4**

**Date Collected: 01/11/18 16:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-4**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Xylene (total)	21	U	21		ug/m3			01/23/18 19:48	6.9
Styrene	5.9	U	5.9		ug/m3			01/23/18 19:48	6.9
Bromoform	14	U	14		ug/m3			01/23/18 19:48	6.9
Cumene	6.8	U	6.8		ug/m3			01/23/18 19:48	6.9
1,1,2,2-Tetrachloroethane	9.5	U	9.5		ug/m3			01/23/18 19:48	6.9
n-Propylbenzene	6.8	U	6.8		ug/m3			01/23/18 19:48	6.9
4-Ethyltoluene	6.8	U	6.8		ug/m3			01/23/18 19:48	6.9
1,3,5-Trimethylbenzene	6.8	U	6.8		ug/m3			01/23/18 19:48	6.9
2-Chlorotoluene	7.1	U	7.1		ug/m3			01/23/18 19:48	6.9
tert-Butylbenzene	7.6	U	7.6		ug/m3			01/23/18 19:48	6.9
1,2,4-Trimethylbenzene	6.8	U	6.8		ug/m3			01/23/18 19:48	6.9
sec-Butylbenzene	7.6	U	7.6		ug/m3			01/23/18 19:48	6.9
4-Isopropyltoluene	7.6	U	7.6		ug/m3			01/23/18 19:48	6.9
1,3-Dichlorobenzene	8.3	U	8.3		ug/m3			01/23/18 19:48	6.9
1,4-Dichlorobenzene	8.3	U	8.3		ug/m3			01/23/18 19:48	6.9
Benzyl chloride	7.1	U	7.1		ug/m3			01/23/18 19:48	6.9
n-Butylbenzene	7.6	U	7.6		ug/m3			01/23/18 19:48	6.9
1,2-Dichlorobenzene	8.3	U	8.3		ug/m3			01/23/18 19:48	6.9
1,2,4-Trichlorobenzene	26	U	26		ug/m3			01/23/18 19:48	6.9
Hexachlorobutadiene	15	U	15		ug/m3			01/23/18 19:48	6.9
Naphthalene	18	U	18		ug/m3			01/23/18 19:48	6.9

**Client Sample ID: AMB-1**

**Date Collected: 01/11/18 15:36**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-5**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
Freon 22	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Chloromethane	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
<b>n-Butane</b>	<b>4.3</b>		0.50		ppb v/v			01/18/18 20:47	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/18/18 20:47	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Bromomethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Chloroethane	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
<b>Trichlorofluoromethane</b>	<b>0.20</b>		0.20		ppb v/v			01/18/18 20:47	1
Freon TF	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 20:47	1
<b>Acetone</b>	<b>9.6</b>		5.0		ppb v/v			01/18/18 20:47	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 20:47	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
<b>Methylene Chloride</b>	<b>10</b>		0.50		ppb v/v			01/18/18 20:47	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 20:47	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/18/18 20:47	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-1**

**Date Collected: 01/11/18 15:36**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-5**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
<b>n-Hexane</b>	<b>0.99</b>		0.20		ppb v/v			01/18/18 20:47	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
<b>Methyl Ethyl Ketone</b>	<b>2.3</b>		0.50		ppb v/v			01/18/18 20:47	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 20:47	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/18/18 20:47	1
Chloroform	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/18/18 20:47	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
<b>Carbon tetrachloride</b>	<b>0.062</b>		0.035		ppb v/v			01/18/18 20:47	1
<b>2,2,4-Trimethylpentane</b>	<b>0.21</b>		0.20		ppb v/v			01/18/18 20:47	1
<b>Benzene</b>	<b>0.31</b>		0.20		ppb v/v			01/18/18 20:47	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
n-Heptane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/18/18 20:47	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/18/18 20:47	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
<b>Toluene</b>	<b>0.45</b>		0.20		ppb v/v			01/18/18 20:47	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/18/18 20:47	1
Styrene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Bromoform	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Cumene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-1**

**Date Collected: 01/11/18 15:36**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-5**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzyl chloride	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/18/18 20:47	1
Naphthalene	0.50	U	0.50		ppb v/v			01/18/18 20:47	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/18/18 20:47	1
Freon 22	1.8	U	1.8		ug/m3			01/18/18 20:47	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/18/18 20:47	1
Chloromethane	1.0	U	1.0		ug/m3			01/18/18 20:47	1
<b>n-Butane</b>	<b>10</b>		1.2		ug/m3			01/18/18 20:47	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/18/18 20:47	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/18/18 20:47	1
Bromomethane	0.78	U	0.78		ug/m3			01/18/18 20:47	1
Chloroethane	1.3	U	1.3		ug/m3			01/18/18 20:47	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/18/18 20:47	1
<b>Trichlorofluoromethane</b>	<b>1.1</b>		1.1		ug/m3			01/18/18 20:47	1
Freon TF	1.5	U	1.5		ug/m3			01/18/18 20:47	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 20:47	1
<b>Acetone</b>	<b>23</b>		12		ug/m3			01/18/18 20:47	1
Isopropyl alcohol	12	U	12		ug/m3			01/18/18 20:47	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/18/18 20:47	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/18/18 20:47	1
<b>Methylene Chloride</b>	<b>36</b>		1.7		ug/m3			01/18/18 20:47	1
tert-Butyl alcohol	15	U	15		ug/m3			01/18/18 20:47	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/18/18 20:47	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/18/18 20:47	1
<b>n-Hexane</b>	<b>3.5</b>		0.70		ug/m3			01/18/18 20:47	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 20:47	1
<b>Methyl Ethyl Ketone</b>	<b>6.8</b>		1.5		ug/m3			01/18/18 20:47	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 20:47	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/18/18 20:47	1
Chloroform	0.98	U	0.98		ug/m3			01/18/18 20:47	1
Tetrahydrofuran	15	U	15		ug/m3			01/18/18 20:47	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 20:47	1
Cyclohexane	0.69	U	0.69		ug/m3			01/18/18 20:47	1
<b>Carbon tetrachloride</b>	<b>0.39</b>		0.22		ug/m3			01/18/18 20:47	1
<b>2,2,4-Trimethylpentane</b>	<b>0.99</b>		0.93		ug/m3			01/18/18 20:47	1
<b>Benzene</b>	<b>1.0</b>		0.64		ug/m3			01/18/18 20:47	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 20:47	1
n-Heptane	0.82	U	0.82		ug/m3			01/18/18 20:47	1
Trichloroethene	0.19	U	0.19		ug/m3			01/18/18 20:47	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/18/18 20:47	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/18/18 20:47	1
1,4-Dioxane	18	U	18		ug/m3			01/18/18 20:47	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/18/18 20:47	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 20:47	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-1**

**Date Collected: 01/11/18 15:36**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-5**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/18/18 20:47	1
<b>Toluene</b>	<b>1.7</b>		0.75		ug/m3			01/18/18 20:47	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 20:47	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 20:47	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/18/18 20:47	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/18/18 20:47	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/18/18 20:47	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/18/18 20:47	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/18/18 20:47	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/18/18 20:47	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/18/18 20:47	1
Xylene, o-	0.87	U	0.87		ug/m3			01/18/18 20:47	1
Xylene (total)	3.0	U	3.0		ug/m3			01/18/18 20:47	1
Styrene	0.85	U	0.85		ug/m3			01/18/18 20:47	1
Bromoform	2.1	U	2.1		ug/m3			01/18/18 20:47	1
Cumene	0.98	U	0.98		ug/m3			01/18/18 20:47	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/18/18 20:47	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/18/18 20:47	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/18/18 20:47	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 20:47	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/18/18 20:47	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 20:47	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 20:47	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 20:47	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/18/18 20:47	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 20:47	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 20:47	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/18/18 20:47	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 20:47	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 20:47	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/18/18 20:47	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/18/18 20:47	1
Naphthalene	2.6	U	2.6		ug/m3			01/18/18 20:47	1

**Client Sample ID: AMB-2**

**Date Collected: 01/11/18 15:38**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-6**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
Freon 22	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
<b>Chloromethane</b>	<b>0.52</b>		0.50		ppb v/v			01/18/18 21:37	1
<b>n-Butane</b>	<b>36</b>		0.50		ppb v/v			01/18/18 21:37	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/18/18 21:37	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Bromomethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-2**

**Date Collected: 01/11/18 15:38**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-6**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloroethane	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Freon TF	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 21:37	1
Acetone	5.0	U	5.0		ppb v/v			01/18/18 21:37	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 21:37	1
<b>Carbon disulfide</b>	<b>0.81</b>		0.50		ppb v/v			01/18/18 21:37	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
Methylene Chloride	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 21:37	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
<b>n-Hexane</b>	<b>1.2</b>		0.20		ppb v/v			01/18/18 21:37	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
<b>Methyl Ethyl Ketone</b>	<b>0.56</b>		0.50		ppb v/v			01/18/18 21:37	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 21:37	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/18/18 21:37	1
Chloroform	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/18/18 21:37	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
<b>Cyclohexane</b>	<b>0.36</b>		0.20		ppb v/v			01/18/18 21:37	1
<b>Carbon tetrachloride</b>	<b>0.064</b>		0.035		ppb v/v			01/18/18 21:37	1
<b>2,2,4-Trimethylpentane</b>	<b>0.48</b>		0.20		ppb v/v			01/18/18 21:37	1
<b>Benzene</b>	<b>0.74</b>		0.20		ppb v/v			01/18/18 21:37	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
<b>n-Heptane</b>	<b>0.24</b>		0.20		ppb v/v			01/18/18 21:37	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/18/18 21:37	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/18/18 21:37	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
<b>Toluene</b>	<b>1.1</b>		0.20		ppb v/v			01/18/18 21:37	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
<b>Ethylbenzene</b>	<b>0.29</b>		0.20		ppb v/v			01/18/18 21:37	1
<b>m,p-Xylene</b>	<b>0.60</b>		0.50		ppb v/v			01/18/18 21:37	1
<b>Xylene, o-</b>	<b>0.24</b>		0.20		ppb v/v			01/18/18 21:37	1
<b>Xylene (total)</b>	<b>0.84</b>		0.70		ppb v/v			01/18/18 21:37	1
Styrene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Bromoform	0.20	U	0.20		ppb v/v			01/18/18 21:37	1

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-2**

**Date Collected: 01/11/18 15:38**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-6**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cumene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/18/18 21:37	1
Naphthalene	0.50	U	0.50		ppb v/v			01/18/18 21:37	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/18/18 21:37	1
Freon 22	1.8	U	1.8		ug/m3			01/18/18 21:37	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/18/18 21:37	1
<b>Chloromethane</b>	<b>1.1</b>		1.0		ug/m3			01/18/18 21:37	1
<b>n-Butane</b>	<b>86</b>		1.2		ug/m3			01/18/18 21:37	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/18/18 21:37	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/18/18 21:37	1
Bromomethane	0.78	U	0.78		ug/m3			01/18/18 21:37	1
Chloroethane	1.3	U	1.3		ug/m3			01/18/18 21:37	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/18/18 21:37	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/18/18 21:37	1
Freon TF	1.5	U	1.5		ug/m3			01/18/18 21:37	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 21:37	1
Acetone	12	U	12		ug/m3			01/18/18 21:37	1
Isopropyl alcohol	12	U	12		ug/m3			01/18/18 21:37	1
<b>Carbon disulfide</b>	<b>2.5</b>		1.6		ug/m3			01/18/18 21:37	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/18/18 21:37	1
Methylene Chloride	1.7	U	1.7		ug/m3			01/18/18 21:37	1
tert-Butyl alcohol	15	U	15		ug/m3			01/18/18 21:37	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/18/18 21:37	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/18/18 21:37	1
<b>n-Hexane</b>	<b>4.2</b>		0.70		ug/m3			01/18/18 21:37	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 21:37	1
<b>Methyl Ethyl Ketone</b>	<b>1.7</b>		1.5		ug/m3			01/18/18 21:37	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 21:37	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/18/18 21:37	1
Chloroform	0.98	U	0.98		ug/m3			01/18/18 21:37	1
Tetrahydrofuran	15	U	15		ug/m3			01/18/18 21:37	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 21:37	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-2**

**Date Collected: 01/11/18 15:38**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-6**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cyclohexane	1.2		0.69		ug/m3			01/18/18 21:37	1
Carbon tetrachloride	0.40		0.22		ug/m3			01/18/18 21:37	1
2,2,4-Trimethylpentane	2.3		0.93		ug/m3			01/18/18 21:37	1
Benzene	2.4		0.64		ug/m3			01/18/18 21:37	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 21:37	1
n-Heptane	0.99		0.82		ug/m3			01/18/18 21:37	1
Trichloroethene	0.19	U	0.19		ug/m3			01/18/18 21:37	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/18/18 21:37	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/18/18 21:37	1
1,4-Dioxane	18	U	18		ug/m3			01/18/18 21:37	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/18/18 21:37	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 21:37	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/18/18 21:37	1
Toluene	4.1		0.75		ug/m3			01/18/18 21:37	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 21:37	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 21:37	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/18/18 21:37	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/18/18 21:37	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/18/18 21:37	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/18/18 21:37	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/18/18 21:37	1
Ethylbenzene	1.3		0.87		ug/m3			01/18/18 21:37	1
m,p-Xylene	2.6		2.2		ug/m3			01/18/18 21:37	1
Xylene, o-	1.0		0.87		ug/m3			01/18/18 21:37	1
Xylene (total)	3.6		3.0		ug/m3			01/18/18 21:37	1
Styrene	0.85	U	0.85		ug/m3			01/18/18 21:37	1
Bromoform	2.1	U	2.1		ug/m3			01/18/18 21:37	1
Cumene	0.98	U	0.98		ug/m3			01/18/18 21:37	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/18/18 21:37	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/18/18 21:37	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/18/18 21:37	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 21:37	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/18/18 21:37	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 21:37	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 21:37	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 21:37	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/18/18 21:37	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 21:37	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 21:37	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/18/18 21:37	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 21:37	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 21:37	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/18/18 21:37	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/18/18 21:37	1
Naphthalene	2.6	U	2.6		ug/m3			01/18/18 21:37	1

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-3**

**Date Collected: 01/11/18 15:40**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-7**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
Freon 22	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
<b>Chloromethane</b>	<b>0.51</b>		0.50		ppb v/v			01/18/18 22:27	1
<b>n-Butane</b>	<b>5.1</b>		0.50		ppb v/v			01/18/18 22:27	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/18/18 22:27	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Bromomethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Chloroethane	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Freon TF	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 22:27	1
<b>Acetone</b>	<b>6.8</b>		5.0		ppb v/v			01/18/18 22:27	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 22:27	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
<b>Methylene Chloride</b>	<b>11</b>		0.50		ppb v/v			01/18/18 22:27	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 22:27	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
<b>n-Hexane</b>	<b>0.86</b>		0.20		ppb v/v			01/18/18 22:27	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
<b>Methyl Ethyl Ketone</b>	<b>1.0</b>		0.50		ppb v/v			01/18/18 22:27	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 22:27	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/18/18 22:27	1
Chloroform	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/18/18 22:27	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
<b>Cyclohexane</b>	<b>0.20</b>		0.20		ppb v/v			01/18/18 22:27	1
<b>Carbon tetrachloride</b>	<b>0.061</b>		0.035		ppb v/v			01/18/18 22:27	1
2,2,4-Trimethylpentane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
<b>Benzene</b>	<b>0.28</b>		0.20		ppb v/v			01/18/18 22:27	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
n-Heptane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/18/18 22:27	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/18/18 22:27	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
<b>Toluene</b>	<b>0.45</b>		0.20		ppb v/v			01/18/18 22:27	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-3**

**Date Collected: 01/11/18 15:40**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-7**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/18/18 22:27	1
Styrene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Bromoform	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Cumene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/18/18 22:27	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/18/18 22:27	1
Naphthalene	0.50	U	0.50		ppb v/v			01/18/18 22:27	1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/18/18 22:27	1
Freon 22	1.8	U	1.8		ug/m3			01/18/18 22:27	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/18/18 22:27	1
<b>Chloromethane</b>	<b>1.0</b>		1.0		ug/m3			01/18/18 22:27	1
<b>n-Butane</b>	<b>12</b>		1.2		ug/m3			01/18/18 22:27	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/18/18 22:27	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/18/18 22:27	1
Bromomethane	0.78	U	0.78		ug/m3			01/18/18 22:27	1
Chloroethane	1.3	U	1.3		ug/m3			01/18/18 22:27	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/18/18 22:27	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/18/18 22:27	1
Freon TF	1.5	U	1.5		ug/m3			01/18/18 22:27	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 22:27	1
<b>Acetone</b>	<b>16</b>		12		ug/m3			01/18/18 22:27	1
Isopropyl alcohol	12	U	12		ug/m3			01/18/18 22:27	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/18/18 22:27	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/18/18 22:27	1
<b>Methylene Chloride</b>	<b>40</b>		1.7		ug/m3			01/18/18 22:27	1
tert-Butyl alcohol	15	U	15		ug/m3			01/18/18 22:27	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/18/18 22:27	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/18/18 22:27	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-3**

**Date Collected: 01/11/18 15:40**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-7**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>n-Hexane</b>	<b>3.0</b>		0.70		ug/m3			01/18/18 22:27	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 22:27	1
<b>Methyl Ethyl Ketone</b>	<b>3.1</b>		1.5		ug/m3			01/18/18 22:27	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 22:27	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/18/18 22:27	1
Chloroform	0.98	U	0.98		ug/m3			01/18/18 22:27	1
Tetrahydrofuran	15	U	15		ug/m3			01/18/18 22:27	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 22:27	1
<b>Cyclohexane</b>	<b>0.68</b>		0.69		ug/m3			01/18/18 22:27	1
<b>Carbon tetrachloride</b>	<b>0.38</b>		0.22		ug/m3			01/18/18 22:27	1
2,2,4-Trimethylpentane	0.93	U	0.93		ug/m3			01/18/18 22:27	1
<b>Benzene</b>	<b>0.90</b>		0.64		ug/m3			01/18/18 22:27	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 22:27	1
n-Heptane	0.82	U	0.82		ug/m3			01/18/18 22:27	1
Trichloroethene	0.19	U	0.19		ug/m3			01/18/18 22:27	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/18/18 22:27	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/18/18 22:27	1
1,4-Dioxane	18	U	18		ug/m3			01/18/18 22:27	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/18/18 22:27	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 22:27	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/18/18 22:27	1
<b>Toluene</b>	<b>1.7</b>		0.75		ug/m3			01/18/18 22:27	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 22:27	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 22:27	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/18/18 22:27	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/18/18 22:27	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/18/18 22:27	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/18/18 22:27	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/18/18 22:27	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/18/18 22:27	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/18/18 22:27	1
Xylene, o-	0.87	U	0.87		ug/m3			01/18/18 22:27	1
Xylene (total)	3.0	U	3.0		ug/m3			01/18/18 22:27	1
Styrene	0.85	U	0.85		ug/m3			01/18/18 22:27	1
Bromoform	2.1	U	2.1		ug/m3			01/18/18 22:27	1
Cumene	0.98	U	0.98		ug/m3			01/18/18 22:27	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/18/18 22:27	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/18/18 22:27	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/18/18 22:27	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 22:27	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/18/18 22:27	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 22:27	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 22:27	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 22:27	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/18/18 22:27	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 22:27	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 22:27	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/18/18 22:27	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-3**

**Date Collected: 01/11/18 15:40**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-7**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
n-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 22:27	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 22:27	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/18/18 22:27	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/18/18 22:27	1
Naphthalene	2.6	U	2.6		ug/m3			01/18/18 22:27	1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
Freon 22	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>Chloromethane</b>	<b>0.53</b>		0.50		ppb v/v			01/18/18 23:17	1
<b>n-Butane</b>	<b>10</b>		0.50		ppb v/v			01/18/18 23:17	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/18/18 23:17	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Bromomethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Chloroethane	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Freon TF	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 23:17	1
<b>Acetone</b>	<b>66</b>	<b>E</b>	5.0		ppb v/v			01/18/18 23:17	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 23:17	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
<b>Methylene Chloride</b>	<b>5.9</b>		0.50		ppb v/v			01/18/18 23:17	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 23:17	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>n-Hexane</b>	<b>1.2</b>		0.20		ppb v/v			01/18/18 23:17	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>Methyl Ethyl Ketone</b>	<b>20</b>		0.50		ppb v/v			01/18/18 23:17	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 23:17	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/18/18 23:17	1
Chloroform	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>Tetrahydrofuran</b>	<b>14</b>		5.0		ppb v/v			01/18/18 23:17	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>Carbon tetrachloride</b>	<b>0.058</b>		0.035		ppb v/v			01/18/18 23:17	1
<b>2,2,4-Trimethylpentane</b>	<b>0.20</b>		0.20		ppb v/v			01/18/18 23:17	1
<b>Benzene</b>	<b>0.42</b>		0.20		ppb v/v			01/18/18 23:17	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>n-Heptane</b>	<b>0.27</b>		0.20		ppb v/v			01/18/18 23:17	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/18/18 23:17	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/18/18 23:17	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
<b>Toluene</b>	<b>0.67</b>		0.20		ppb v/v			01/18/18 23:17	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/18/18 23:17	1
Styrene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Bromoform	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Cumene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
<b>1,2,4-Trimethylbenzene</b>	<b>0.25</b>		0.20		ppb v/v			01/18/18 23:17	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/18/18 23:17	1
Naphthalene	0.50	U	0.50		ppb v/v			01/18/18 23:17	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/18/18 23:17	1
Freon 22	1.8	U	1.8		ug/m3			01/18/18 23:17	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/18/18 23:17	1
<b>Chloromethane</b>	<b>1.1</b>		1.0		ug/m3			01/18/18 23:17	1
<b>n-Butane</b>	<b>24</b>		1.2		ug/m3			01/18/18 23:17	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/18/18 23:17	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/18/18 23:17	1
Bromomethane	0.78	U	0.78		ug/m3			01/18/18 23:17	1
Chloroethane	1.3	U	1.3		ug/m3			01/18/18 23:17	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/18/18 23:17	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/18/18 23:17	1
Freon TF	1.5	U	1.5		ug/m3			01/18/18 23:17	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 23:17	1
<b>Acetone</b>	<b>160</b>	<b>E</b>	12		ug/m3			01/18/18 23:17	1
Isopropyl alcohol	12	U	12		ug/m3			01/18/18 23:17	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/18/18 23:17	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/18/18 23:17	1
<b>Methylene Chloride</b>	<b>21</b>		1.7		ug/m3			01/18/18 23:17	1
tert-Butyl alcohol	15	U	15		ug/m3			01/18/18 23:17	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/18/18 23:17	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/18/18 23:17	1
<b>n-Hexane</b>	<b>4.4</b>		0.70		ug/m3			01/18/18 23:17	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 23:17	1
<b>Methyl Ethyl Ketone</b>	<b>60</b>		1.5		ug/m3			01/18/18 23:17	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 23:17	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/18/18 23:17	1
Chloroform	0.98	U	0.98		ug/m3			01/18/18 23:17	1
<b>Tetrahydrofuran</b>	<b>43</b>		15		ug/m3			01/18/18 23:17	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 23:17	1
Cyclohexane	0.69	U	0.69		ug/m3			01/18/18 23:17	1
<b>Carbon tetrachloride</b>	<b>0.37</b>		0.22		ug/m3			01/18/18 23:17	1
<b>2,2,4-Trimethylpentane</b>	<b>0.93</b>		0.93		ug/m3			01/18/18 23:17	1
<b>Benzene</b>	<b>1.4</b>		0.64		ug/m3			01/18/18 23:17	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 23:17	1
<b>n-Heptane</b>	<b>1.1</b>		0.82		ug/m3			01/18/18 23:17	1
Trichloroethene	0.19	U	0.19		ug/m3			01/18/18 23:17	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/18/18 23:17	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/18/18 23:17	1
1,4-Dioxane	18	U	18		ug/m3			01/18/18 23:17	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/18/18 23:17	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 23:17	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/18/18 23:17	1
<b>Toluene</b>	<b>2.5</b>		0.75		ug/m3			01/18/18 23:17	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 23:17	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 23:17	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/18/18 23:17	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/18/18 23:17	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/18/18 23:17	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/18/18 23:17	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/18/18 23:17	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/18/18 23:17	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/18/18 23:17	1
Xylene, o-	0.87	U	0.87		ug/m3			01/18/18 23:17	1
Xylene (total)	3.0	U	3.0		ug/m3			01/18/18 23:17	1
Styrene	0.85	U	0.85		ug/m3			01/18/18 23:17	1
Bromoform	2.1	U	2.1		ug/m3			01/18/18 23:17	1
Cumene	0.98	U	0.98		ug/m3			01/18/18 23:17	1

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/18/18 23:17	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/18/18 23:17	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/18/18 23:17	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 23:17	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/18/18 23:17	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 23:17	1
<b>1,2,4-Trimethylbenzene</b>	<b>1.2</b>		0.98		ug/m3			01/18/18 23:17	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 23:17	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/18/18 23:17	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 23:17	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 23:17	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/18/18 23:17	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 23:17	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 23:17	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/18/18 23:17	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/18/18 23:17	1
Naphthalene	2.6	U	2.6		ug/m3			01/18/18 23:17	1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
Freon 22	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
1,2-Dichlorotetrafluoroethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Chloromethane	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
<b>n-Butane</b>	<b>11</b>	<b>D</b>	1.3		ppb v/v			01/19/18 09:27	2.5
Vinyl chloride	0.088	U	0.088		ppb v/v			01/19/18 09:27	2.5
1,3-Butadiene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Bromomethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Chloroethane	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
Bromoethene(Vinyl Bromide)	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Trichlorofluoromethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Freon TF	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,1-Dichloroethene	0.088	U	0.088		ppb v/v			01/19/18 09:27	2.5
<b>Acetone</b>	<b>68</b>	<b>D</b>	13		ppb v/v			01/19/18 09:27	2.5
Isopropyl alcohol	13	U	13		ppb v/v			01/19/18 09:27	2.5
Carbon disulfide	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
3-Chloropropene	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
<b>Methylene Chloride</b>	<b>6.2</b>	<b>D</b>	1.3		ppb v/v			01/19/18 09:27	2.5
tert-Butyl alcohol	13	U	13		ppb v/v			01/19/18 09:27	2.5
Methyl tert-butyl ether	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
trans-1,2-Dichloroethene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
<b>n-Hexane</b>	<b>1.3</b>	<b>D</b>	0.50		ppb v/v			01/19/18 09:27	2.5
1,1-Dichloroethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
<b>Methyl Ethyl Ketone</b>	<b>21</b>	<b>D</b>	1.3		ppb v/v			01/19/18 09:27	2.5
cis-1,2-Dichloroethene	0.088	U	0.088		ppb v/v			01/19/18 09:27	2.5
1,2-Dichloroethene, Total	1.0	U	1.0		ppb v/v			01/19/18 09:27	2.5
Chloroform	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
<b>Tetrahydrofuran</b>	<b>15</b>	<b>D</b>	13		ppb v/v			01/19/18 09:27	2.5
1,1,1-Trichloroethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cyclohexane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Carbon tetrachloride	0.088	U	0.088		ppb v/v			01/19/18 09:27	2.5
2,2,4-Trimethylpentane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Benzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,2-Dichloroethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
n-Heptane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Trichloroethene	0.088	U	0.088		ppb v/v			01/19/18 09:27	2.5
Methyl methacrylate	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
1,2-Dichloropropane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,4-Dioxane	13	U	13		ppb v/v			01/19/18 09:27	2.5
Bromodichloromethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
cis-1,3-Dichloropropene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
methyl isobutyl ketone	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
<b>Toluene</b>	<b>0.71</b>	<b>D</b>	0.50		ppb v/v			01/19/18 09:27	2.5
trans-1,3-Dichloropropene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,1,2-Trichloroethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Tetrachloroethene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Methyl Butyl Ketone (2-Hexanone)	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
Dibromochloromethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,2-Dibromoethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Chlorobenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Ethylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
m,p-Xylene	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
Xylene, o-	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Xylene (total)	1.8	U	1.8		ppb v/v			01/19/18 09:27	2.5
Styrene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Bromoform	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Cumene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,1,2,2-Tetrachloroethane	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
n-Propylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
4-Ethyltoluene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,3,5-Trimethylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
2-Chlorotoluene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
tert-Butylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,2,4-Trimethylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
sec-Butylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
4-Isopropyltoluene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,3-Dichlorobenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,4-Dichlorobenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Benzyl chloride	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
n-Butylbenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,2-Dichlorobenzene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
1,2,4-Trichlorobenzene	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
Hexachlorobutadiene	0.50	U	0.50		ppb v/v			01/19/18 09:27	2.5
Naphthalene	1.3	U	1.3		ppb v/v			01/19/18 09:27	2.5
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	6.2	U	6.2		ug/m3			01/19/18 09:27	2.5
Freon 22	4.4	U	4.4		ug/m3			01/19/18 09:27	2.5

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichlorotetrafluoroethane	3.5	U	3.5		ug/m3			01/19/18 09:27	2.5
Chloromethane	2.6	U	2.6		ug/m3			01/19/18 09:27	2.5
<b>n-Butane</b>	<b>25</b>	<b>D</b>	3.0		ug/m3			01/19/18 09:27	2.5
Vinyl chloride	0.22	U	0.22		ug/m3			01/19/18 09:27	2.5
1,3-Butadiene	1.1	U	1.1		ug/m3			01/19/18 09:27	2.5
Bromomethane	1.9	U	1.9		ug/m3			01/19/18 09:27	2.5
Chloroethane	3.3	U	3.3		ug/m3			01/19/18 09:27	2.5
Bromoethene(Vinyl Bromide)	2.2	U	2.2		ug/m3			01/19/18 09:27	2.5
Trichlorofluoromethane	2.8	U	2.8		ug/m3			01/19/18 09:27	2.5
Freon TF	3.8	U	3.8		ug/m3			01/19/18 09:27	2.5
1,1-Dichloroethene	0.35	U	0.35		ug/m3			01/19/18 09:27	2.5
<b>Acetone</b>	<b>160</b>	<b>D</b>	30		ug/m3			01/19/18 09:27	2.5
Isopropyl alcohol	31	U	31		ug/m3			01/19/18 09:27	2.5
Carbon disulfide	3.9	U	3.9		ug/m3			01/19/18 09:27	2.5
3-Chloropropene	3.9	U	3.9		ug/m3			01/19/18 09:27	2.5
<b>Methylene Chloride</b>	<b>21</b>	<b>D</b>	4.3		ug/m3			01/19/18 09:27	2.5
tert-Butyl alcohol	38	U	38		ug/m3			01/19/18 09:27	2.5
Methyl tert-butyl ether	1.8	U	1.8		ug/m3			01/19/18 09:27	2.5
trans-1,2-Dichloroethene	2.0	U	2.0		ug/m3			01/19/18 09:27	2.5
<b>n-Hexane</b>	<b>4.5</b>	<b>D</b>	1.8		ug/m3			01/19/18 09:27	2.5
1,1-Dichloroethane	2.0	U	2.0		ug/m3			01/19/18 09:27	2.5
<b>Methyl Ethyl Ketone</b>	<b>62</b>	<b>D</b>	3.7		ug/m3			01/19/18 09:27	2.5
cis-1,2-Dichloroethene	0.35	U	0.35		ug/m3			01/19/18 09:27	2.5
1,2-Dichloroethene, Total	4.0	U	4.0		ug/m3			01/19/18 09:27	2.5
Chloroform	2.4	U	2.4		ug/m3			01/19/18 09:27	2.5
<b>Tetrahydrofuran</b>	<b>43</b>	<b>D</b>	37		ug/m3			01/19/18 09:27	2.5
1,1,1-Trichloroethane	2.7	U	2.7		ug/m3			01/19/18 09:27	2.5
Cyclohexane	1.7	U	1.7		ug/m3			01/19/18 09:27	2.5
Carbon tetrachloride	0.55	U	0.55		ug/m3			01/19/18 09:27	2.5
2,2,4-Trimethylpentane	2.3	U	2.3		ug/m3			01/19/18 09:27	2.5
Benzene	1.6	U	1.6		ug/m3			01/19/18 09:27	2.5
1,2-Dichloroethane	2.0	U	2.0		ug/m3			01/19/18 09:27	2.5
n-Heptane	2.0	U	2.0		ug/m3			01/19/18 09:27	2.5
Trichloroethene	0.47	U	0.47		ug/m3			01/19/18 09:27	2.5
Methyl methacrylate	5.1	U	5.1		ug/m3			01/19/18 09:27	2.5
1,2-Dichloropropane	2.3	U	2.3		ug/m3			01/19/18 09:27	2.5
1,4-Dioxane	45	U	45		ug/m3			01/19/18 09:27	2.5
Bromodichloromethane	3.4	U	3.4		ug/m3			01/19/18 09:27	2.5
cis-1,3-Dichloropropene	2.3	U	2.3		ug/m3			01/19/18 09:27	2.5
methyl isobutyl ketone	5.1	U	5.1		ug/m3			01/19/18 09:27	2.5
<b>Toluene</b>	<b>2.7</b>	<b>D</b>	1.9		ug/m3			01/19/18 09:27	2.5
trans-1,3-Dichloropropene	2.3	U	2.3		ug/m3			01/19/18 09:27	2.5
1,1,2-Trichloroethane	2.7	U	2.7		ug/m3			01/19/18 09:27	2.5
Tetrachloroethene	3.4	U	3.4		ug/m3			01/19/18 09:27	2.5
Methyl Butyl Ketone (2-Hexanone)	5.1	U	5.1		ug/m3			01/19/18 09:27	2.5
Dibromochloromethane	4.3	U	4.3		ug/m3			01/19/18 09:27	2.5
1,2-Dibromoethane	3.8	U	3.8		ug/m3			01/19/18 09:27	2.5
Chlorobenzene	2.3	U	2.3		ug/m3			01/19/18 09:27	2.5

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ethylbenzene	2.2	U	2.2		ug/m3			01/19/18 09:27	2.5
m,p-Xylene	5.4	U	5.4		ug/m3			01/19/18 09:27	2.5
Xylene, o-	2.2	U	2.2		ug/m3			01/19/18 09:27	2.5
Xylene (total)	7.6	U	7.6		ug/m3			01/19/18 09:27	2.5
Styrene	2.1	U	2.1		ug/m3			01/19/18 09:27	2.5
Bromoform	5.2	U	5.2		ug/m3			01/19/18 09:27	2.5
Cumene	2.5	U	2.5		ug/m3			01/19/18 09:27	2.5
1,1,2,2-Tetrachloroethane	3.4	U	3.4		ug/m3			01/19/18 09:27	2.5
n-Propylbenzene	2.5	U	2.5		ug/m3			01/19/18 09:27	2.5
4-Ethyltoluene	2.5	U	2.5		ug/m3			01/19/18 09:27	2.5
1,3,5-Trimethylbenzene	2.5	U	2.5		ug/m3			01/19/18 09:27	2.5
2-Chlorotoluene	2.6	U	2.6		ug/m3			01/19/18 09:27	2.5
tert-Butylbenzene	2.7	U	2.7		ug/m3			01/19/18 09:27	2.5
1,2,4-Trimethylbenzene	2.5	U	2.5		ug/m3			01/19/18 09:27	2.5
sec-Butylbenzene	2.7	U	2.7		ug/m3			01/19/18 09:27	2.5
4-Isopropyltoluene	2.7	U	2.7		ug/m3			01/19/18 09:27	2.5
1,3-Dichlorobenzene	3.0	U	3.0		ug/m3			01/19/18 09:27	2.5
1,4-Dichlorobenzene	3.0	U	3.0		ug/m3			01/19/18 09:27	2.5
Benzyl chloride	2.6	U	2.6		ug/m3			01/19/18 09:27	2.5
n-Butylbenzene	2.7	U	2.7		ug/m3			01/19/18 09:27	2.5
1,2-Dichlorobenzene	3.0	U	3.0		ug/m3			01/19/18 09:27	2.5
1,2,4-Trichlorobenzene	9.3	U	9.3		ug/m3			01/19/18 09:27	2.5
Hexachlorobutadiene	5.3	U	5.3		ug/m3			01/19/18 09:27	2.5
Naphthalene	6.6	U	6.6		ug/m3			01/19/18 09:27	2.5

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.59		0.50		ppb v/v			01/20/18 02:27	1
Freon 22	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Chloromethane	1.4		0.50		ppb v/v			01/20/18 02:27	1
n-Butane	9.0		0.50		ppb v/v			01/20/18 02:27	1
Vinyl chloride	0.069		0.035		ppb v/v			01/20/18 02:27	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Bromomethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Chloroethane	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Trichlorofluoromethane	0.23		0.20		ppb v/v			01/20/18 02:27	1
Freon TF	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/20/18 02:27	1
Acetone	77	E	5.0		ppb v/v			01/20/18 02:27	1
Isopropyl alcohol	200	E	5.0		ppb v/v			01/20/18 02:27	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/20/18 02:27	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>Methylene Chloride</b>	<b>9.8</b>		0.50		ppb v/v			01/20/18 02:27	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/20/18 02:27	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
<b>n-Hexane</b>	<b>1.2</b>		0.20		ppb v/v			01/20/18 02:27	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
<b>Methyl Ethyl Ketone</b>	<b>8.4</b>		0.50		ppb v/v			01/20/18 02:27	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/20/18 02:27	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/20/18 02:27	1
Chloroform	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/20/18 02:27	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
<b>Cyclohexane</b>	<b>0.25</b>		0.20		ppb v/v			01/20/18 02:27	1
<b>Carbon tetrachloride</b>	<b>0.068</b>		0.035		ppb v/v			01/20/18 02:27	1
<b>2,2,4-Trimethylpentane</b>	<b>0.35</b>		0.20		ppb v/v			01/20/18 02:27	1
<b>Benzene</b>	<b>0.48</b>		0.20		ppb v/v			01/20/18 02:27	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
<b>n-Heptane</b>	<b>0.33</b>		0.20		ppb v/v			01/20/18 02:27	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/20/18 02:27	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/20/18 02:27	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
<b>Toluene</b>	<b>0.79</b>		0.20		ppb v/v			01/20/18 02:27	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
<b>m,p-Xylene</b>	<b>0.54</b>		0.50		ppb v/v			01/20/18 02:27	1
<b>Xylene, o-</b>	<b>0.21</b>		0.20		ppb v/v			01/20/18 02:27	1
<b>Xylene (total)</b>	<b>0.75</b>		0.70		ppb v/v			01/20/18 02:27	1
Styrene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Bromoform	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Cumene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
<b>1,3-Dichlorobenzene</b>	<b>0.45</b>		0.20		ppb v/v			01/20/18 02:27	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/20/18 02:27	1
Naphthalene	0.50	U	0.50		ppb v/v			01/20/18 02:27	1
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
<b>Dichlorodifluoromethane</b>	<b>2.9</b>		2.5		ug/m3			01/20/18 02:27	1
Freon 22	1.8	U	1.8		ug/m3			01/20/18 02:27	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/20/18 02:27	1
<b>Chloromethane</b>	<b>2.9</b>		1.0		ug/m3			01/20/18 02:27	1
<b>n-Butane</b>	<b>21</b>		1.2		ug/m3			01/20/18 02:27	1
<b>Vinyl chloride</b>	<b>0.18</b>		0.089		ug/m3			01/20/18 02:27	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/20/18 02:27	1
Bromomethane	0.78	U	0.78		ug/m3			01/20/18 02:27	1
Chloroethane	1.3	U	1.3		ug/m3			01/20/18 02:27	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/20/18 02:27	1
<b>Trichlorofluoromethane</b>	<b>1.3</b>		1.1		ug/m3			01/20/18 02:27	1
Freon TF	1.5	U	1.5		ug/m3			01/20/18 02:27	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/20/18 02:27	1
<b>Acetone</b>	<b>180</b>	<b>E</b>	12		ug/m3			01/20/18 02:27	1
<b>Isopropyl alcohol</b>	<b>480</b>	<b>E</b>	12		ug/m3			01/20/18 02:27	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/20/18 02:27	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/20/18 02:27	1
<b>Methylene Chloride</b>	<b>34</b>		1.7		ug/m3			01/20/18 02:27	1
tert-Butyl alcohol	15	U	15		ug/m3			01/20/18 02:27	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/20/18 02:27	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/20/18 02:27	1
<b>n-Hexane</b>	<b>4.1</b>		0.70		ug/m3			01/20/18 02:27	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/20/18 02:27	1
<b>Methyl Ethyl Ketone</b>	<b>25</b>		1.5		ug/m3			01/20/18 02:27	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/20/18 02:27	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/20/18 02:27	1
Chloroform	0.98	U	0.98		ug/m3			01/20/18 02:27	1
Tetrahydrofuran	15	U	15		ug/m3			01/20/18 02:27	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/20/18 02:27	1
<b>Cyclohexane</b>	<b>0.86</b>		0.69		ug/m3			01/20/18 02:27	1
<b>Carbon tetrachloride</b>	<b>0.43</b>		0.22		ug/m3			01/20/18 02:27	1
<b>2,2,4-Trimethylpentane</b>	<b>1.6</b>		0.93		ug/m3			01/20/18 02:27	1
<b>Benzene</b>	<b>1.5</b>		0.64		ug/m3			01/20/18 02:27	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/20/18 02:27	1
<b>n-Heptane</b>	<b>1.4</b>		0.82		ug/m3			01/20/18 02:27	1
Trichloroethene	0.19	U	0.19		ug/m3			01/20/18 02:27	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/20/18 02:27	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/20/18 02:27	1

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,4-Dioxane	18	U	18		ug/m3			01/20/18 02:27	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/20/18 02:27	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/20/18 02:27	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/20/18 02:27	1
<b>Toluene</b>	<b>3.0</b>		0.75		ug/m3			01/20/18 02:27	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/20/18 02:27	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/20/18 02:27	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/20/18 02:27	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/20/18 02:27	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/20/18 02:27	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/20/18 02:27	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/20/18 02:27	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/20/18 02:27	1
<b>m,p-Xylene</b>	<b>2.3</b>		2.2		ug/m3			01/20/18 02:27	1
<b>Xylene, o-</b>	<b>0.93</b>		0.87		ug/m3			01/20/18 02:27	1
<b>Xylene (total)</b>	<b>3.3</b>		3.0		ug/m3			01/20/18 02:27	1
Styrene	0.85	U	0.85		ug/m3			01/20/18 02:27	1
Bromoform	2.1	U	2.1		ug/m3			01/20/18 02:27	1
Cumene	0.98	U	0.98		ug/m3			01/20/18 02:27	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/20/18 02:27	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/20/18 02:27	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/20/18 02:27	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/20/18 02:27	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/20/18 02:27	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 02:27	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/20/18 02:27	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 02:27	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/20/18 02:27	1
<b>1,3-Dichlorobenzene</b>	<b>2.7</b>		1.2		ug/m3			01/20/18 02:27	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 02:27	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/20/18 02:27	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/20/18 02:27	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/20/18 02:27	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/20/18 02:27	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/20/18 02:27	1
Naphthalene	2.6	U	2.6		ug/m3			01/20/18 02:27	1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Freon 22	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
1,2-Dichlorotetrafluoroethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Chloromethane	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
<b>n-Butane</b>	<b>6.0</b>	<b>D</b>	4.0		ppb v/v			01/23/18 20:39	8
Vinyl chloride	0.28	U	0.28		ppb v/v			01/23/18 20:39	8
1,3-Butadiene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Bromomethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Chloroethane	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Bromoethene(Vinyl Bromide)	1.6	U	1.6		ppb v/v			01/23/18 20:39	8

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Trichlorofluoromethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Freon TF	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,1-Dichloroethene	0.28	U	0.28		ppb v/v			01/23/18 20:39	8
Acetone	57	D	40		ppb v/v			01/23/18 20:39	8
Isopropyl alcohol	130	D	40		ppb v/v			01/23/18 20:39	8
Carbon disulfide	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
3-Chloropropene	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Methylene Chloride	6.7	D	4.0		ppb v/v			01/23/18 20:39	8
tert-Butyl alcohol	40	U	40		ppb v/v			01/23/18 20:39	8
Methyl tert-butyl ether	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
trans-1,2-Dichloroethene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
n-Hexane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,1-Dichloroethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Methyl Ethyl Ketone	5.5	D	4.0		ppb v/v			01/23/18 20:39	8
cis-1,2-Dichloroethene	0.28	U	0.28		ppb v/v			01/23/18 20:39	8
1,2-Dichloroethene, Total	3.2	U	3.2		ppb v/v			01/23/18 20:39	8
Chloroform	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Tetrahydrofuran	40	U	40		ppb v/v			01/23/18 20:39	8
1,1,1-Trichloroethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Cyclohexane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Carbon tetrachloride	0.28	U	0.28		ppb v/v			01/23/18 20:39	8
2,2,4-Trimethylpentane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Benzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,2-Dichloroethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
n-Heptane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Trichloroethene	0.28	U	0.28		ppb v/v			01/23/18 20:39	8
Methyl methacrylate	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
1,2-Dichloropropane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,4-Dioxane	40	U	40		ppb v/v			01/23/18 20:39	8
Bromodichloromethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
cis-1,3-Dichloropropene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
methyl isobutyl ketone	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Toluene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
trans-1,3-Dichloropropene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,1,2-Trichloroethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Tetrachloroethene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Methyl Butyl Ketone (2-Hexanone)	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Dibromochloromethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,2-Dibromoethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Chlorobenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Ethylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
m,p-Xylene	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Xylene, o-	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Xylene (total)	5.6	U	5.6		ppb v/v			01/23/18 20:39	8
Styrene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Bromoform	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Cumene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,1,2,2-Tetrachloroethane	1.6	U	1.6		ppb v/v			01/23/18 20:39	8

TestAmerica Burlington



# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
n-Propylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
4-Ethyltoluene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,3,5-Trimethylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
2-Chlorotoluene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
tert-Butylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,2,4-Trimethylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
sec-Butylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
4-Isopropyltoluene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,3-Dichlorobenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,4-Dichlorobenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Benzyl chloride	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
n-Butylbenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,2-Dichlorobenzene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
1,2,4-Trichlorobenzene	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Hexachlorobutadiene	1.6	U	1.6		ppb v/v			01/23/18 20:39	8
Naphthalene	4.0	U	4.0		ppb v/v			01/23/18 20:39	8
Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	20	U	20		ug/m3			01/23/18 20:39	8
Freon 22	14	U	14		ug/m3			01/23/18 20:39	8
1,2-Dichlorotetrafluoroethane	11	U	11		ug/m3			01/23/18 20:39	8
Chloromethane	8.3	U	8.3		ug/m3			01/23/18 20:39	8
<b>n-Butane</b>	<b>14</b>	<b>D</b>	9.5		ug/m3			01/23/18 20:39	8
Vinyl chloride	0.72	U	0.72		ug/m3			01/23/18 20:39	8
1,3-Butadiene	3.5	U	3.5		ug/m3			01/23/18 20:39	8
Bromomethane	6.2	U	6.2		ug/m3			01/23/18 20:39	8
Chloroethane	11	U	11		ug/m3			01/23/18 20:39	8
Bromoethene(Vinyl Bromide)	7.0	U	7.0		ug/m3			01/23/18 20:39	8
Trichlorofluoromethane	9.0	U	9.0		ug/m3			01/23/18 20:39	8
Freon TF	12	U	12		ug/m3			01/23/18 20:39	8
1,1-Dichloroethene	1.1	U	1.1		ug/m3			01/23/18 20:39	8
<b>Acetone</b>	<b>140</b>	<b>D</b>	95		ug/m3			01/23/18 20:39	8
<b>Isopropyl alcohol</b>	<b>320</b>	<b>D</b>	98		ug/m3			01/23/18 20:39	8
Carbon disulfide	12	U	12		ug/m3			01/23/18 20:39	8
3-Chloropropene	13	U	13		ug/m3			01/23/18 20:39	8
<b>Methylene Chloride</b>	<b>23</b>	<b>D</b>	14		ug/m3			01/23/18 20:39	8
tert-Butyl alcohol	120	U	120		ug/m3			01/23/18 20:39	8
Methyl tert-butyl ether	5.8	U	5.8		ug/m3			01/23/18 20:39	8
trans-1,2-Dichloroethene	6.3	U	6.3		ug/m3			01/23/18 20:39	8
n-Hexane	5.6	U	5.6		ug/m3			01/23/18 20:39	8
1,1-Dichloroethane	6.5	U	6.5		ug/m3			01/23/18 20:39	8
<b>Methyl Ethyl Ketone</b>	<b>16</b>	<b>D</b>	12		ug/m3			01/23/18 20:39	8
cis-1,2-Dichloroethene	1.1	U	1.1		ug/m3			01/23/18 20:39	8
1,2-Dichloroethene, Total	13	U	13		ug/m3			01/23/18 20:39	8
Chloroform	7.8	U	7.8		ug/m3			01/23/18 20:39	8
Tetrahydrofuran	120	U	120		ug/m3			01/23/18 20:39	8
1,1,1-Trichloroethane	8.7	U	8.7		ug/m3			01/23/18 20:39	8
Cyclohexane	5.5	U	5.5		ug/m3			01/23/18 20:39	8
Carbon tetrachloride	1.8	U	1.8		ug/m3			01/23/18 20:39	8

TestAmerica Burlington

# Client Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Sample Container: Summa Canister 6L**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

## Method: TO-15 - Volatile Organic Compounds in Ambient Air - DL (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
2,2,4-Trimethylpentane	7.5	U	7.5		ug/m3			01/23/18 20:39	8
Benzene	5.1	U	5.1		ug/m3			01/23/18 20:39	8
1,2-Dichloroethane	6.5	U	6.5		ug/m3			01/23/18 20:39	8
n-Heptane	6.6	U	6.6		ug/m3			01/23/18 20:39	8
Trichloroethene	1.5	U	1.5		ug/m3			01/23/18 20:39	8
Methyl methacrylate	16	U	16		ug/m3			01/23/18 20:39	8
1,2-Dichloropropane	7.4	U	7.4		ug/m3			01/23/18 20:39	8
1,4-Dioxane	140	U	140		ug/m3			01/23/18 20:39	8
Bromodichloromethane	11	U	11		ug/m3			01/23/18 20:39	8
cis-1,3-Dichloropropene	7.3	U	7.3		ug/m3			01/23/18 20:39	8
methyl isobutyl ketone	16	U	16		ug/m3			01/23/18 20:39	8
Toluene	6.0	U	6.0		ug/m3			01/23/18 20:39	8
trans-1,3-Dichloropropene	7.3	U	7.3		ug/m3			01/23/18 20:39	8
1,1,2-Trichloroethane	8.7	U	8.7		ug/m3			01/23/18 20:39	8
Tetrachloroethene	11	U	11		ug/m3			01/23/18 20:39	8
Methyl Butyl Ketone (2-Hexanone)	16	U	16		ug/m3			01/23/18 20:39	8
Dibromochloromethane	14	U	14		ug/m3			01/23/18 20:39	8
1,2-Dibromoethane	12	U	12		ug/m3			01/23/18 20:39	8
Chlorobenzene	7.4	U	7.4		ug/m3			01/23/18 20:39	8
Ethylbenzene	6.9	U	6.9		ug/m3			01/23/18 20:39	8
m,p-Xylene	17	U	17		ug/m3			01/23/18 20:39	8
Xylene, o-	6.9	U	6.9		ug/m3			01/23/18 20:39	8
Xylene (total)	24	U	24		ug/m3			01/23/18 20:39	8
Styrene	6.8	U	6.8		ug/m3			01/23/18 20:39	8
Bromoform	17	U	17		ug/m3			01/23/18 20:39	8
Cumene	7.9	U	7.9		ug/m3			01/23/18 20:39	8
1,1,2,2-Tetrachloroethane	11	U	11		ug/m3			01/23/18 20:39	8
n-Propylbenzene	7.9	U	7.9		ug/m3			01/23/18 20:39	8
4-Ethyltoluene	7.9	U	7.9		ug/m3			01/23/18 20:39	8
1,3,5-Trimethylbenzene	7.9	U	7.9		ug/m3			01/23/18 20:39	8
2-Chlorotoluene	8.3	U	8.3		ug/m3			01/23/18 20:39	8
tert-Butylbenzene	8.8	U	8.8		ug/m3			01/23/18 20:39	8
1,2,4-Trimethylbenzene	7.9	U	7.9		ug/m3			01/23/18 20:39	8
sec-Butylbenzene	8.8	U	8.8		ug/m3			01/23/18 20:39	8
4-Isopropyltoluene	8.8	U	8.8		ug/m3			01/23/18 20:39	8
1,3-Dichlorobenzene	9.6	U	9.6		ug/m3			01/23/18 20:39	8
1,4-Dichlorobenzene	9.6	U	9.6		ug/m3			01/23/18 20:39	8
Benzyl chloride	8.3	U	8.3		ug/m3			01/23/18 20:39	8
n-Butylbenzene	8.8	U	8.8		ug/m3			01/23/18 20:39	8
1,2-Dichlorobenzene	9.6	U	9.6		ug/m3			01/23/18 20:39	8
1,2,4-Trichlorobenzene	30	U	30		ug/m3			01/23/18 20:39	8
Hexachlorobutadiene	17	U	17		ug/m3			01/23/18 20:39	8
Naphthalene	21	U	21		ug/m3			01/23/18 20:39	8

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air

Lab Sample ID: MB 200-125550/5

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Freon 22	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Chloromethane	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
n-Butane	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/18/18 14:01	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Bromomethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Chloroethane	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Freon TF	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 14:01	1
Acetone	5.0	U	5.0		ppb v/v			01/18/18 14:01	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 14:01	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Methylene Chloride	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/18/18 14:01	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
n-Hexane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Methyl Ethyl Ketone	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/18/18 14:01	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/18/18 14:01	1
Chloroform	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/18/18 14:01	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Carbon tetrachloride	0.035	U	0.035		ppb v/v			01/18/18 14:01	1
2,2,4-Trimethylpentane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Benzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
n-Heptane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/18/18 14:01	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/18/18 14:01	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Toluene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125550/5

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/18/18 14:01	1
Styrene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Bromoform	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Cumene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/18/18 14:01	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/18/18 14:01	1
Naphthalene	0.50	U	0.50		ppb v/v			01/18/18 14:01	1

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/18/18 14:01	1
Freon 22	1.8	U	1.8		ug/m3			01/18/18 14:01	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/18/18 14:01	1
Chloromethane	1.0	U	1.0		ug/m3			01/18/18 14:01	1
n-Butane	1.2	U	1.2		ug/m3			01/18/18 14:01	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/18/18 14:01	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/18/18 14:01	1
Bromomethane	0.78	U	0.78		ug/m3			01/18/18 14:01	1
Chloroethane	1.3	U	1.3		ug/m3			01/18/18 14:01	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/18/18 14:01	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/18/18 14:01	1
Freon TF	1.5	U	1.5		ug/m3			01/18/18 14:01	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 14:01	1
Acetone	12	U	12		ug/m3			01/18/18 14:01	1
Isopropyl alcohol	12	U	12		ug/m3			01/18/18 14:01	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/18/18 14:01	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/18/18 14:01	1
Methylene Chloride	1.7	U	1.7		ug/m3			01/18/18 14:01	1
tert-Butyl alcohol	15	U	15		ug/m3			01/18/18 14:01	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/18/18 14:01	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125550/5

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/18/18 14:01	1
n-Hexane	0.70	U	0.70		ug/m3			01/18/18 14:01	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 14:01	1
Methyl Ethyl Ketone	1.5	U	1.5		ug/m3			01/18/18 14:01	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/18/18 14:01	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/18/18 14:01	1
Chloroform	0.98	U	0.98		ug/m3			01/18/18 14:01	1
Tetrahydrofuran	15	U	15		ug/m3			01/18/18 14:01	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 14:01	1
Cyclohexane	0.69	U	0.69		ug/m3			01/18/18 14:01	1
Carbon tetrachloride	0.22	U	0.22		ug/m3			01/18/18 14:01	1
2,2,4-Trimethylpentane	0.93	U	0.93		ug/m3			01/18/18 14:01	1
Benzene	0.64	U	0.64		ug/m3			01/18/18 14:01	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/18/18 14:01	1
n-Heptane	0.82	U	0.82		ug/m3			01/18/18 14:01	1
Trichloroethene	0.19	U	0.19		ug/m3			01/18/18 14:01	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/18/18 14:01	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/18/18 14:01	1
1,4-Dioxane	18	U	18		ug/m3			01/18/18 14:01	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/18/18 14:01	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 14:01	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/18/18 14:01	1
Toluene	0.75	U	0.75		ug/m3			01/18/18 14:01	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/18/18 14:01	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/18/18 14:01	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/18/18 14:01	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/18/18 14:01	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/18/18 14:01	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/18/18 14:01	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/18/18 14:01	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/18/18 14:01	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/18/18 14:01	1
Xylene, o-	0.87	U	0.87		ug/m3			01/18/18 14:01	1
Xylene (total)	3.0	U	3.0		ug/m3			01/18/18 14:01	1
Styrene	0.85	U	0.85		ug/m3			01/18/18 14:01	1
Bromoform	2.1	U	2.1		ug/m3			01/18/18 14:01	1
Cumene	0.98	U	0.98		ug/m3			01/18/18 14:01	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/18/18 14:01	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/18/18 14:01	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/18/18 14:01	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 14:01	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/18/18 14:01	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 14:01	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/18/18 14:01	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 14:01	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/18/18 14:01	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 14:01	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 14:01	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125550/5

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Benzyl chloride	1.0	U	1.0		ug/m3			01/18/18 14:01	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/18/18 14:01	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/18/18 14:01	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/18/18 14:01	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/18/18 14:01	1
Naphthalene	2.6	U	2.6		ug/m3			01/18/18 14:01	1

Lab Sample ID: LCS 200-125550/3

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	10.0	9.07		ppb v/v		91	68 - 128
Freon 22	10.0	8.48		ppb v/v		85	64 - 128
1,2-Dichlorotetrafluoroethane	10.0	10.3		ppb v/v		103	78 - 138
Chloromethane	10.0	8.25		ppb v/v		82	57 - 126
n-Butane	10.0	8.18		ppb v/v		82	56 - 130
Vinyl chloride	10.0	8.51		ppb v/v		85	62 - 125
1,3-Butadiene	10.0	8.39		ppb v/v		84	59 - 125
Bromomethane	10.0	9.12		ppb v/v		91	68 - 128
Chloroethane	10.0	8.59		ppb v/v		86	65 - 125
Bromoethene(Vinyl Bromide)	10.0	9.67		ppb v/v		97	67 - 127
Trichlorofluoromethane	10.0	9.40		ppb v/v		94	67 - 127
Freon TF	10.0	9.70		ppb v/v		97	68 - 128
1,1-Dichloroethene	10.0	9.52		ppb v/v		95	67 - 127
Acetone	10.0	8.86		ppb v/v		89	64 - 136
Isopropyl alcohol	10.0	8.06		ppb v/v		81	55 - 124
Carbon disulfide	10.0	10.7		ppb v/v		107	81 - 141
3-Chloropropene	10.0	8.94		ppb v/v		89	53 - 133
Methylene Chloride	10.0	8.66		ppb v/v		87	62 - 122
tert-Butyl alcohol	10.0	8.61		ppb v/v		86	64 - 124
Methyl tert-butyl ether	10.0	9.51		ppb v/v		95	67 - 127
trans-1,2-Dichloroethene	10.0	9.66		ppb v/v		97	72 - 132
n-Hexane	10.0	9.54		ppb v/v		95	71 - 131
1,1-Dichloroethane	10.0	9.21		ppb v/v		92	66 - 126
Methyl Ethyl Ketone	10.0	9.85		ppb v/v		99	62 - 122
cis-1,2-Dichloroethene	10.0	9.66		ppb v/v		97	67 - 127
Chloroform	10.0	10.1		ppb v/v		101	69 - 129
Tetrahydrofuran	10.0	8.39		ppb v/v		84	61 - 136
1,1,1-Trichloroethane	10.0	9.69		ppb v/v		97	70 - 130
Cyclohexane	10.0	9.66		ppb v/v		97	69 - 129
Carbon tetrachloride	10.0	10.4		ppb v/v		104	62 - 143
2,2,4-Trimethylpentane	10.0	9.28		ppb v/v		93	67 - 127
Benzene	10.0	9.57		ppb v/v		96	67 - 127
1,2-Dichloroethane	10.0	9.78		ppb v/v		98	67 - 132
n-Heptane	10.0	9.05		ppb v/v		91	62 - 130
Trichloroethene	10.0	10.3		ppb v/v		103	68 - 128
Methyl methacrylate	10.0	10.1		ppb v/v		101	70 - 130

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125550/3

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,2-Dichloropropane	10.0	9.68		ppb v/v		97	67 - 127
1,4-Dioxane	10.0	9.58		ppb v/v		96	66 - 132
Bromodichloromethane	10.0	10.3		ppb v/v		103	69 - 129
cis-1,3-Dichloropropene	10.0	10.3		ppb v/v		103	70 - 130
methyl isobutyl ketone	10.0	9.20		ppb v/v		92	62 - 130
Toluene	10.0	10.3		ppb v/v		103	67 - 127
trans-1,3-Dichloropropene	10.0	10.1		ppb v/v		101	69 - 129
1,1,2-Trichloroethane	10.0	10.3		ppb v/v		103	69 - 129
Tetrachloroethene	10.0	10.7		ppb v/v		107	70 - 130
Methyl Butyl Ketone (2-Hexanone)	10.0	9.49		ppb v/v		95	61 - 127
Dibromochloromethane	10.0	10.8		ppb v/v		108	66 - 130
1,2-Dibromoethane	10.0	10.6		ppb v/v		106	70 - 130
Chlorobenzene	10.0	10.3		ppb v/v		103	68 - 128
Ethylbenzene	10.0	10.2		ppb v/v		102	68 - 128
m,p-Xylene	20.0	20.5		ppb v/v		102	68 - 128
Xylene, o-	10.0	10.1		ppb v/v		101	67 - 127
Styrene	10.0	10.6		ppb v/v		106	68 - 128
Bromoform	10.0	11.9		ppb v/v		119	34 - 170
Cumene	10.0	10.1		ppb v/v		101	67 - 127
1,1,2,2-Tetrachloroethane	10.0	10.2		ppb v/v		102	69 - 129
n-Propylbenzene	10.0	9.98		ppb v/v		100	67 - 127
4-Ethyltoluene	10.0	10.4		ppb v/v		104	69 - 129
1,3,5-Trimethylbenzene	10.0	10.3		ppb v/v		103	65 - 125
2-Chlorotoluene	10.0	10.0		ppb v/v		100	67 - 127
tert-Butylbenzene	10.0	10.3		ppb v/v		103	63 - 125
1,2,4-Trimethylbenzene	10.0	10.3		ppb v/v		103	65 - 125
sec-Butylbenzene	10.0	10.2		ppb v/v		102	66 - 126
4-Isopropyltoluene	10.0	10.4		ppb v/v		104	67 - 129
1,3-Dichlorobenzene	10.0	10.3		ppb v/v		103	67 - 127
1,4-Dichlorobenzene	10.0	10.3		ppb v/v		103	66 - 126
Benzyl chloride	10.0	10.6		ppb v/v		107	54 - 135
n-Butylbenzene	10.0	10.1		ppb v/v		101	67 - 127
1,2-Dichlorobenzene	10.0	10.5		ppb v/v		105	67 - 127
1,2,4-Trichlorobenzene	10.0	9.19		ppb v/v		92	59 - 126
Hexachlorobutadiene	10.0	9.47		ppb v/v		95	62 - 130
Naphthalene	10.0	8.60		ppb v/v		86	50 - 121
Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	49	44.9		ug/m3		91	68 - 128
Freon 22	35	30.0		ug/m3		85	64 - 128
1,2-Dichlorotetrafluoroethane	70	71.7		ug/m3		103	78 - 138
Chloromethane	21	17.0		ug/m3		82	57 - 126
n-Butane	24	19.4		ug/m3		82	56 - 130
Vinyl chloride	26	21.8		ug/m3		85	62 - 125
1,3-Butadiene	22	18.6		ug/m3		84	59 - 125
Bromomethane	39	35.4		ug/m3		91	68 - 128
Chloroethane	26	22.7		ug/m3		86	65 - 125

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125550/3

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromoethene(Vinyl Bromide)	44	42.3		ug/m3		97	67 - 127
Trichlorofluoromethane	56	52.8		ug/m3		94	67 - 127
Freon TF	77	74.3		ug/m3		97	68 - 128
1,1-Dichloroethene	40	37.8		ug/m3		95	67 - 127
Acetone	24	21.0		ug/m3		89	64 - 136
Isopropyl alcohol	25	19.8		ug/m3		81	55 - 124
Carbon disulfide	31	33.3		ug/m3		107	81 - 141
3-Chloropropene	31	28.0		ug/m3		89	53 - 133
Methylene Chloride	35	30.1		ug/m3		87	62 - 122
tert-Butyl alcohol	30	26.1		ug/m3		86	64 - 124
Methyl tert-butyl ether	36	34.3		ug/m3		95	67 - 127
trans-1,2-Dichloroethene	40	38.3		ug/m3		97	72 - 132
n-Hexane	35	33.6		ug/m3		95	71 - 131
1,1-Dichloroethane	40	37.3		ug/m3		92	66 - 126
Methyl Ethyl Ketone	29	29.1		ug/m3		99	62 - 122
cis-1,2-Dichloroethene	40	38.3		ug/m3		97	67 - 127
Chloroform	49	49.4		ug/m3		101	69 - 129
Tetrahydrofuran	29	24.7		ug/m3		84	61 - 136
1,1,1-Trichloroethane	55	52.9		ug/m3		97	70 - 130
Cyclohexane	34	33.3		ug/m3		97	69 - 129
Carbon tetrachloride	63	65.3		ug/m3		104	62 - 143
2,2,4-Trimethylpentane	47	43.4		ug/m3		93	67 - 127
Benzene	32	30.6		ug/m3		96	67 - 127
1,2-Dichloroethane	40	39.6		ug/m3		98	67 - 132
n-Heptane	41	37.1		ug/m3		91	62 - 130
Trichloroethene	54	55.3		ug/m3		103	68 - 128
Methyl methacrylate	41	41.6		ug/m3		101	70 - 130
1,2-Dichloropropane	46	44.7		ug/m3		97	67 - 127
1,4-Dioxane	36	34.5		ug/m3		96	66 - 132
Bromodichloromethane	67	68.9		ug/m3		103	69 - 129
cis-1,3-Dichloropropene	45	46.9		ug/m3		103	70 - 130
methyl isobutyl ketone	41	37.7		ug/m3		92	62 - 130
Toluene	38	38.7		ug/m3		103	67 - 127
trans-1,3-Dichloropropene	45	45.9		ug/m3		101	69 - 129
1,1,2-Trichloroethane	55	56.4		ug/m3		103	69 - 129
Tetrachloroethene	68	72.7		ug/m3		107	70 - 130
Methyl Butyl Ketone (2-Hexanone)	41	38.9		ug/m3		95	61 - 127
Dibromochloromethane	85	92.0		ug/m3		108	66 - 130
1,2-Dibromoethane	77	81.5		ug/m3		106	70 - 130
Chlorobenzene	46	47.2		ug/m3		103	68 - 128
Ethylbenzene	43	44.3		ug/m3		102	68 - 128
m,p-Xylene	87	88.9		ug/m3		102	68 - 128
Xylene, o-	43	44.1		ug/m3		101	67 - 127
Styrene	43	45.0		ug/m3		106	68 - 128
Bromoform	100	123		ug/m3		119	34 - 170
Cumene	49	49.8		ug/m3		101	67 - 127
1,1,2,2-Tetrachloroethane	69	70.0		ug/m3		102	69 - 129

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125550/3

Matrix: Air

Analysis Batch: 125550

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
n-Propylbenzene	49	49.1		ug/m3		100	67 - 127
4-Ethyltoluene	49	51.3		ug/m3		104	69 - 129
1,3,5-Trimethylbenzene	49	50.7		ug/m3		103	65 - 125
2-Chlorotoluene	52	51.9		ug/m3		100	67 - 127
tert-Butylbenzene	55	56.7		ug/m3		103	63 - 125
1,2,4-Trimethylbenzene	49	50.8		ug/m3		103	65 - 125
sec-Butylbenzene	55	55.7		ug/m3		102	66 - 126
4-Isopropyltoluene	55	57.3		ug/m3		104	67 - 129
1,3-Dichlorobenzene	60	62.1		ug/m3		103	67 - 127
1,4-Dichlorobenzene	60	62.1		ug/m3		103	66 - 126
Benzyl chloride	52	55.1		ug/m3		107	54 - 135
n-Butylbenzene	55	55.5		ug/m3		101	67 - 127
1,2-Dichlorobenzene	60	63.1		ug/m3		105	67 - 127
1,2,4-Trichlorobenzene	74	68.2		ug/m3		92	59 - 126
Hexachlorobutadiene	110	101		ug/m3		95	62 - 130
Naphthalene	52	45.1		ug/m3		86	50 - 121

Lab Sample ID: MB 200-125595/4

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Freon 22	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Chloromethane	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
n-Butane	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/19/18 13:53	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Bromomethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Chloroethane	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Freon TF	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/19/18 13:53	1
Acetone	5.0	U	5.0		ppb v/v			01/19/18 13:53	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/19/18 13:53	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Methylene Chloride	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/19/18 13:53	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
n-Hexane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Methyl Ethyl Ketone	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/19/18 13:53	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/19/18 13:53	1

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125595/4

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloroform	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/19/18 13:53	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Carbon tetrachloride	0.035	U	0.035		ppb v/v			01/19/18 13:53	1
2,2,4-Trimethylpentane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Benzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
n-Heptane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/19/18 13:53	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/19/18 13:53	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Toluene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/19/18 13:53	1
Styrene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Bromoform	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Cumene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/19/18 13:53	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/19/18 13:53	1
Naphthalene	0.50	U	0.50		ppb v/v			01/19/18 13:53	1

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/19/18 13:53	1
Freon 22	1.8	U	1.8		ug/m3			01/19/18 13:53	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/19/18 13:53	1
Chloromethane	1.0	U	1.0		ug/m3			01/19/18 13:53	1
n-Butane	1.2	U	1.2		ug/m3			01/19/18 13:53	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/19/18 13:53	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/19/18 13:53	1
Bromomethane	0.78	U	0.78		ug/m3			01/19/18 13:53	1
Chloroethane	1.3	U	1.3		ug/m3			01/19/18 13:53	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/19/18 13:53	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/19/18 13:53	1
Freon TF	1.5	U	1.5		ug/m3			01/19/18 13:53	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/19/18 13:53	1
Acetone	12	U	12		ug/m3			01/19/18 13:53	1
Isopropyl alcohol	12	U	12		ug/m3			01/19/18 13:53	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/19/18 13:53	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/19/18 13:53	1
Methylene Chloride	1.7	U	1.7		ug/m3			01/19/18 13:53	1
tert-Butyl alcohol	15	U	15		ug/m3			01/19/18 13:53	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/19/18 13:53	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/19/18 13:53	1
n-Hexane	0.70	U	0.70		ug/m3			01/19/18 13:53	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/19/18 13:53	1
Methyl Ethyl Ketone	1.5	U	1.5		ug/m3			01/19/18 13:53	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/19/18 13:53	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/19/18 13:53	1
Chloroform	0.98	U	0.98		ug/m3			01/19/18 13:53	1
Tetrahydrofuran	15	U	15		ug/m3			01/19/18 13:53	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/19/18 13:53	1
Cyclohexane	0.69	U	0.69		ug/m3			01/19/18 13:53	1
Carbon tetrachloride	0.22	U	0.22		ug/m3			01/19/18 13:53	1
2,2,4-Trimethylpentane	0.93	U	0.93		ug/m3			01/19/18 13:53	1
Benzene	0.64	U	0.64		ug/m3			01/19/18 13:53	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/19/18 13:53	1
n-Heptane	0.82	U	0.82		ug/m3			01/19/18 13:53	1
Trichloroethene	0.19	U	0.19		ug/m3			01/19/18 13:53	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/19/18 13:53	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/19/18 13:53	1
1,4-Dioxane	18	U	18		ug/m3			01/19/18 13:53	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/19/18 13:53	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/19/18 13:53	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/19/18 13:53	1
Toluene	0.75	U	0.75		ug/m3			01/19/18 13:53	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/19/18 13:53	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/19/18 13:53	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/19/18 13:53	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/19/18 13:53	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/19/18 13:53	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/19/18 13:53	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/19/18 13:53	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/19/18 13:53	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/19/18 13:53	1
Xylene, o-	0.87	U	0.87		ug/m3			01/19/18 13:53	1
Xylene (total)	3.0	U	3.0		ug/m3			01/19/18 13:53	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125595/4

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Styrene	0.85	U	0.85		ug/m3			01/19/18 13:53	1
Bromoform	2.1	U	2.1		ug/m3			01/19/18 13:53	1
Cumene	0.98	U	0.98		ug/m3			01/19/18 13:53	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/19/18 13:53	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/19/18 13:53	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/19/18 13:53	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/19/18 13:53	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/19/18 13:53	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/19/18 13:53	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/19/18 13:53	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/19/18 13:53	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/19/18 13:53	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/19/18 13:53	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/19/18 13:53	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/19/18 13:53	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/19/18 13:53	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/19/18 13:53	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/19/18 13:53	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/19/18 13:53	1
Naphthalene	2.6	U	2.6		ug/m3			01/19/18 13:53	1

Lab Sample ID: LCS 200-125595/3

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	10.0	10.4		ppb v/v		104	68 - 128
Freon 22	10.0	10.4		ppb v/v		104	64 - 128
1,2-Dichlorotetrafluoroethane	10.0	10.8		ppb v/v		108	78 - 138
Chloromethane	10.0	9.76		ppb v/v		98	57 - 126
n-Butane	10.0	10.2		ppb v/v		102	56 - 130
Vinyl chloride	10.0	9.33		ppb v/v		93	62 - 125
1,3-Butadiene	10.0	9.51		ppb v/v		95	59 - 125
Bromomethane	10.0	9.51		ppb v/v		95	68 - 128
Chloroethane	10.0	10.1		ppb v/v		101	65 - 125
Bromoethene(Vinyl Bromide)	10.0	9.61		ppb v/v		96	67 - 127
Trichlorofluoromethane	10.0	10.0		ppb v/v		100	67 - 127
Freon TF	10.0	9.72		ppb v/v		97	68 - 128
1,1-Dichloroethene	10.0	9.10		ppb v/v		91	67 - 127
Acetone	10.0	11.2		ppb v/v		112	64 - 136
Isopropyl alcohol	10.0	10.3		ppb v/v		103	55 - 124
Carbon disulfide	10.0	11.7		ppb v/v		117	81 - 141
3-Chloropropene	10.0	10.5		ppb v/v		105	53 - 133
Methylene Chloride	10.0	10.4		ppb v/v		104	62 - 122
tert-Butyl alcohol	10.0	10.7		ppb v/v		107	64 - 124
Methyl tert-butyl ether	10.0	10.1		ppb v/v		101	67 - 127
trans-1,2-Dichloroethene	10.0	10.6		ppb v/v		106	72 - 132
n-Hexane	10.0	10.6		ppb v/v		106	71 - 131

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125595/3

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1-Dichloroethane	10.0	10.1		ppb v/v		101	66 - 126
Methyl Ethyl Ketone	10.0	10.4		ppb v/v		104	62 - 122
cis-1,2-Dichloroethene	10.0	9.86		ppb v/v		99	67 - 127
Chloroform	10.0	10.1		ppb v/v		101	69 - 129
Tetrahydrofuran	10.0	11.7		ppb v/v		117	61 - 136
1,1,1-Trichloroethane	10.0	10.9		ppb v/v		109	70 - 130
Cyclohexane	10.0	10.7		ppb v/v		107	69 - 129
Carbon tetrachloride	10.0	11.3		ppb v/v		113	62 - 143
2,2,4-Trimethylpentane	10.0	10.2		ppb v/v		102	67 - 127
Benzene	10.0	9.81		ppb v/v		98	67 - 127
1,2-Dichloroethane	10.0	10.7		ppb v/v		107	67 - 132
n-Heptane	10.0	10.5		ppb v/v		105	62 - 130
Trichloroethene	10.0	10.1		ppb v/v		101	68 - 128
Methyl methacrylate	10.0	11.7		ppb v/v		117	70 - 130
1,2-Dichloropropane	10.0	10.4		ppb v/v		104	67 - 127
1,4-Dioxane	10.0	11.5		ppb v/v		115	66 - 132
Bromodichloromethane	10.0	11.4		ppb v/v		114	69 - 129
cis-1,3-Dichloropropene	10.0	11.1		ppb v/v		111	70 - 130
methyl isobutyl ketone	10.0	12.5		ppb v/v		125	62 - 130
Toluene	10.0	9.87		ppb v/v		99	67 - 127
trans-1,3-Dichloropropene	10.0	11.8		ppb v/v		118	69 - 129
1,1,2-Trichloroethane	10.0	10.2		ppb v/v		102	69 - 129
Tetrachloroethene	10.0	9.64		ppb v/v		96	70 - 130
Methyl Butyl Ketone (2-Hexanone)	10.0	11.7		ppb v/v		118	61 - 127
Dibromochloromethane	10.0	10.6		ppb v/v		106	66 - 130
1,2-Dibromoethane	10.0	10.4		ppb v/v		104	70 - 130
Chlorobenzene	10.0	9.96		ppb v/v		100	68 - 128
Ethylbenzene	10.0	10.3		ppb v/v		103	68 - 128
m,p-Xylene	20.0	20.6		ppb v/v		103	68 - 128
Xylene, o-	10.0	10.2		ppb v/v		102	67 - 127
Styrene	10.0	10.9		ppb v/v		109	68 - 128
Bromoform	10.0	12.0		ppb v/v		120	34 - 170
Cumene	10.0	10.4		ppb v/v		104	67 - 127
1,1,2,2-Tetrachloroethane	10.0	11.2		ppb v/v		112	69 - 129
n-Propylbenzene	10.0	10.7		ppb v/v		107	67 - 127
4-Ethyltoluene	10.0	11.4		ppb v/v		114	69 - 129
1,3,5-Trimethylbenzene	10.0	10.6		ppb v/v		106	65 - 125
2-Chlorotoluene	10.0	11.0		ppb v/v		110	67 - 127
tert-Butylbenzene	10.0	10.4		ppb v/v		104	63 - 125
1,2,4-Trimethylbenzene	10.0	10.6		ppb v/v		106	65 - 125
sec-Butylbenzene	10.0	10.7		ppb v/v		107	66 - 126
4-Isopropyltoluene	10.0	11.0		ppb v/v		110	67 - 129
1,3-Dichlorobenzene	10.0	11.0		ppb v/v		110	67 - 127
1,4-Dichlorobenzene	10.0	10.8		ppb v/v		108	66 - 126
Benzyl chloride	10.0	11.4		ppb v/v		114	54 - 135
n-Butylbenzene	10.0	11.4		ppb v/v		114	67 - 127
1,2-Dichlorobenzene	10.0	10.7		ppb v/v		107	67 - 127

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125595/3

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,2,4-Trichlorobenzene	10.0	10.6		ppb v/v		106	59 - 126
Hexachlorobutadiene	10.0	10.3		ppb v/v		103	62 - 130
Naphthalene	10.0	10.3		ppb v/v		103	50 - 121
Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	49	51.2		ug/m3		104	68 - 128
Freon 22	35	36.7		ug/m3		104	64 - 128
1,2-Dichlorotetrafluoroethane	70	75.2		ug/m3		108	78 - 138
Chloromethane	21	20.2		ug/m3		98	57 - 126
n-Butane	24	24.2		ug/m3		102	56 - 130
Vinyl chloride	26	23.9		ug/m3		93	62 - 125
1,3-Butadiene	22	21.0		ug/m3		95	59 - 125
Bromomethane	39	36.9		ug/m3		95	68 - 128
Chloroethane	26	26.8		ug/m3		101	65 - 125
Bromoethene(Vinyl Bromide)	44	42.0		ug/m3		96	67 - 127
Trichlorofluoromethane	56	56.2		ug/m3		100	67 - 127
Freon TF	77	74.5		ug/m3		97	68 - 128
1,1-Dichloroethene	40	36.1		ug/m3		91	67 - 127
Acetone	24	26.5		ug/m3		112	64 - 136
Isopropyl alcohol	25	25.4		ug/m3		103	55 - 124
Carbon disulfide	31	36.5		ug/m3		117	81 - 141
3-Chloropropene	31	32.8		ug/m3		105	53 - 133
Methylene Chloride	35	36.1		ug/m3		104	62 - 122
tert-Butyl alcohol	30	32.6		ug/m3		107	64 - 124
Methyl tert-butyl ether	36	36.4		ug/m3		101	67 - 127
trans-1,2-Dichloroethene	40	42.0		ug/m3		106	72 - 132
n-Hexane	35	37.3		ug/m3		106	71 - 131
1,1-Dichloroethane	40	41.0		ug/m3		101	66 - 126
Methyl Ethyl Ketone	29	30.7		ug/m3		104	62 - 122
cis-1,2-Dichloroethene	40	39.1		ug/m3		99	67 - 127
Chloroform	49	49.2		ug/m3		101	69 - 129
Tetrahydrofuran	29	34.4		ug/m3		117	61 - 136
1,1,1-Trichloroethane	55	59.6		ug/m3		109	70 - 130
Cyclohexane	34	36.7		ug/m3		107	69 - 129
Carbon tetrachloride	63	71.1		ug/m3		113	62 - 143
2,2,4-Trimethylpentane	47	47.9		ug/m3		102	67 - 127
Benzene	32	31.3		ug/m3		98	67 - 127
1,2-Dichloroethane	40	43.2		ug/m3		107	67 - 132
n-Heptane	41	43.0		ug/m3		105	62 - 130
Trichloroethene	54	54.3		ug/m3		101	68 - 128
Methyl methacrylate	41	48.0		ug/m3		117	70 - 130
1,2-Dichloropropane	46	48.3		ug/m3		104	67 - 127
1,4-Dioxane	36	41.3		ug/m3		115	66 - 132
Bromodichloromethane	67	76.6		ug/m3		114	69 - 129
cis-1,3-Dichloropropene	45	50.4		ug/m3		111	70 - 130
methyl isobutyl ketone	41	51.2		ug/m3		125	62 - 130
Toluene	38	37.2		ug/m3		99	67 - 127
trans-1,3-Dichloropropene	45	53.8		ug/m3		118	69 - 129

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125595/3

Matrix: Air

Analysis Batch: 125595

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1,2-Trichloroethane	55	55.6		ug/m3		102	69 - 129
Tetrachloroethene	68	65.4		ug/m3		96	70 - 130
Methyl Butyl Ketone (2-Hexanone)	41	48.1		ug/m3		118	61 - 127
Dibromochloromethane	85	90.3		ug/m3		106	66 - 130
1,2-Dibromoethane	77	80.1		ug/m3		104	70 - 130
Chlorobenzene	46	45.8		ug/m3		100	68 - 128
Ethylbenzene	43	44.9		ug/m3		103	68 - 128
m,p-Xylene	87	89.3		ug/m3		103	68 - 128
Xylene, o-	43	44.4		ug/m3		102	67 - 127
Styrene	43	46.6		ug/m3		109	68 - 128
Bromoform	100	124		ug/m3		120	34 - 170
Cumene	49	51.0		ug/m3		104	67 - 127
1,1,2,2-Tetrachloroethane	69	76.8		ug/m3		112	69 - 129
n-Propylbenzene	49	52.7		ug/m3		107	67 - 127
4-Ethyltoluene	49	56.1		ug/m3		114	69 - 129
1,3,5-Trimethylbenzene	49	52.2		ug/m3		106	65 - 125
2-Chlorotoluene	52	56.7		ug/m3		110	67 - 127
tert-Butylbenzene	55	57.0		ug/m3		104	63 - 125
1,2,4-Trimethylbenzene	49	52.2		ug/m3		106	65 - 125
sec-Butylbenzene	55	58.7		ug/m3		107	66 - 126
4-Isopropyltoluene	55	60.5		ug/m3		110	67 - 129
1,3-Dichlorobenzene	60	65.9		ug/m3		110	67 - 127
1,4-Dichlorobenzene	60	64.8		ug/m3		108	66 - 126
Benzyl chloride	52	59.3		ug/m3		114	54 - 135
n-Butylbenzene	55	62.5		ug/m3		114	67 - 127
1,2-Dichlorobenzene	60	64.1		ug/m3		107	67 - 127
1,2,4-Trichlorobenzene	74	78.4		ug/m3		106	59 - 126
Hexachlorobutadiene	110	110		ug/m3		103	62 - 130
Naphthalene	52	53.8		ug/m3		103	50 - 121

Lab Sample ID: MB 200-125688/5

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Freon 22	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Chloromethane	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
n-Butane	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/23/18 13:05	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Bromomethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Chloroethane	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Freon TF	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/23/18 13:05	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125688/5

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	5.0	U	5.0		ppb v/v			01/23/18 13:05	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/23/18 13:05	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Methylene Chloride	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/23/18 13:05	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
n-Hexane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Methyl Ethyl Ketone	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/23/18 13:05	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/23/18 13:05	1
Chloroform	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/23/18 13:05	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Carbon tetrachloride	0.035	U	0.035		ppb v/v			01/23/18 13:05	1
2,2,4-Trimethylpentane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Benzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
n-Heptane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/23/18 13:05	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/23/18 13:05	1
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Toluene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/23/18 13:05	1
Styrene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Bromoform	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Cumene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125688/5

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/23/18 13:05	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/23/18 13:05	1
Naphthalene	0.50	U	0.50		ppb v/v			01/23/18 13:05	1

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/23/18 13:05	1
Freon 22	1.8	U	1.8		ug/m3			01/23/18 13:05	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/23/18 13:05	1
Chloromethane	1.0	U	1.0		ug/m3			01/23/18 13:05	1
n-Butane	1.2	U	1.2		ug/m3			01/23/18 13:05	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/23/18 13:05	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/23/18 13:05	1
Bromomethane	0.78	U	0.78		ug/m3			01/23/18 13:05	1
Chloroethane	1.3	U	1.3		ug/m3			01/23/18 13:05	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/23/18 13:05	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/23/18 13:05	1
Freon TF	1.5	U	1.5		ug/m3			01/23/18 13:05	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/23/18 13:05	1
Acetone	12	U	12		ug/m3			01/23/18 13:05	1
Isopropyl alcohol	12	U	12		ug/m3			01/23/18 13:05	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/23/18 13:05	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/23/18 13:05	1
Methylene Chloride	1.7	U	1.7		ug/m3			01/23/18 13:05	1
tert-Butyl alcohol	15	U	15		ug/m3			01/23/18 13:05	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/23/18 13:05	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/23/18 13:05	1
n-Hexane	0.70	U	0.70		ug/m3			01/23/18 13:05	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/23/18 13:05	1
Methyl Ethyl Ketone	1.5	U	1.5		ug/m3			01/23/18 13:05	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/23/18 13:05	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/23/18 13:05	1
Chloroform	0.98	U	0.98		ug/m3			01/23/18 13:05	1
Tetrahydrofuran	15	U	15		ug/m3			01/23/18 13:05	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/23/18 13:05	1
Cyclohexane	0.69	U	0.69		ug/m3			01/23/18 13:05	1
Carbon tetrachloride	0.22	U	0.22		ug/m3			01/23/18 13:05	1
2,2,4-Trimethylpentane	0.93	U	0.93		ug/m3			01/23/18 13:05	1
Benzene	0.64	U	0.64		ug/m3			01/23/18 13:05	1

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125688/5

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/23/18 13:05	1
n-Heptane	0.82	U	0.82		ug/m3			01/23/18 13:05	1
Trichloroethene	0.19	U	0.19		ug/m3			01/23/18 13:05	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/23/18 13:05	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/23/18 13:05	1
1,4-Dioxane	18	U	18		ug/m3			01/23/18 13:05	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/23/18 13:05	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/23/18 13:05	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/23/18 13:05	1
Toluene	0.75	U	0.75		ug/m3			01/23/18 13:05	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/23/18 13:05	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/23/18 13:05	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/23/18 13:05	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/23/18 13:05	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/23/18 13:05	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/23/18 13:05	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/23/18 13:05	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/23/18 13:05	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/23/18 13:05	1
Xylene, o-	0.87	U	0.87		ug/m3			01/23/18 13:05	1
Xylene (total)	3.0	U	3.0		ug/m3			01/23/18 13:05	1
Styrene	0.85	U	0.85		ug/m3			01/23/18 13:05	1
Bromoform	2.1	U	2.1		ug/m3			01/23/18 13:05	1
Cumene	0.98	U	0.98		ug/m3			01/23/18 13:05	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/23/18 13:05	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/23/18 13:05	1
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/23/18 13:05	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/23/18 13:05	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/23/18 13:05	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/23/18 13:05	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/23/18 13:05	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/23/18 13:05	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/23/18 13:05	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/23/18 13:05	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/23/18 13:05	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/23/18 13:05	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/23/18 13:05	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/23/18 13:05	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/23/18 13:05	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/23/18 13:05	1
Naphthalene	2.6	U	2.6		ug/m3			01/23/18 13:05	1

Lab Sample ID: LCS 200-125688/4

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	10.0	9.61		ppb v/v		96	68 - 128

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125688/4

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Freon 22	10.0	9.67		ppb v/v		97	64 - 128
1,2-Dichlorotetrafluoroethane	10.0	11.0		ppb v/v		110	78 - 138
Chloromethane	10.0	9.38		ppb v/v		94	57 - 126
n-Butane	10.0	9.48		ppb v/v		95	56 - 130
Vinyl chloride	10.0	9.55		ppb v/v		96	62 - 125
1,3-Butadiene	10.0	9.49		ppb v/v		95	59 - 125
Bromomethane	10.0	9.87		ppb v/v		99	68 - 128
Chloroethane	10.0	9.81		ppb v/v		98	65 - 125
Bromoethene(Vinyl Bromide)	10.0	10.1		ppb v/v		101	67 - 127
Trichlorofluoromethane	10.0	9.96		ppb v/v		100	67 - 127
Freon TF	10.0	10.2		ppb v/v		102	68 - 128
1,1-Dichloroethene	10.0	9.91		ppb v/v		99	67 - 127
Acetone	10.0	10.1		ppb v/v		101	64 - 136
Isopropyl alcohol	10.0	9.11		ppb v/v		91	55 - 124
Carbon disulfide	10.0	11.5		ppb v/v		115	81 - 141
3-Chloropropene	10.0	10.2		ppb v/v		102	53 - 133
Methylene Chloride	10.0	9.80		ppb v/v		98	62 - 122
tert-Butyl alcohol	10.0	9.45		ppb v/v		95	64 - 124
Methyl tert-butyl ether	10.0	10.2		ppb v/v		102	67 - 127
trans-1,2-Dichloroethene	10.0	10.7		ppb v/v		107	72 - 132
n-Hexane	10.0	10.5		ppb v/v		105	71 - 131
1,1-Dichloroethane	10.0	10.1		ppb v/v		101	66 - 126
Methyl Ethyl Ketone	10.0	10.3		ppb v/v		103	62 - 122
cis-1,2-Dichloroethene	10.0	9.78		ppb v/v		98	67 - 127
Chloroform	10.0	10.4		ppb v/v		104	69 - 129
Tetrahydrofuran	10.0	9.83		ppb v/v		98	61 - 136
1,1,1-Trichloroethane	10.0	10.3		ppb v/v		103	70 - 130
Cyclohexane	10.0	10.3		ppb v/v		103	69 - 129
Carbon tetrachloride	10.0	10.8		ppb v/v		108	62 - 143
2,2,4-Trimethylpentane	10.0	10.0		ppb v/v		100	67 - 127
Benzene	10.0	10.0		ppb v/v		100	67 - 127
1,2-Dichloroethane	10.0	10.4		ppb v/v		104	67 - 132
n-Heptane	10.0	9.88		ppb v/v		99	62 - 130
Trichloroethene	10.0	10.2		ppb v/v		102	68 - 128
Methyl methacrylate	10.0	10.2		ppb v/v		102	70 - 130
1,2-Dichloropropane	10.0	9.93		ppb v/v		99	67 - 127
1,4-Dioxane	10.0	9.48		ppb v/v		95	66 - 132
Bromodichloromethane	10.0	10.4		ppb v/v		104	69 - 129
cis-1,3-Dichloropropene	10.0	10.4		ppb v/v		104	70 - 130
methyl isobutyl ketone	10.0	9.73		ppb v/v		97	62 - 130
Toluene	10.0	9.98		ppb v/v		100	67 - 127
trans-1,3-Dichloropropene	10.0	10.1		ppb v/v		101	69 - 129
1,1,2-Trichloroethane	10.0	10.2		ppb v/v		102	69 - 129
Tetrachloroethene	10.0	9.97		ppb v/v		100	70 - 130
Methyl Butyl Ketone (2-Hexanone)	10.0	9.72		ppb v/v		97	61 - 127
Dibromochloromethane	10.0	10.3		ppb v/v		103	66 - 130
1,2-Dibromoethane	10.0	10.2		ppb v/v		102	70 - 130

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125688/4

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chlorobenzene	10.0	9.80		ppb v/v		98	68 - 128
Ethylbenzene	10.0	9.87		ppb v/v		99	68 - 128
m,p-Xylene	20.0	19.6		ppb v/v		98	68 - 128
Xylene, o-	10.0	9.59		ppb v/v		96	67 - 127
Styrene	10.0	10.1		ppb v/v		101	68 - 128
Bromoform	10.0	11.0		ppb v/v		110	34 - 170
Cumene	10.0	9.71		ppb v/v		97	67 - 127
1,1,2,2-Tetrachloroethane	10.0	10.1		ppb v/v		101	69 - 129
n-Propylbenzene	10.0	9.77		ppb v/v		98	67 - 127
4-Ethyltoluene	10.0	10.3		ppb v/v		103	69 - 129
1,3,5-Trimethylbenzene	10.0	9.82		ppb v/v		98	65 - 125
2-Chlorotoluene	10.0	10.1		ppb v/v		101	67 - 127
tert-Butylbenzene	10.0	9.79		ppb v/v		98	63 - 125
1,2,4-Trimethylbenzene	10.0	9.85		ppb v/v		99	65 - 125
sec-Butylbenzene	10.0	9.79		ppb v/v		98	66 - 126
4-Isopropyltoluene	10.0	10.0		ppb v/v		100	67 - 129
1,3-Dichlorobenzene	10.0	9.78		ppb v/v		98	67 - 127
1,4-Dichlorobenzene	10.0	9.80		ppb v/v		98	66 - 126
Benzyl chloride	10.0	10.2		ppb v/v		102	54 - 135
n-Butylbenzene	10.0	9.99		ppb v/v		100	67 - 127
1,2-Dichlorobenzene	10.0	9.88		ppb v/v		99	67 - 127
1,2,4-Trichlorobenzene	10.0	9.11		ppb v/v		91	59 - 126
Hexachlorobutadiene	10.0	8.87		ppb v/v		89	62 - 130
Naphthalene	10.0	8.60		ppb v/v		86	50 - 121

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	49	47.5		ug/m3		96	68 - 128
Freon 22	35	34.2		ug/m3		97	64 - 128
1,2-Dichlorotetrafluoroethane	70	77.1		ug/m3		110	78 - 138
Chloromethane	21	19.4		ug/m3		94	57 - 126
n-Butane	24	22.5		ug/m3		95	56 - 130
Vinyl chloride	26	24.4		ug/m3		96	62 - 125
1,3-Butadiene	22	21.0		ug/m3		95	59 - 125
Bromomethane	39	38.3		ug/m3		99	68 - 128
Chloroethane	26	25.9		ug/m3		98	65 - 125
Bromoethene(Vinyl Bromide)	44	44.1		ug/m3		101	67 - 127
Trichlorofluoromethane	56	56.0		ug/m3		100	67 - 127
Freon TF	77	77.9		ug/m3		102	68 - 128
1,1-Dichloroethene	40	39.3		ug/m3		99	67 - 127
Acetone	24	24.1		ug/m3		101	64 - 136
Isopropyl alcohol	25	22.4		ug/m3		91	55 - 124
Carbon disulfide	31	35.9		ug/m3		115	81 - 141
3-Chloropropene	31	32.0		ug/m3		102	53 - 133
Methylene Chloride	35	34.1		ug/m3		98	62 - 122
tert-Butyl alcohol	30	28.7		ug/m3		95	64 - 124
Methyl tert-butyl ether	36	36.8		ug/m3		102	67 - 127
trans-1,2-Dichloroethene	40	42.4		ug/m3		107	72 - 132
n-Hexane	35	37.1		ug/m3		105	71 - 131

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125688/4

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1-Dichloroethane	40	40.9		ug/m3		101	66 - 126
Methyl Ethyl Ketone	29	30.3		ug/m3		103	62 - 122
cis-1,2-Dichloroethene	40	38.8		ug/m3		98	67 - 127
Chloroform	49	50.8		ug/m3		104	69 - 129
Tetrahydrofuran	29	29.0		ug/m3		98	61 - 136
1,1,1-Trichloroethane	55	56.1		ug/m3		103	70 - 130
Cyclohexane	34	35.3		ug/m3		103	69 - 129
Carbon tetrachloride	63	68.0		ug/m3		108	62 - 143
2,2,4-Trimethylpentane	47	46.8		ug/m3		100	67 - 127
Benzene	32	32.0		ug/m3		100	67 - 127
1,2-Dichloroethane	40	42.0		ug/m3		104	67 - 132
n-Heptane	41	40.5		ug/m3		99	62 - 130
Trichloroethene	54	54.8		ug/m3		102	68 - 128
Methyl methacrylate	41	42.0		ug/m3		102	70 - 130
1,2-Dichloropropane	46	45.9		ug/m3		99	67 - 127
1,4-Dioxane	36	34.2		ug/m3		95	66 - 132
Bromodichloromethane	67	69.6		ug/m3		104	69 - 129
cis-1,3-Dichloropropene	45	47.1		ug/m3		104	70 - 130
methyl isobutyl ketone	41	39.9		ug/m3		97	62 - 130
Toluene	38	37.6		ug/m3		100	67 - 127
trans-1,3-Dichloropropene	45	46.1		ug/m3		101	69 - 129
1,1,2-Trichloroethane	55	55.4		ug/m3		102	69 - 129
Tetrachloroethene	68	67.6		ug/m3		100	70 - 130
Methyl Butyl Ketone (2-Hexanone)	41	39.8		ug/m3		97	61 - 127
Dibromochloromethane	85	87.5		ug/m3		103	66 - 130
1,2-Dibromoethane	77	78.2		ug/m3		102	70 - 130
Chlorobenzene	46	45.1		ug/m3		98	68 - 128
Ethylbenzene	43	42.9		ug/m3		99	68 - 128
m,p-Xylene	87	85.2		ug/m3		98	68 - 128
Xylene, o-	43	41.7		ug/m3		96	67 - 127
Styrene	43	43.0		ug/m3		101	68 - 128
Bromoform	100	114		ug/m3		110	34 - 170
Cumene	49	47.7		ug/m3		97	67 - 127
1,1,2,2-Tetrachloroethane	69	69.3		ug/m3		101	69 - 129
n-Propylbenzene	49	48.1		ug/m3		98	67 - 127
4-Ethyltoluene	49	50.8		ug/m3		103	69 - 129
1,3,5-Trimethylbenzene	49	48.3		ug/m3		98	65 - 125
2-Chlorotoluene	52	52.1		ug/m3		101	67 - 127
tert-Butylbenzene	55	53.7		ug/m3		98	63 - 125
1,2,4-Trimethylbenzene	49	48.4		ug/m3		99	65 - 125
sec-Butylbenzene	55	53.7		ug/m3		98	66 - 126
4-Isopropyltoluene	55	54.9		ug/m3		100	67 - 129
1,3-Dichlorobenzene	60	58.8		ug/m3		98	67 - 127
1,4-Dichlorobenzene	60	58.9		ug/m3		98	66 - 126
Benzyl chloride	52	52.9		ug/m3		102	54 - 135
n-Butylbenzene	55	54.9		ug/m3		100	67 - 127
1,2-Dichlorobenzene	60	59.4		ug/m3		99	67 - 127

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125688/4

Matrix: Air

Analysis Batch: 125688

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,2,4-Trichlorobenzene	74	67.6		ug/m3		91	59 - 126
Hexachlorobutadiene	110	94.6		ug/m3		89	62 - 130
Naphthalene	52	45.1		ug/m3		86	50 - 121

Lab Sample ID: MB 200-125744/4

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Freon 22	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
1,2-Dichlorotetrafluoroethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Chloromethane	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
n-Butane	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Vinyl chloride	0.035	U	0.035		ppb v/v			01/24/18 13:08	1
1,3-Butadiene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Bromomethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Chloroethane	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Bromoethene(Vinyl Bromide)	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Trichlorofluoromethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Freon TF	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,1-Dichloroethene	0.035	U	0.035		ppb v/v			01/24/18 13:08	1
Acetone	5.0	U	5.0		ppb v/v			01/24/18 13:08	1
Isopropyl alcohol	5.0	U	5.0		ppb v/v			01/24/18 13:08	1
Carbon disulfide	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
3-Chloropropene	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Methylene Chloride	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
tert-Butyl alcohol	5.0	U	5.0		ppb v/v			01/24/18 13:08	1
Methyl tert-butyl ether	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
trans-1,2-Dichloroethene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
n-Hexane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,1-Dichloroethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Methyl Ethyl Ketone	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
cis-1,2-Dichloroethene	0.035	U	0.035		ppb v/v			01/24/18 13:08	1
1,2-Dichloroethene, Total	0.40	U	0.40		ppb v/v			01/24/18 13:08	1
Chloroform	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Tetrahydrofuran	5.0	U	5.0		ppb v/v			01/24/18 13:08	1
1,1,1-Trichloroethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Cyclohexane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Carbon tetrachloride	0.035	U	0.035		ppb v/v			01/24/18 13:08	1
2,2,4-Trimethylpentane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Benzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,2-Dichloroethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
n-Heptane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Trichloroethene	0.035	U	0.035		ppb v/v			01/24/18 13:08	1
Methyl methacrylate	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
1,2-Dichloropropane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,4-Dioxane	5.0	U	5.0		ppb v/v			01/24/18 13:08	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125744/4

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bromodichloromethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
cis-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
methyl isobutyl ketone	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Toluene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
trans-1,3-Dichloropropene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,1,2-Trichloroethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Tetrachloroethene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Methyl Butyl Ketone (2-Hexanone)	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Dibromochloromethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,2-Dibromoethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Chlorobenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Ethylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
m,p-Xylene	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Xylene, o-	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Xylene (total)	0.70	U	0.70		ppb v/v			01/24/18 13:08	1
Styrene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Bromoform	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Cumene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,1,2,2-Tetrachloroethane	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
n-Propylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
4-Ethyltoluene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,3,5-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
2-Chlorotoluene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
tert-Butylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,2,4-Trimethylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
sec-Butylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
4-Isopropyltoluene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,3-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,4-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Benzyl chloride	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
n-Butylbenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,2-Dichlorobenzene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
1,2,4-Trichlorobenzene	0.50	U	0.50		ppb v/v			01/24/18 13:08	1
Hexachlorobutadiene	0.20	U	0.20		ppb v/v			01/24/18 13:08	1
Naphthalene	0.50	U	0.50		ppb v/v			01/24/18 13:08	1

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dichlorodifluoromethane	2.5	U	2.5		ug/m3			01/24/18 13:08	1
Freon 22	1.8	U	1.8		ug/m3			01/24/18 13:08	1
1,2-Dichlorotetrafluoroethane	1.4	U	1.4		ug/m3			01/24/18 13:08	1
Chloromethane	1.0	U	1.0		ug/m3			01/24/18 13:08	1
n-Butane	1.2	U	1.2		ug/m3			01/24/18 13:08	1
Vinyl chloride	0.089	U	0.089		ug/m3			01/24/18 13:08	1
1,3-Butadiene	0.44	U	0.44		ug/m3			01/24/18 13:08	1
Bromomethane	0.78	U	0.78		ug/m3			01/24/18 13:08	1
Chloroethane	1.3	U	1.3		ug/m3			01/24/18 13:08	1
Bromoethene(Vinyl Bromide)	0.87	U	0.87		ug/m3			01/24/18 13:08	1
Trichlorofluoromethane	1.1	U	1.1		ug/m3			01/24/18 13:08	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125744/4

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Freon TF	1.5	U	1.5		ug/m3			01/24/18 13:08	1
1,1-Dichloroethene	0.14	U	0.14		ug/m3			01/24/18 13:08	1
Acetone	12	U	12		ug/m3			01/24/18 13:08	1
Isopropyl alcohol	12	U	12		ug/m3			01/24/18 13:08	1
Carbon disulfide	1.6	U	1.6		ug/m3			01/24/18 13:08	1
3-Chloropropene	1.6	U	1.6		ug/m3			01/24/18 13:08	1
Methylene Chloride	1.7	U	1.7		ug/m3			01/24/18 13:08	1
tert-Butyl alcohol	15	U	15		ug/m3			01/24/18 13:08	1
Methyl tert-butyl ether	0.72	U	0.72		ug/m3			01/24/18 13:08	1
trans-1,2-Dichloroethene	0.79	U	0.79		ug/m3			01/24/18 13:08	1
n-Hexane	0.70	U	0.70		ug/m3			01/24/18 13:08	1
1,1-Dichloroethane	0.81	U	0.81		ug/m3			01/24/18 13:08	1
Methyl Ethyl Ketone	1.5	U	1.5		ug/m3			01/24/18 13:08	1
cis-1,2-Dichloroethene	0.14	U	0.14		ug/m3			01/24/18 13:08	1
1,2-Dichloroethene, Total	1.6	U	1.6		ug/m3			01/24/18 13:08	1
Chloroform	0.98	U	0.98		ug/m3			01/24/18 13:08	1
Tetrahydrofuran	15	U	15		ug/m3			01/24/18 13:08	1
1,1,1-Trichloroethane	1.1	U	1.1		ug/m3			01/24/18 13:08	1
Cyclohexane	0.69	U	0.69		ug/m3			01/24/18 13:08	1
Carbon tetrachloride	0.22	U	0.22		ug/m3			01/24/18 13:08	1
2,2,4-Trimethylpentane	0.93	U	0.93		ug/m3			01/24/18 13:08	1
Benzene	0.64	U	0.64		ug/m3			01/24/18 13:08	1
1,2-Dichloroethane	0.81	U	0.81		ug/m3			01/24/18 13:08	1
n-Heptane	0.82	U	0.82		ug/m3			01/24/18 13:08	1
Trichloroethene	0.19	U	0.19		ug/m3			01/24/18 13:08	1
Methyl methacrylate	2.0	U	2.0		ug/m3			01/24/18 13:08	1
1,2-Dichloropropane	0.92	U	0.92		ug/m3			01/24/18 13:08	1
1,4-Dioxane	18	U	18		ug/m3			01/24/18 13:08	1
Bromodichloromethane	1.3	U	1.3		ug/m3			01/24/18 13:08	1
cis-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/24/18 13:08	1
methyl isobutyl ketone	2.0	U	2.0		ug/m3			01/24/18 13:08	1
Toluene	0.75	U	0.75		ug/m3			01/24/18 13:08	1
trans-1,3-Dichloropropene	0.91	U	0.91		ug/m3			01/24/18 13:08	1
1,1,2-Trichloroethane	1.1	U	1.1		ug/m3			01/24/18 13:08	1
Tetrachloroethene	1.4	U	1.4		ug/m3			01/24/18 13:08	1
Methyl Butyl Ketone (2-Hexanone)	2.0	U	2.0		ug/m3			01/24/18 13:08	1
Dibromochloromethane	1.7	U	1.7		ug/m3			01/24/18 13:08	1
1,2-Dibromoethane	1.5	U	1.5		ug/m3			01/24/18 13:08	1
Chlorobenzene	0.92	U	0.92		ug/m3			01/24/18 13:08	1
Ethylbenzene	0.87	U	0.87		ug/m3			01/24/18 13:08	1
m,p-Xylene	2.2	U	2.2		ug/m3			01/24/18 13:08	1
Xylene, o-	0.87	U	0.87		ug/m3			01/24/18 13:08	1
Xylene (total)	3.0	U	3.0		ug/m3			01/24/18 13:08	1
Styrene	0.85	U	0.85		ug/m3			01/24/18 13:08	1
Bromoform	2.1	U	2.1		ug/m3			01/24/18 13:08	1
Cumene	0.98	U	0.98		ug/m3			01/24/18 13:08	1
1,1,2,2-Tetrachloroethane	1.4	U	1.4		ug/m3			01/24/18 13:08	1
n-Propylbenzene	0.98	U	0.98		ug/m3			01/24/18 13:08	1

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: MB 200-125744/4

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
4-Ethyltoluene	0.98	U	0.98		ug/m3			01/24/18 13:08	1
1,3,5-Trimethylbenzene	0.98	U	0.98		ug/m3			01/24/18 13:08	1
2-Chlorotoluene	1.0	U	1.0		ug/m3			01/24/18 13:08	1
tert-Butylbenzene	1.1	U	1.1		ug/m3			01/24/18 13:08	1
1,2,4-Trimethylbenzene	0.98	U	0.98		ug/m3			01/24/18 13:08	1
sec-Butylbenzene	1.1	U	1.1		ug/m3			01/24/18 13:08	1
4-Isopropyltoluene	1.1	U	1.1		ug/m3			01/24/18 13:08	1
1,3-Dichlorobenzene	1.2	U	1.2		ug/m3			01/24/18 13:08	1
1,4-Dichlorobenzene	1.2	U	1.2		ug/m3			01/24/18 13:08	1
Benzyl chloride	1.0	U	1.0		ug/m3			01/24/18 13:08	1
n-Butylbenzene	1.1	U	1.1		ug/m3			01/24/18 13:08	1
1,2-Dichlorobenzene	1.2	U	1.2		ug/m3			01/24/18 13:08	1
1,2,4-Trichlorobenzene	3.7	U	3.7		ug/m3			01/24/18 13:08	1
Hexachlorobutadiene	2.1	U	2.1		ug/m3			01/24/18 13:08	1
Naphthalene	2.6	U	2.6		ug/m3			01/24/18 13:08	1

Lab Sample ID: LCS 200-125744/3

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	10.0	8.61		ppb v/v		86	68 - 128
Freon 22	10.0	8.77		ppb v/v		88	64 - 128
1,2-Dichlorotetrafluoroethane	10.0	9.71		ppb v/v		97	78 - 138
Chloromethane	10.0	8.49		ppb v/v		85	57 - 126
n-Butane	10.0	8.96		ppb v/v		90	56 - 130
Vinyl chloride	10.0	8.82		ppb v/v		88	62 - 125
1,3-Butadiene	10.0	8.95		ppb v/v		90	59 - 125
Bromomethane	10.0	9.01		ppb v/v		90	68 - 128
Chloroethane	10.0	8.93		ppb v/v		89	65 - 125
Bromoethene(Vinyl Bromide)	10.0	8.90		ppb v/v		89	67 - 127
Trichlorofluoromethane	10.0	8.85		ppb v/v		88	67 - 127
Freon TF	10.0	9.00		ppb v/v		90	68 - 128
1,1-Dichloroethene	10.0	9.10		ppb v/v		91	67 - 127
Acetone	10.0	9.76		ppb v/v		98	64 - 136
Isopropyl alcohol	10.0	9.08		ppb v/v		91	55 - 124
Carbon disulfide	10.0	10.6		ppb v/v		106	81 - 141
3-Chloropropene	10.0	9.40		ppb v/v		94	53 - 133
Methylene Chloride	10.0	9.16		ppb v/v		92	62 - 122
tert-Butyl alcohol	10.0	8.97		ppb v/v		90	64 - 124
Methyl tert-butyl ether	10.0	9.26		ppb v/v		93	67 - 127
trans-1,2-Dichloroethene	10.0	10.0		ppb v/v		100	72 - 132
n-Hexane	10.0	10.4		ppb v/v		104	71 - 131
1,1-Dichloroethane	10.0	9.45		ppb v/v		95	66 - 126
Methyl Ethyl Ketone	10.0	9.24		ppb v/v		92	62 - 122
cis-1,2-Dichloroethene	10.0	9.09		ppb v/v		91	67 - 127
Chloroform	10.0	9.19		ppb v/v		92	69 - 129
Tetrahydrofuran	10.0	9.43		ppb v/v		94	61 - 136

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125744/3

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1,1-Trichloroethane	10.0	9.18		ppb v/v		92	70 - 130
Cyclohexane	10.0	9.54		ppb v/v		95	69 - 129
Carbon tetrachloride	10.0	9.70		ppb v/v		97	62 - 143
2,2,4-Trimethylpentane	10.0	9.49		ppb v/v		95	67 - 127
Benzene	10.0	9.20		ppb v/v		92	67 - 127
1,2-Dichloroethane	10.0	9.39		ppb v/v		94	67 - 132
n-Heptane	10.0	9.68		ppb v/v		97	62 - 130
Trichloroethene	10.0	9.13		ppb v/v		91	68 - 128
Methyl methacrylate	10.0	9.39		ppb v/v		94	70 - 130
1,2-Dichloropropane	10.0	9.14		ppb v/v		91	67 - 127
1,4-Dioxane	10.0	8.43		ppb v/v		84	66 - 132
Bromodichloromethane	10.0	9.19		ppb v/v		92	69 - 129
cis-1,3-Dichloropropene	10.0	9.39		ppb v/v		94	70 - 130
methyl isobutyl ketone	10.0	8.95		ppb v/v		90	62 - 130
Toluene	10.0	9.26		ppb v/v		93	67 - 127
trans-1,3-Dichloropropene	10.0	9.26		ppb v/v		93	69 - 129
1,1,2-Trichloroethane	10.0	9.18		ppb v/v		92	69 - 129
Tetrachloroethene	10.0	8.67		ppb v/v		87	70 - 130
Methyl Butyl Ketone (2-Hexanone)	10.0	8.72		ppb v/v		87	61 - 127
Dibromochloromethane	10.0	9.03		ppb v/v		90	66 - 130
1,2-Dibromoethane	10.0	9.18		ppb v/v		92	70 - 130
Chlorobenzene	10.0	8.81		ppb v/v		88	68 - 128
Ethylbenzene	10.0	9.04		ppb v/v		90	68 - 128
m,p-Xylene	20.0	18.1		ppb v/v		91	68 - 128
Xylene, o-	10.0	8.93		ppb v/v		89	67 - 127
Styrene	10.0	9.21		ppb v/v		92	68 - 128
Bromoform	10.0	9.60		ppb v/v		96	34 - 170
Cumene	10.0	9.00		ppb v/v		90	67 - 127
1,1,2,2-Tetrachloroethane	10.0	9.23		ppb v/v		92	69 - 129
n-Propylbenzene	10.0	9.20		ppb v/v		92	67 - 127
4-Ethyltoluene	10.0	9.44		ppb v/v		94	69 - 129
1,3,5-Trimethylbenzene	10.0	8.97		ppb v/v		90	65 - 125
2-Chlorotoluene	10.0	9.10		ppb v/v		91	67 - 127
tert-Butylbenzene	10.0	8.90		ppb v/v		89	63 - 125
1,2,4-Trimethylbenzene	10.0	9.11		ppb v/v		91	65 - 125
sec-Butylbenzene	10.0	9.17		ppb v/v		92	66 - 126
4-Isopropyltoluene	10.0	9.18		ppb v/v		92	67 - 129
1,3-Dichlorobenzene	10.0	9.12		ppb v/v		91	67 - 127
1,4-Dichlorobenzene	10.0	9.06		ppb v/v		91	66 - 126
Benzyl chloride	10.0	9.08		ppb v/v		91	54 - 135
n-Butylbenzene	10.0	9.67		ppb v/v		97	67 - 127
1,2-Dichlorobenzene	10.0	8.95		ppb v/v		89	67 - 127
1,2,4-Trichlorobenzene	10.0	7.94		ppb v/v		79	59 - 126
Hexachlorobutadiene	10.0	8.08		ppb v/v		81	62 - 130
Naphthalene	10.0	7.35		ppb v/v		73	50 - 121

TestAmerica Burlington



# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Dichlorodifluoromethane	49	42.6		ug/m3		86	68 - 128
Freon 22	35	31.0		ug/m3		88	64 - 128
1,2-Dichlorotetrafluoroethane	70	67.9		ug/m3		97	78 - 138
Chloromethane	21	17.5		ug/m3		85	57 - 126
n-Butane	24	21.3		ug/m3		90	56 - 130
Vinyl chloride	26	22.5		ug/m3		88	62 - 125
1,3-Butadiene	22	19.8		ug/m3		90	59 - 125
Bromomethane	39	35.0		ug/m3		90	68 - 128
Chloroethane	26	23.6		ug/m3		89	65 - 125
Bromoethene(Vinyl Bromide)	44	39.0		ug/m3		89	67 - 127
Trichlorofluoromethane	56	49.7		ug/m3		88	67 - 127
Freon TF	77	68.9		ug/m3		90	68 - 128
1,1-Dichloroethene	40	36.1		ug/m3		91	67 - 127
Acetone	24	23.2		ug/m3		98	64 - 136
Isopropyl alcohol	25	22.3		ug/m3		91	55 - 124
Carbon disulfide	31	32.9		ug/m3		106	81 - 141
3-Chloropropene	31	29.4		ug/m3		94	53 - 133
Methylene Chloride	35	31.8		ug/m3		92	62 - 122
tert-Butyl alcohol	30	27.2		ug/m3		90	64 - 124
Methyl tert-butyl ether	36	33.4		ug/m3		93	67 - 127
trans-1,2-Dichloroethene	40	39.7		ug/m3		100	72 - 132
n-Hexane	35	36.6		ug/m3		104	71 - 131
1,1-Dichloroethane	40	38.3		ug/m3		95	66 - 126
Methyl Ethyl Ketone	29	27.2		ug/m3		92	62 - 122
cis-1,2-Dichloroethene	40	36.0		ug/m3		91	67 - 127
Chloroform	49	44.9		ug/m3		92	69 - 129
Tetrahydrofuran	29	27.8		ug/m3		94	61 - 136
1,1,1-Trichloroethane	55	50.1		ug/m3		92	70 - 130
Cyclohexane	34	32.8		ug/m3		95	69 - 129
Carbon tetrachloride	63	61.0		ug/m3		97	62 - 143
2,2,4-Trimethylpentane	47	44.3		ug/m3		95	67 - 127
Benzene	32	29.4		ug/m3		92	67 - 127
1,2-Dichloroethane	40	38.0		ug/m3		94	67 - 132
n-Heptane	41	39.7		ug/m3		97	62 - 130
Trichloroethene	54	49.1		ug/m3		91	68 - 128
Methyl methacrylate	41	38.4		ug/m3		94	70 - 130
1,2-Dichloropropane	46	42.3		ug/m3		91	67 - 127
1,4-Dioxane	36	30.4		ug/m3		84	66 - 132
Bromodichloromethane	67	61.6		ug/m3		92	69 - 129
cis-1,3-Dichloropropene	45	42.6		ug/m3		94	70 - 130
methyl isobutyl ketone	41	36.7		ug/m3		90	62 - 130
Toluene	38	34.9		ug/m3		93	67 - 127
trans-1,3-Dichloropropene	45	42.0		ug/m3		93	69 - 129
1,1,2-Trichloroethane	55	50.1		ug/m3		92	69 - 129
Tetrachloroethene	68	58.8		ug/m3		87	70 - 130
Methyl Butyl Ketone (2-Hexanone)	41	35.7		ug/m3		87	61 - 127
Dibromochloromethane	85	76.9		ug/m3		90	66 - 130
1,2-Dibromoethane	77	70.5		ug/m3		92	70 - 130
Chlorobenzene	46	40.5		ug/m3		88	68 - 128
Ethylbenzene	43	39.2		ug/m3		90	68 - 128
m,p-Xylene	87	78.6		ug/m3		91	68 - 128
Xylene, o-	43	38.8		ug/m3		89	67 - 127
Styrene	43	39.2		ug/m3		92	68 - 128

TestAmerica Burlington

# QC Sample Results

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Method: TO-15 - Volatile Organic Compounds in Ambient Air (Continued)

Lab Sample ID: LCS 200-125744/3

Matrix: Air

Analysis Batch: 125744

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromoform	100	99.2		ug/m3		96	34 - 170
Cumene	49	44.2		ug/m3		90	67 - 127
1,1,2,2-Tetrachloroethane	69	63.4		ug/m3		92	69 - 129
n-Propylbenzene	49	45.2		ug/m3		92	67 - 127
4-Ethyltoluene	49	46.4		ug/m3		94	69 - 129
1,3,5-Trimethylbenzene	49	44.1		ug/m3		90	65 - 125
2-Chlorotoluene	52	47.1		ug/m3		91	67 - 127
tert-Butylbenzene	55	48.9		ug/m3		89	63 - 125
1,2,4-Trimethylbenzene	49	44.8		ug/m3		91	65 - 125
sec-Butylbenzene	55	50.3		ug/m3		92	66 - 126
4-Isopropyltoluene	55	50.4		ug/m3		92	67 - 129
1,3-Dichlorobenzene	60	54.9		ug/m3		91	67 - 127
1,4-Dichlorobenzene	60	54.5		ug/m3		91	66 - 126
Benzyl chloride	52	47.0		ug/m3		91	54 - 135
n-Butylbenzene	55	53.1		ug/m3		97	67 - 127
1,2-Dichlorobenzene	60	53.8		ug/m3		89	67 - 127
1,2,4-Trichlorobenzene	74	58.9		ug/m3		79	59 - 126
Hexachlorobutadiene	110	86.2		ug/m3		81	62 - 130
Naphthalene	52	38.5		ug/m3		73	50 - 121

# QC Association Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Air - GC/MS VOA

### Analysis Batch: 125550

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
200-41898-5	AMB-1	Total/NA	Air	TO-15	
200-41898-6	AMB-2	Total/NA	Air	TO-15	
200-41898-7	AMB-3	Total/NA	Air	TO-15	
200-41898-8	AMB-4	Total/NA	Air	TO-15	
200-41898-8 - DL	AMB-4	Total/NA	Air	TO-15	
MB 200-125550/5	Method Blank	Total/NA	Air	TO-15	
LCS 200-125550/3	Lab Control Sample	Total/NA	Air	TO-15	

### Analysis Batch: 125595

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
200-41898-2	SV-2	Total/NA	Air	TO-15	
200-41898-3	SV-3	Total/NA	Air	TO-15	
200-41898-4	SV-4	Total/NA	Air	TO-15	
200-41898-9	DUP-1	Total/NA	Air	TO-15	
MB 200-125595/4	Method Blank	Total/NA	Air	TO-15	
LCS 200-125595/3	Lab Control Sample	Total/NA	Air	TO-15	

### Analysis Batch: 125688

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
200-41898-1 - DL	SV-1	Total/NA	Air	TO-15	
200-41898-2 - DL	SV-2	Total/NA	Air	TO-15	
200-41898-3 - DL	SV-3	Total/NA	Air	TO-15	
200-41898-4 - DL	SV-4	Total/NA	Air	TO-15	
200-41898-9 - DL	DUP-1	Total/NA	Air	TO-15	
MB 200-125688/5	Method Blank	Total/NA	Air	TO-15	
LCS 200-125688/4	Lab Control Sample	Total/NA	Air	TO-15	

### Analysis Batch: 125744

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
200-41898-1	SV-1	Total/NA	Air	TO-15	
MB 200-125744/4	Method Blank	Total/NA	Air	TO-15	
LCS 200-125744/3	Lab Control Sample	Total/NA	Air	TO-15	

# Lab Chronicle

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Client Sample ID: SV-1

Date Collected: 01/11/18 17:05

Date Received: 01/17/18 15:00

## Lab Sample ID: 200-41898-1

Matrix: Air

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125744	01/25/18 10:09	A1B	TAL BUR
Total/NA	Analysis	TO-15	DL	5	125688	01/23/18 17:18	K1P	TAL BUR

## Client Sample ID: SV-2

Date Collected: 01/11/18 17:20

Date Received: 01/17/18 15:00

## Lab Sample ID: 200-41898-2

Matrix: Air

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125595	01/19/18 23:56	A1B	TAL BUR
Total/NA	Analysis	TO-15	DL	2	125688	01/23/18 18:08	K1P	TAL BUR

## Client Sample ID: SV-3

Date Collected: 01/11/18 16:28

Date Received: 01/17/18 15:00

## Lab Sample ID: 200-41898-3

Matrix: Air

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125595	01/20/18 00:47	A1B	TAL BUR
Total/NA	Analysis	TO-15	DL	6.06	125688	01/23/18 18:58	K1P	TAL BUR

## Client Sample ID: SV-4

Date Collected: 01/11/18 16:05

Date Received: 01/17/18 15:00

## Lab Sample ID: 200-41898-4

Matrix: Air

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125595	01/20/18 01:37	A1B	TAL BUR
Total/NA	Analysis	TO-15	DL	6.9	125688	01/23/18 19:48	K1P	TAL BUR

## Client Sample ID: AMB-1

Date Collected: 01/11/18 15:36

Date Received: 01/17/18 15:00

## Lab Sample ID: 200-41898-5

Matrix: Air

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125550	01/18/18 20:47	K1P	TAL BUR

## Client Sample ID: AMB-2

Date Collected: 01/11/18 15:38

Date Received: 01/17/18 15:00

## Lab Sample ID: 200-41898-6

Matrix: Air

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125550	01/18/18 21:37	K1P	TAL BUR

TestAmerica Burlington

# Lab Chronicle

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

**Client Sample ID: AMB-3**

**Date Collected: 01/11/18 15:40**

**Date Received: 01/17/18 15:00**

**Lab Sample ID: 200-41898-7**

**Matrix: Air**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125550	01/18/18 22:27	K1P	TAL BUR

**Client Sample ID: AMB-4**

**Date Collected: 01/11/18 15:43**

**Date Received: 01/17/18 15:00**

**Lab Sample ID: 200-41898-8**

**Matrix: Air**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125550	01/18/18 23:17	K1P	TAL BUR
Total/NA	Analysis	TO-15	DL	2.5	125550	01/19/18 09:27	K1P	TAL BUR

**Client Sample ID: DUP-1**

**Date Collected: 01/11/18 17:05**

**Date Received: 01/17/18 15:00**

**Lab Sample ID: 200-41898-9**

**Matrix: Air**

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	TO-15		1	125595	01/20/18 02:27	A1B	TAL BUR
Total/NA	Analysis	TO-15	DL	8	125688	01/23/18 20:39	K1P	TAL BUR

## Laboratory References:

TAL BUR = TestAmerica Burlington, 30 Community Drive, Suite 11, South Burlington, VT 05403, TEL (802)660-1990

# Accreditation/Certification Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

## Laboratory: TestAmerica Burlington

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	EPA Region	Identification Number	Expiration Date
New York	NELAP	2	10391	04-01-18

The following analytes are included in this report, but accreditation/certification is not offered by the governing authority:

Analysis Method	Prep Method	Matrix	Analyte
TO-15		Air	1,2-Dichloroethene, Total
TO-15		Air	4-Ethyltoluene
TO-15		Air	4-Isopropyltoluene
TO-15		Air	Cumene
TO-15		Air	Freon 22
TO-15		Air	Methyl Butyl Ketone (2-Hexanone)
TO-15		Air	n-Butane
TO-15		Air	n-Butylbenzene
TO-15		Air	n-Propylbenzene
TO-15		Air	sec-Butylbenzene
TO-15		Air	tert-Butylbenzene
TO-15		Air	Tetrahydrofuran

## Method Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Method	Method Description	Protocol	Laboratory
TO-15	Volatile Organic Compounds in Ambient Air	EPA	TAL BUR

### Protocol References:

EPA = US Environmental Protection Agency

### Laboratory References:

TAL BUR = TestAmerica Burlington, 30 Community Drive, Suite 11, South Burlington, VT 05403, TEL (802)660-1990

# Sample Summary

Client: AECOM, Inc.  
Project/Site: Rosedale, New York

TestAmerica Job ID: 200-41898-1  
SDG: 200-41898-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
200-41898-1	SV-1	Air	01/11/18 17:05	01/17/18 15:00
200-41898-2	SV-2	Air	01/11/18 17:20	01/17/18 15:00
200-41898-3	SV-3	Air	01/11/18 16:28	01/17/18 15:00
200-41898-4	SV-4	Air	01/11/18 16:05	01/17/18 15:00
200-41898-5	AMB-1	Air	01/11/18 15:36	01/17/18 15:00
200-41898-6	AMB-2	Air	01/11/18 15:38	01/17/18 15:00
200-41898-7	AMB-3	Air	01/11/18 15:40	01/17/18 15:00
200-41898-8	AMB-4	Air	01/11/18 15:43	01/17/18 15:00
200-41898-9	DUP-1	Air	01/11/18 17:05	01/17/18 15:00



TestAmerica Burlington  
30 Community Drive  
Suite 11

South Burlington, VT 05403-6809  
phone 802.660.1990 fax 802.660.1919

## Canister Samples Chain of

TestAmerica Laboratories, Inc. assumes no liability with respect to the 200-41898 Chain of Custody

TestAmerica  
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact Information		Client Project Manager: NELSON ABRAMS		Samples Collected By: JOHN CRESPO		COC No: 1 of 1 COCs																							
Company Name: AECOM CORP		Phone:																											
Address: 125 BROAD ST.		Email: NELSON.ABRAMS@AECOM.COM																											
City/State/Zip: N.Y.C. N.Y.		Site Contact: JOHN CRESPO																											
Phone: 212-377-8400		Tel/Fax:																											
Project Name: ROSEDALE NY		Analysis Turnaround Time																											
Site/Location: 205 DMS		Standard (Specific):																											
P.O.# 6054077		Rush (Specify):																											
Sample Identification		Sample Date(s)	Time Start	Time Stop	Canister Vacuum in Field, 'Hg (Start)	Canister Vacuum in Field, 'Hg (Stop)	Canister ID	Flow Controller ID	TO-15 SIM	EPA 3C	EPA 25C	ASTM D-1946	EPA 15/16	Other (Please specify in notes section)	Sample Type	Indoor Air/Ambient Air	Sub-Slab	Soil Gas	Soil Vapor Extraction (SVE)	Landfill Gas	Other (Please specify in notes section)								
SV-1	11/18	9:05	17:05	-30	-26	4989	2547	X																					
SV-2		9:20	17:20	-30	-9	5232	2534	X																					
SV-3		8:28	16:28	-30	-10	3181	4163	X																					
SV-4		8:05	16:05	-30	-8	4246	4242	X																					
AMB-1		7:36	15:36	-30	-26	3742	3043	X																					
AMB-2		7:38	15:38	-30	-5	3171	4098	X																					
AMB-3		7:40	15:40	-30	-24	3170	3662	X																					
AMB-4		7:43	15:43	-30	-21	4721	4913	X																					
DUP-1		9:05	17:05	-30	-24	5205	4472	X																					
Special Instructions/QC Requirements & Comments:		TO-15																											
Start		Interior		Ambient		Temperature (Fahrenheit)															Start		Interior		Ambient		Pressure (inches of Hg)		
Stop																					Stop								
Start		Interior		Ambient		Pressure (inches of Hg)															Start		Interior		Ambient		Pressure (inches of Hg)		
Stop																					Stop								
Samples Shipped by: John Karp		Date / Time: 1/12/18		Samples Received by: John Karp		Date / Time: 1/12/18		Received by: John Karp		Date / Time: 1/12/18		Received by: John Karp		Date / Time: 1/12/18		Received by: John Karp		Date / Time: 1/12/18		Received by: John Karp		Date / Time: 1/12/18							
Samples Relinquished by: John Karp		Date / Time: 1/12/18		Relinquished by: John Karp		Date / Time: 1/12/18		Relinquished by: John Karp		Date / Time: 1/12/18		Relinquished by: John Karp		Date / Time: 1/12/18		Relinquished by: John Karp		Date / Time: 1/12/18		Relinquished by: John Karp		Date / Time: 1/12/18							
Lab Use Only:		Shipped Name: JC		Opened by: JKT		Condition: Intact																Lab Use Only:		Shipped Name: JC		Opened by: JKT		Condition: Intact	

ORIGIN ID:YAKA (631) 624-1989  
JOHN CRESPO

4 DASKAMS LN UNIT 304

NORWALK, CT 06851  
UNITED STATES US

SHIP DATE: 13JAN18  
ACTWGT: 8.10 LB  
CAD: 6990425/SSFO1822  
DIMS: 16x10x10 IN

BILL THIRD PARTY

Part # 15629740507AD3-EXP 08/18

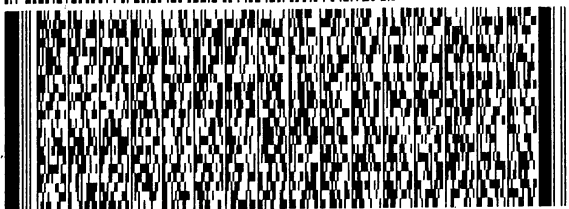
TO ATTN: SAMPLE MANAGEMENT  
TEST AMERICA BURLINGTON  
30 COMMUNITY DR  
STE 11  
SOUTH BURLINGTON VT 05403

(802) 923-1058

REF:

NU:

DEPT:



FedEx  
Express



JT72117091301W

1 of 3  
TRK# 7893 3456 0499  
0201

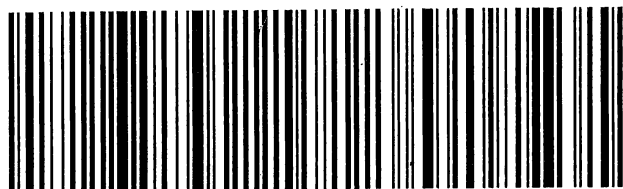
## MASTER ##

**XH BTVA**

MON - 15 JAN 10:30A  
PRIORITY OVERNIGHT

DSR  
05403

VT-US BTV



ORIGIN ID:YAKA (631) 624-1989  
JOHN CRESPO

4 DASKAMS LN UNIT 304

NORWALK, CT 06851  
UNITED STATES US

SHIP DATE: 13JAN18  
ACTWGT: 34.50 LB  
CAD: 6990425/SSFO1822  
DIMS: 20x20x17 IN

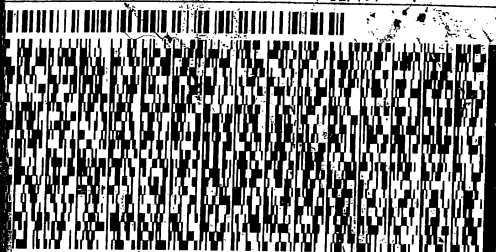
BILL THIRD PARTY

ATTN: SAMPLE MANAGEMENT  
TEST AMERICA BURLINGTON  
30 COMMUNITY DR  
STE 11  
SOUTH BURLINGTON VT 05403

(802) 923-1058

REF:

DEPT:



FedEx  
Express



JT72117091301W

2 of 3  
7893 3456 0503  
# 7893 3456 0499

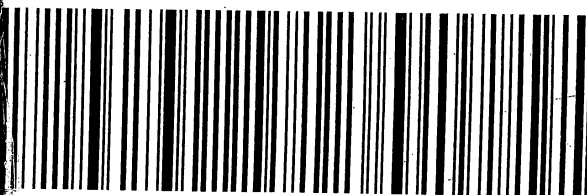
0201

**XH BTVA**

MON - 15 JAN 10:30A  
PRIORITY OVERNIGHT

DSR  
05403

VT-US BTV



Part # 15629740507AD3-EXP 08/18

SHIP DATE: 13JAN18  
ACTWGT: 33.50 LB  
CAD: 6990425/SSFO1822  
DIMS: 20x20x17 IN

BILL THIRD PARTY

ORIGIN ID:YAKA (631) 624-1989  
JOHN CRESPO

4 DASKAMS LN UNIT 304

NORWALK, CT 06851  
UNITED STATES US

TO ATTN: SAMPLE MANAGEMENT  
TEST AMERICA BURLINGTON  
30 COMMUNITY DR  
STE 11  
SOUTH BURLINGTON VT 05403

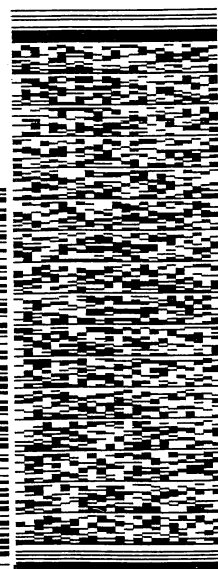
(802) 923-1058

REF:

NU:

DEPT:

FedEx  
Express



3 of 3  
MPS# 7893 3456 0514  
0263

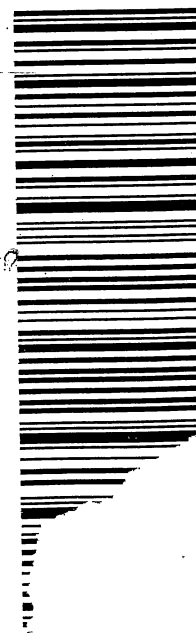
Mstr# 7893 3456 0499

**XH BTVA**

MON - 15 JAN 10:30A  
PRIORITY OVERNIGHT

DSR  
05403

VT-US BTV



## Login Sample Receipt Checklist

Client: AECOM, Inc.

Job Number: 200-41898-1

SDG Number: 200-41898-1

**Login Number: 41898**

**List Number: 1**

**Creator: Deason, Barbara N**

**List Source: TestAmerica Burlington**

Question	Answer	Comment
Radioactivity wasn't checked or is $\leq$ background as measured by a survey meter.		
The cooler's custody seal, if present, is intact.		
Sample custody seals, if present, are intact.		
The cooler or samples do not appear to have been compromised or tampered with.		
Samples were received on ice.		
Cooler Temperature is acceptable.		
Cooler Temperature is recorded.		
COC is present.		
COC is filled out in ink and legible.		
COC is filled out with all pertinent information.		
Is the Field Sampler's name present on COC?		
There are no discrepancies between the containers received and the COC.		
Samples are received within Holding Time (excluding tests with immediate HTs)		
Sample containers have legible labels.		
Containers are not broken or leaking.		
Sample collection date/times are provided.		
Appropriate sample containers are used.		
Sample bottles are completely filled.		
Sample Preservation Verified.		
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs		
Containers requiring zero headspace have no headspace or bubble is $<6\text{mm}$ (1/4").		
Multiphasic samples are not present.		
Samples do not require splitting or compositing.		
Residual Chlorine Checked.		

# Pre-Shipment Clean Canister Certification Report

System ID										Canister Cleaning & Pre-Shipment Leak Test				Certification Type:			
Oven 3/4		Max DF#	# Cycles	Cleaning Date	Technician	Canister Size	Individual	Batch									
Port	Can ID	Initial (psia)	Final (psia)	Diff. <sup>3</sup>	Final ("Hg)	Gauge:	Date:	Tech:	Time:	Date:	Time:	Tech:	Temp:				
1	4808	.05	.05	0	-29.6	G25	12/5/17	CE	13:11	12/23/17	1430	SW	22				
2	3337	.13	.13	0	-29.6												
3	6310	.05	.05	0	-29.6												
4	2534	.04	.04	0	-30.3		12/5/17	CE	13:11	12/23/17	1430	SW	22				
5	2858	.05	.05	0	-29.6												
6	5727	.05	.05	0	-29.6												
7	4383	.05	.05	0	-29.6												
8	4345	.05	.05	0	-29.6												
9	4094	.09	.09	.04	-29.6												
10	4333	.10	.10	.05	-29.6												
11	3474	.05	.05	0	-29.6												
12	2739	.05	.05	0	-29.6												

<sup>1</sup> Batch Certification: The reading is taken on the "batch" canister and this value is used as the initial pressure for all canisters in the batch.  
<sup>3</sup> Difference = Final Pressure - Initial Pressure . Acceptance Criteria: (1) The difference must be less than or equal to + 0.25psi. (2) Pressure readings must be at least 24 hours apart.

If time frame was not met, the PM must authorize shipment of canister

Clean Canister Certification Analysis & Authorization of Release to Inventory									
Can ID	Date	Sequence	Analyst	Inventory Level	Limited	Review Date	Reviewer		
2534	12/13/17	28309	ER-1	XXXX		12/13/17	UTP		
	12/18/17	28372				12/18/17	JP		

Comments:

- Inventory Level 1: Individual Canister Certification (TO15LL 0.01).
- Inventory Level 2: Individual or Batch Certification (TO15 0.04 ppbv).
- Inventory Level 3: Individual or Batch Certification (TO15 0.2 ppbv).
- Inventory Level 4: Individual or Batch Certification (TO15LLNJ 0.08 ppbv).
- Inventory Level Limited: Canisters may only be used for certain projects.

Form ID: FAI023-11  
Revision Date: 11-15-2017

TestAmerica Burlington

200-41261-A-4  
2534  
Location: Air-Storage  
Bottle: Summa Canister 6L  
Sampled: 12/4/2017 12:00 AM 200-1102117

Loc: 200  
**41261**  
**#4**  
**A**



# Pre-Shipment Clean Canister Certification Report

## Canister Cleaning & Pre-Shipment Leak Test

[illegible]

Comments:

**Inventory Level 1: Individual Canister Certification (TO15LL 0.01).**

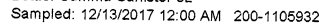
**Inventory Level 2:** Individual or Batch Certification (TO15 0.04 ppbv).

**Inventory Level 3:** Individual or Batch Certification (TO15 0.2 ppbv).

**Inventory Level 4: Individual or Batch Certification (TO15LLNJ 0.08 ppbv).**

**Inventory Level Limited:** Canisters may only be used for certain projects.

FAI023:04.26.17:10  
TestAmerica Burlington



**Loc: 200**

**41411**

# #11

# A

# Pre-shipment Clean Canister Certification Report

Canister Cleaning & Pre-shipment Leak Test													
System ID		# Cycles		Cleaning Date		Technician		Canister Size		Certification Type:			
Oven 3/4		32		12/13/2017		SML		1L 6L		Individual			
Port	Can ID	Initial <sup>1</sup> (psia)	Final (psia)	Diff. <sup>3</sup>	Final ("Hg)	Final Reading							
						Gauge:	Date:	Tech:	Time:	Gauge:	Date:	Tech:	Time:
1	3274	104	104	0	-30.1	025	12/19/17	5-	22	025	12/21/17	SMC	22
2	4148		104	0	-30.1								
3	4270		108	04	-30.1								
4	3140		108	04	-30.1								
5	2547		104	0	-30.1								
6	4341		104	0	-30.1								
7	4794		104	0	-30.1								
8	5447												
9	2746		104	0	-30.1								
10	5648		111	07	-30.1								
11	6164		104	0	-30.1								
12	5447		104	0	-30.1								

<sup>1</sup> Batch Certification: The reading is taken on the "batch" canister and this value is used as the initial pressure for all canisters in the batch.  
<sup>3</sup> Difference = Final Pressure - Initial Pressure. Acceptance Criteria: (1) The difference must be less than or equal to + 0.25psi. (2) Pressure readings must be at least 24 hours apart.

If time frame was not met, the PM must authorize shipment of canister

PM Authorization

Date:

Clean Canister Certification Analysis & Authorization of Release to Inventory										
Test Method: ≤ TO15 Routine ≤ TO15 LL ≤ NJDEP-LL TO15		Inventory Level				Secondary Review				
Can ID	Date	Sequence	Analyst	1	2	3	4	Limited	Review Date	Reviewer
3274	12/18/17	28387	AS		XXXX				12/18/17	UTP
4148					XXXX					
4270					XXXX					
3140					XXXX					
2547					XXXX					
4341					XXXX					
4794					XXXX					
5111					XXXX					
2746					XXXX					
5648					XXXX					
6164					XXXX					
5447					XXXX					

Comments:

Inventory Level 1: Individual Canister Certification (TO15LL 0.01).

Inventory Level 2: Individual or Batch Certification (TO15 0.04 ppbv).

Inventory Level 3: Individual or Batch Certification (TO15 0.2 ppbv).

Inventory Level 4: Individual or Batch Certification (TO15LLNJ 0.08 ppbv).

Inventory Level Limited: Canisters may only be used for certain projects.

200-41413-A-1  
3274  
Location: Air-Storage  
Bottle: Summa Canister 6L  
Sampled: 12/13/2017 12:00 AM 200-1105939

Loc: 200  
41413  
#1  
A

1  
2  
3  
4  
5  
6  
7  
8  
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**Inventory Level 1:** Individual Canister Certification (TO15LL 0.01).  
**Inventory Level 2:** Individual or Batch Certification (TO15 0.04 ppbv).  
**Inventory Level 3:** Individual or Batch Certification (TO15 0.2 ppbv).  
**Inventory Level 4:** Individual or Batch Certification (TO15LLNJ 0.08 ppbv).  
**Inventory Level Limited:** Canisters may only be used for certain projects.

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FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: <u>TestAmerica Burlington</u>	Job No.: <u>200-41261-1</u>
SDG No.: _____	
Client Sample ID: <u>2534</u>	Lab Sample ID: <u>200-41261-4</u>
Matrix: <u>Air</u>	Lab File ID: <u>28309-25.D</u>
Analysis Method: <u>TO-15</u>	Date Collected: <u>12/04/2017 00:00</u>
Sample wt/vol: <u>1000 (mL)</u>	Date Analyzed: <u>12/13/2017 08:05</u>
Soil Aliquot Vol: _____	Dilution Factor: <u>0.2</u>
Soil Extract Vol.: _____	GC Column: <u>RTX-624</u> ID: <u>0.32 (mm)</u>
% Moisture: _____	Level: (low/med) <u>Low</u>
Analysis Batch No.: <u>124339</u>	Units: <u>ppb v/v</u>

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41261-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2534 Lab Sample ID: 200-41261-4  
 Matrix: Air Lab File ID: 28309-25.D  
 Analysis Method: TO-15 Date Collected: 12/04/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/13/2017 08:05  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124339 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41261-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2534 Lab Sample ID: 200-41261-4  
 Matrix: Air Lab File ID: 28309-25.D  
 Analysis Method: TO-15 Date Collected: 12/04/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/13/2017 08:05  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124339 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171212-28309.b\28309-25.D  
 Lims ID: 200-41261-A-4  
 Client ID: 2534  
 Sample Type: Client  
 Inject. Date: 13-Dec-2017 08:05:30 ALS Bottle#: 25 Worklist Smp#: 25  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028309-025  
 Misc. Info.: 41261-04  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171212-28309.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 13-Dec-2017 08:50:28 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK003

First Level Reviewer: phamvu

Date: 13-Dec-2017 11:45:37

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.134				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.225				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.704				ND	
13 Vinyl bromide	106		5.114				ND	
14 Trichlorofluoromethane	101		5.216				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101	6.257	6.246	0.011	89	3159	0.0457	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.678				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.014				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.012				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.325				ND	
35 Ethyl acetate	88		9.325				ND	
* 39 Chlorobromomethane	128	9.694	9.694	0.000	93	348411	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.768				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.046				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.102	-0.005	94	1778821	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.031				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.970				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.032				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.443				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	85	1466097	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91		15.319				ND	
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
S 77 Xylenes, Total	106		16.000				ND	
79 Styrene	104		16.002				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.797				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.994				ND	
88 2-Chlorotoluene	91		17.037				ND	
89 1,3,5-Trimethylbenzene	105		17.058				ND	
91 tert-Butylbenzene	119		17.437				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.694				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.521				ND	
103 1,2,4-Trichlorobenzene	180		20.880				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.360				ND	

**Reagents:**

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

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TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171212-28309.b\28309-25.D

Injection Date: 13-Dec-2017 08:05:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41261-A-4

Lab Sample ID: 200-41261-4

Worklist Smp#: 25

Client ID: 2534

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

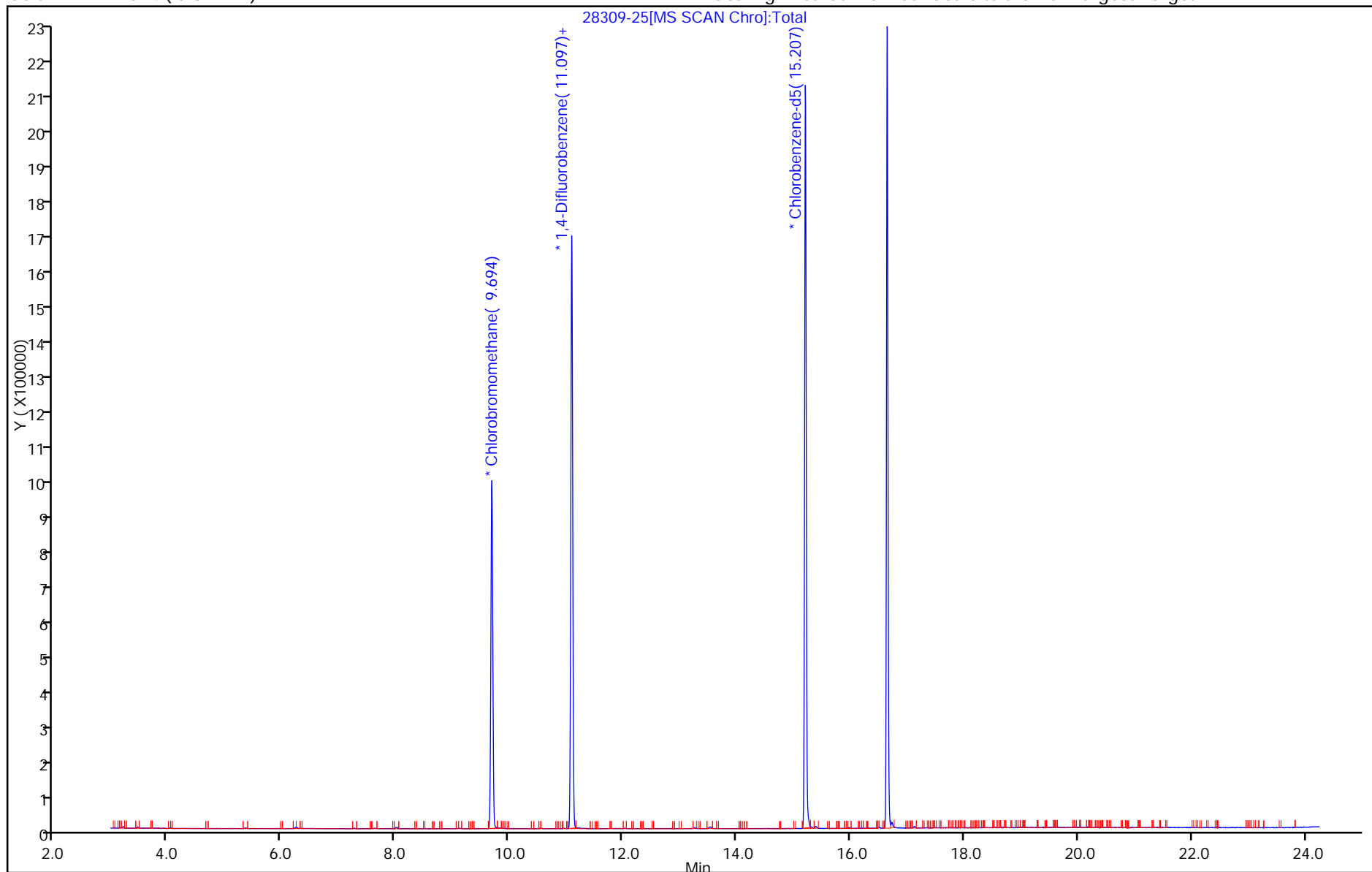
ALS Bottle#: 25

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 ( 0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: <u>TestAmerica Burlington</u>	Job No.: <u>200-41411-1</u>
SDG No.: _____	
Client Sample ID: <u>4355</u>	Lab Sample ID: <u>200-41411-11</u>
Matrix: <u>Air</u>	Lab File ID: <u>28372-23.D</u>
Analysis Method: <u>TO-15</u>	Date Collected: <u>12/13/2017 00:00</u>
Sample wt/vol: <u>1000 (mL)</u>	Date Analyzed: <u>12/16/2017 03:40</u>
Soil Aliquot Vol: _____	Dilution Factor: <u>0.2</u>
Soil Extract Vol.: _____	GC Column: <u>RTX-624</u> ID: <u>0.32 (mm)</u>
% Moisture: _____	Level: (low/med) <u>Low</u>
Analysis Batch No.: <u>124492</u>	Units: <u>ppb v/v</u>

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: <u>TestAmerica Burlington</u>	Job No.: <u>200-41411-1</u>
SDG No.: _____	
Client Sample ID: <u>4355</u>	Lab Sample ID: <u>200-41411-11</u>
Matrix: <u>Air</u>	Lab File ID: <u>28372-23.D</u>
Analysis Method: <u>TO-15</u>	Date Collected: <u>12/13/2017 00:00</u>
Sample wt/vol: <u>1000 (mL)</u>	Date Analyzed: <u>12/16/2017 03:40</u>
Soil Aliquot Vol: _____	Dilution Factor: <u>0.2</u>
Soil Extract Vol.: _____	GC Column: <u>RTX-624</u> ID: <u>0.32 (mm)</u>
% Moisture: _____	Level: (low/med) <u>Low</u>
Analysis Batch No.: <u>124492</u>	Units: <u>ppb v/v</u>

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41411-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4355 Lab Sample ID: 200-41411-11  
 Matrix: Air Lab File ID: 28372-23.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 03:40  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124492 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHG.i\20171215-28372.b\28372-23.D  
 Lims ID: 200-41411-A-11  
 Client ID: 4355  
 Sample Type: Client  
 Inject. Date: 16-Dec-2017 03:40:30 ALS Bottle#: 28 Worklist Smp#: 23  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028372-023  
 Misc. Info.: 41411-11  
 Operator ID: pad Instrument ID: CHG.i  
 Method: \\ChromNA\Burlington\ChromData\CHG.i\20171215-28372.b\TO15\_MasterMethod\_(v1)\_G.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 16:04:44 Calib Date: 12-Dec-2017 02:10:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHG.i\20171211-28297.b\28297-12.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK009

First Level Reviewer: puangmaleek

Date:

18-Dec-2017 16:04:44

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.122				ND	
2 Dichlorodifluoromethane	85		3.176				ND	
3 Chlorodifluoromethane	51		3.213				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.385				ND	
5 Chloromethane	50		3.508				ND	
6 Butane	43		3.657				ND	
7 Vinyl chloride	62		3.695				ND	
8 Butadiene	54		3.754				ND	
10 Bromomethane	94		4.299				ND	
11 Chloroethane	64		4.476				ND	
13 Vinyl bromide	106		4.797				ND	
14 Trichlorofluoromethane	101		4.866				ND	
17 Ethanol	45		5.343				ND	
20 1,1,2-Trichloro-1,2,2-trif	101		5.744				ND	
21 1,1-Dichloroethene	96		5.803				ND	
22 Acetone	43		6.022				ND	
23 Carbon disulfide	76		6.166				ND	
24 Isopropyl alcohol	45		6.257				ND	
25 3-Chloro-1-propene	41		6.477				ND	
27 Methylene Chloride	49		6.734				ND	
28 2-Methyl-2-propanol	59		6.942				ND	
29 Methyl tert-butyl ether	73		7.113				ND	
31 trans-1,2-Dichloroethene	61		7.124				ND	
33 Hexane	57		7.461				ND	
34 1,1-Dichloroethane	63		7.927				ND	
35 Vinyl acetate	43		7.991				ND	
37 cis-1,2-Dichloroethene	96		8.948				ND	
38 2-Butanone (MEK)	72		9.018				ND	
39 Ethyl acetate	88		9.050				ND	
* 40 Chlorobromomethane	128	9.376	9.392	-0.016	76	311890	10.0	
41 Tetrahydrofuran	42		9.430				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
42 Chloroform	83		9.505				ND	
S 30 1,2-Dichloroethene, Total	61		9.665				ND	
43 Cyclohexane	84		9.745				ND	
44 1,1,1-Trichloroethane	97		9.772				ND	
45 Carbon tetrachloride	117		10.008				ND	
46 Isooctane	57		10.419				ND	
47 Benzene	78		10.468				ND	
48 1,2-Dichloroethane	62		10.644				ND	
49 n-Heptane	43		10.794				ND	
* 50 1,4-Difluorobenzene	114	11.270	11.281	-0.011	94	1554758	10.0	
53 Trichloroethene	95		11.741				ND	
54 1,2-Dichloropropane	63		12.297				ND	
55 Methyl methacrylate	69		12.468				ND	
57 Dibromomethane	174		12.543				ND	
56 1,4-Dioxane	88		12.549				ND	
58 Dichlorobromomethane	83		12.832				ND	
60 cis-1,3-Dichloropropene	75		13.752				ND	
61 4-Methyl-2-pentanone (MIBK)	43		14.068				ND	
65 Toluene	92		14.330				ND	
66 trans-1,3-Dichloropropene	75		14.929				ND	
67 1,1,2-Trichloroethane	83		15.304				ND	
68 Tetrachloroethene	166		15.395				ND	
69 2-Hexanone	43		15.785				ND	
71 Chlorodibromomethane	129		16.058				ND	
72 Ethylene Dibromide	107		16.331				ND	
* 74 Chlorobenzene-d5	117	17.229	17.235	-0.006	86	1270998	10.0	
75 Chlorobenzene	112		17.294				ND	
76 Ethylbenzene	91		17.454				ND	
78 m-Xylene & p-Xylene	106		17.706				ND	
79 o-Xylene	106		18.562				ND	
80 Styrene	104		18.621				ND	
81 Bromoform	173		19.065				ND	
82 Isopropylbenzene	105		19.300				ND	
S 73 Xylenes, Total	106		19.600				ND	
84 1,1,2,2-Tetrachloroethane	83		20.006				ND	
85 N-Propylbenzene	91		20.070				ND	
88 4-Ethyltoluene	105		20.274				ND	
89 2-Chlorotoluene	91		20.274				ND	
90 1,3,5-Trimethylbenzene	105		20.391				ND	
92 tert-Butylbenzene	119		20.894				ND	
93 1,2,4-Trimethylbenzene	105		20.996				ND	
94 sec-Butylbenzene	105		21.237				ND	
95 4-Isopropyltoluene	119		21.451				ND	
96 1,3-Dichlorobenzene	146		21.467				ND	
97 1,4-Dichlorobenzene	146		21.606				ND	
98 Benzyl chloride	91		21.814				ND	
100 n-Butylbenzene	91		22.028				ND	
101 1,2-Dichlorobenzene	146		22.141				ND	
103 1,2,4-Trichlorobenzene	180		24.580				ND	
104 Hexachlorobutadiene	225		24.762				ND	
105 Naphthalene	128		25.046				ND	

**Reagents:**

ATTO15GIS\_00015

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

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11

12

13

14

15

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHG.i\20171215-28372.b\28372-23.D

Injection Date: 16-Dec-2017 03:40:30

Instrument ID: CHG.i

Operator ID: pad

Lims ID: 200-41411-A-11

Lab Sample ID: 200-41411-11

Worklist Smp#: 23

Client ID: 4355

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

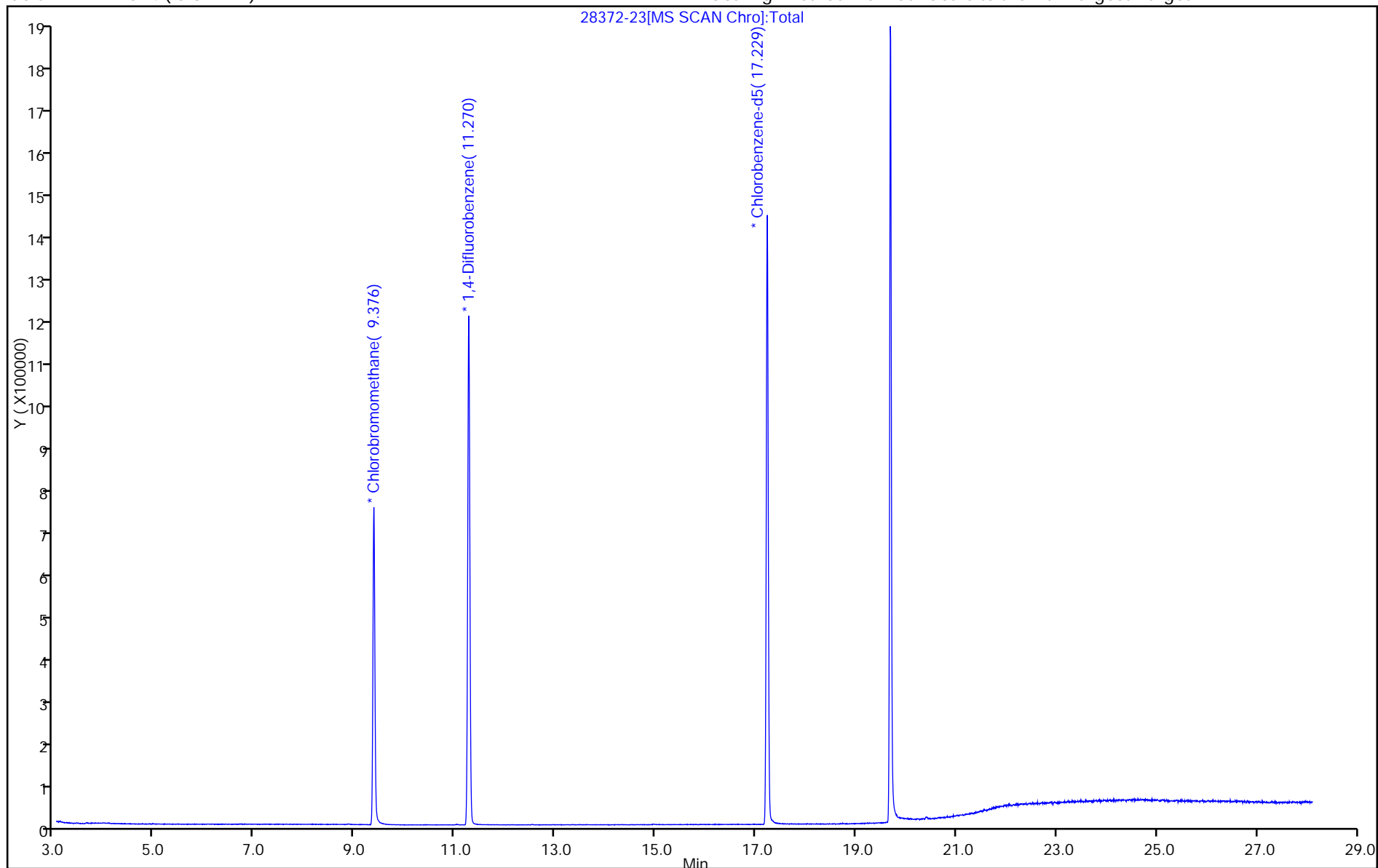
ALS Bottle#: 28

Method: TO15\_MasterMethod\_(v1)\_G

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 3274 Lab Sample ID: 200-41413-1  
 Matrix: Air Lab File ID: 28387-06.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 16:39  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 3274 Lab Sample ID: 200-41413-1  
 Matrix: Air Lab File ID: 28387-06.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 16:39  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 3274 Lab Sample ID: 200-41413-1  
 Matrix: Air Lab File ID: 28387-06.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 16:39  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10



TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-06.D  
 Lims ID: 200-41413-A-1  
 Client ID: 3274  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 16:39:30 ALS Bottle#: 6 Worklist Smp#: 6  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-006  
 Misc. Info.: 41413-01  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LLNIJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 16:48:52 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 16:48:52

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	99	281758	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1428942	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	M
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1186391	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	3177	0.0205	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	M

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

5

6

7

8

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15

Report Date: 18-Dec-2017 16:48:53

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-06.D

Injection Date: 15-Dec-2017 16:39:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-1

Lab Sample ID: 200-41413-1

Worklist Smp#: 6

Client ID: 3274

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

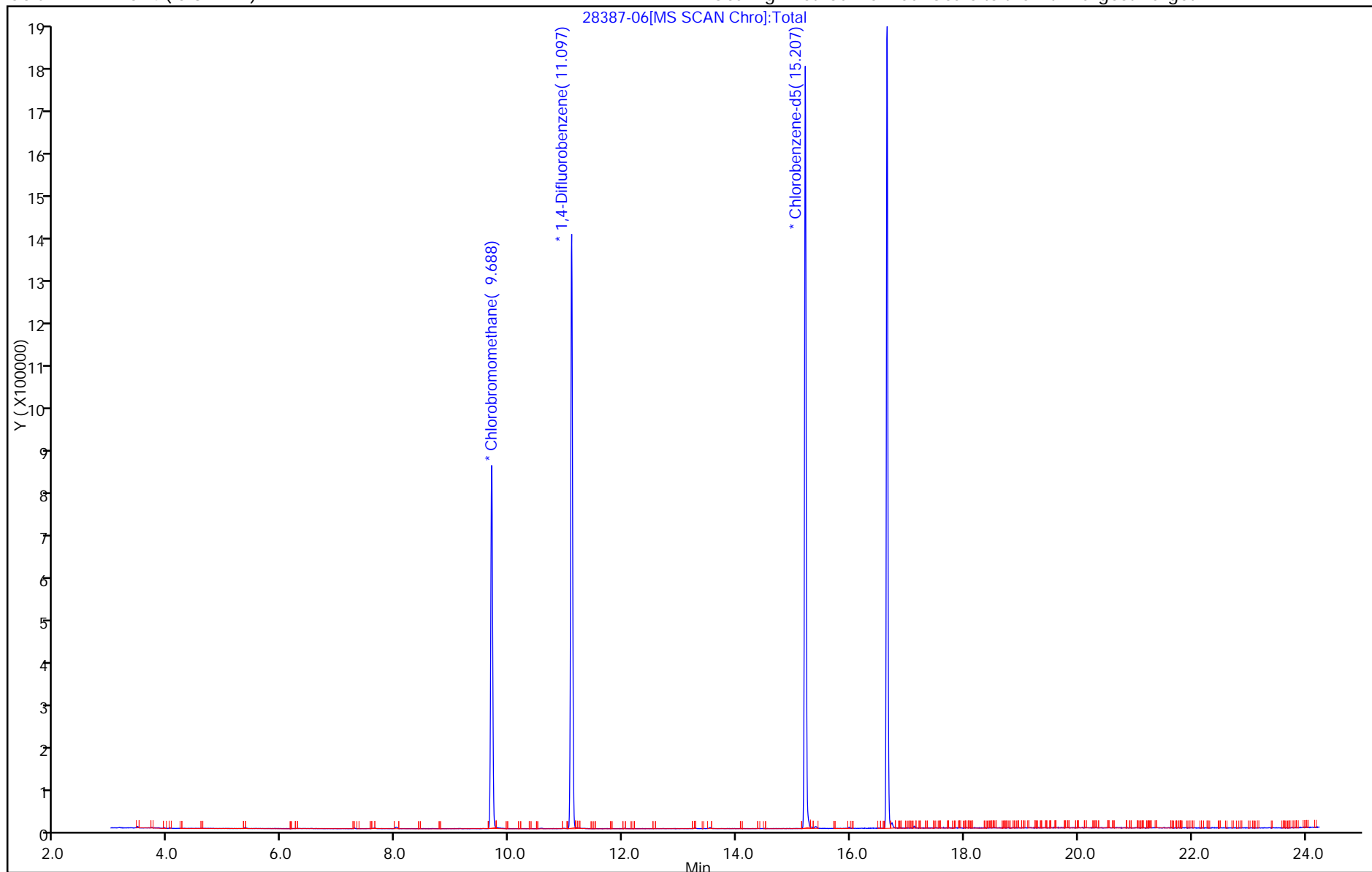
ALS Bottle#: 6

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4148 Lab Sample ID: 200-41413-2  
 Matrix: Air Lab File ID: 28387-07.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 17:41  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4148 Lab Sample ID: 200-41413-2  
 Matrix: Air Lab File ID: 28387-07.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 17:41  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4148 Lab Sample ID: 200-41413-2  
 Matrix: Air Lab File ID: 28387-07.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 17:41  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-07.D  
 Lims ID: 200-41413-A-2  
 Client ID: 4148  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 17:41:30 ALS Bottle#: 7 Worklist Smp#: 7  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-007  
 Misc. Info.: 41413-02  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LLNIJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 16:51:42 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 16:51:42

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	M
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	99	279845	10.0	
38 Tetrahydrofuran	42		9.710				ND	



Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1415441	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	M
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	88	1169462	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.319	15.319	0.006	1	3049	0.0199	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

5

6

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8

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Report Date: 18-Dec-2017 16:51:42

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-07.D

Injection Date: 15-Dec-2017 17:41:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-2

Lab Sample ID: 200-41413-2

Worklist Smp#: 7

Client ID: 4148

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

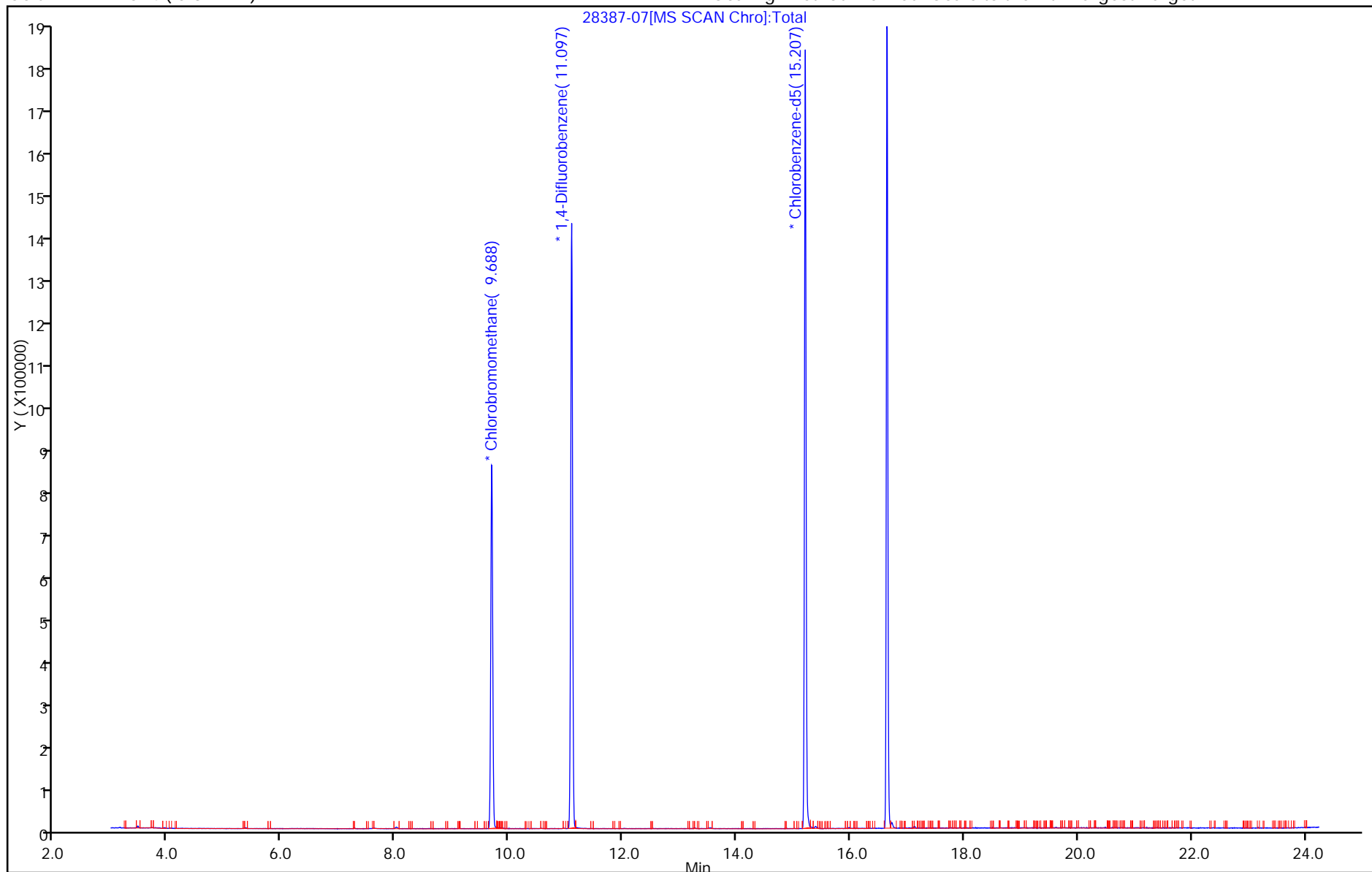
ALS Bottle#: 7

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4270 Lab Sample ID: 200-41413-3  
 Matrix: Air Lab File ID: 28387-08.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 18:44  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4270 Lab Sample ID: 200-41413-3  
 Matrix: Air Lab File ID: 28387-08.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 18:44  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4270 Lab Sample ID: 200-41413-3  
 Matrix: Air Lab File ID: 28387-08.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 18:44  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-08.D  
 Lims ID: 200-41413-A-3  
 Client ID: 4270  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 18:44:30 ALS Bottle#: 8 Worklist Smp#: 8  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-008  
 Misc. Info.: 41413-03  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 16:54:04 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 16:54:04

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.694	9.699	-0.005	99	276048	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1412952	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1168428	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2819	0.0184	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	



[QC Flag Legend](#)

Processing Flags

7 - Failed Limit of Detection

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

Report Date: 18-Dec-2017 16:54:04

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-08.D

Injection Date: 15-Dec-2017 18:44:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-3

Lab Sample ID: 200-41413-3

Worklist Smp#: 8

Client ID: 4270

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

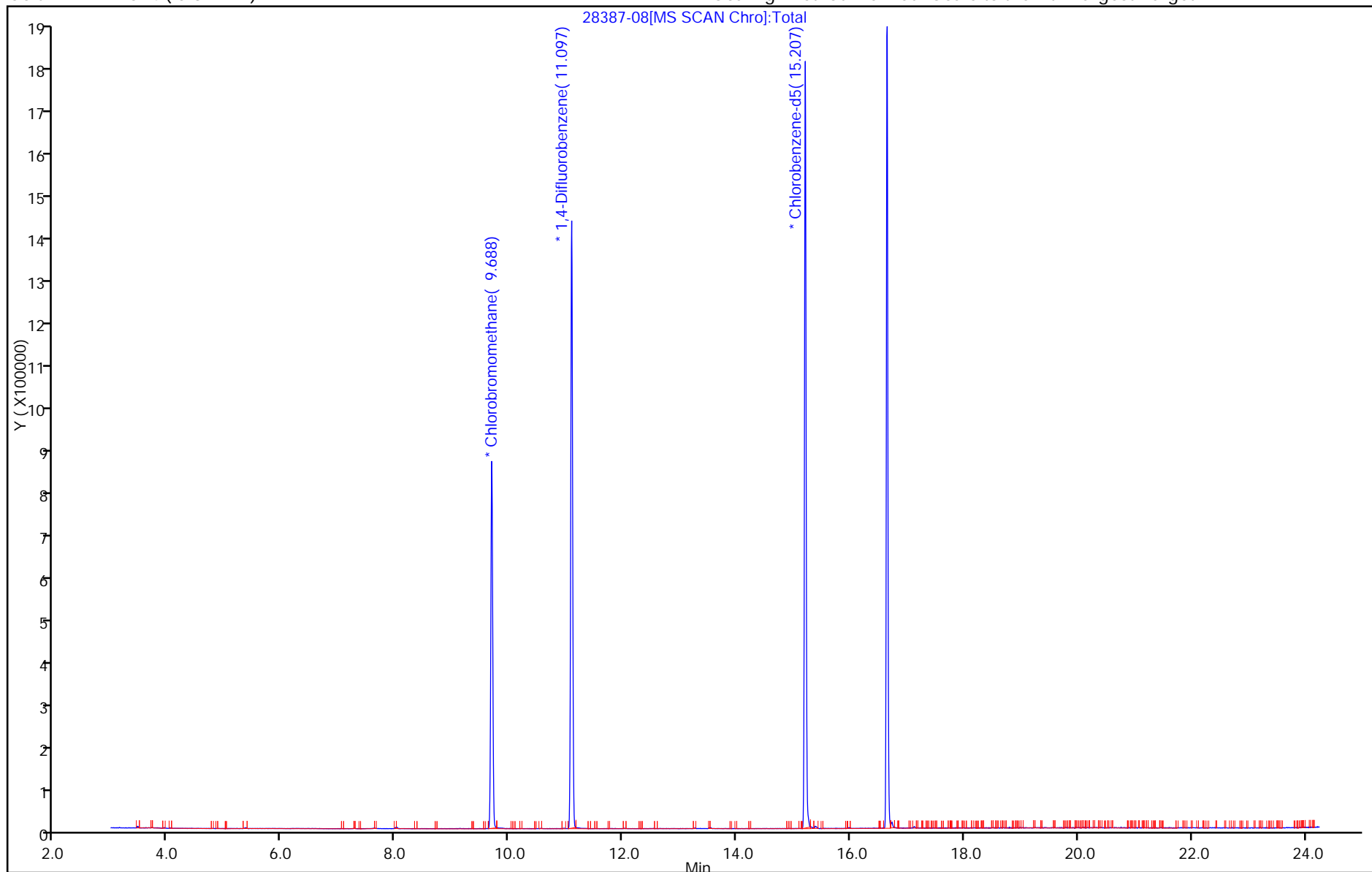
ALS Bottle#: 8

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 ( 0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 3140 Lab Sample ID: 200-41413-4  
 Matrix: Air Lab File ID: 28387-09.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 19:46  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
SDG No.: \_\_\_\_\_  
Client Sample ID: 3140 Lab Sample ID: 200-41413-4  
Matrix: Air Lab File ID: 28387-09.D  
Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 19:46  
Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
% Moisture: \_\_\_\_\_ Level: (low/med) Low  
Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 3140 Lab Sample ID: 200-41413-4  
 Matrix: Air Lab File ID: 28387-09.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 19:46  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-09.D  
 Lims ID: 200-41413-A-4  
 Client ID: 3140  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 19:46:30 ALS Bottle#: 9 Worklist Smp#: 9  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-009  
 Misc. Info.: 41413-04  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LLNIJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 16:56:39 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 16:56:39

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.693	9.699	-0.006	99	266320	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1358033	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.206	15.212	-0.006	87	1122667	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91		15.313				ND	
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

**Reagents:**

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

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TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-09.D

Injection Date: 15-Dec-2017 19:46:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-4

Lab Sample ID: 200-41413-4

Worklist Smp#: 9

Client ID: 3140

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

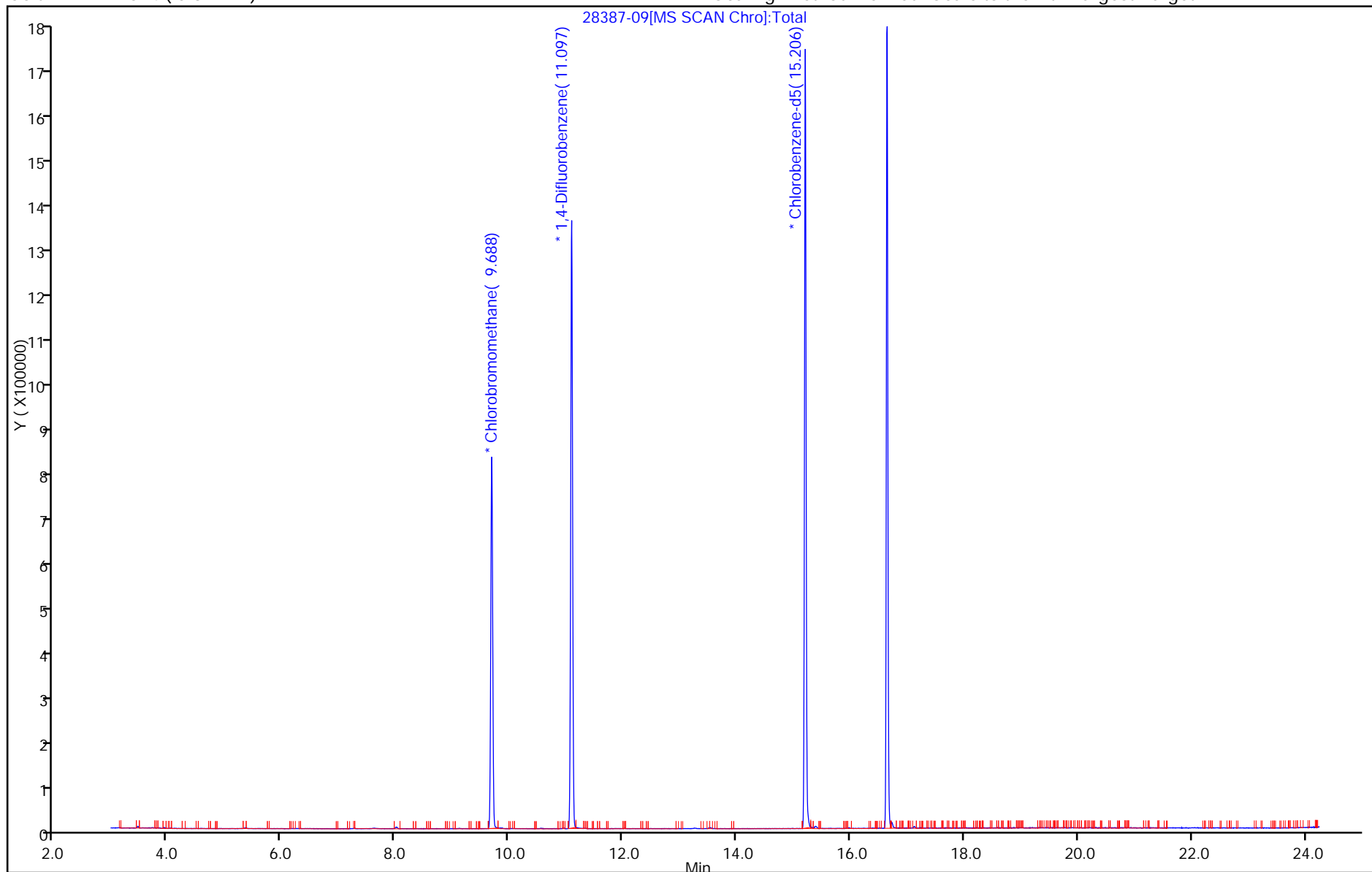
ALS Bottle#: 9

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2547 Lab Sample ID: 200-41413-5  
 Matrix: Air Lab File ID: 28387-10.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 20:49  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2547 Lab Sample ID: 200-41413-5  
 Matrix: Air Lab File ID: 28387-10.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 20:49  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2547 Lab Sample ID: 200-41413-5  
 Matrix: Air Lab File ID: 28387-10.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 20:49  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-10.D  
 Lims ID: 200-41413-A-5  
 Client ID: 2547  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 20:49:30 ALS Bottle#: 10 Worklist Smp#: 10  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-010  
 Misc. Info.: 41413-05  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:00:31 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:00:31

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	99	266408	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1374659	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1134995	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2815	0.0189	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

Processing Flags

7 - Failed Limit of Detection

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

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TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-10.D

Injection Date: 15-Dec-2017 20:49:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-5

Lab Sample ID: 200-41413-5

Worklist Smp#: 10

Client ID: 2547

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

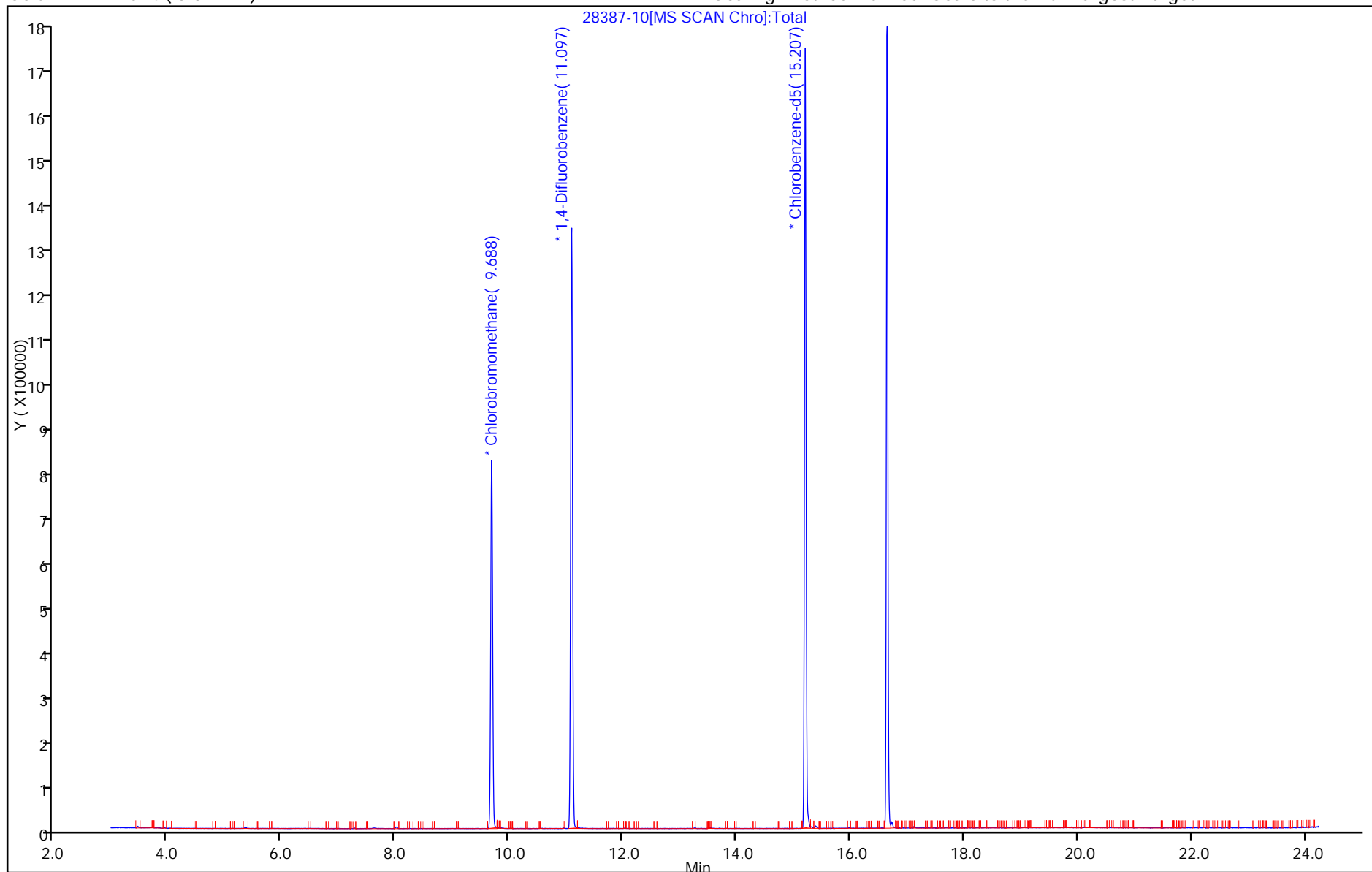
ALS Bottle#: 10

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 ( 0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1





FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4341 Lab Sample ID: 200-41413-6  
 Matrix: Air Lab File ID: 28387-11.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 21:51  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4341 Lab Sample ID: 200-41413-6  
 Matrix: Air Lab File ID: 28387-11.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 21:51  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4341 Lab Sample ID: 200-41413-6  
 Matrix: Air Lab File ID: 28387-11.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 21:51  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-11.D  
 Lims ID: 200-41413-A-6  
 Client ID: 4341  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 21:51:30 ALS Bottle#: 11 Worklist Smp#: 11  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-011  
 Misc. Info.: 41413-06  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:04:02 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:04:02

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	M
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	100	263910	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	M
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1341881	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1116326	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.319	15.319	0.006	1	2445	0.0167	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15

Report Date: 18-Dec-2017 17:04:03

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-11.D

Injection Date: 15-Dec-2017 21:51:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-6

Lab Sample ID: 200-41413-6

Worklist Smp#: 11

Client ID: 4341

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

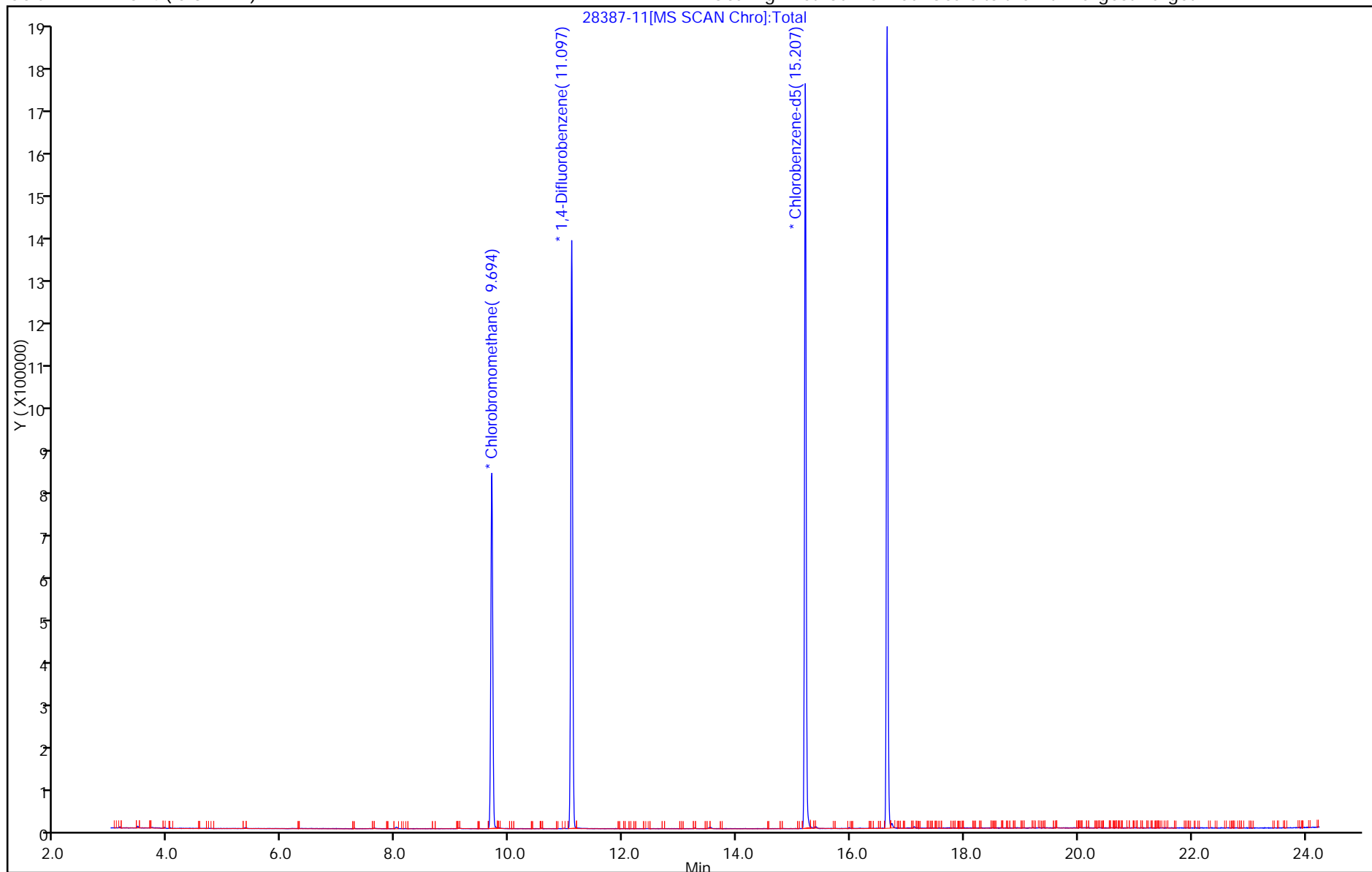
ALS Bottle#: 11

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4794 Lab Sample ID: 200-41413-7  
 Matrix: Air Lab File ID: 28387-12.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 22:54  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4794 Lab Sample ID: 200-41413-7  
 Matrix: Air Lab File ID: 28387-12.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 22:54  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4794 Lab Sample ID: 200-41413-7  
 Matrix: Air Lab File ID: 28387-12.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 22:54  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-12.D  
 Lims ID: 200-41413-A-7  
 Client ID: 4794  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 22:54:30 ALS Bottle#: 12 Worklist Smp#: 12  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-012  
 Misc. Info.: 41413-07  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:06:23 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:06:23

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	M
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.694	9.699	-0.005	100	257685	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1318689	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1088885	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2605	0.0183	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

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TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-12.D

Injection Date: 15-Dec-2017 22:54:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-7

Lab Sample ID: 200-41413-7

Worklist Smp#: 12

Client ID: 4794

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

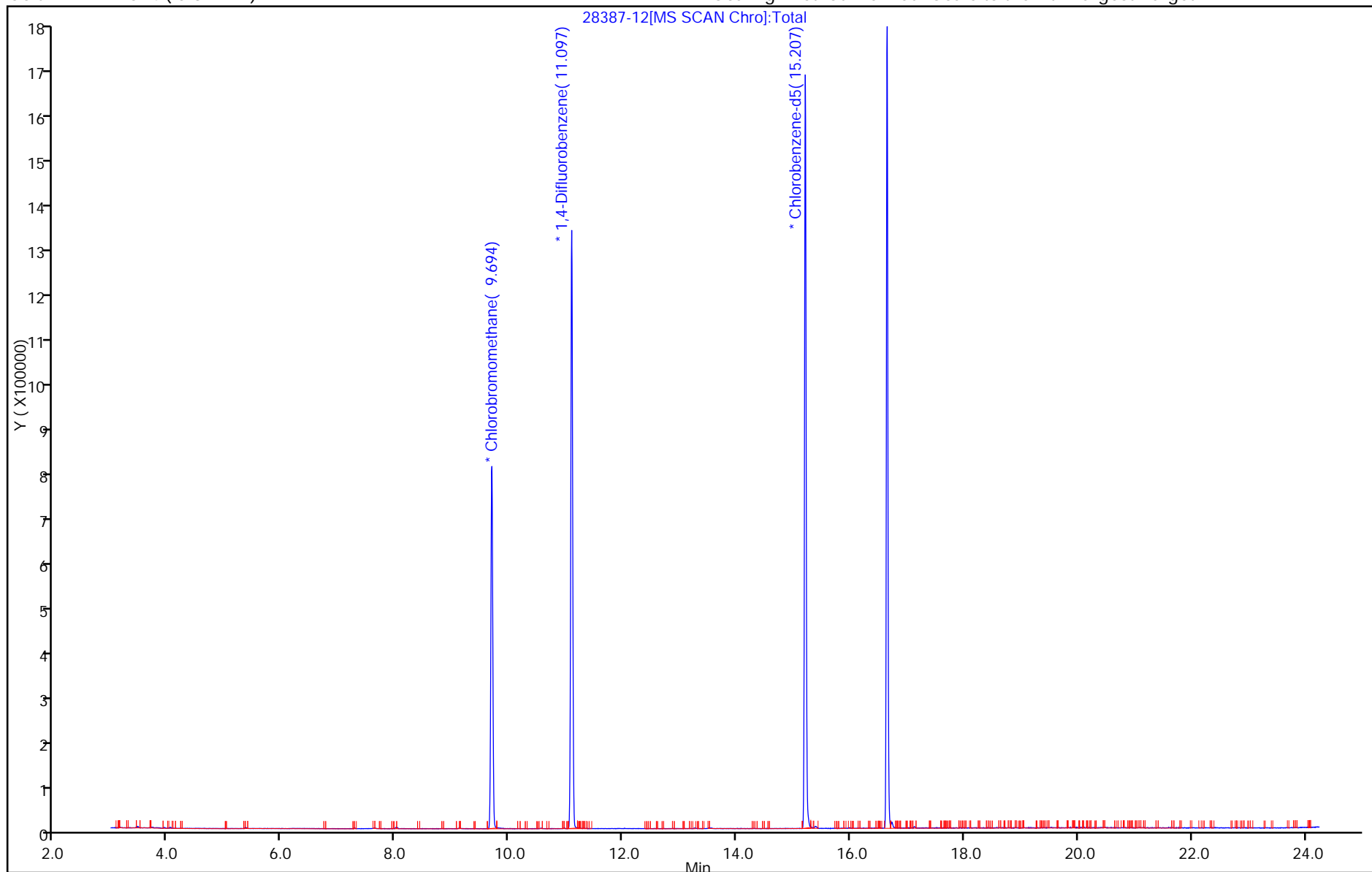
ALS Bottle#: 12

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5111 Lab Sample ID: 200-41413-8  
 Matrix: Air Lab File ID: 28387-13.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 23:56  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5111 Lab Sample ID: 200-41413-8  
 Matrix: Air Lab File ID: 28387-13.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 23:56  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5111 Lab Sample ID: 200-41413-8  
 Matrix: Air Lab File ID: 28387-13.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/15/2017 23:56  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-13.D  
 Lims ID: 200-41413-A-8  
 Client ID: 5111  
 Sample Type: Client  
 Inject. Date: 15-Dec-2017 23:56:30 ALS Bottle#: 13 Worklist Smp#: 13  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-013  
 Misc. Info.: 41413-08  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:10:09 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:10:09

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	M
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.693	9.699	-0.006	100	247835	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	97	1262460	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	90	1048865	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2577	0.0188	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

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3

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Report Date: 18-Dec-2017 17:10:10

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-13.D

Injection Date: 15-Dec-2017 23:56:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-8

Lab Sample ID: 200-41413-8

Worklist Smp#: 13

Client ID: 5111

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

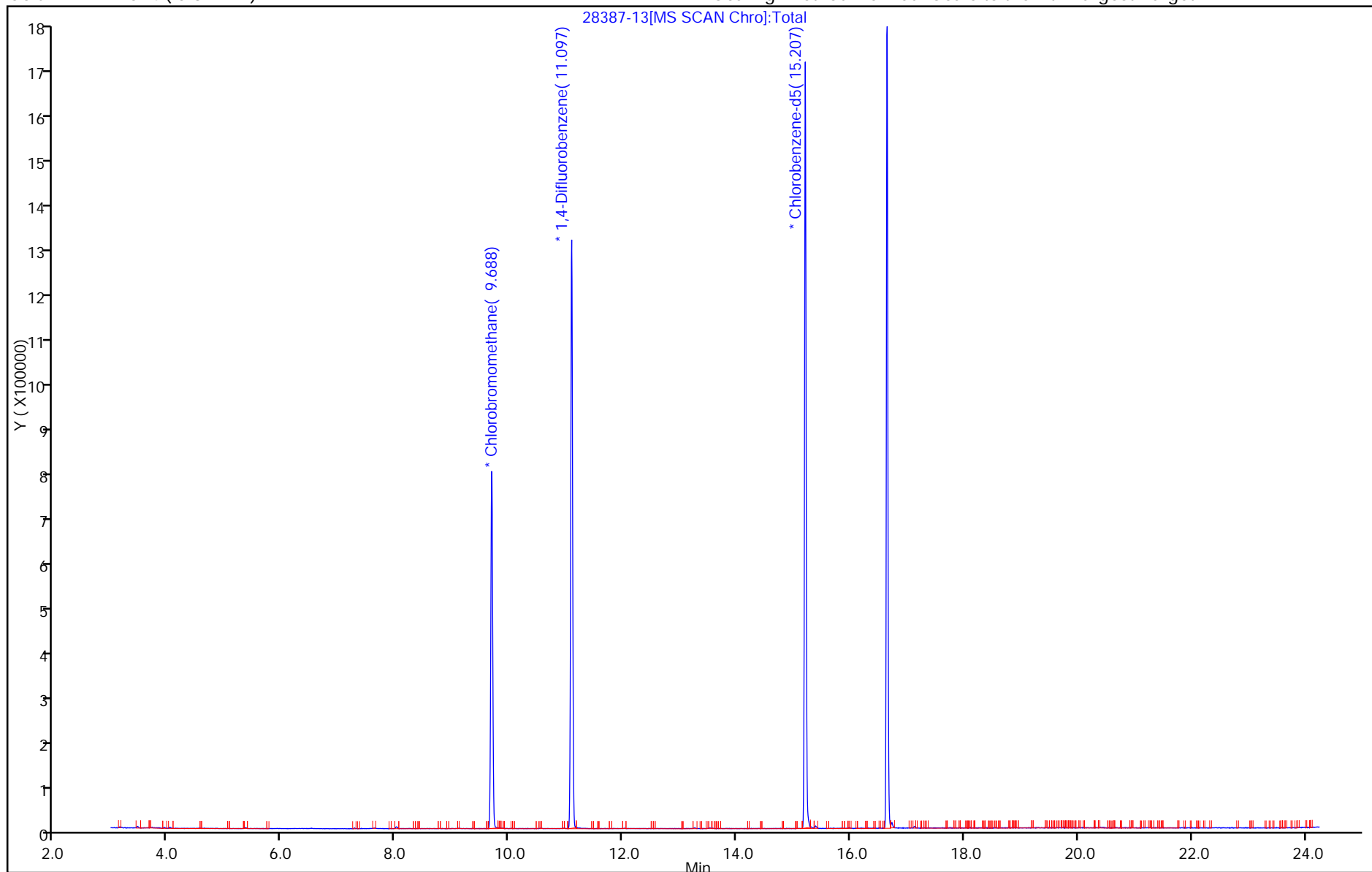
ALS Bottle#: 13

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 ( 0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2746 Lab Sample ID: 200-41413-9  
 Matrix: Air Lab File ID: 28387-14.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 00:59  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2746 Lab Sample ID: 200-41413-9  
 Matrix: Air Lab File ID: 28387-14.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 00:59  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 2746 Lab Sample ID: 200-41413-9  
 Matrix: Air Lab File ID: 28387-14.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 00:59  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10



TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-14.D  
 Lims ID: 200-41413-A-9  
 Client ID: 2746  
 Sample Type: Client  
 Inject. Date: 16-Dec-2017 00:59:30 ALS Bottle#: 14 Worklist Smp#: 14  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-014  
 Misc. Info.: 41413-09  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LLNIJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:14:16 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:14:16

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	99	241349	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1235275	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1024199	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2493	0.0186	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

Processing Flags

7 - Failed Limit of Detection

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

Report Date: 18-Dec-2017 17:14:16

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-14.D

Injection Date: 16-Dec-2017 00:59:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-9

Lab Sample ID: 200-41413-9

Worklist Smp#: 14

Client ID: 2746

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

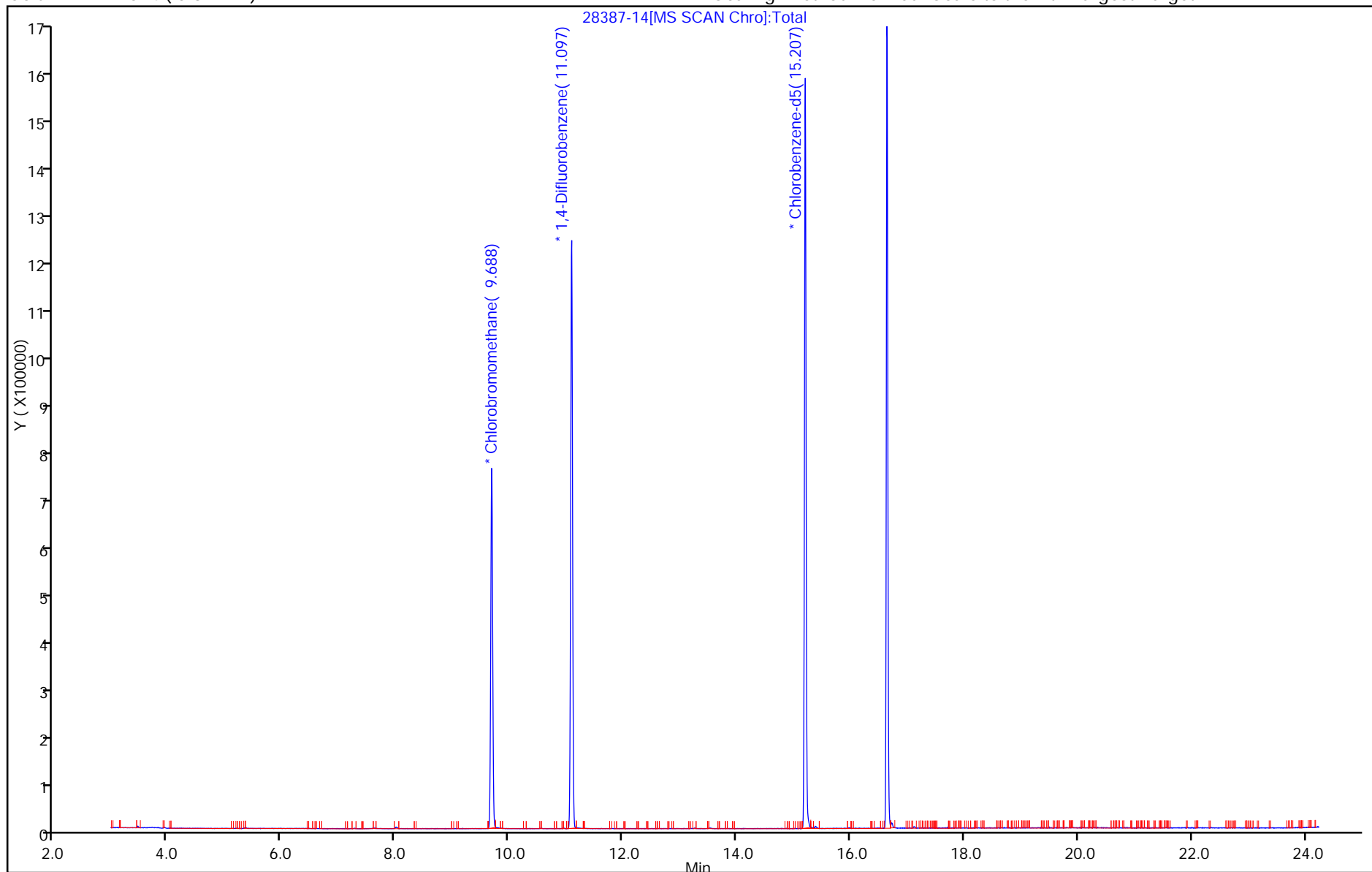
ALS Bottle#: 14

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5648 Lab Sample ID: 200-41413-10  
 Matrix: Air Lab File ID: 28387-15.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 02:01  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5648 Lab Sample ID: 200-41413-10  
 Matrix: Air Lab File ID: 28387-15.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 02:01  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5648 Lab Sample ID: 200-41413-10  
 Matrix: Air Lab File ID: 28387-15.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 02:01  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-15.D  
 Lims ID: 200-41413-A-10  
 Client ID: 5648  
 Sample Type: Client  
 Inject. Date: 16-Dec-2017 02:01:30 ALS Bottle#: 15 Worklist Smp#: 15  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-015  
 Misc. Info.: 41413-10  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:18:44 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:18:44

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	99	236398	10.0	
38 Tetrahydrofuran	42		9.710				ND	



Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1213850	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1018773	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.324	15.324	0.011	1	2423	0.0182	7M
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

Report Date: 18-Dec-2017 17:18:45

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-15.D

Injection Date: 16-Dec-2017 02:01:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-10

Lab Sample ID: 200-41413-10

Worklist Smp#: 15

Client ID: 5648

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

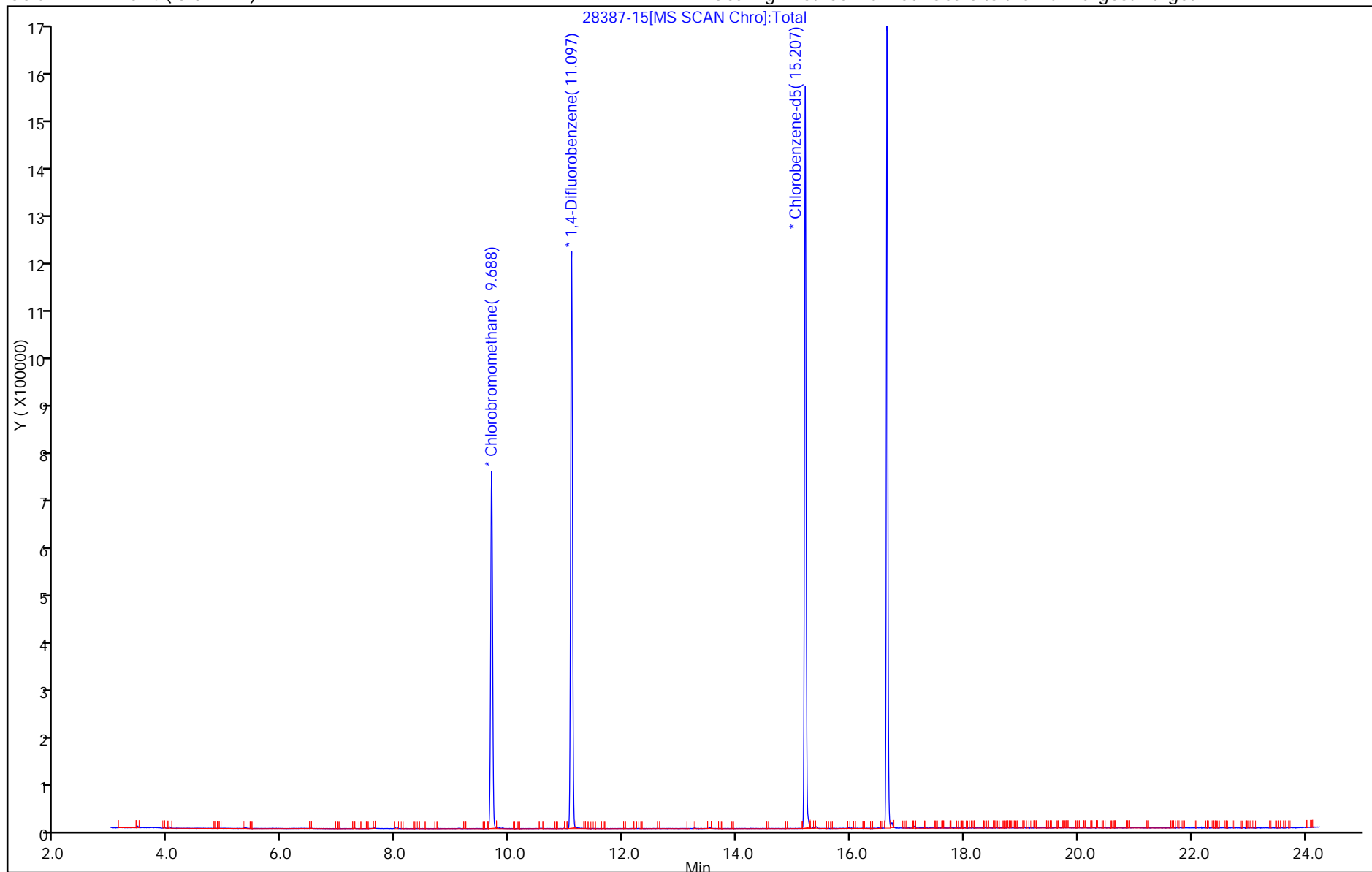
ALS Bottle#: 15

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



## TestAmerica Burlington

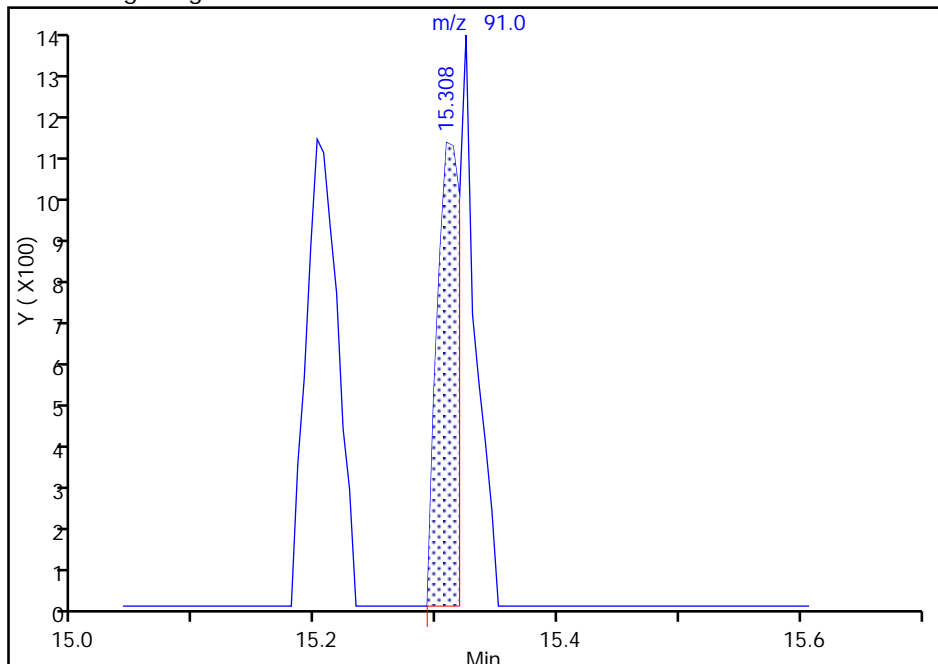
Data File:	\\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-15.D		
Injection Date:	16-Dec-2017 02:01:30	Instrument ID:	CHB.i
Lims ID:	200-41413-A-10	Lab Sample ID:	200-41413-10
Client ID:	5648		
Operator ID:	vtp	ALS Bottle#:	15
Purge Vol:	200.000 mL	Dil. Factor:	0.2000
Method:	TO15_LLNI_TO3	Limit Group:	AI_TO15_ICAL
Column:	RTX-624 (0.32 mm)	Detector:	MS SCAN
		Worklist Smp#:	15

**74 Ethylbenzene, CAS: 100-41-4**

Signal: 1

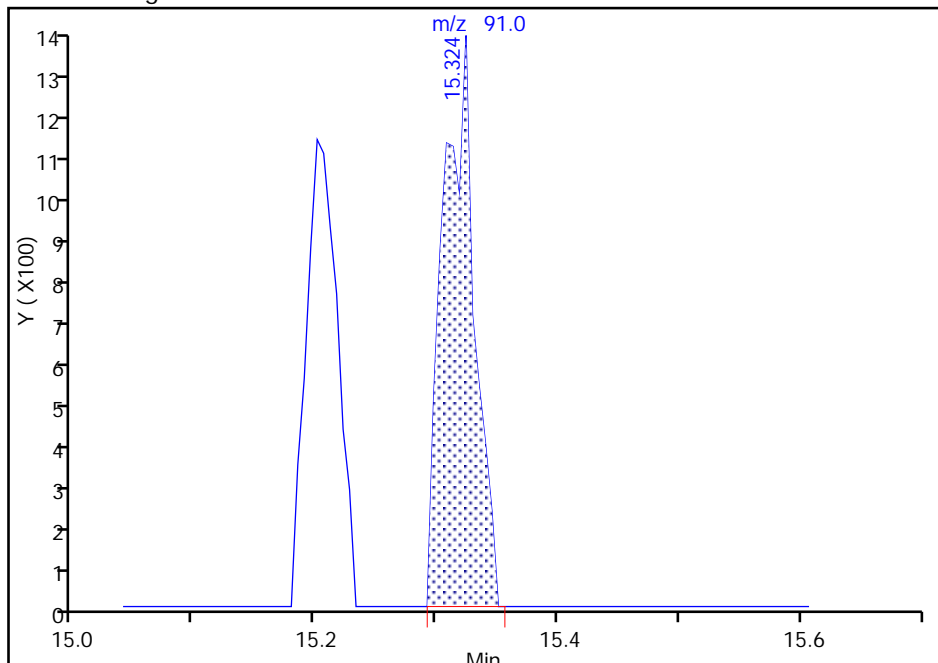
RT: 15.31  
Area: 1418  
Amount: 0.010631  
Amount Units: ppb v/v

## Processing Integration Results



RT: 15.32  
Area: 2423  
Amount: 0.018165  
Amount Units: ppb v/v

## Manual Integration Results



Reviewer: bunmaa, 18-Dec-2017 17:16:35

Audit Action: Assigned Compound ID

Audit Reason: Assign Peak

## TestAmerica Burlington

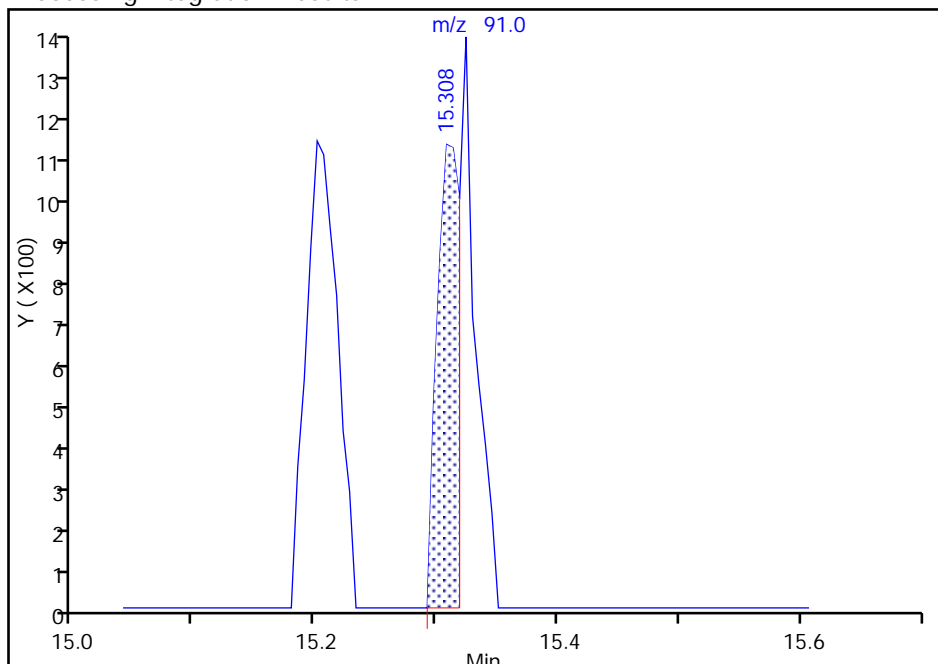
Data File:	\\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-15.D		
Injection Date:	16-Dec-2017 02:01:30	Instrument ID:	CHB.i
Lims ID:	200-41413-A-10	Lab Sample ID:	200-41413-10
Client ID:	5648		
Operator ID:	vtp	ALS Bottle#:	15
Purge Vol:	200.000 mL	Dil. Factor:	0.2000
Method:	TO15_LLNJ_TO3	Limit Group:	AI_TO15_ICAL
Column:	RTX-624 (0.32 mm)	Detector:	MS SCAN
		Worklist Smp#:	15

**74 Ethylbenzene, CAS: 100-41-4**

Signal: 1

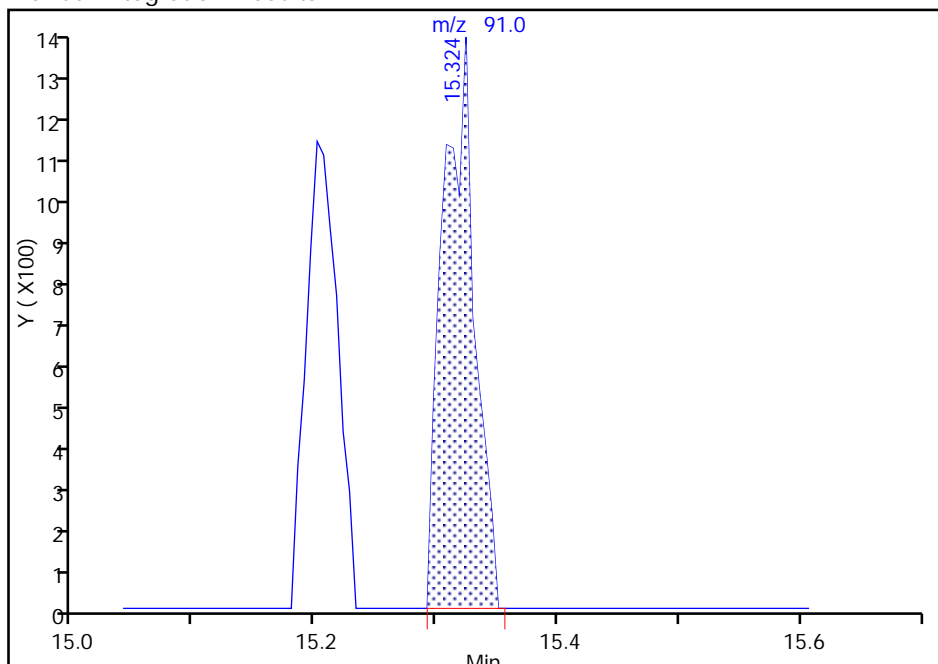
RT: 15.31  
Area: 1418  
Amount: 0.010631  
Amount Units: ppb v/v

## Processing Integration Results



RT: 15.32  
Area: 2423  
Amount: 0.018165  
Amount Units: ppb v/v

## Manual Integration Results



Reviewer: bunmaa, 18-Dec-2017 17:16:44

Audit Action: Manually Integrated

Audit Reason: Assign Peak

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 6164 Lab Sample ID: 200-41413-11  
 Matrix: Air Lab File ID: 28387-16.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 03:03  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 6164 Lab Sample ID: 200-41413-11  
 Matrix: Air Lab File ID: 28387-16.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 03:03  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 6164 Lab Sample ID: 200-41413-11  
 Matrix: Air Lab File ID: 28387-16.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 03:03  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10



TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-16.D  
 Lims ID: 200-41413-A-11  
 Client ID: 6164  
 Sample Type: Client  
 Inject. Date: 16-Dec-2017 03:03:30 ALS Bottle#: 16 Worklist Smp#: 16  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-016  
 Misc. Info.: 41413-11  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:21:45 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:21:45

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.688	9.699	-0.011	99	233419	10.0	
38 Tetrahydrofuran	42		9.710				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.097	11.103	-0.006	95	1191880	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1000142	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2552	0.0195	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	M
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

## Processing Flags

7 - Failed Limit of Detection

## Review Flags

M - Manually Integrated

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

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15

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-16.D

Injection Date: 16-Dec-2017 03:03:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-11

Lab Sample ID: 200-41413-11

Worklist Smp#: 16

Client ID: 6164

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

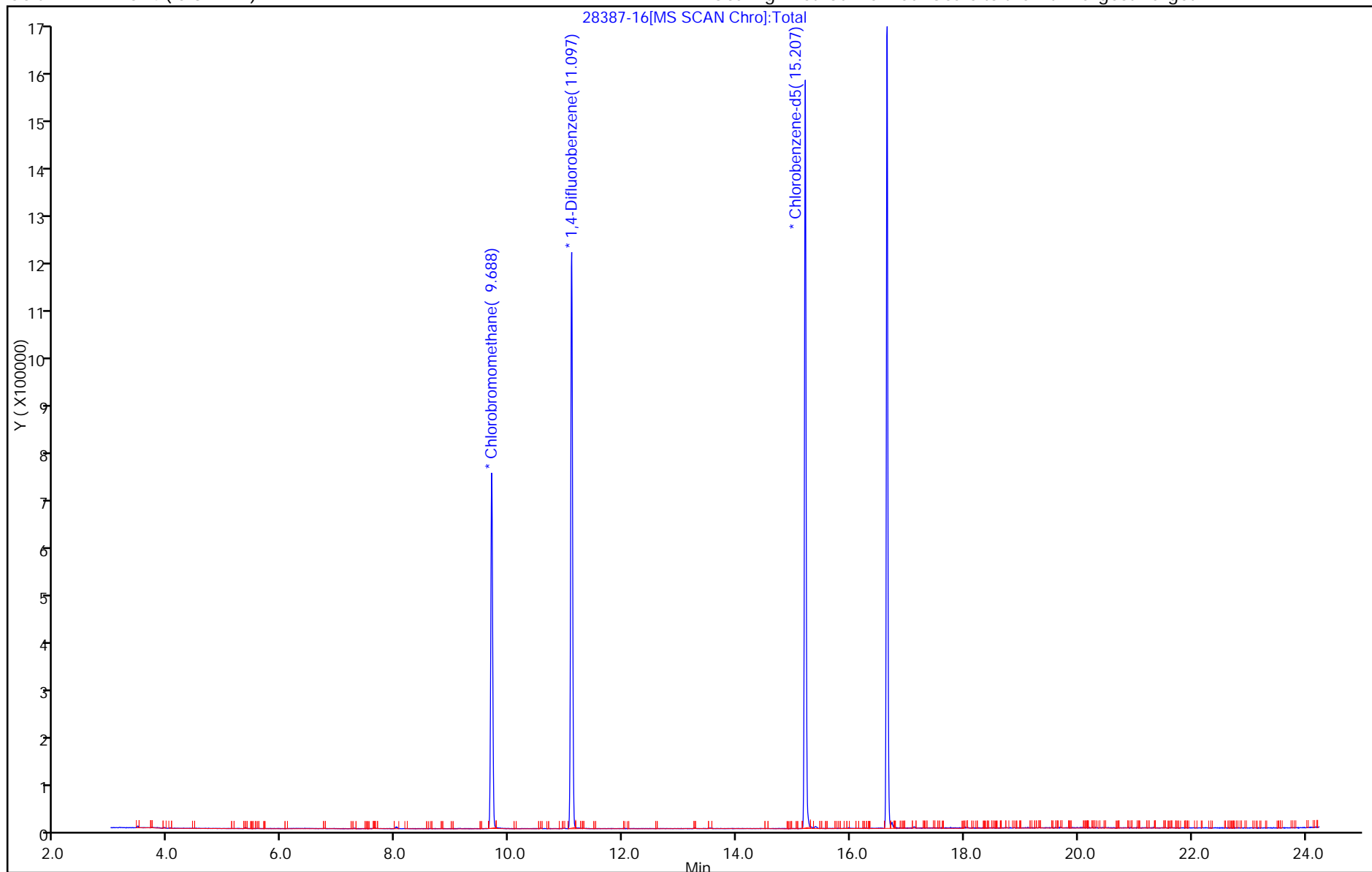
ALS Bottle#: 16

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5447 Lab Sample ID: 200-41413-12  
 Matrix: Air Lab File ID: 28387-17.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 04:06  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5447 Lab Sample ID: 200-41413-12  
 Matrix: Air Lab File ID: 28387-17.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 04:06  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41413-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 5447 Lab Sample ID: 200-41413-12  
 Matrix: Air Lab File ID: 28387-17.D  
 Analysis Method: TO-15 Date Collected: 12/13/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 04:06  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124514 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-17.D  
 Lims ID: 200-41413-A-12  
 Client ID: 5447  
 Sample Type: Client  
 Inject. Date: 16-Dec-2017 04:06:30 ALS Bottle#: 17 Worklist Smp#: 17  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028387-017  
 Misc. Info.: 41413-12  
 Operator ID: vtp Instrument ID: CHB.i  
 Method: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\TO15\_LL NJ\_TO3.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 17:25:36 Calib Date: 07-Nov-2017 01:49:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal/External Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHB.i\20171106-27754.b\27754-13.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK023

First Level Reviewer: bunmaa

Date: 18-Dec-2017 17:25:36

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.135				ND	
2 Dichlorodifluoromethane	85		3.193				ND	
3 Chlorodifluoromethane	51		3.231				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.412				ND	
5 Chloromethane	50		3.535				ND	
6 Butane	43		3.711				ND	
7 Vinyl chloride	62		3.748				ND	
8 Butadiene	54		3.812				ND	
10 Bromomethane	94		4.479				ND	
11 Chloroethane	64		4.709				ND	
13 Vinyl bromide	106		5.120				ND	
14 Trichlorofluoromethane	101		5.221				ND	
16 Ethanol	45		5.675				ND	
19 1,1,2-Trichloro-1,2,2-trif	101		6.246				ND	
20 1,1-Dichloroethene	96		6.315				ND	
21 Acetone	43		6.465				ND	
22 Isopropyl alcohol	45		6.684				ND	
23 Carbon disulfide	76		6.748				ND	
24 3-Chloro-1-propene	41		7.015				ND	
27 Methylene Chloride	49		7.271				ND	
28 2-Methyl-2-propanol	59		7.383				ND	
29 Methyl tert-butyl ether	73		7.623				ND	
30 trans-1,2-Dichloroethene	61		7.682				ND	
32 Hexane	57		8.013				ND	
33 1,1-Dichloroethane	63		8.423				ND	
34 Vinyl acetate	43		8.429				ND	
36 2-Butanone (MEK)	72		9.315				ND	
37 cis-1,2-Dichloroethene	96		9.331				ND	
35 Ethyl acetate	88		9.331				ND	
* 39 Chlorobromomethane	128	9.699	9.699	0.000	99	236516	10.0	
38 Tetrahydrofuran	42		9.710				ND	



Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
40 Chloroform	83		9.774				ND	
S 41 1,2-Dichloroethene, Total	61		10.000				ND	
42 1,1,1-Trichloroethane	97		10.030				ND	
43 Cyclohexane	84		10.041				ND	
44 Carbon tetrachloride	117		10.238				ND	
45 Isooctane	57		10.521				ND	
46 Benzene	78		10.558				ND	
47 1,2-Dichloroethane	62		10.660				ND	
48 n-Heptane	43		10.772				ND	
* 50 1,4-Difluorobenzene	114	11.103	11.103	0.000	95	1221143	10.0	
53 Trichloroethene	95		11.471				ND	
54 1,2-Dichloropropane	63		11.839				ND	
55 Methyl methacrylate	69		11.876				ND	
56 1,4-Dioxane	88		11.967				ND	
57 Dibromomethane	174		12.026				ND	
58 Dichlorobromomethane	83		12.197				ND	
60 cis-1,3-Dichloropropene	75		12.826				ND	
61 4-Methyl-2-pentanone (MIBK)	43		12.971				ND	
64 Toluene	92		13.259				ND	
66 trans-1,3-Dichloropropene	75		13.616				ND	
67 1,1,2-Trichloroethane	83		13.888				ND	
68 Tetrachloroethene	166		14.033				ND	
69 2-Hexanone	43		14.150				ND	
70 Chlorodibromomethane	129		14.444				ND	
71 Ethylene Dibromide	107		14.646				ND	
* 72 Chlorobenzene-d5	117	15.207	15.212	-0.005	87	1009955	10.0	
73 Chlorobenzene	112		15.249				ND	
74 Ethylbenzene	91	15.313	15.313	0.000	1	2175	0.0164	7
76 m-Xylene & p-Xylene	106		15.463				ND	
78 o-Xylene	106		15.975				ND	
79 Styrene	104		15.997				ND	
S 77 Xylenes, Total	106		16.000				ND	
80 Bromoform	173		16.290				ND	
81 Isopropylbenzene	105		16.386				ND	
83 1,1,2,2-Tetrachloroethane	83		16.792				ND	
84 N-Propylbenzene	91		16.866				ND	
87 4-Ethyltoluene	105		16.989				ND	
88 2-Chlorotoluene	91		17.032				ND	
89 1,3,5-Trimethylbenzene	105		17.059				ND	
91 tert-Butylbenzene	119		17.432				ND	
92 1,2,4-Trimethylbenzene	105		17.507				ND	
93 sec-Butylbenzene	105		17.688				ND	
94 4-Isopropyltoluene	119		17.843				ND	
95 1,3-Dichlorobenzene	146		17.923				ND	
96 1,4-Dichlorobenzene	146		18.035				ND	
97 Benzyl chloride	91		18.185				ND	
99 n-Butylbenzene	91		18.350				ND	
100 1,2-Dichlorobenzene	146		18.516				ND	
103 1,2,4-Trichlorobenzene	180		20.874				ND	
104 Hexachlorobutadiene	225		21.045				ND	
105 Naphthalene	128		21.355				ND	

[QC Flag Legend](#)

Processing Flags

7 - Failed Limit of Detection

[Reagents:](#)

ATTO15BISs\_00006

Amount Added: 20.00

Units: mL

Run Reagent

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15

Report Date: 18-Dec-2017 17:25:36

Chrom Revision: 2.2 08-Dec-2017 11:41:26

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHB.i\20171215-28387.b\28387-17.D

Injection Date: 16-Dec-2017 04:06:30

Instrument ID: CHB.i

Operator ID: vtp

Lims ID: 200-41413-A-12

Lab Sample ID: 200-41413-12

Worklist Smp#: 17

Client ID: 5447

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

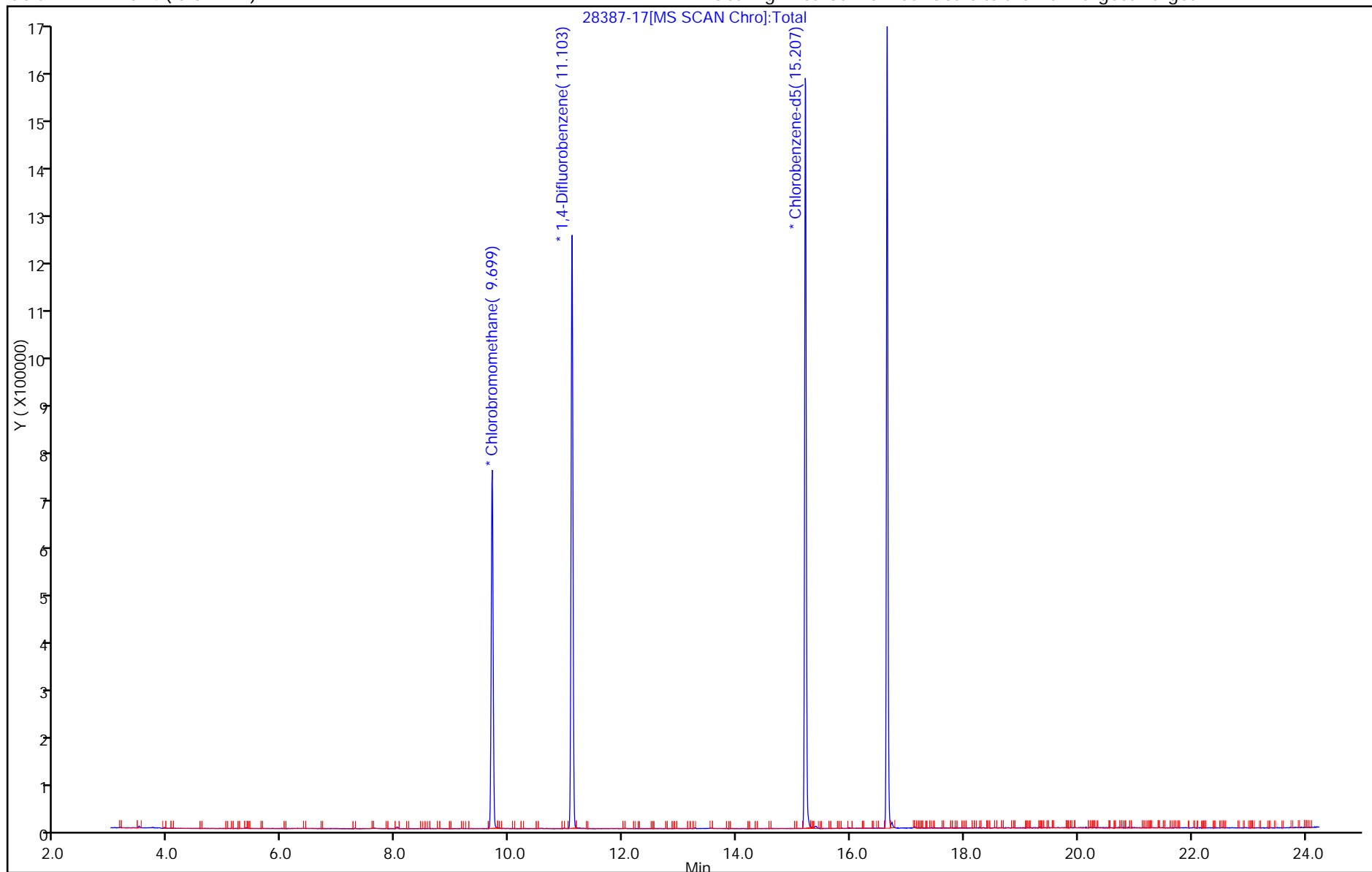
ALS Bottle#: 17

Method: TO15\_LLNJ\_TO3

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 ( 0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: <u>TestAmerica Burlington</u>	Job No.: <u>200-41436-1</u>
SDG No.: _____	
Client Sample ID: <u>4220</u>	Lab Sample ID: <u>200-41436-8</u>
Matrix: <u>Air</u>	Lab File ID: <u>28372-19.D</u>
Analysis Method: <u>TO-15</u>	Date Collected: <u>12/14/2017 00:00</u>
Sample wt/vol: <u>1000 (mL)</u>	Date Analyzed: <u>12/16/2017 00:17</u>
Soil Aliquot Vol: _____	Dilution Factor: <u>0.2</u>
Soil Extract Vol.: _____	GC Column: <u>RTX-624</u> ID: <u>0.32 (mm)</u>
% Moisture: _____	Level: (low/med) <u>Low</u>
Analysis Batch No.: <u>124492</u>	Units: <u>ppb v/v</u>

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
115-07-1	Propylene	1.0	U	1.0	1.0
75-71-8	Dichlorodifluoromethane	0.10	U	0.10	0.10
75-45-6	Freon 22	0.10	U	0.10	0.10
76-14-2	1,2-Dichlorotetrafluoroethane	0.040	U	0.040	0.040
74-87-3	Chloromethane	0.10	U	0.10	0.10
106-97-8	n-Butane	0.10	U	0.10	0.10
75-01-4	Vinyl chloride	0.040	U	0.040	0.040
106-99-0	1,3-Butadiene	0.040	U	0.040	0.040
74-83-9	Bromomethane	0.040	U	0.040	0.040
75-00-3	Chloroethane	0.10	U	0.10	0.10
593-60-2	Bromoethene (Vinyl Bromide)	0.040	U	0.040	0.040
75-69-4	Trichlorofluoromethane	0.040	U	0.040	0.040
64-17-5	Ethanol	1.0	U	1.0	1.0
76-13-1	Freon TF	0.040	U	0.040	0.040
75-35-4	1,1-Dichloroethene	0.040	U	0.040	0.040
67-64-1	Acetone	1.0	U	1.0	1.0
67-63-0	Isopropyl alcohol	1.0	U	1.0	1.0
75-15-0	Carbon disulfide	0.10	U	0.10	0.10
107-05-1	3-Chloropropene	0.10	U	0.10	0.10
75-09-2	Methylene Chloride	0.10	U	0.10	0.10
75-65-0	tert-Butyl alcohol	1.0	U	1.0	1.0
1634-04-4	Methyl tert-butyl ether	0.040	U	0.040	0.040
156-60-5	trans-1,2-Dichloroethene	0.040	U	0.040	0.040
110-54-3	n-Hexane	0.040	U	0.040	0.040
75-34-3	1,1-Dichloroethane	0.040	U	0.040	0.040
108-05-4	Vinyl acetate	1.0	U	1.0	1.0
141-78-6	Ethyl acetate	1.0	U	1.0	1.0
78-93-3	Methyl Ethyl Ketone	0.10	U	0.10	0.10
156-59-2	cis-1,2-Dichloroethene	0.040	U	0.040	0.040
540-59-0	1,2-Dichloroethene, Total	0.080	U	0.080	0.080
67-66-3	Chloroform	0.040	U	0.040	0.040
109-99-9	Tetrahydrofuran	1.0	U	1.0	1.0
71-55-6	1,1,1-Trichloroethane	0.040	U	0.040	0.040
110-82-7	Cyclohexane	0.040	U	0.040	0.040
56-23-5	Carbon tetrachloride	0.040	U	0.040	0.040
540-84-1	2,2,4-Trimethylpentane	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: <u>TestAmerica Burlington</u>	Job No.: <u>200-41436-1</u>
SDG No.: _____	
Client Sample ID: <u>4220</u>	Lab Sample ID: <u>200-41436-8</u>
Matrix: <u>Air</u>	Lab File ID: <u>28372-19.D</u>
Analysis Method: <u>TO-15</u>	Date Collected: <u>12/14/2017 00:00</u>
Sample wt/vol: <u>1000 (mL)</u>	Date Analyzed: <u>12/16/2017 00:17</u>
Soil Aliquot Vol: _____	Dilution Factor: <u>0.2</u>
Soil Extract Vol.: _____	GC Column: <u>RTX-624</u> ID: <u>0.32 (mm)</u>
% Moisture: _____	Level: (low/med) <u>Low</u>
Analysis Batch No.: <u>124492</u>	Units: <u>ppb v/v</u>

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
71-43-2	Benzene	0.040	U	0.040	0.040
107-06-2	1,2-Dichloroethane	0.040	U	0.040	0.040
142-82-5	n-Heptane	0.040	U	0.040	0.040
79-01-6	Trichloroethene	0.040	U	0.040	0.040
80-62-6	Methyl methacrylate	0.10	U	0.10	0.10
78-87-5	1,2-Dichloropropane	0.040	U	0.040	0.040
123-91-1	1,4-Dioxane	1.0	U	1.0	1.0
75-27-4	Bromodichloromethane	0.040	U	0.040	0.040
10061-01-5	cis-1,3-Dichloropropene	0.040	U	0.040	0.040
108-10-1	methyl isobutyl ketone	0.10	U	0.10	0.10
108-88-3	Toluene	0.040	U	0.040	0.040
10061-02-6	trans-1,3-Dichloropropene	0.040	U	0.040	0.040
79-00-5	1,1,2-Trichloroethane	0.040	U	0.040	0.040
127-18-4	Tetrachloroethene	0.040	U	0.040	0.040
591-78-6	Methyl Butyl Ketone (2-Hexanone)	0.10	U	0.10	0.10
124-48-1	Dibromochloromethane	0.040	U	0.040	0.040
106-93-4	1,2-Dibromoethane	0.040	U	0.040	0.040
108-90-7	Chlorobenzene	0.040	U	0.040	0.040
100-41-4	Ethylbenzene	0.040	U	0.040	0.040
179601-23-1	m,p-Xylene	0.10	U	0.10	0.10
95-47-6	Xylene, o-	0.040	U	0.040	0.040
1330-20-7	Xylene (total)	0.14	U	0.14	0.14
100-42-5	Styrene	0.040	U	0.040	0.040
75-25-2	Bromoform	0.040	U	0.040	0.040
98-82-8	Cumene	0.040	U	0.040	0.040
79-34-5	1,1,2,2-Tetrachloroethane	0.040	U	0.040	0.040
103-65-1	n-Propylbenzene	0.040	U	0.040	0.040
622-96-8	4-Ethyltoluene	0.040	U	0.040	0.040
108-67-8	1,3,5-Trimethylbenzene	0.040	U	0.040	0.040
95-49-8	2-Chlorotoluene	0.040	U	0.040	0.040
98-06-6	tert-Butylbenzene	0.040	U	0.040	0.040
95-63-6	1,2,4-Trimethylbenzene	0.040	U	0.040	0.040
135-98-8	sec-Butylbenzene	0.040	U	0.040	0.040
99-87-6	4-Isopropyltoluene	0.040	U	0.040	0.040
541-73-1	1,3-Dichlorobenzene	0.040	U	0.040	0.040
106-46-7	1,4-Dichlorobenzene	0.040	U	0.040	0.040

FORM I  
AIR - GC/MS VOA ORGANICS ANALYSIS DATA SHEET

Lab Name: TestAmerica Burlington Job No.: 200-41436-1  
 SDG No.: \_\_\_\_\_  
 Client Sample ID: 4220 Lab Sample ID: 200-41436-8  
 Matrix: Air Lab File ID: 28372-19.D  
 Analysis Method: TO-15 Date Collected: 12/14/2017 00:00  
 Sample wt/vol: 1000 (mL) Date Analyzed: 12/16/2017 00:17  
 Soil Aliquot Vol: \_\_\_\_\_ Dilution Factor: 0.2  
 Soil Extract Vol.: \_\_\_\_\_ GC Column: RTX-624 ID: 0.32 (mm)  
 % Moisture: \_\_\_\_\_ Level: (low/med) Low  
 Analysis Batch No.: 124492 Units: ppb v/v

CAS NO.	COMPOUND NAME	RESULT	Q	RL	RL
100-44-7	Benzyl chloride	0.040	U	0.040	0.040
104-51-8	n-Butylbenzene	0.040	U	0.040	0.040
95-50-1	1,2-Dichlorobenzene	0.040	U	0.040	0.040
120-82-1	1,2,4-Trichlorobenzene	0.10	U	0.10	0.10
87-68-3	Hexachlorobutadiene	0.040	U	0.040	0.040
91-20-3	Naphthalene	0.10	U	0.10	0.10

TestAmerica Burlington  
Target Compound Quantitation Report

Data File: \\ChromNA\Burlington\ChromData\CHG.i\20171215-28372.b\28372-19.D  
 Lims ID: 200-41436-A-8  
 Client ID: 4220  
 Sample Type: Client  
 Inject. Date: 16-Dec-2017 00:17:30 ALS Bottle#: 24 Worklist Smp#: 19  
 Purge Vol: 200.000 mL Dil. Factor: 0.2000  
 Sample Info: 200-0028372-019  
 Misc. Info.: 41436-08  
 Operator ID: pad Instrument ID: CHG.i  
 Method: \\ChromNA\Burlington\ChromData\CHG.i\20171215-28372.b\TO15\_MasterMethod\_(v1)\_G.m  
 Limit Group: AI\_TO15\_ICAL  
 Last Update: 18-Dec-2017 15:55:39 Calib Date: 12-Dec-2017 02:10:30  
 Integrator: RTE ID Type: Deconvolution ID  
 Quant Method: Internal Standard Quant By: Initial Calibration  
 Last ICal File: \\ChromNA\Burlington\ChromData\CHG.i\20171211-28297.b\28297-12.D  
 Column 1 : RTX-624 ( 0.32 mm) Det: MS SCAN  
 Process Host: XAWRK009

First Level Reviewer: puangmaleek

Date: 18-Dec-2017 15:55:39

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
1 Propene	41		3.122				ND	
2 Dichlorodifluoromethane	85		3.176				ND	
3 Chlorodifluoromethane	51		3.213				ND	
4 1,2-Dichloro-1,1,2,2-tetra	85		3.385				ND	
5 Chloromethane	50		3.508				ND	
6 Butane	43		3.657				ND	
7 Vinyl chloride	62		3.695				ND	
8 Butadiene	54		3.754				ND	
10 Bromomethane	94		4.299				ND	
11 Chloroethane	64		4.476				ND	
13 Vinyl bromide	106		4.797				ND	
14 Trichlorofluoromethane	101		4.866				ND	
17 Ethanol	45		5.343				ND	
20 1,1,2-Trichloro-1,2,2-trif	101		5.744				ND	
21 1,1-Dichloroethene	96		5.803				ND	
22 Acetone	43		6.022				ND	
23 Carbon disulfide	76	6.188	6.159	0.022	56	908	0.0156	
24 Isopropyl alcohol	45	6.343	6.247	0.086	98	17522	0.7272	
25 3-Chloro-1-propene	41		6.477				ND	
27 Methylene Chloride	49		6.734				ND	
28 2-Methyl-2-propanol	59		6.942				ND	
29 Methyl tert-butyl ether	73		7.113				ND	
31 trans-1,2-Dichloroethene	61		7.124				ND	
33 Hexane	57		7.461				ND	
34 1,1-Dichloroethane	63		7.927				ND	
35 Vinyl acetate	43		7.991				ND	
37 cis-1,2-Dichloroethene	96		8.948				ND	
38 2-Butanone (MEK)	72		9.018				ND	
39 Ethyl acetate	88		9.050				ND	
* 40 Chlorobromomethane	128	9.392	9.392	0.000	76	279626	10.0	
41 Tetrahydrofuran	42		9.430				ND	

Compound	Sig	RT (min.)	Adj RT (min.)	Dlt RT (min.)	Q	Response	OnCol Amt ppb v/v	Flags
42 Chloroform	83		9.505				ND	
S 30 1,2-Dichloroethene, Total	61		9.665				ND	
43 Cyclohexane	84		9.745				ND	
44 1,1,1-Trichloroethane	97		9.772				ND	
45 Carbon tetrachloride	117		10.008				ND	
46 Isooctane	57		10.419				ND	
47 Benzene	78		10.468				ND	
48 1,2-Dichloroethane	62		10.644				ND	
49 n-Heptane	43		10.794				ND	
* 50 1,4-Difluorobenzene	114	11.286	11.281	0.005	94	1353091	10.0	
53 Trichloroethene	95		11.741				ND	
54 1,2-Dichloropropane	63		12.297				ND	
55 Methyl methacrylate	69		12.468				ND	
57 Dibromomethane	174		12.543				ND	
56 1,4-Dioxane	88		12.549				ND	
58 Dichlorobromomethane	83		12.832				ND	
60 cis-1,3-Dichloropropene	75		13.752				ND	
61 4-Methyl-2-pentanone (MIBK)	43		14.068				ND	
65 Toluene	92		14.330				ND	
66 trans-1,3-Dichloropropene	75		14.929				ND	
67 1,1,2-Trichloroethane	83		15.304				ND	
68 Tetrachloroethene	166		15.395				ND	
69 2-Hexanone	43		15.785				ND	
71 Chlorodibromomethane	129		16.058				ND	
72 Ethylene Dibromide	107		16.331				ND	
* 74 Chlorobenzene-d5	117	17.230	17.235	-0.005	87	1107405	10.0	
75 Chlorobenzene	112		17.294				ND	
76 Ethylbenzene	91		17.454				ND	
78 m-Xylene & p-Xylene	106		17.706				ND	
79 o-Xylene	106		18.562				ND	
80 Styrene	104		18.621				ND	
81 Bromoform	173		19.065				ND	
82 Isopropylbenzene	105		19.300				ND	
S 73 Xylenes, Total	106		19.600				ND	
84 1,1,2,2-Tetrachloroethane	83		20.006				ND	
85 N-Propylbenzene	91		20.070				ND	
88 4-Ethyltoluene	105		20.274				ND	
89 2-Chlorotoluene	91		20.274				ND	
90 1,3,5-Trimethylbenzene	105		20.391				ND	
92 tert-Butylbenzene	119		20.894				ND	
93 1,2,4-Trimethylbenzene	105		20.996				ND	
94 sec-Butylbenzene	105		21.237				ND	
95 4-Isopropyltoluene	119		21.451				ND	
96 1,3-Dichlorobenzene	146		21.467				ND	
97 1,4-Dichlorobenzene	146		21.606				ND	
98 Benzyl chloride	91		21.814				ND	
100 n-Butylbenzene	91		22.028				ND	
101 1,2-Dichlorobenzene	146		22.141				ND	
103 1,2,4-Trichlorobenzene	180		24.580				ND	
104 Hexachlorobutadiene	225		24.762				ND	
105 Naphthalene	128		25.046				ND	



**Reagents:**

ATTO15GIS\_00015

Amount Added: 20.00

Units: mL

Run Reagent

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

TestAmerica Burlington

Data File: \\ChromNA\Burlington\ChromData\CHG.i\20171215-28372.b\28372-19.D

Injection Date: 16-Dec-2017 00:17:30

Instrument ID: CHG.i

Operator ID: pad

Lims ID: 200-41436-A-8

Lab Sample ID: 200-41436-8

Worklist Smp#: 19

Client ID: 4220

Purge Vol: 200.000 mL

Dil. Factor: 0.2000

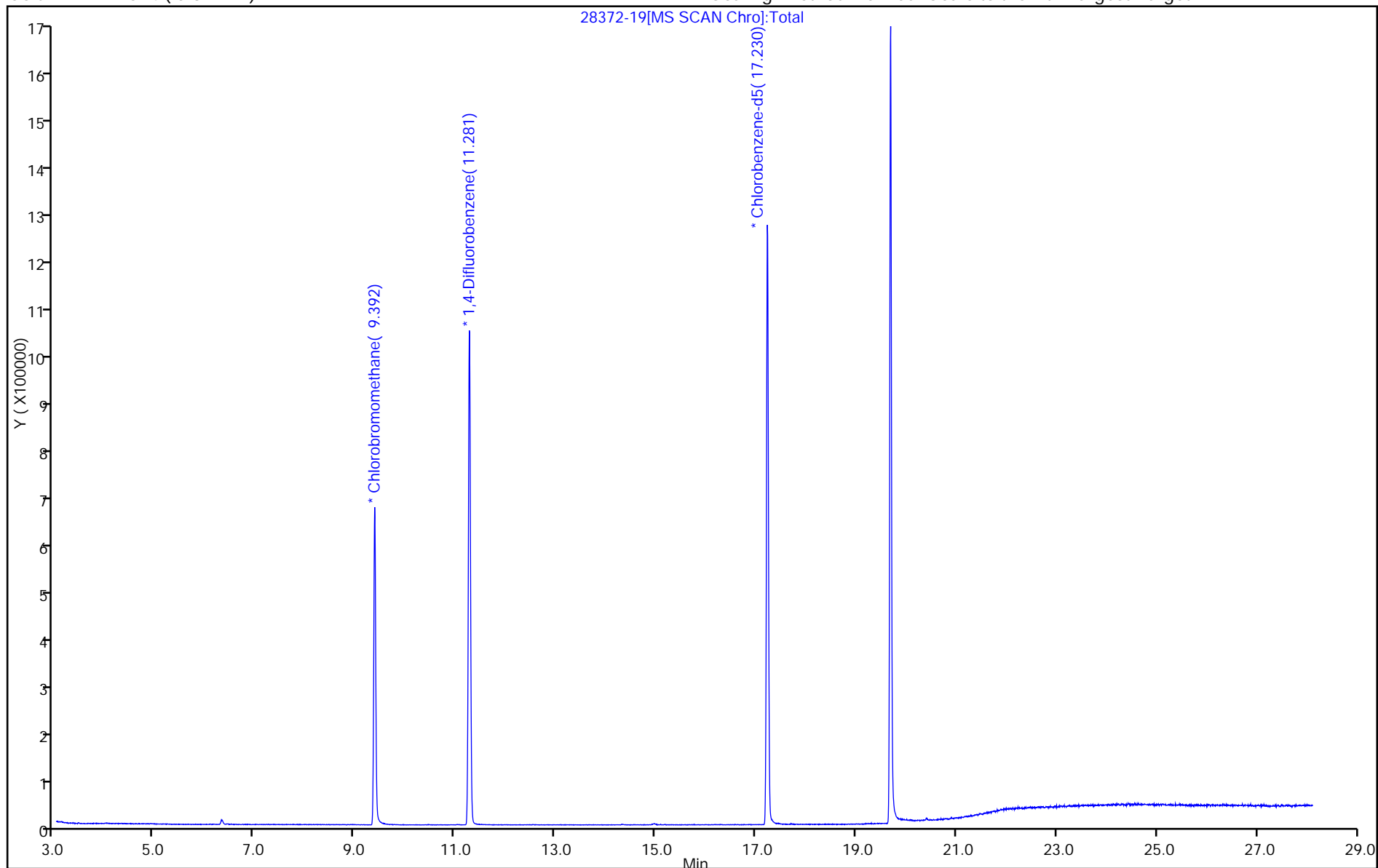
ALS Bottle#: 24

Method: TO15\_MasterMethod\_(v1)\_G

Limit Group: AI\_TO15\_ICAL

Column: RTX-624 (0.32 mm)

Y Scaling: Method Defined: Scale to the Nth Largest Target: 1



AECOM

# GEOTECHNICAL DATA REPORT

**DDC PROJECT: New 116<sup>th</sup> Precinct**  
**244-04 North Conduit Avenue**  
**Borough of Queens, New York**

**SES NO.: 4231A**

**CONTRACT REG NO.: 20181411926**

**WORK ORDER NO.: 14145-CDM-1-R-12714**

*Prepared for:*



**Department of  
Design and  
Construction**

City of New York Department of Design and Construction  
Division of Program Management Safety and Site Support  
Office of Environmental and Geotechnical Services  
30-30 Thomson Avenue, Fourth Floor  
Long Island City, NY 11101

*Prepared by:*

CDM Smith  
14 Wall Street, Suite 1702  
New York, New York 10005

DDC Project No.: PO002-116  
May 9, 2018



*To: Richard Meserole, Section Chief, DDC OECS*

*From: Kapila Pathirage, Ph.D., P.E.*

*Date: May 9, 2018*

*RE: GEOTECHNICAL DATA REPORT  
DDC Project # PO002-116  
New 116<sup>th</sup> Precinct  
244-04 North Conduit Avenue  
Borough of Queens, New York*

<b>Contract Code CDM and Registration Number:</b>	20181411926
<b>Task ID #:</b>	14145 - Geotechnical II: Project Oversight
<b>CDM Smith WOL #:</b>	14145-CDM-1-R-12714
<b>Location and Details:</b>	244-04 North Conduit Avenue 4 permeability tests

This report was developed as the final deliverable for the subsurface investigation of the New 116<sup>th</sup> Precinct at 244-04 North Conduit Avenue, Borough of Queens project, performed from April 19, 2018 to April 24, 2018. This report contains the following data:

- Record of Borings for SB-1 through SB-3 and Permeability Tests PT-1 through PT-5;
- Boring as-drilled location coordinates;
- Permeability Test Data; and
- Geotechnical Laboratory Test Results for samples collected at SB-1 through SB-3;

**RECORD OF BORINGS**

Boring ID	GEOGRAPHIC		NAD 83		NAD 27		QUEENS	
	Latitude	Longitude	N	E	N	E	W	S
SB-1	40.666461	-73.735335	182197.176	1057673.448	160755.99	2073425.41	79545.365	-43045.188
SB-2	40.666469	-73.734782	182200.226	1057826.798	160759.04	2073578.76	79678.060	-42968.245
SB-3	40.666459	-73.734205	182197.177	1057986.713	160755.99	2073738.68	79819.454	-42893.459
PT-1	40.666274	-73.732995	182131.016	1058322.761	160689.83	2074074.74	80145.523	-42788.580
PT-2	40.666280	-73.733805	182132.482	1058097.961	160691.30	2073849.93	79948.125	-42896.178
PT-3	40.666462	-73.734228	182198.288	1057980.550	160757.10	2073732.52	79813.525	-42895.472
PT-4	40.666464	-73.734764	182198.675	1057831.824	160757.49	2073583.79	79683.209	-42967.168
PT-5	40.666423	-73.735332	182183.006	1057674.323	160741.82	2073426.28	79552.993	-43057.162



SOIL SIZES			
Description Term	Pass Sieve No.	Retained Sieve No.	Size Range
Clay			
Silt	200	(Note 1)	< 0.075 mm
Fine Sand (F)	40	200	0.075 to 0.420 mm
Medium Sand (M)	10	40	0.420 to 2.00 mm
Coarse Sand (C)	4	10	2.00 to 4.75 mm
Gravel (Note 2)	----	----	4.75 to 75 mm (3")
Cobbles	----	----	3" to 12"
Boulders	----	----	>12"

QUANTITATIVE ESTIMATE		FINE-GRAINED SOIL		
Minor Components	Percentage Range	Soil Type	Thread Dia.	Plasticity Index
AND	35 - 50	SILT	None	Zero
SOME	20 - 35	CLAYEY SILT	1/4 inch thread	1 to 5
LITTLE	10 - 20	SILT & CLAY	1/8 inch thread	5 to 10
TRACE	<10	CLAY & SILT	1/16 inch thread	10 to 20
		SILTY CLAY	1/32 inch thread	20 to 40
		CLAY	1/64 inch thread	40 or more

USCS	Typical Descriptions	USCS	Typical Descriptions
GW	Well-graded gravels, gravel - sand mixtures, less than 5% fines.	ML	Inorganic silts and very fine sands, rock flour, silt or clayey fine sands or clayey silts with slight plasticity
GP	Poorly-graded gravels, gravel - sand mixtures, less than 5% fines.	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
GM	Silty gravels, gravel - sand - silt mixtures, more than 12% fines.	OL	Organic silts and organic silty clays of low plasticity
GC	Clayey gravels, gravel-sand-clay mixtures, more than 12% fines.	MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
SW	Well-graded sands, gravelly sands, less than 5% fines	CH	Inorganic clays of high plasticity. Fat clays.
SP	Poorly-graded sands, gravelly sands, less than 5% fines.	OH	Organic clays of medium to high plasticity, organic silts.
SM	Silty sands, sand - silt mixtures, more than 12% fines.	PT	Peat and other highly organic soils.
SC	Clayey sands, sand - clay mixtures, more than 12% fines.		

1. Bedrock 1a. Hard sound rock 1b. Medium rock 1c. Intermediate rock 1d. Soft rock	4. Clays (SC, CL and CH) 4a. Hard 4b. Stiff 4c. Medium
2. Sandy gravel and gravel (GW, GP) 2a. Dense 2b. Medium	5. Silts and silty soils (ML and MH) 5a. Dense 5b. Medium
3. Granular soils (GC, GM, SW, SP, SM and SC) 3a. Dense 3b. Medium	6. Normally unsatisfactory bearing materials 7. Controlled and uncontrolled fills

Hardness:	Weathering:
Extremely (Ext) Hard - Inact specimen can only be chipped, not broken, by repeated, heavy blows of a geological hammer	Fresh (Fr) - No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces
Very (V) Hard - Cannot be scratched by a steel nail. Inact specimen breaks only by repeated, heavy blows with geological hammer	Slightly - Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition
Hard - Inact hand-held specimen requires more than one hammer blow to break. Can be faintly scratched by steel nail	
Moderately (Mod) Hard - Can't be peeled or scraped with steel nail. Can be distinctly scratched with a steel nail	Moderately (Mod) - Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as concretion
Soft - Slightly (S) Hard - Small indentations (0.04 to 0.12 in.) can be made by firm blows with point of geologic pick. Can be peeled with pocket knife with difficulty	
Soft - Hand-held specimen crumbles under firm blows with point of geologic pick	Highly - More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as concretions
Very (V) Soft - Soil - Can be scratched with fingernail. Slight indentation produced by light blow of point of geologic pick. Requires power tools for excavation	Completely (Comp) - All rock material is decomposed and/or disintegrated to soil. The original mass structure is still large. Intact

**GENERAL NOTES:**

1. Soil analyzed with organic content greater than 12 percent is classified as organic soil (OL or OH). Soil with less than 12 percent is classified as "trace organics" and not classified as organic soil. Soil with 30 percent or more organic content is classified as Peat (Pt).
2. When laboratory results are not available, the group symbols are assigned based on the DDC soil classification by visual identification and field tests by the Inspector.
3. All borings unless otherwise noted are cleared for utilities using either hand auger or vacuum extraction method to a feet below ground and then tested to the depth of the soil classification indicated in the borings within this zone are inferred based on visual observations and field judgment by the field inspector.
4. If any of the fine-grain size is less than 10 percent by weight but the sum of them the grain size is not included in the sample description. If any of the fine-grain size is less than 10 percent by weight but the summation of the two equals or greater than 10 percent, then report as fines.

**B-5 (OW)**  
 SURF. EL. 12.2  
 05/01/2012

**Boring Number**  
 (OW = Observation Well)

**4" CASING**

**DRILLING MUD**

**Fill**  
 3b  
 1A  
 1B  
 2  
 6  
 8  
 15  
 15  
 24  
 5.2  
 1.2  
 2.3  
 1b  
 g  
 e  
 d  
 h  
 x  
 a  
 c  
 f  
 r  
 n  
 s  
 k  
 y  
 t

**ROCK**  
 R1  
 R2

**REC=63%  
 ROD=75%**

**REC=67%  
 ROD=53%**

**05/02/2012  
 EOB @ 26 FT**

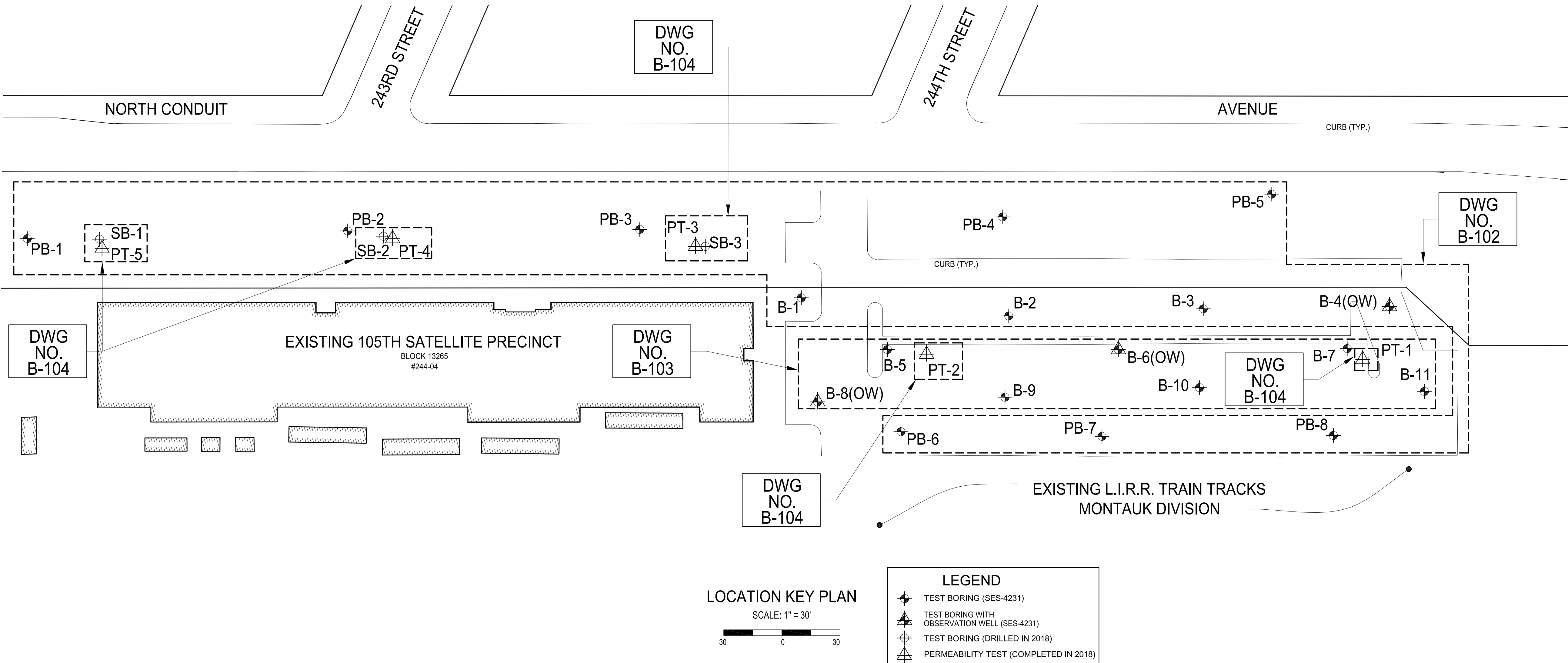
**SPoon SAMPLES**  
 1 = Number of Blows required to drive sample spoon for each 6-inch increment of penetration in accordance with ASTM D-1586  
 WOR = Weight of hammer  
 WOR = Weight of rod  
 Z = Sample Number or :  
 N = Missed sample  
 U = Undisturbed sample  
 X = Soil sample recovered in the split spoon (inches)

**CORE DRILLING**  
 r = Run number  
 k = Elevation, at start of core drilling  
 y = Elevation, at completion of Run  
 N = Percentage of rock core recovered  
 S = Percentage of Rock Quality Designation (ROD)  
 ROD = (Sum of Intact and Sound Record Z 4") / (Core Run Length)  
 t = Coring rate in minutes/foot for both bedrock and boulder

**SPoon SAMPLES**  
 Unless otherwise specified, sample spoon was driven 24 inches.  
 h = Number of Blows required to drive sample spoon for each 6-inch increment of penetration in accordance with ASTM D-1586  
 WOR = Weight of hammer  
 WOR = Weight of rod  
 Z = Sample Number or :  
 N = Missed sample  
 U = Undisturbed sample  
 X = Soil sample recovered in the split spoon (inches)

Type of spoon hammer	<u>AUTO</u>	Size of Split spoon	<u>2.0</u>	inches.
Weight of casing hammer	<u>140</u>	Size of Core Bit	<u>-</u>	inches.
Weight of spoon hammer	<u>140</u>	Type of Core Barrel	<u>-</u>	
Size of Casing	<u>4.0</u>			inches.

ALEX KUHN <hr/> SOIL AND ROCK ANALYSIS BY	KAPILA PATHIRAGE, Ph.D., P.E. <hr/> GEOTECHNICAL ENGINEER CDM SMITH
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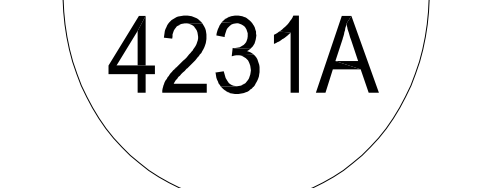



1. TEST BORINGS B-1 THROUGH B-11 AND PB-1 THROUGH PB-8 WERE CONDUCTED BY CDM SMITH FOR NYC DSD AND PRESENTED ON RECORD OF BORINGS, SES-4231 DATED OCTOBER 20, 2017.
2. TEST BORINGS SB-1 THROUGH SB-3 AND PERMEABILITY TESTS PT-1 THROUGH PT-5 WERE CONDUCTED FROM APRIL 19, 2018 TO APRIL 24, 2018.
3. "IN-SITU PERMEABILITY TESTS WERE PERFORMED IN ACCORDANCE WITH PROCEDURES OUTLINED IN "PROCEDURE GOVERNING LIMITED GEOCHEMICAL INVESTIGATION" DATED DECEMBER 2015, PREPARED BY DEPARTMENT OF ENVIRONMENTAL PROTECTION, OFFICE OF GREEN INFRASTRUCTURE. SEE GEOCHEMICAL DATA REPORT DATED MAY 2018, PREPARED BY CDM SMITH, FOR IN-SITU PERMEABILITY TEST RESULTS.

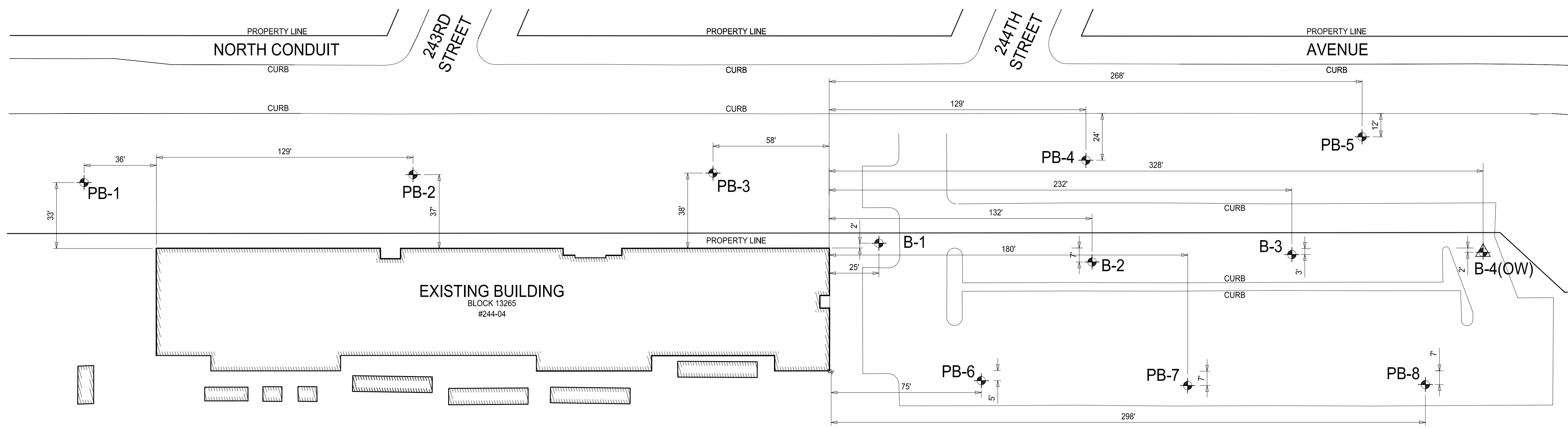
1. The Boring Logs shown on this sheet are the result of inferences drawn by the engineers or scientists during boring operations at the site, and from certain visual evidence such as: (a) samples of subsurface materials recovered during boring operations; (b) the logs kept by the drill operator and the inspector, which contain, among other things, expression of their opinions as to the nature of subsurface materials encountered during boring operations; and (c) other records concerning the site deemed pertinent by the engineers. The driller's log, the inspector's log, the samples and the records, together with the engineer's reports, are made available for inspection and study by the bidders so that they may draw their own inferences from all of the available evidence.
2. Bidders are warned that in the subsurface, other than that actually penetrated by the borings, obstructions, both natural and man-made, and which are not indicated on the Boring Logs, may be encountered, and that the Boring Logs make no representations or warranties either as to the presence or absence of such obstructions, or as to their nature and extent. Where possible, borings are located to avoid all obstructions and previous construction which can be found by inspection of the surface, and the bidder is required to estimate the influence of such features from his own inspection of the site.
3. In addition, bidders are warned that in the subsurface other than that actually penetrated by the borings, soil or rock may vary widely, with regard to elevation, composition, texture, structure, perviousness, soundness, and other characteristics, from the descriptions given on the Boring Logs and all reports.
4. The "groundwater reading", shows the elevation of groundwater in the boring holes at the times indicated. They may or may not indicate the elevations of perched water or true groundwater table during boring operations or subsequently thereafter.
5. The samples are described using the DDC Soil Description and Rock Classification, followed by Group Symbols from the Unified Soil Classification System and the 2014 NYC Building Code Class of Materials.

1	05-09-18	ADDED TEST BORINGS SB-1 THROUGH	RGM
		SB-3 AND PERMEABILITY TEST PT-1	
		THROUGH PT-5	
NO.	DATE	DESCRIPTIONS	APPR
		REVISIONS	

DRAWING INDEX	
DWG NO	CONTENTS
B-101	LOCATION KEY PLAN
B-102	TEST BORINGS B-1 TO B-4 AND PB-1 TO PB-8
B-103	TEST BORINGS B-5 TO B-11
B-104	TEST BORINGS SB-1 TO SB-3 PERMEABILITY TESTS PB-1 TO PB-5

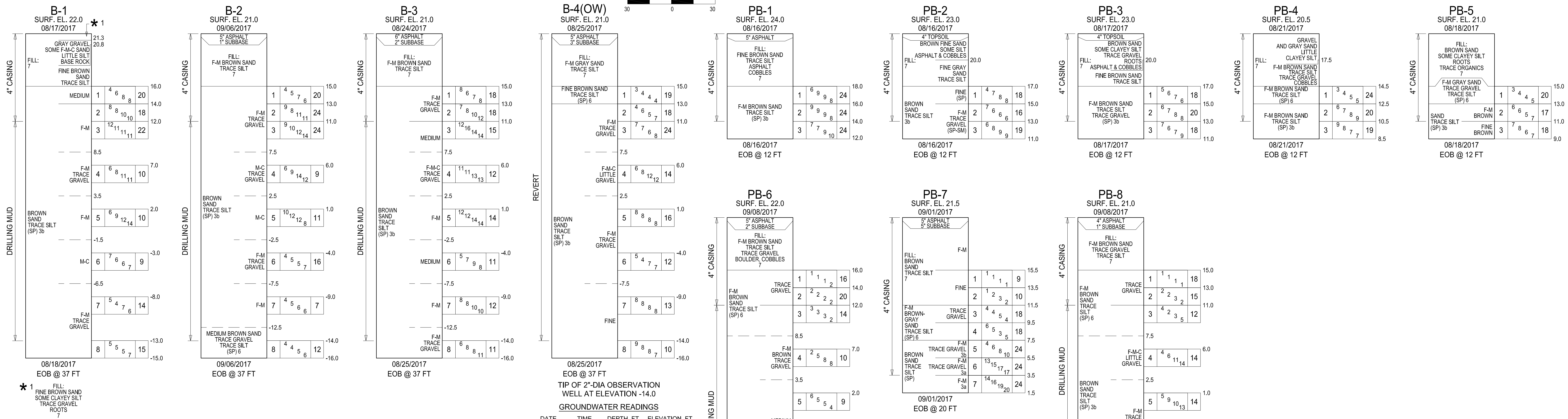
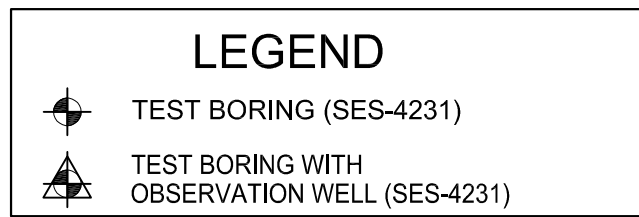
 <b>Department of Design and Construction</b>		<b>CITY OF NEW YORK DEPARTMENT OF DESIGN &amp; CONSTRUCTION</b>	
<b>PO002-116</b> 		<b>PREPARED FOR:</b> <b>DIVISION OF PROGRAM MANAGEMENT SAFETY AND SITE SUPPORT OFFICE OF ENVIRONMENTAL AND GEOTECHNICAL SERVICES</b>	
<b>CONSULTANT NAME:</b> <b>CDM SMITH</b> 14 WALL STREET, SUITE 1702 NEW YORK, NEW YORK 10005		<b>CONTRACTOR NAME:</b> <b>AQUIFER DRILLING &amp; TESTING, INC</b> 75 EAST 2ND STREET MINEOLA, NEW YORK 11501	
<b>PROJECT NAME:</b> <b>NEW 116TH PRECINCT</b> 244-04 NORTH CONDUIT AVENUE <b>BOROUGH OF QUEENS</b>			
<b>RECORD OF BORINGS</b>			
<b>SEAL &amp; SIGNATURE</b> 		<b>DATE:</b> OCTOBER 20, 2017 <b>PROJECT NO:</b> PO002-116 <b>DRAWING BY:</b> RON BARDHAN <b>CHK BY:</b> ERALDA ALLAJBE	
<b>DWG No:</b> B-101.00		<b>SHEET</b> 1 OF 4	
<b>CADD FILE No:</b> 4231A-ROB-01			





LOCATION PLAN

SCALE: 1" = 30'



LABORATORY ANALYSIS SUMMARY \*

Soil Sample Identification And Index Properties


BORING NO.	SAMPLE NO.	DEPTH, ft	D100, mm	D60, mm	D30, mm	D10, mm	% GRAVEL (> #4 SIEVE)	% SAND	% SILT OR CLAY (< #200 SIEVE)	WC %	Cc	Cu	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	pH	ORGANIC CONTENT (%)	USCS SYMBOL
B-1	4	15-17	-	0.38	0.26	0.15	0.3	95.6	4.1	-	1.13	2.50	-	-	-	-	-	SP
B-1	7	30-32	-	0.34	0.24	0.17	0.7	96.9	2.4	-	1.04	2.05	-	-	-	-	-	SP
B-2	3	10-12	-	0.34	0.25	0.16	0.1	96.8	3.1	-	1.16	2.16	-	-	-	-	-	SP
B-2	6	25-27	-	0.36	0.24	0.15	0.1	97.6	2.3	-	1.08	2.36	-	-	-	-	-	SP
B-3	1	6-8	-	0.38	0.29	0.22	0.2	98.0	1.8	-	1.01	1.78	-	-	-	-	-	SP
B-3	8	35-37	-	0.31	0.23	0.16	1.3	96.2	2.5	-	1.02	1.96	-	-	-	-	-	SP
B-4	3	10-12	-	0.40	0.28	0.20	0.8	98.2	1.0	-	1.01	2.05	-	-	-	-	-	SP
B-4	5	20-22	-	0.35	0.26	0.17	0.2	96.8	3.0	-	1.10	2.05	-	-	-	-	-	SP
PB-1	1	6-8	-	0.38	0.28	0.20	0.0	97.6	2.4	-	1.04	1.91	-	-	-	-	-	SP
PB-2	2	8-10	-	0.29	0.18	0.10	0.3	94.5	5.2	-	1.10	2.76	-	-	-	-	-	SP-SM
PB-3	3	10-12	-	0.38	0.28	0.19	0.4	97.5	2.1	-	1.05	1.99	-	-	-	-	-	SP
PB-4	2	8-10	-	0.37	0.26	0.18	0.0	97.7	2.3	-	1.07	2.10	-	-	-	-	-	SP
PB-5	1	6-8	-	0.37	0.27	0.19	0.1	98.8	1.1	-	1.04	1.93	-	-	-	-	-	SP
PB-6	4	15-17	-	0.46	0.30	0.20	4.7	92.2	3.1	-	0.99	2.32	-	-	-	-	-	SP
PB-7	5	14-16	-	0.36	0.25	0.18	0.2	98.7	1.1	-	1.02	2.07	-	-	-	-	-	SP
PB-8	5	20-22	-	0.37	0.26	0.15	0.4	95.5	4.1	-	1.22	2.49	-	-	-	-	-	SP

\* Refer to detailed laboratory analysis data for additional information regarding the results presented herein.

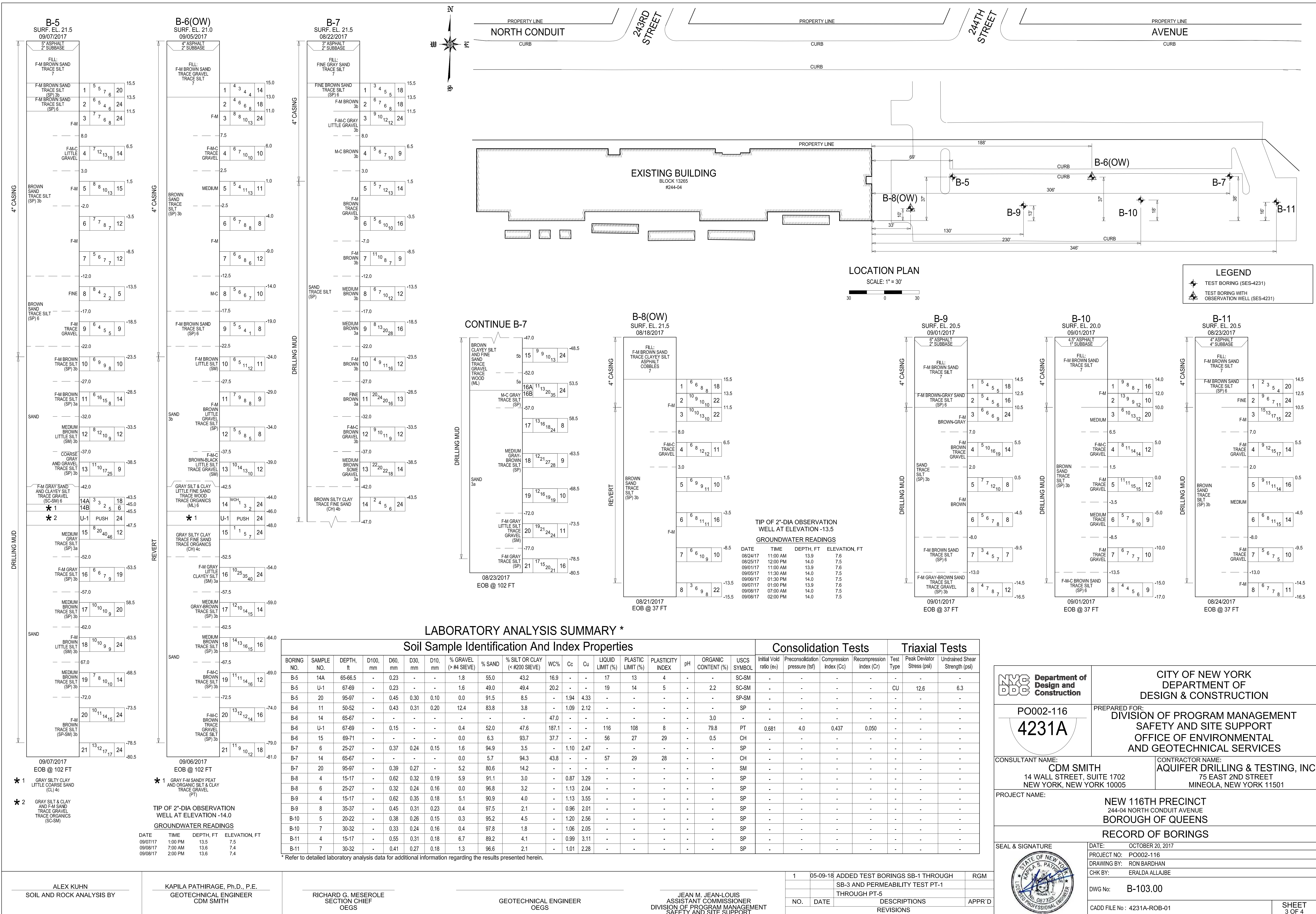
DATE	TIME	DEPTH, FT	ELEVATION, FT
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09/05/17	11:30 AM	13.7	7.3
09/06/17	11:30 AM	13.6	7.4
09/07/17	01:00 PM	13.6	7.4
09/08/17	07:00 AM	13.7	7.3
09/08/17	02:00 PM	13.7	7.3

GROUNDWATER READINGS

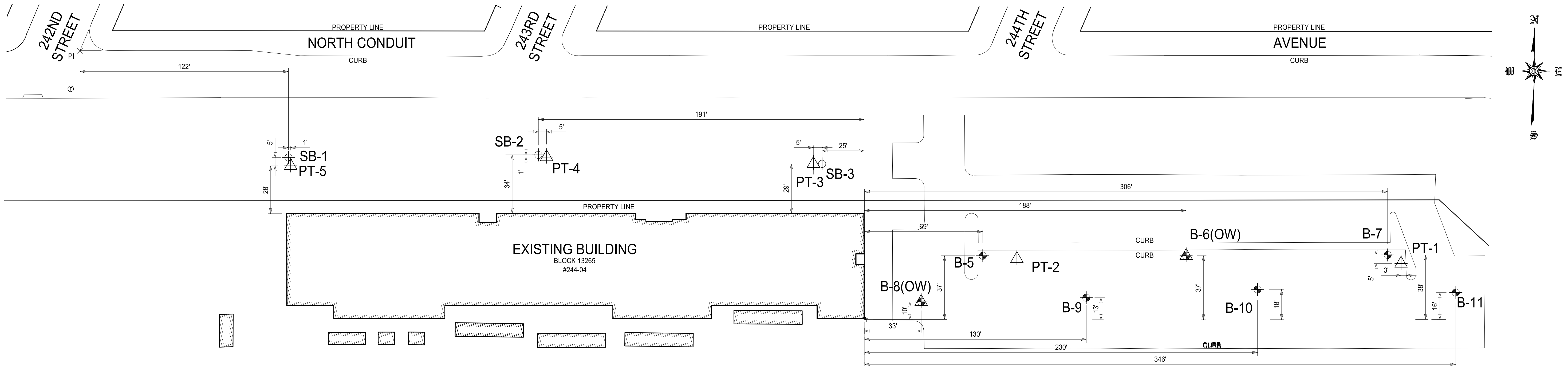
1	05-09-18	ADDED TEST BORINGS SB-1 THROUGH SB-3 AND PERMEABILITY TEST PT-1 THROUGH PT-5	RGM
NO.	DATE	DESCRIPTIONS	APPR'D
		REVISIONS	

 <b>Department of Design and Construction</b>	<b>CITY OF NEW YORK DEPARTMENT OF DESIGN &amp; CONSTRUCTION</b>	
	PREPARED FOR: <b>DIVISION OF PROGRAM MANAGEMENT SAFETY AND SITE SUPPORT OFFICE OF ENVIRONMENTAL AND GEOTECHNICAL SERVICES</b>	
CONSULTANT NAME: <b>CDM SMITH 14 WALL STREET, SUITE 1702 NEW YORK, NEW YORK 10005</b>		CONTRACTOR NAME: <b>AQUIFER DRILLING &amp; TESTING, INC 75 EAST 2ND STREET MINEOLA, NEW YORK 11501</b>
PROJECT NAME: <b>NEW 116TH PRECINCT 244-04 NORTH CONDUIT AVENUE BOROUGH OF QUEENS</b>		
<b>RECORD OF BORINGS</b>		
SEAL & SIGNATURE 	DATE: OCTOBER 20, 2017 PROJECT NO: PO002-116 DRAWING BY: RON BARDHAN CHK BY: ERLDA ALLAUBE	
DWG No: <b>B-102.00</b>		SHEET 2 OF 4
CADD File No: 4231A-ROB-01		



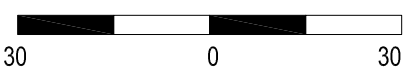






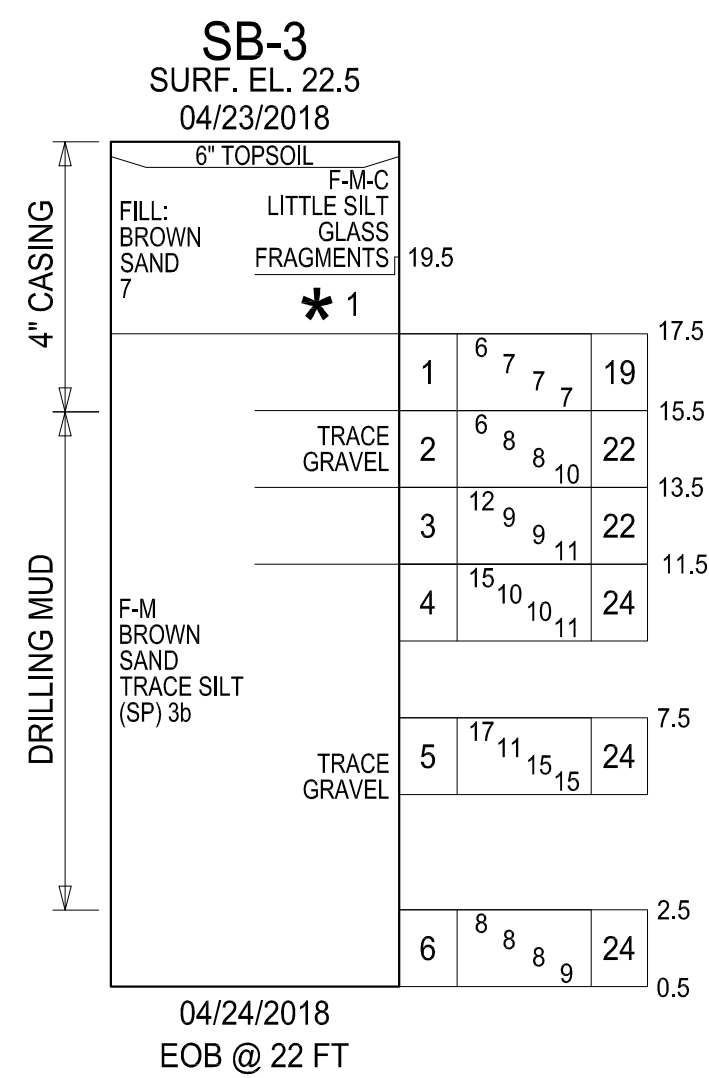
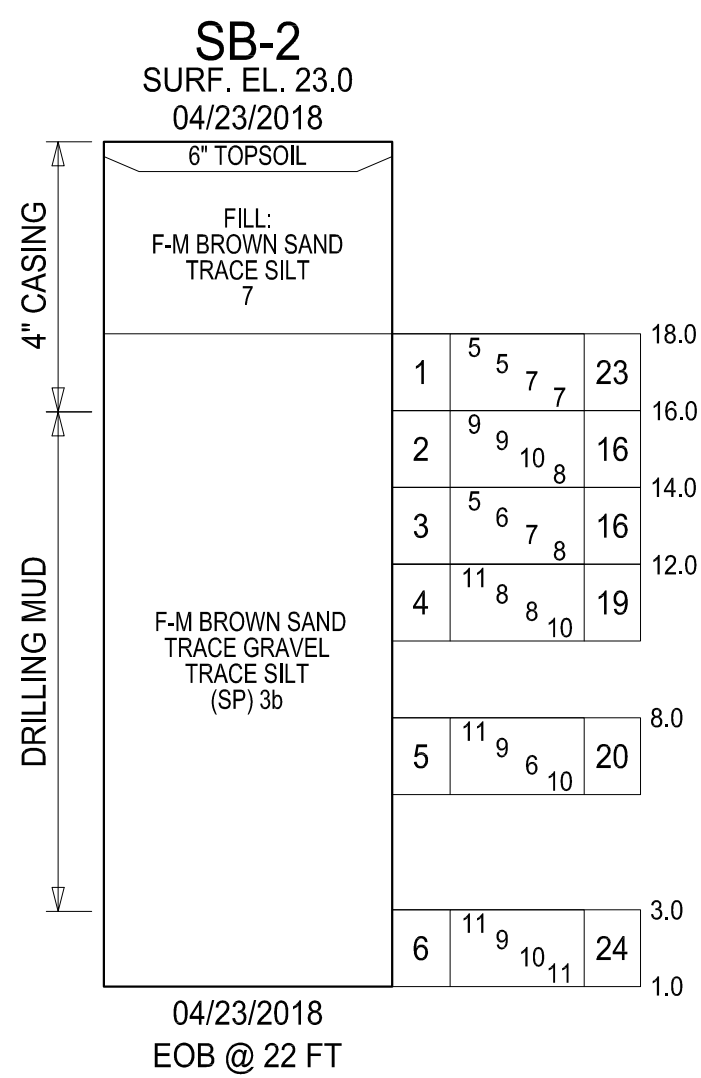
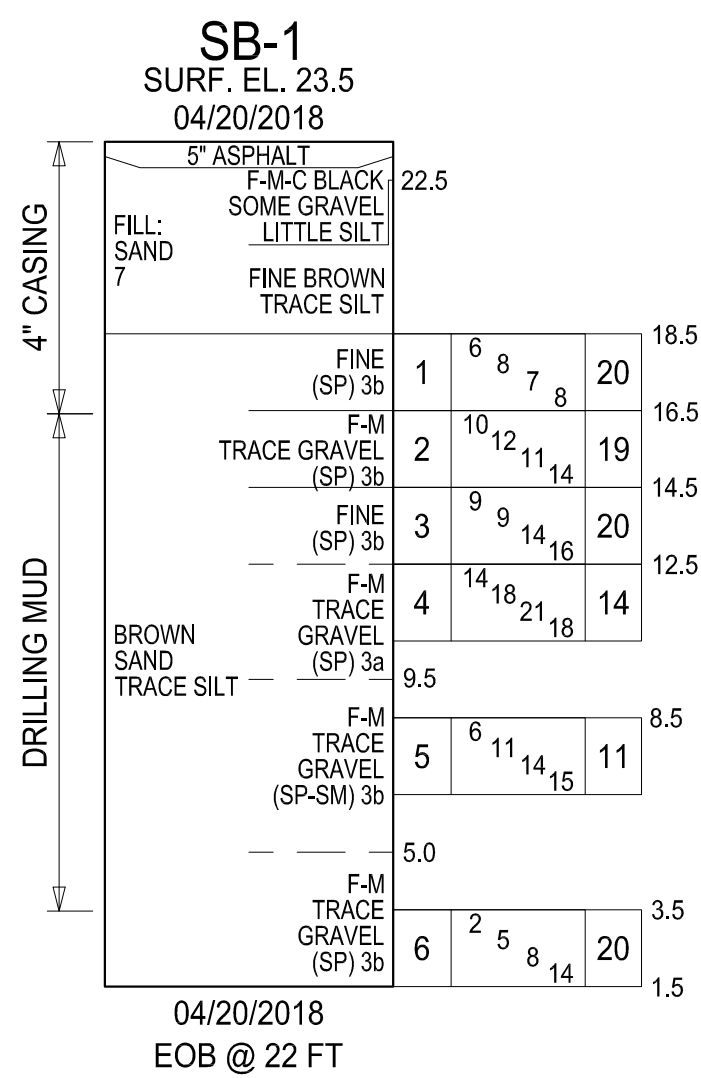
LOCATION PLAN

SCALE: 1" = 30'



LEGEND

- TEST BORING (SES-4231)
- TEST BORING WITH OBSERVATION WELL (SES-4231)
- TEST BORING (DRILLED IN 2018)
- PERMEABILITY TEST (COMPLETED IN 2018)



\* 1  
FILL: F-M BROWN SAND  
TRACE SILT  
7

LABORATORY ANALYSIS SUMMARY \*

Soil Sample Identification And Index Properties

BORING NO.	SAMPLE NO.	DEPTH, ft	D100, mm	D60, mm	D30, mm	D10, mm	% GRAVEL (> #4 SIEVE)	% SAND	% SILT OR CLAY (< #200 SIEVE)	WC %	Cc	Cu	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX	pH	ORGANIC CONTENT (%)	USCS SYMBOL
SB-1	1	5-7	-	0.23	0.16	0.11	0.0	95.4	4.6	17.1	1.07	2.16	-	-	-	-	-	SP
SB-1	2	7-9	-	0.38	0.25	0.16	0.4	96.5	3.1	3.7	1.06	2.35	-	-	-	-	-	SP
SB-1	4	11-13	-	0.35	0.25	0.16	1.0	97.1	1.9	5.6	1.12	2.26	-	-	-	-	-	SP
SB-1	5	15-17	-	0.25	0.16	0.09	0.3	92.2	7.5	23.4	1.17	2.78	-	-	-	-	-	SP-SM
SB-1	6	20-22	-	0.46	0.32	0.24	3.0	96.1	0.9	20.6	0.92	1.94	-	-	-	-	-	SP
SB-2	1	5-7	-	0.34	0.25	0.18	0.2	98.7	1.1	6.0	1.01	1.95	-	-	-	-	-	SP
SB-2	2	7-9	-	0.55	0.21	0.12	0.1	95.8	4.1	5.6	0.68	4.57	-	-	-	-	-	SP
SB-2	4	11-13	-	0.55	0.22	0.13	0.2	96.6	3.2	7.6	0.69	4.35	-	-	-	-	-	SP
SB-2	5	15-17	-	0.40	0.27	0.17	3.4	94.3	2.3	25.6	1.11	2.38	-	-	-	-	-	SP
SB-2	6	20-22	-	0.37	0.27	0.18	1.0	96.2	2.8	24.0	1.11	2.07	-	-	-	-	-	SP
SB-3	1	5-7	-	0.36	0.25	0.16	0.0	97.7	2.3	6.9	1.11	2.29	-	-	-	-	-	SP
SB-3	2	7-9	-	0.35	0.28	0.21	0.2	98.6	1.2	5.5	1.02	1.67	-	-	-	-	-	SP
SB-3	4	11-13	-	0.33	0.22	0.13	0.3	97.3	2.4	18.9	1.14	2.49	-	-	-	-	-	SP
SB-3	5	15-17	-	0.33	0.24	0.15	0.1	95.3	4.6	24.3	1.16	2.27	-	-	-	-	-	SP
SB-3	6	20-22	-	0.42	0.29	0.19	0.3	96.4	3.3	24.0	1.07	2.19	-	-	-	-	-	SP

\* Refer to detailed laboratory analysis data for additional information regarding the results presented herein.

<b>NYC DDC</b> Department of Design and Construction	<b>CITY OF NEW YORK</b> DEPARTMENT OF DESIGN & CONSTRUCTION
PO002-116 <b>4231A</b>	PREPARED FOR: DIVISION OF PROGRAM MANAGEMENT SAFETY AND SITE SUPPORT OFFICE OF ENVIRONMENTAL AND GEOTECHNICAL SERVICES
CONSULTANT NAME: CDM SMITH 14 WALL STREET, SUITE 1702 NEW YORK, NEW YORK 10005	CONTRACTOR NAME: AQUIFER DRILLING & TESTING, INC 75 EAST 2ND STREET MINEOLA, NEW YORK 11501
PROJECT NAME: <b>NEW 116TH PRECINCT</b> 244-04 NORTH CONDUIT AVENUE BOROUGH OF QUEENS	
<b>RECORD OF BORINGS</b>	
SEAL & SIGNATURE 	DATE: OCTOBER 20, 2017 PROJECT NO: PO002-116 DRAWING BY: RON BARDHAN CHK BY: ERALDA ALLAJIBE
DWG No: <b>B-104.00</b>	
CADD File No: 4231A-ROB-01	SHEET 4 OF 4

1	05-09-18	ADDED TEST BORINGS SB-1 THROUGH SB-3 AND PERMEABILITY TEST PT-1 THROUGH PT-5	RGM
NO.	DATE	DESCRIPTIONS	APPR'D
		REVISIONS	

ALEX KUHN  
SOIL AND ROCK ANALYSIS BY

KAPILA PATHIRAGE, Ph.D., P.E.  
GEOTECHNICAL ENGINEER  
CDM SMITH

RICHARD G. MESEROLE  
SECTION CHIEF  
OEGS

GEOTECHNICAL ENGINEER  
OEGS

JEAN M. JEAN-LOUIS  
ASSISTANT COMMISSIONER  
DIVISION OF PROGRAM MANAGEMENT  
SAFETY AND SITE SUPPORT

**PERMEABILITY TEST DATA**

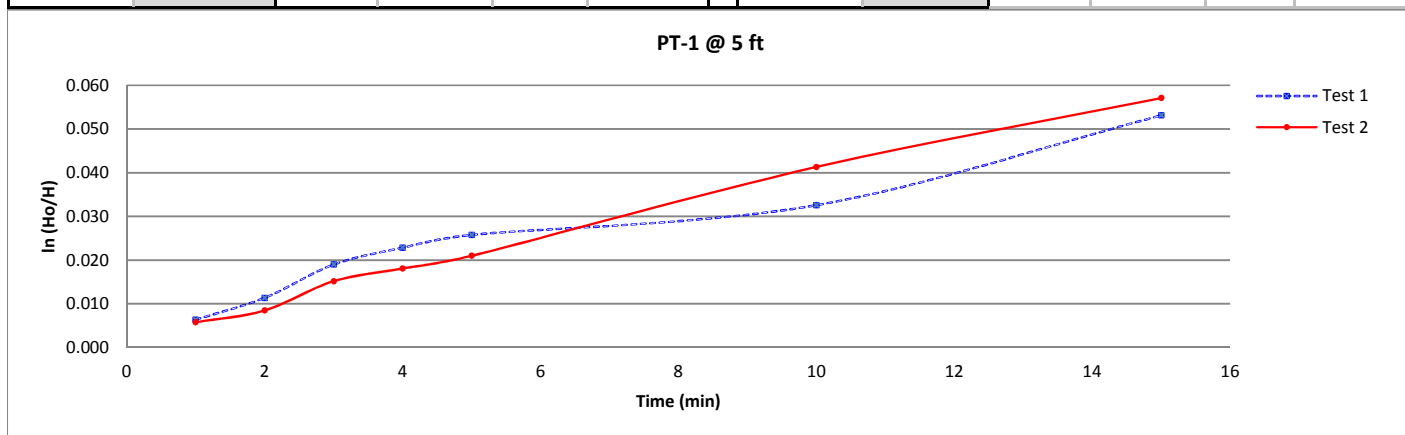


PT ID No. PT- 1  
Sheet 1 of 2

Prepared for: <b>NYC Department of Design and Construction</b>		PROJECT: New 116th Precinct (Task ID 14145)	
		LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY	
INSPECTOR: Dan Maeso	DRILLER: M. Beverage	Start Date: 4/19/2018	Weather: 9° C
CONTRACTOR: ADT	HELPER: N. Benson	Start Time: 9:01 AM	Rain
P.E./REP.: K. Pathirage			
Depth of PT: 5 ft	Drill Bit Type: Roller	Weight of Hammer for casing: 140 lbs	
Rig Type: CME-75	Casing Internal Diameter: 4 in	Type of Hammer: Auto	
	Casing Length: 66.5 in		

General Formula:	Formula for 4" internal diameter casing (in/hr):
ASTM D-6391 – 11 PERMEABILITY COEFFICIENT (Km) FORMULA:	
$K_m = \pi R_t \times \frac{\left[ D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\} \right]}{11 \times (t_2 - t_1)}$	$K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$
where:	$R_t = 2.2902(0.9842^T) / T^{0.1702}$

PT-1 @ 5 ft											
TEST 1						TEST 2					
Water temperature (°C), T:			9.5			Rt=			1.34		
FIELD DATA			CALCULATED DATA			FIELD DATA			CALCULATED DATA		
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	0.420	66.080	0.006	0.017	0.5828	1	0.380	66.120	0.006	0.017	0.5271
2	0.750	65.750	0.011	0.017	0.4605	2	0.560	65.940	0.008	0.017	0.2508
3	1.250	65.250	0.019	0.017	0.7022	3	1.000	65.500	0.015	0.017	0.6159
4	1.500	65.000	0.023	0.017	0.3531	4	1.190	65.310	0.018	0.017	0.2672
5	1.690	64.810	0.026	0.017	0.2693	5	1.380	65.120	0.021	0.017	0.2680
10	2.130	64.370	0.033	0.083	0.1253	10	2.690	63.810	0.041	0.083	0.3739
15	3.440	63.060	0.053	0.083	0.3783	15	3.690	62.810	0.057	0.083	0.2906



TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average	Km=	0.3257 in/hr	Time Weighted Average	Km=	0.3501 in/hr
Permeability Coefficient			Permeability Coefficient		

AVERAGE PT-1 @ 5 ft		
Time Weighted Average	Km=	0.3379 in/hr
Permeability Coefficient		

Inspectors Remarks: NR means Not Recorded  
Moist, gray, fine to coarse SAND, little silt (SM) (FILL)

#### DEFINITION OF VARIABLES

\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km

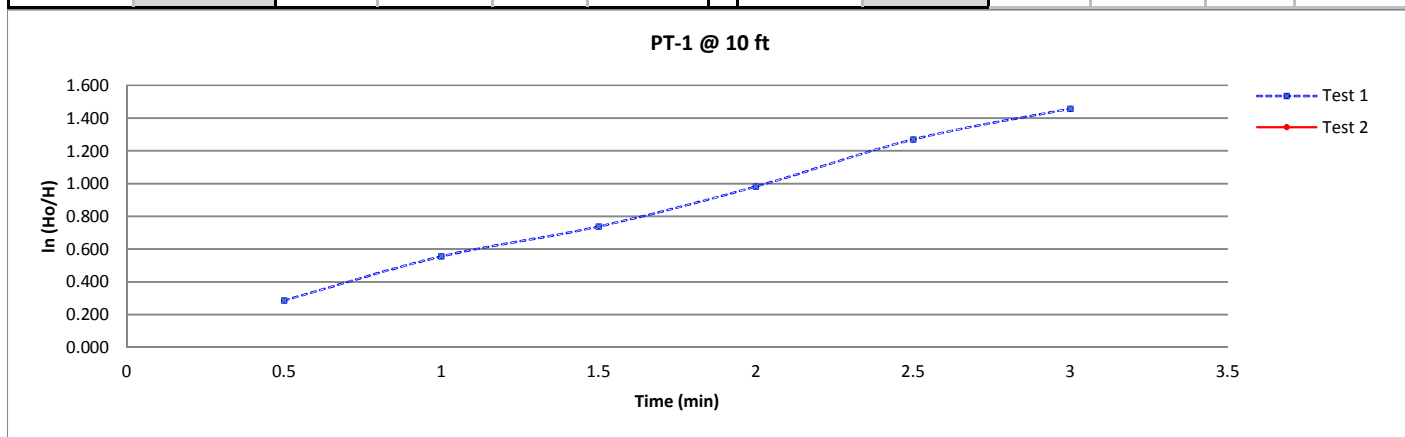


PT ID No. PT- 1  
Sheet 2 of 2

Prepared for: <b>NYC Department of Design and Construction</b>	PROJECT: New 116th Precinct (Task ID 14145) LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY
INSPECTOR: Dan Maeso CONTRACTOR: ADT P.E./REP.: K. Pathirage	DRILLER: M. Beverage HELPER: N. Benson Start Date: 4/19/2018 Start Time: 10:50 AM Weather: 9° C Rain
Depth of PT: 10 ft Rig Type: CME-75	Drill Bit Type: Roller Casing Internal Diameter: 4 in Casing Length: 149.5 in Weight of Hammer for casing: 140 lbs Type of Hammer: Auto

ASTM D-6391 – 11 PERMEABILITY COEFFICIENT (Km) FORMULA:	General Formula: $K_m = \pi R_t \times \frac{\left[ D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\} \right]}{11 \times (t_2 - t_1)}$ where: $R_t = 2.2902(0.9842^T) / T^{0.1702}$	Formula for 4" internal diameter casing (in/hr): $K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$
--	--	--

PT-1 @ 10 ft											
TEST 1 - Rapid Test						TEST 2					
Water temperature (°C), T:			9.5			Rt=			1.34		
FIELD DATA			CALCULATED DATA			FIELD DATA			CALCULATED DATA		
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
0.5	37.200	112.300	0.286	0.008	52.6390			149.500	0.000	0.000	-
1	63.700	85.800	0.555	0.008	49.5174			149.500	0.000	0.000	-
1.5	78.000	71.500	0.738	0.008	33.5423			149.500	0.000	0.000	-
2	93.500	56.000	0.982	0.008	44.9531			149.500	0.000	0.000	-
2.5	107.500	42.000	1.270	0.008	52.9259			149.500	0.000	0.000	-
3	114.680	34.820	1.457	0.008	34.4909			149.500	0.000	0.000	-



TEST 1 FINAL RESULTS	TEST 2 FINAL RESULTS
Time Weighted Average Km= 44.6781 in/hr Permeability Coefficient	Time Weighted Average Km= #DIV/0! in/hr Permeability Coefficient

AVERAGE PT-1 @ 10 ft	
Time Weighted Average Km= #DIV/0! in/hr Permeability Coefficient	

Inspectors Remarks: NR means Not Recorded  
Rapid test.  
Moist, brown, fine to medium SAND, little silt (SM)

**DEFINITION OF VARIABLES**  
\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km  
t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km



PT ID No. PT- 2  
Sheet 1 of 2

Prepared for:		PROJECT:	Task ID 14145 New 116th Precinct II				
		LOCATION / BOROUGH :	244-04 North Conduit Avenue, Queens, NY				
INSPECTOR:	Dan Maeso	DRILLER:	M. Beverage	Start Date:	4/20/2018	Weather:	11.5° C
CONTRACTOR:	ADT	HELPER:	N. Benson	Start Time:	11:40 AM		Sun
P.E./REP.:	K. Pathirage						
Depth of PT:	5 ft	Drill Bit Type:	Roller	Weight of Hammer for casing:	140 lbs		
Rig Type:	CME-75	Casing Internal Diameter:	4 in	Type of Hammer:	Auto		
		Casing Length:	88.35 in				

General Formula: Formula for 4" internal diameter casing (in/hr):

$$K_m = \pi R_t \times \frac{D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\}}{11 \times (t_2 - t_1)}$$
$$K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$$

ASTM D-6391 – 11 PERMEABILITY COEFFICIENT (Km) FORMULA:

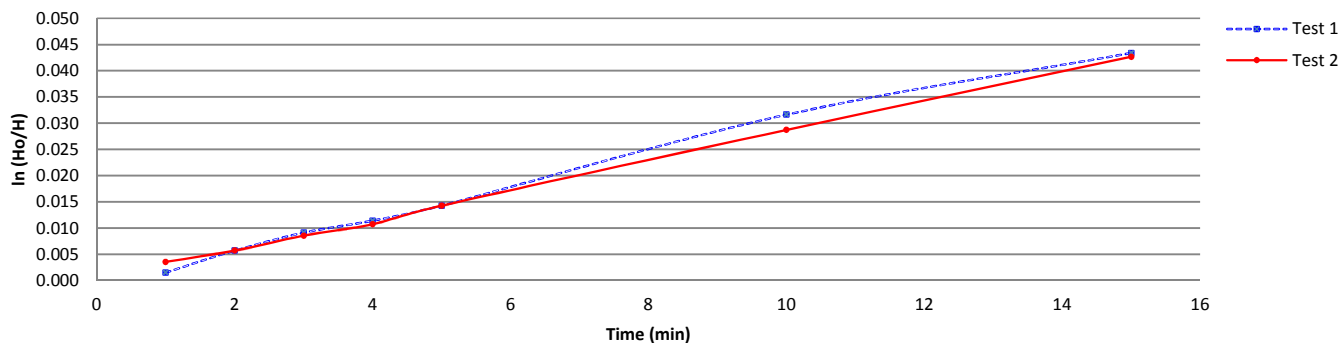
where:  $R_t = 2.2902(0.9842^T) / T^{0.1702}$

PT-2 @ 5 ft

TEST 1					
Water temperature (°C), T:		10.5		Rt=	1.30
FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	0.130	88.220	0.001	0.017	0.1311
2	0.500	87.850	0.006	0.017	0.3741
3	0.800	87.550	0.009	0.017	0.3045
4	1.000	87.350	0.011	0.017	0.2036
5	1.250	87.100	0.014	0.017	0.2551
10	2.750	85.600	0.032	0.083	0.3092
15	3.750	84.600	0.043	0.083	0.2092

TEST 2					
Water temperature (°C), T:		10.5		Rt=	1.30
FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	0.310	88.040	0.004	0.017	0.3128
2	0.500	87.850	0.006	0.017	0.1923
3	0.750	87.600	0.009	0.017	0.2536
4	0.940	87.410	0.011	0.017	0.1933
5	1.250	87.100	0.014	0.017	0.3162
10	2.500	85.850	0.029	0.083	0.2573
15	3.690	84.660	0.043	0.083	0.2485

PT-2 @ 5 ft



TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average	Km=	0.2574 in/hr	Time Weighted Average	Km=	0.2531 in/hr
Permeability Coefficient			Permeability Coefficient		

AVERAGE PT-2 @ 5 ft		
Time Weighted Average	Km=	0.2552 in/hr
Permeability Coefficient		

Inspectors Remarks: NR means Not Recorded  
Dry, brown, fine to coarse SAND, trace silt (SP)

DEFINITION OF VARIABLES

\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km

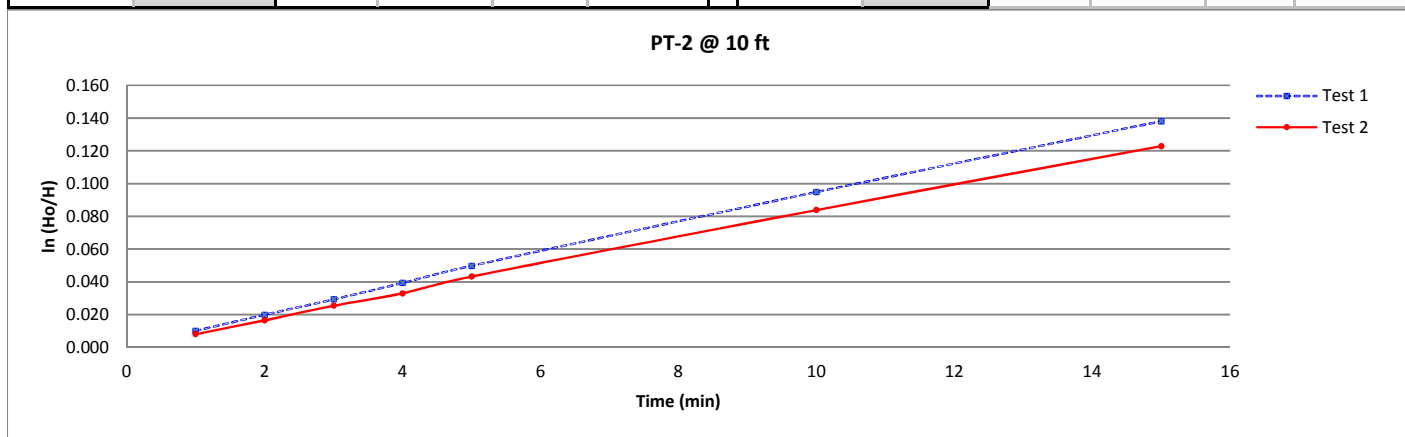


PT ID No. PT- 2  
Sheet 2 of 2

Prepared for: <b>NYC Department of Design and Construction</b>		PROJECT: New 116th Precinct (Task ID 14145)	
		LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY	
INSPECTOR: Dan Maeso	DRILLER: M. Beverage	Start Date: 4/20/2018	Weather: 12° C
CONTRACTOR: ADT	HELPER: N. Benson	Start Time: 2:00 PM	Sun
P.E./REP.: K. Pathirage			
Depth of PT: 10 ft	Drill Bit Type: Roller	Weight of Hammer for casing: 140 lbs	
Rig Type: CME-75	Casing Internal Diameter: 4 in	Type of Hammer: Auto	
	Casing Length: 149.25 in		

General Formula:	Formula for 4" internal diameter casing (in/hr):
$K_m = \pi R_t \times \frac{D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\}}{11 \times (t_2 - t_1)}$	$K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$
ASTM D-6391 – 11 PERMEABILITY COEFFICIENT (Km) FORMULA:	
where:	$R_t = 2.2902(0.9842^T) / T^{0.1702}$

PT-2 @ 10 ft											
TEST 1						TEST 2					
Water temperature (°C), T:			12			Rt=			1.24		
FIELD DATA			CALCULATED DATA			FIELD DATA			CALCULATED DATA		
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	1.500	147.750	0.010	0.017	0.8581	1	1.190	148.060	0.008	0.017	0.6800
2	2.940	146.310	0.020	0.017	0.8320	2	2.440	146.810	0.016	0.017	0.7202
3	4.310	144.940	0.029	0.017	0.7992	3	3.750	145.500	0.025	0.017	0.7614
4	5.750	143.500	0.039	0.017	0.8482	4	4.840	144.410	0.033	0.017	0.6388
5	7.250	142.000	0.050	0.017	0.8927	5	6.310	142.940	0.043	0.017	0.8692
10	13.500	135.750	0.095	0.083	0.7648	10	12.000	137.250	0.084	0.083	0.6902
15	19.250	130.000	0.138	0.083	0.7353	15	17.250	132.000	0.123	0.083	0.6626



TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average	Km=	0.7820 in/hr	Time Weighted Average	Km=	0.6956 in/hr
Permeability Coefficient			Permeability Coefficient		

AVERAGE PT-2 @ 10 ft		
Time Weighted Average	Km=	0.7388 in/hr
Permeability Coefficient		

Inspectors Remarks: NR means Not Recorded  
Moist, brown, fine to medium SAND, trace silt (SP)

#### DEFINITION OF VARIABLES

\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km





PT ID No. PT- 3  
Sheet 1 of 2

Prepared for: **NYC Department of Design and Construction**

PROJECT: New 116th Precinct (Task ID 14145)  
LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY

INSPECTOR: Dan Maeso  
CONTRACTOR: ADT  
P.E./REP.: K. Pathirage

DRILLER: F. Martinez  
HELPER: Hugh

Start Date: 4/23/2018  
Start Time: 11:00 AM  
Weather: 17.5° C Sun

Depth of PT: 5 ft  
Rig Type: CME-75

Drill Bit Type: Roller  
Casing Internal Diameter: 4 in  
Casing Length: 79 in

Weight of Hammer for casing: 140 lbs  
Type of Hammer: Auto

General Formula:

Formula for 4" internal diameter casing (in/hr):

ASTM D-6391 – 11  
PERMEABILITY COEFFICIENT (Km) FORMULA:

$$K_m = \pi R_t \times \frac{\left[ D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\} \right]}{11 \times (t_2 - t_1)}$$

$$K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$$

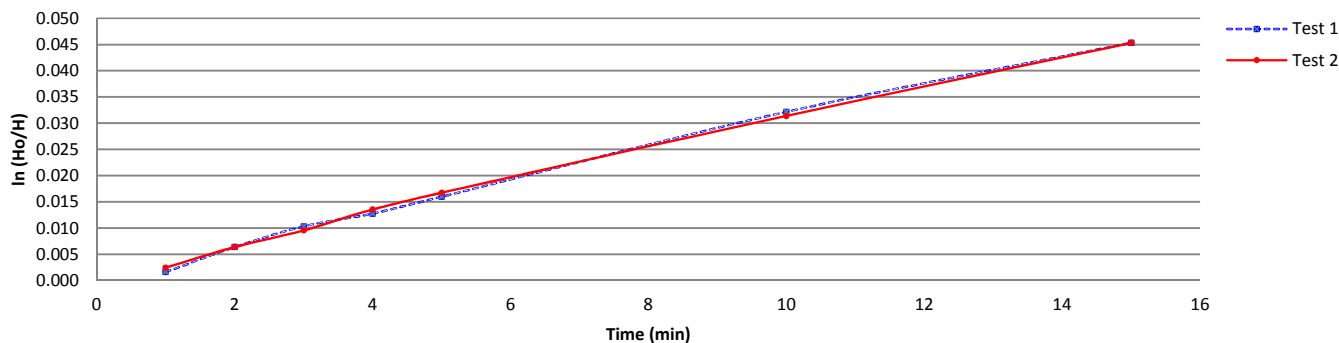
where:

$$R_t = 2.2902(0.9842^T) / T^{0.1702}$$

#### PT-3 @ 5 ft

TEST 1						TEST 2					
Water temperature (°C), T:			16.5			Rt= 1.09			Water temperature (°C), T:		
FIELD DATA			CALCULATED DATA			FIELD DATA			CALCULATED DATA		
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	0.125	78.875	0.002	0.017	0.1186	1	0.190	78.810	0.002	0.017	0.1804
2	0.500	78.500	0.006	0.017	0.3570	2	0.500	78.500	0.006	0.017	0.2952
3	0.810	78.190	0.010	0.017	0.2964	3	0.750	78.250	0.010	0.017	0.2389
4	1.000	78.000	0.013	0.017	0.1822	4	1.060	77.940	0.014	0.017	0.2973
5	1.250	77.750	0.016	0.017	0.2405	5	1.310	77.690	0.017	0.017	0.2406
10	2.500	76.500	0.032	0.083	0.2428	10	2.440	76.560	0.031	0.083	0.2195
15	3.500	75.500	0.045	0.083	0.1971	15	3.500	75.500	0.045	0.083	0.2089

#### PT-3 @ 5 ft



TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average Permeability Coefficient	Km=	0.2263 in/hr	Time Weighted Average Permeability Coefficient	Km=	0.2263 in/hr

AVERAGE PT-3 @ 5 ft		
Time Weighted Average Permeability Coefficient	Km=	0.2263 in/hr

Inspectors Remarks: NR means Not Recorded

Dry, brown, fine to medium SAND, trace silt (SP)

#### DEFINITION OF VARIABLES

\*Km= Mean permeability

T = Temperature of permeant (water), in °C

Ln = Natural Logarithmic

t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km

h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km

h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km

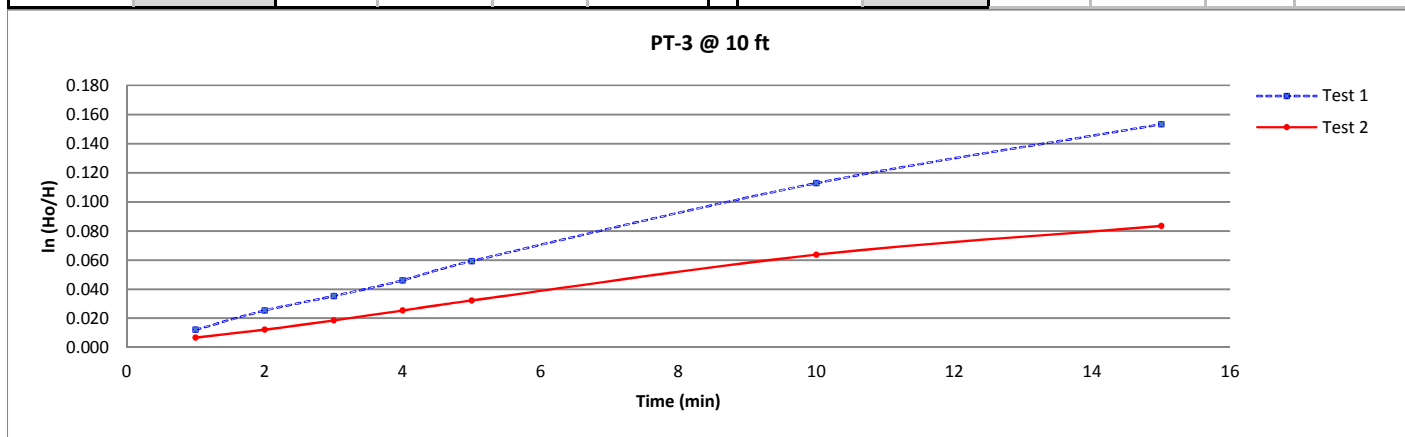


PT ID No. PT- 3  
Sheet 2 of 2

Prepared for: <b>NYC Department of Design and Construction</b>		PROJECT: New 116th Precinct (Task ID 14145)	
		LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY	
INSPECTOR: Dan Maeso	DRILLER: F. Martinez	Start Date: 4/23/2018	Weather: 18.5° C
CONTRACTOR: ADT	HELPER: Hugh	Start Time: 12:42 PM	Sun
P.E./REP.: K. Pathirage			
Depth of PT: 10 ft	Drill Bit Type: Roller	Weight of Hammer for casing: 140 lbs	
Rig Type: CME-75	Casing Internal Diameter: 4 in	Type of Hammer: Auto	
	Casing Length: 150 in		

General Formula:	Formula for 4" internal diameter casing (in/hr):
$K_m = \pi R_t \times \frac{D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\}}{11 \times (t_2 - t_1)}$	$K_m = 1.142 R_t \times \frac{Ln \left( \frac{h_1}{h_2} \right)}{(t_2 - t_1)}$
ASTM D-6391 – 11 PERMEABILITY COEFFICIENT (Km) FORMULA:	
where:	$R_t = 2.2902(0.9842^T) / T^{0.1702}$

PT-3 @ 10 ft											
TEST 1						TEST 2					
Water temperature (°C), T:			16.5			Rt=			1.09		
FIELD DATA			CALCULATED DATA			FIELD DATA			CALCULATED DATA		
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	1.810	148.190	0.012	0.017	0.9093	1	1.000	149.000	0.007	0.017	0.5010
2	3.750	146.250	0.025	0.017	0.9871	2	1.810	148.190	0.012	0.017	0.4083
3	5.190	144.810	0.035	0.017	0.7412	3	2.750	147.250	0.019	0.017	0.4766
4	6.750	143.250	0.046	0.017	0.8113	4	3.750	146.250	0.025	0.017	0.5104
5	8.630	141.370	0.059	0.017	0.9895	5	4.750	145.250	0.032	0.017	0.5139
10	16.000	134.000	0.113	0.083	0.8021	10	9.250	140.750	0.064	0.083	0.4715
15	21.310	128.690	0.153	0.083	0.6057	15	12.000	138.000	0.083	0.083	0.2956



TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average	Km=	0.7652 in/hr	Time Weighted Average	Km=	0.4164 in/hr
Permeability Coefficient			Permeability Coefficient		

AVERAGE PT-3 @ 10 ft		
Time Weighted Average	Km=	0.5908 in/hr
Permeability Coefficient		

Inspectors Remarks: NR means Not Recorded  
Moist, brown, fine to coarse SAND, trace silt (SP)

#### DEFINITION OF VARIABLES

\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km



PT ID No. PT- 4  
Sheet 1 of 2

Prepared for: **NYC Department of Design and Construction**

PROJECT: New 116th Precinct (Task ID 14145)  
LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY

INSPECTOR: Dan Maeso  
CONTRACTOR: ADT  
P.E./REP.: K. Pathirage

DRILLER: F. Martinez  
HELPER: Hugh

Start Date: 4/24/2018  
Start Time: 8:50 AM

Weather: 13° C  
Sun

Depth of PT: 5 ft  
Rig Type: CME-75

Drill Bit Type: Roller  
Casing Internal Diameter: 4 in  
Casing Length: 83.15 in

Weight of Hammer for casing: 140 lbs  
Type of Hammer: Auto

General Formula:

Formula for 4" internal diameter casing (in/hr):

ASTM D-6391 – 11  
PERMEABILITY COEFFICIENT (Km) FORMULA:

$$K_m = \pi R_t \times \frac{\left[ D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\} \right]}{11 \times (t_2 - t_1)}$$

$$K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$$

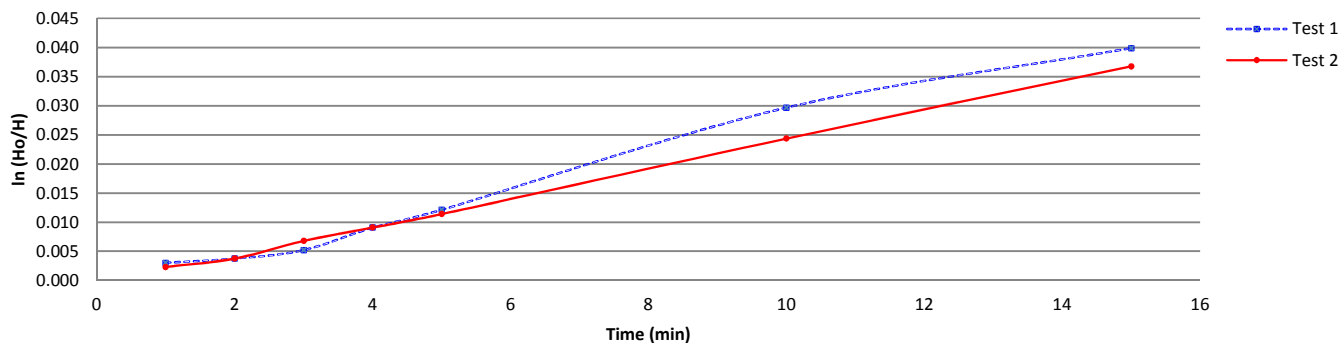
where:

$$R_t = 2.2902(0.9842^T) / T^{0.1702}$$

#### PT-4 @ 5 ft

TEST 1						TEST 2					
Water temperature (°C), T:		10.5		Rt= 1.30		Water temperature (°C), T:		10.5		Rt= 1.30	
FIELD DATA		CALCULATED DATA				FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	0.250	82.900	0.003	0.017	0.2680	1	0.190	82.960	0.002	0.017	0.2036
2	0.310	82.840	0.004	0.017	0.0644	2	0.310	82.840	0.004	0.017	0.1288
3	0.430	82.720	0.005	0.017	0.1290	3	0.560	82.590	0.007	0.017	0.2690
4	0.750	82.400	0.009	0.017	0.3450	4	0.750	82.400	0.009	0.017	0.2050
5	1.000	82.150	0.012	0.017	0.2704	5	0.940	82.210	0.011	0.017	0.2055
10	2.430	80.720	0.030	0.083	0.3126	10	2.000	81.150	0.024	0.083	0.2310
15	3.250	79.900	0.040	0.083	0.1818	15	3.000	80.150	0.037	0.083	0.2207

#### PT-4 @ 5 ft



TEST 1 FINAL RESULTS			TEST 2 FINAL RESULTS		
Time Weighted Average Permeability Coefficient	Km=	0.2366 in/hr	Time Weighted Average Permeability Coefficient	Km=	0.2180 in/hr
AVERAGE PT-4 @ 5 ft					
Time Weighted Average Permeability Coefficient	Km=	0.2273 in/hr			

Inspectors Remarks: NR means Not Recorded

Dry, brown, fine to medium SAND, trace silt (SP)

#### DEFINITION OF VARIABLES

\*Km= Mean permeability

T = Temperature of permeant (water), in °C

Ln = Natural Logarithmic

t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km

h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km

h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km



PT ID No. PT- 4  
Sheet 2 of 2

Prepared for: <b>NYC Department of Design and Construction</b>		PROJECT: New 116th Precinct (Task ID 14145)	
		LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY	
INSPECTOR: Dan Maeso	DRILLER: F. Martinez	Start Date: 4/24/2018	Weather: 15° C
CONTRACTOR: ADT	HELPER: Hugh	Start Time: 10:36 AM	Sun
P.E./REP.: K. Pathirage			
Depth of PT: 10 ft	Drill Bit Type: Roller	Weight of Hammer for casing: 140 lbs	
Rig Type: CME-75	Casing Internal Diameter: 4 in	Type of Hammer: Auto	
	Casing Length: 149.5 in		

General Formula: 
$$K_m = \pi R_t \times \frac{D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\}}{11 \times (t_2 - t_1)}$$

ASTM D-6391 – 11 PERMEABILITY COEFFICIENT (Km) FORMULA:

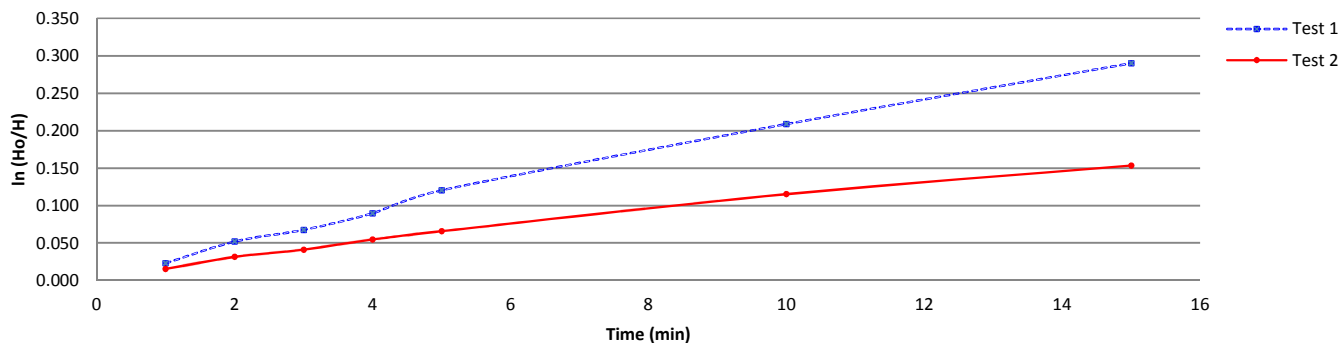
where:  $R_t = \frac{2.2902(0.9842^T)}{T^{0.1702}}$

Formula for 4" internal diameter casing (in/hr): 
$$K_m = 1.142 R_t \times \frac{\ln \left( \frac{h_1}{h_2} \right)}{(t_2 - t_1)}$$

PT-4 @ 10 ft

TEST 1						TEST 2					
Water temperature (°C), T:		15		Rt= 1.14		Water temperature (°C), T:		15		Rt= 1.14	
FIELD DATA		CALCULATED DATA				FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	3.380	146.120	0.023	0.017	1.7830	1	2.250	147.250	0.015	0.017	1.1824
2	7.560	141.940	0.052	0.017	2.2630	2	4.610	144.890	0.031	0.017	1.2597
3	9.750	139.750	0.067	0.017	1.2124	3	6.000	143.500	0.041	0.017	0.7516
4	12.810	136.690	0.090	0.017	1.7262	4	7.940	141.560	0.055	0.017	1.0613
5	16.940	132.560	0.120	0.017	2.3921	5	9.500	140.000	0.066	0.017	0.8640
10	28.160	121.340	0.209	0.083	1.3791	10	16.250	133.250	0.115	0.083	0.7706
15	37.630	111.870	0.290	0.083	1.2671	15	21.250	128.250	0.153	0.083	0.5964

PT-4 @ 10 ft



TEST 1 FINAL RESULTS	TEST 2 FINAL RESULTS				
Time Weighted Average Permeability Coefficient Km= 1.5072 in/hr	Time Weighted Average Permeability Coefficient Km= 0.7969 in/hr				
<table><tr><th colspan="2">AVERAGE PT-4 @ 10 ft</th></tr><tr><td>Time Weighted Average Permeability Coefficient</td><td>Km= 1.1521 in/hr</td></tr></table>		AVERAGE PT-4 @ 10 ft		Time Weighted Average Permeability Coefficient	Km= 1.1521 in/hr
AVERAGE PT-4 @ 10 ft					
Time Weighted Average Permeability Coefficient	Km= 1.1521 in/hr				

Inspectors Remarks: NR means Not Recorded  
Dry, brown, fine to medium SAND, trace silt (SP)

DEFINITION OF VARIABLES

\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km





PT ID No. PT- 5  
Sheet 2 of 2

Prepared for: <b>NYC Department of Design and Construction</b>		PROJECT: New 116th Precinct (Task ID 14145)	
		LOCATION / BOROUGH : 244-04 North Conduit Avenue, Queens, NY	
INSPECTOR: Dan Maeso	DRILLER: M. Beverage	Start Date: 4/19/2018	Weather: 7° C
CONTRACTOR: ADT	HELPER: N. Benson	Start Time: 1:40 PM	Rain
P.E./REP.: K. Pathirage			
Depth of PT: 10 ft	Drill Bit Type: Roller	Weight of Hammer for casing: 140 lbs	
Rig Type: CME-75	Casing Internal Diameter: 4 in	Type of Hammer: Auto	
	Casing Length: 126.13 in		

General Formula: 
$$K_m = \pi R_t \times \frac{D \left\{ \ln \left( \frac{h_1}{h_2} \right) \right\}}{11 \times (t_2 - t_1)}$$

Formula for 4" internal diameter casing (in/hr): 
$$K_m = 1.142 R_t \times \frac{\left[ \ln \left( \frac{h_1}{h_2} \right) \right]}{(t_2 - t_1)}$$

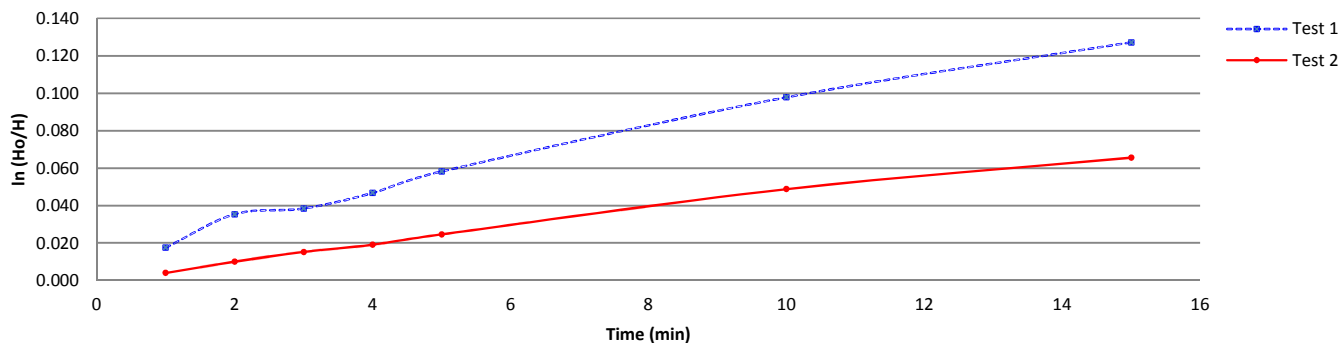
ASTM D-6391 – 11  
PERMEABILITY COEFFICIENT (Km) FORMULA:

where: 
$$R_t = 2.2902(0.9842^T) / T^{0.1702}$$

PT-5 @ 10 ft

TEST 1						TEST 2					
Water temperature (°C), T:		8.5		Rt= 1.39		Water temperature (°C), T:		8.5		Rt= 1.39	
FIELD DATA		CALCULATED DATA				FIELD DATA		CALCULATED DATA			
Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)	Time (min)	Depth (in)	Height (in)	Ln (Ho/H)	(t <sub>2</sub> -t <sub>1</sub> )	*Km (in/hr)
1	2.180	123.950	0.017	0.017	1.6607	1	0.500	125.630	0.004	0.017	0.3783
2	4.380	121.750	0.035	0.017	1.7058	2	1.250	124.880	0.010	0.017	0.5703
3	4.750	121.380	0.038	0.017	0.2899	3	1.900	124.230	0.015	0.017	0.4971
4	5.750	120.380	0.047	0.017	0.7880	4	2.380	123.750	0.019	0.017	0.3687
5	7.130	119.000	0.058	0.017	1.0982	5	3.060	123.070	0.025	0.017	0.5248
10	11.750	114.380	0.098	0.083	0.7543	10	6.000	120.130	0.049	0.083	0.4606
15	15.060	111.070	0.127	0.083	0.5594	15	8.000	118.130	0.066	0.083	0.3198

PT-5 @ 10 ft



TEST 1 FINAL RESULTS	TEST 2 FINAL RESULTS				
Time Weighted Average Permeability Coefficient Km= 0.8074 in/hr	Time Weighted Average Permeability Coefficient Km= 0.4161 in/hr				
<table><tr><th colspan="2">AVERAGE PT-5 @ 10 ft</th></tr><tr><td>Time Weighted Average Permeability Coefficient</td><td>Km= 0.6118 in/hr</td></tr></table>		AVERAGE PT-5 @ 10 ft		Time Weighted Average Permeability Coefficient	Km= 0.6118 in/hr
AVERAGE PT-5 @ 10 ft					
Time Weighted Average Permeability Coefficient	Km= 0.6118 in/hr				

Inspectors Remarks: NR means Not Recorded  
Moist, brown, fine to coarse SAND, little silt (SP)

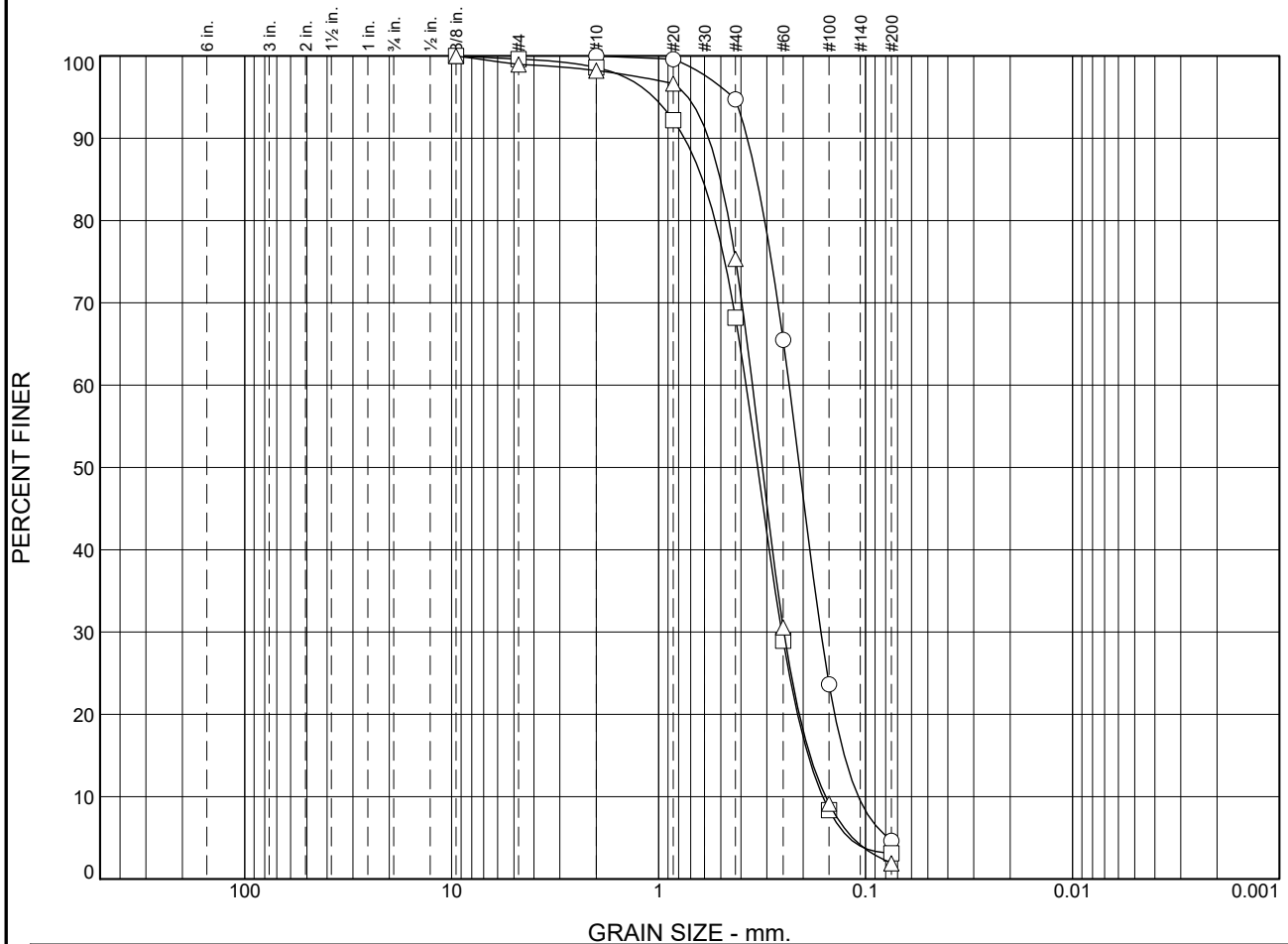
DEFINITION OF VARIABLES

\*Km= Mean permeability  
T = Temperature of permeant (water), in °C  
Ln = Natural Logarithmic  
t1 = Time at the start of the test in the same units selected for Km

t2= Time at the end of the test in the units selected for Km  
h1= Height of the water above the bottom of the casing at the start of the test in the same units selected for Km  
h2= Height of the water above the bottom of the casing at the end of the test in the same units selected for Km

**GEOTECHNICAL LABORATORY TEST RESULTS**

# Particle Size Distribution Report No. CT3828SL-36-04-18



	% Cobbles		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.0	0.0	5.3	90.1	4.6		
□	0.0		0.0	0.4	1.0	30.4	65.1	3.1		
△	0.0		0.0	1.0	0.8	22.9	73.4	1.9		
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.3354	0.2339	0.2085	0.1643	0.1267	0.1083	1.07	2.16
□			0.6132	0.3778	0.3318	0.2541	0.1892	0.1611	1.06	2.35
△			0.5028	0.3519	0.3151	0.2480	0.1854	0.1559	1.12	2.26

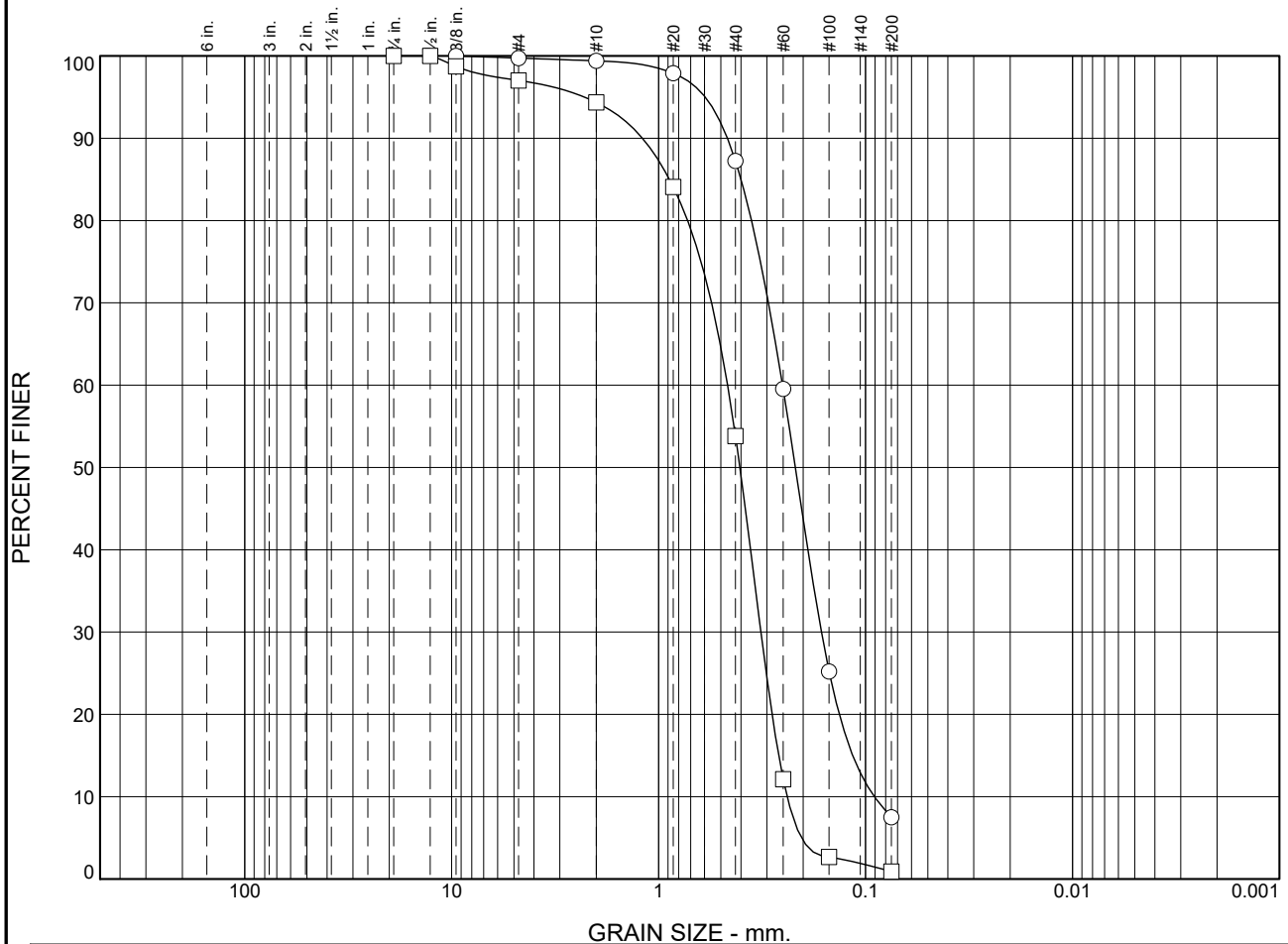
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							05/01/18	SP	17.1
□ Poorly graded sand							05/01/18	SP	3.7
△ Poorly graded sand							05/01/18	SP	5.6

<b>Project No.</b> <b>Project:</b> New 116th Pecinct II, Queens, NY CAPIS ID: PO002-116 ○ <b>Source of Sample:</b> SB-1 <b>Depth:</b> 5-7' <b>Sample Number:</b> S-1 □ <b>Source of Sample:</b> SB-1 <b>Depth:</b> 7-9' <b>Sample Number:</b> S-2 △ <b>Source of Sample:</b> SB-1 <b>Depth:</b> 11-13' <b>Sample Number:</b> S-4	<b>Client:</b> CDM Smith - NYC DDC Proejct  <b>Remarks:</b>   
<b>ATLANTIC TESTING LABORATORIES, LIMITED</b>  <b>Canton, New York</b>	

Figure



# Particle Size Distribution Report No. CT3828SL-36-04-18



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.3	0.3	12.2	79.7	7.5	
□	0.0	0.0	3.0	2.7	40.5	52.9	0.9	

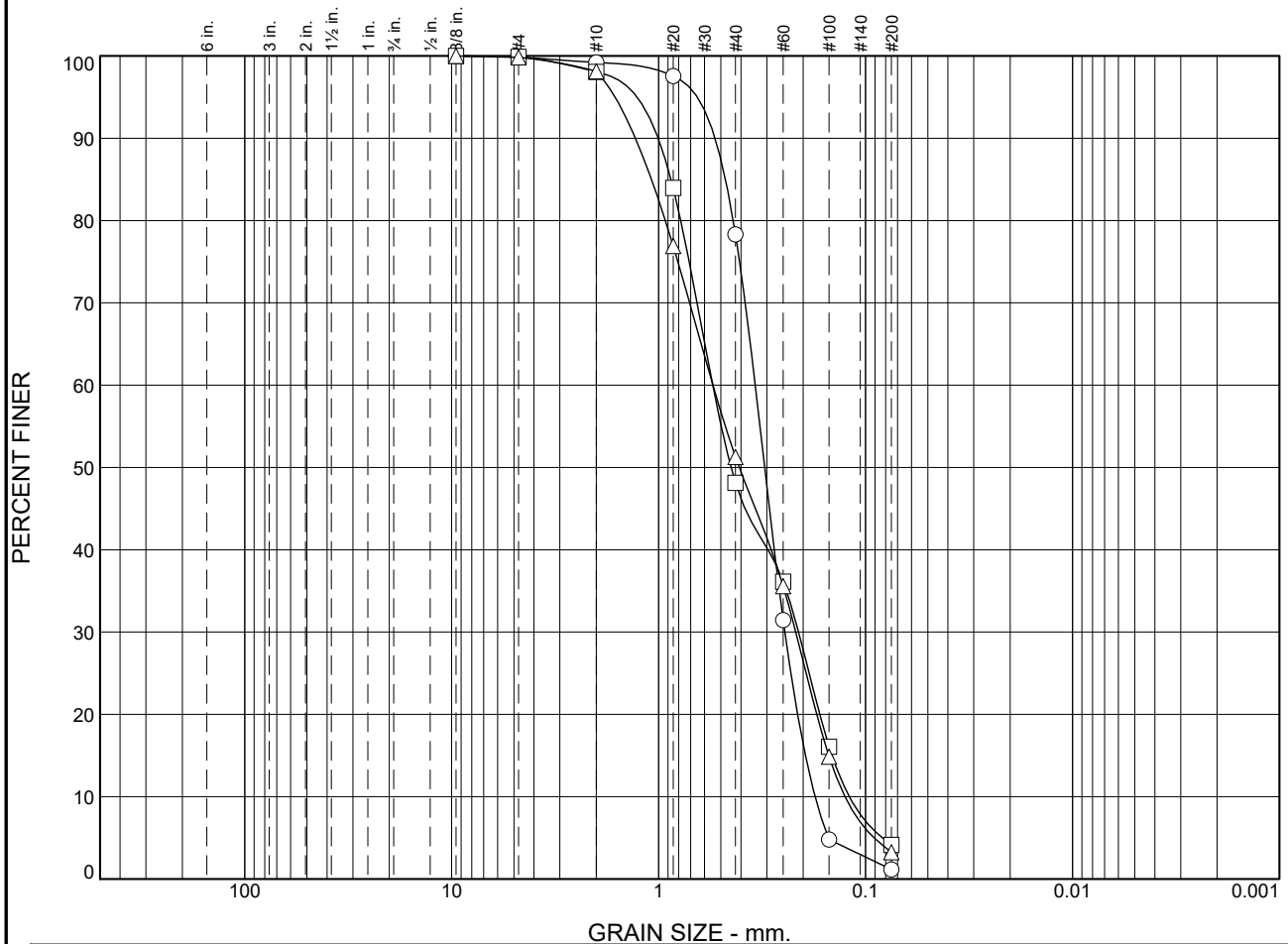
LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○		0.3997	0.2517	0.2184	0.1632	0.1154	0.0906	1.17	2.78
□		0.8870	0.4641	0.4047	0.3203	0.2628	0.2394	0.92	1.94

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand with silt							05/01/18	SP-SM	23.4
□ Poorly graded sand							05/01/18	SP	20.6

<b>Project No.</b> <b>Project:</b> New 116th Pecinct II, Queens, NY CAPIS ID: PO002-116 ○ <b>Source of Sample:</b> SB-1 <b>Depth:</b> 15-17' <b>Sample Number:</b> S-5 □ <b>Source of Sample:</b> SB-1 <b>Depth:</b> 20-22' <b>Sample Number:</b> S-6	<b>Remarks:</b>
<b>ATLANTIC TESTING LABORATORIES, LIMITED</b>  <b>Canton, New York</b>	

Figure

# Particle Size Distribution Report No. CT3828SL-36-04-18



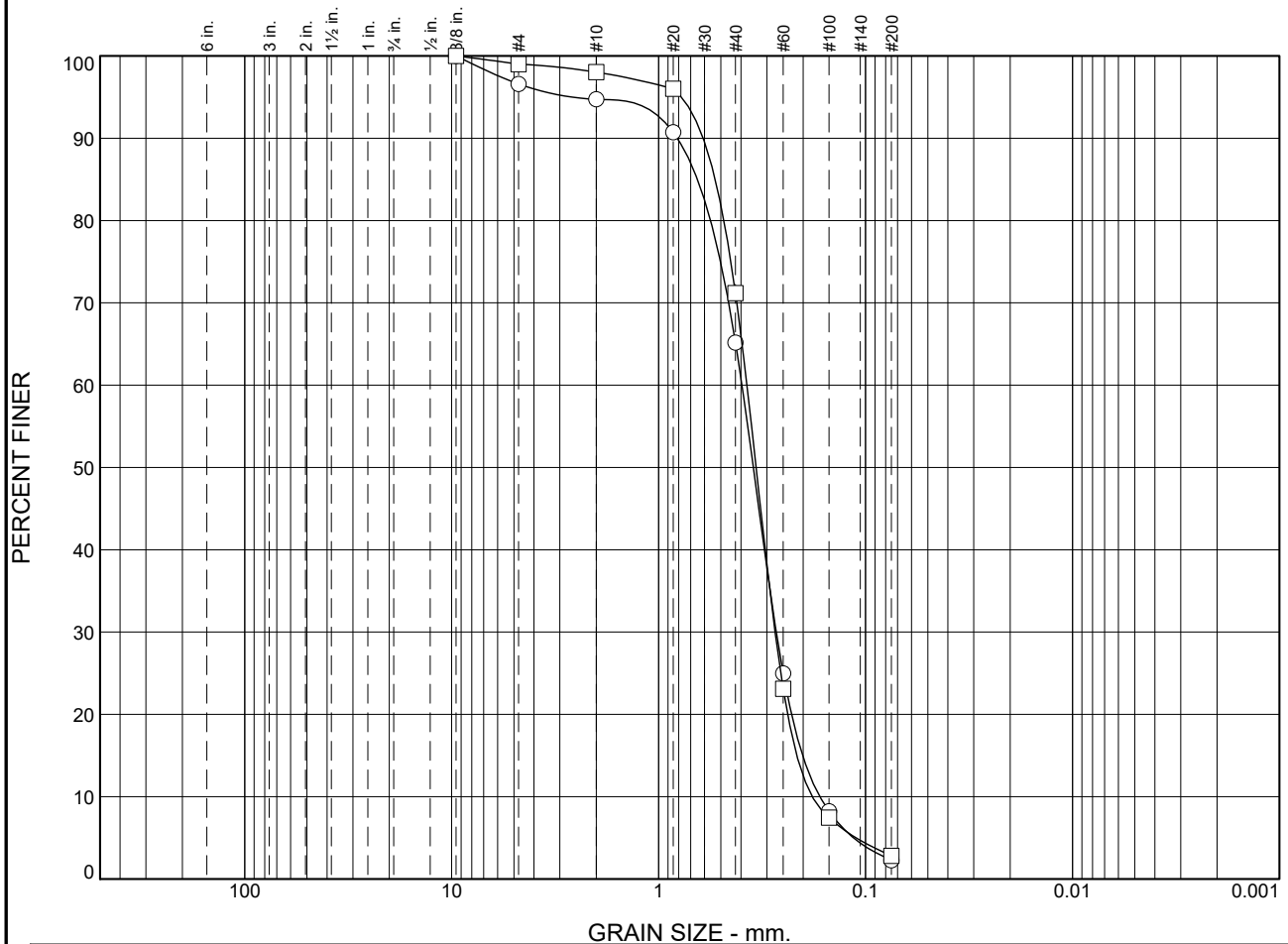
	% Cobbles		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.2	0.6	20.9	77.2	1.1		
□	0.0		0.0	0.1	1.8	50.0	44.0	4.1		
△	0.0		0.0	0.2	1.7	46.8	48.1	3.2		
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.4752	0.3412	0.3070	0.2455	0.1951	0.1753	1.01	1.95
□			0.8712	0.5475	0.4465	0.2107	0.1453	0.1199	0.68	4.57
△			1.0830	0.5464	0.4074	0.2175	0.1506	0.1257	0.69	4.35

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							05/01/18	SP	6.0
□ Poorly graded sand							05/01/18	SP	5.6
△ Poorly graded sand							05/01/18	SP	7.6

<b>Project No.</b> <b>Project:</b> New 116th Pecinct II, Queens, NY CAPIS ID: PO002-116 ○ <b>Source of Sample:</b> SB-2 <b>Depth:</b> 5-7' <b>Sample Number:</b> S-1 □ <b>Source of Sample:</b> SB-2 <b>Depth:</b> 7-9' <b>Sample Number:</b> S-2 △ <b>Source of Sample:</b> SB-2 <b>Depth:</b> 11-13' <b>Sample Number:</b> S-4	<b>Client:</b> CDM Smith - NYC DDC Proejct  <b>Remarks:</b>
<b>ATLANTIC TESTING LABORATORIES, LIMITED</b>  Canton, New York	

Figure

# Particle Size Distribution Report No. CT3828SL-36-04-18



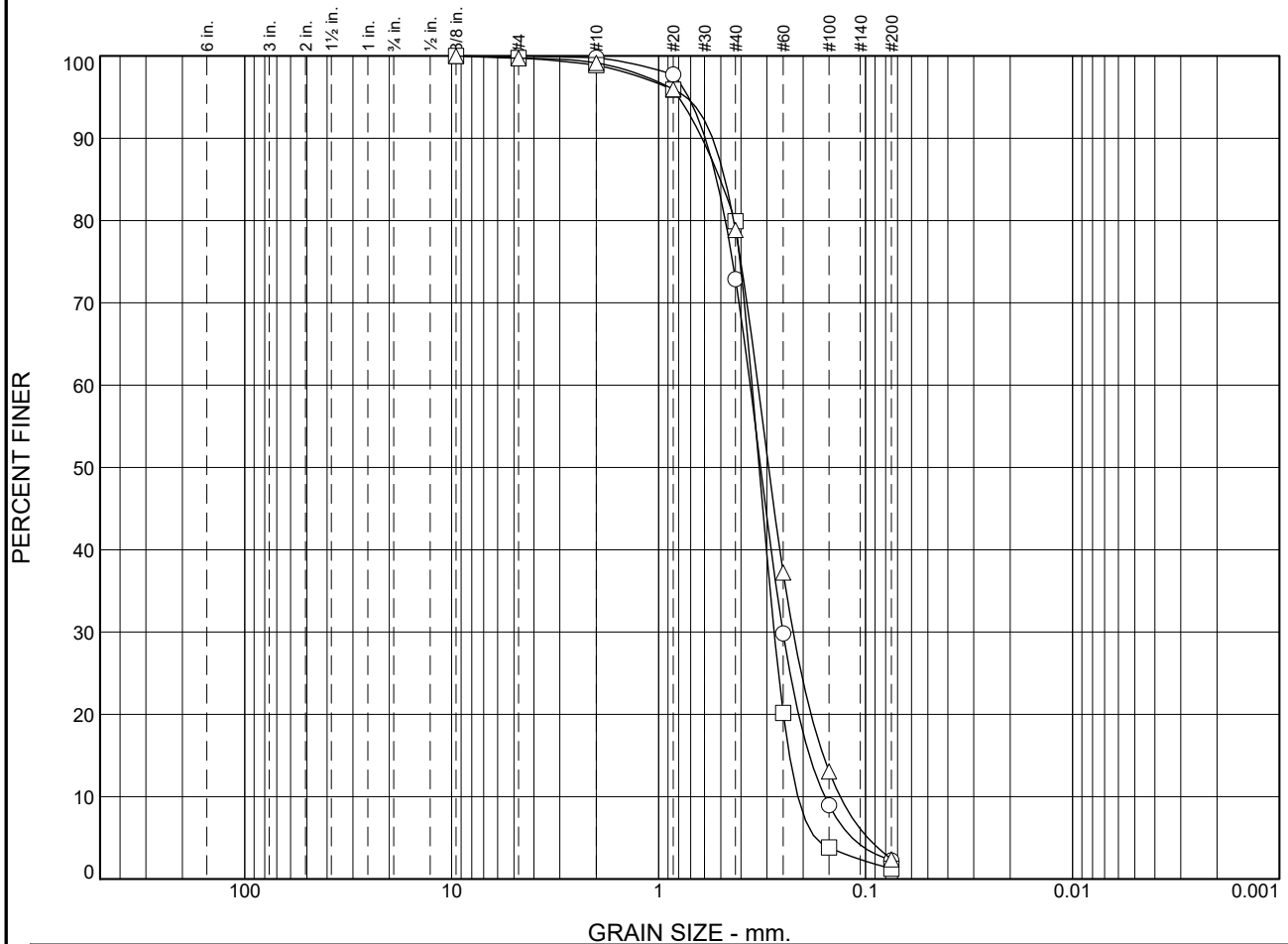
	% Cobbles		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
<input type="radio"/>	0.0		0.0	3.4	1.9	29.5	62.9	2.3		
<input type="checkbox"/>	0.0		0.0	1.0	1.0	26.8	68.4	2.8		
<input checked="" type="checkbox"/>	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
<input type="radio"/>			0.6490	0.3955	0.3484	0.2700	0.2014	0.1663	1.11	2.38
<input type="checkbox"/>			0.5328	0.3743	0.3379	0.2735	0.2149	0.1809	1.11	2.07

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
<input type="radio"/> Poorly graded sand							05/01/18	SP	25.6
<input type="checkbox"/> Poorly graded sand							05/01/18	SP	24.0

<b>Project No.</b> <b>Project:</b> New 116th Pecinct II, Queens, NY CAPIS ID: PO002-116 <input type="radio"/> <b>Source of Sample:</b> SB-2 <b>Depth:</b> 15-17' <b>Sample Number:</b> S-5 <input type="checkbox"/> <b>Source of Sample:</b> SB-2 <b>Depth:</b> 20-22' <b>Sample Number:</b> S-6	<b>Client:</b> CDM Smith - NYC DDC Proejct  <b>Remarks:</b>
<b>ATLANTIC TESTING LABORATORIES, LIMITED</b>  Canton, New York	

Figure

# Particle Size Distribution Report No. CT3828SL-36-04-18



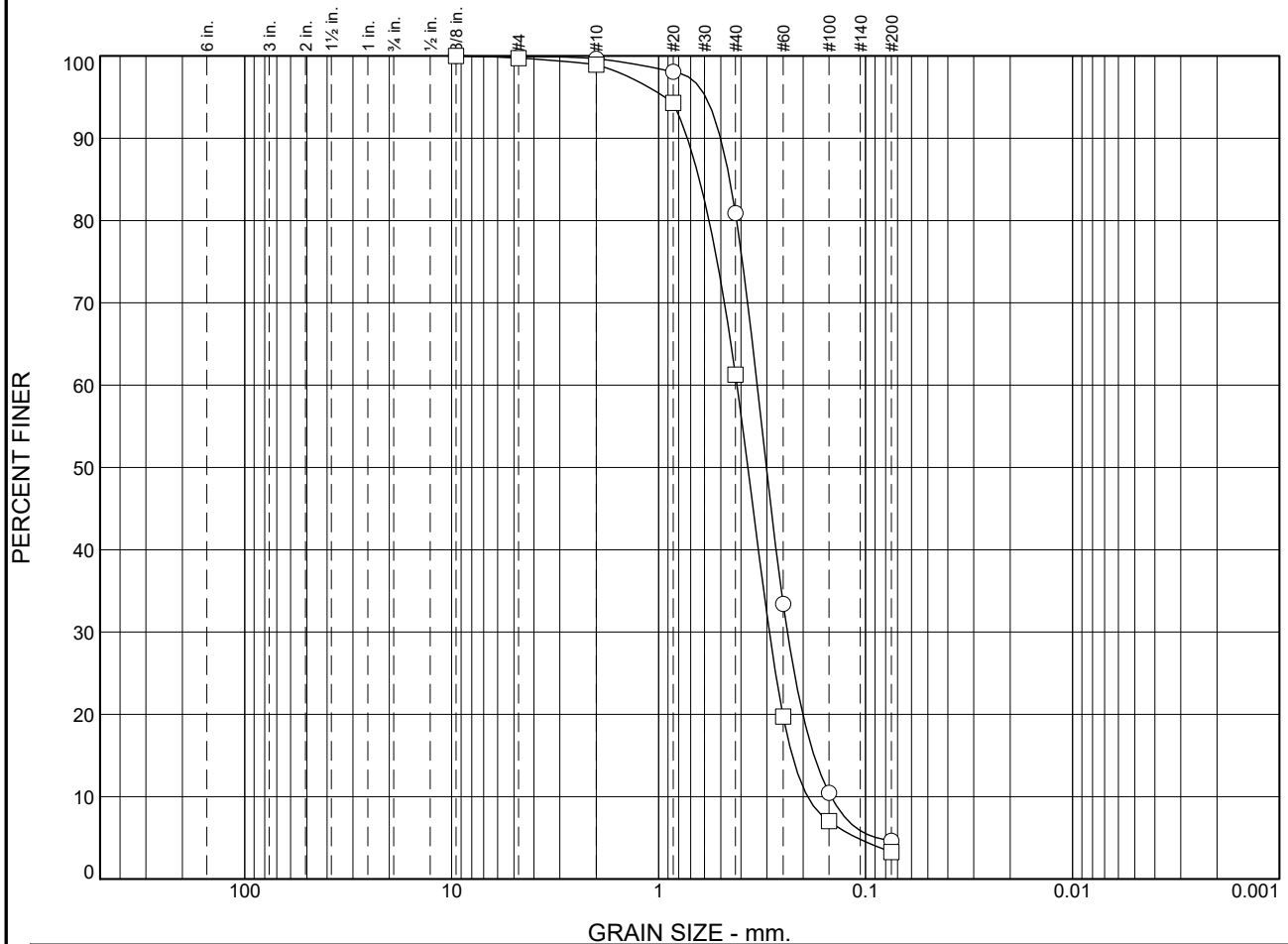
	% Cobbles		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.0	0.2	26.9	70.6	2.3		
□	0.0		0.0	0.2	0.9	19.0	78.7	1.2		
△	0.0		0.0	0.3	0.6	20.2	76.5	2.4		
×	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.5247	0.3608	0.3214	0.2506	0.1867	0.1573	1.11	2.29
□			0.5046	0.3536	0.3264	0.2764	0.2332	0.2123	1.02	1.67
△			0.4776	0.3308	0.2939	0.2239	0.1600	0.1326	1.14	2.49

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							05/01/18	SP	6.9
□ Poorly graded sand							05/01/18	SP	5.5
△ Poorly graded sand							05/01/18	SP	18.9

<b>Project No.</b> <b>Project:</b> New 116th Pecinct II, Queens, NY CAPIS ID: PO002-116 ○ <b>Source of Sample:</b> SB-3 <b>Depth:</b> 5-7' <b>Sample Number:</b> S-1 □ <b>Source of Sample:</b> SB-3 <b>Depth:</b> 7-9' <b>Sample Number:</b> S-2 △ <b>Source of Sample:</b> SB-3 <b>Depth:</b> 11-13' <b>Sample Number:</b> S-4	<b>Client:</b> CDM Smith - NYC DDC Proejct  <b>Remarks:</b>
<b>ATLANTIC TESTING LABORATORIES, LIMITED</b>  Canton, New York	

Figure

# Particle Size Distribution Report No. CT3828SL-36-04-18



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.3	18.7	76.3	4.6	
□	0.0	0.0	0.3	0.8	37.6	58.0	3.3	

	LL	PL	D <sub>85</sub>	D <sub>60</sub>	D <sub>50</sub>	D <sub>30</sub>	D <sub>15</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>
○			0.4533	0.3338	0.3012	0.2387	0.1774	0.1467	1.16	2.27
□			0.6353	0.4181	0.3704	0.2913	0.2263	0.1906	1.07	2.19

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ Poorly graded sand							05/01/18	SP	24.3
□ Poorly graded sand							05/01/18	SP	24.0

<b>Project No.</b> <b>Project:</b> New 116th Pecinct II, Queens, NY CAPIS ID: PO002-116 ○ <b>Source of Sample:</b> SB-3 <b>Depth:</b> 15-17' <b>Sample Number:</b> S-5 □ <b>Source of Sample:</b> SB-3 <b>Depth:</b> 20-22' <b>Sample Number:</b> S-6	<b>Remarks:</b>
<b>ATLANTIC TESTING LABORATORIES, LIMITED</b>  <b>Canton, New York</b>	

Figure

Tested By: M. Stiles

Checked By: J. Ames

## **APPENDIX B**

### **CONSTRUCTION HEALTH AND SAFETY PLAN**

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# CONSTRUCTION HEALTH AND SAFETY PLAN

**FOR**

**NYPD 116<sup>th</sup> Precinct  
Block 13265, Lot 30  
244-04 North Conduit Avenue  
Queens, NY 11422  
CEQR No. 18NYP002Q**

***Prepared For***

**Dattner Architects  
1385 Broadway, 15<sup>th</sup> Floor  
New York, New York**

***Prepared By:***

**Langan Engineering, Environmental, Surveying  
Landscape Architecture, and Geology, D.P.C.  
21 Penn Plaza  
360 West 31<sup>st</sup> Street, 8<sup>th</sup> Floor  
New York, New York 10001**

***LANGAN***

**May 2019  
*Revised June 10, 2019*  
Langan Project No. 170495201**

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\* Items to be posted prominently on site, or made readily available to personnel.

## **1.0 INTRODUCTION**

### **1.1 General**

This CONSTRUCTION HEALTH AND SAFETY PLAN (CHASP) was developed to address disturbance of known and reasonably anticipated subsurface contaminants and comply with Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.120(b)(4), *Hazardous Waste Operations and Emergency Response* during anticipated site work at 244-04 North Conduit Avenue, Queens, New York (Tax Map Block 13265, Lot 30) ("the Site"). This CHASP provides the minimum requirements for implementing site operations during future possible remedial measure activities. All contractors performing work on this site shall implement their own CHASP that, at a minimum, adheres to this CHASP. The contractor is responsible for their own health and safety and that of their subcontractors. Langan personnel will implement this CHASP while onsite.

The management of the day-to-day site activities and implementation of this CHASP in the field is the responsibility of the site Langan Field Team Leader (FTL). Assistance in the implementation of this CHASP can also be obtained from the site Langan Health and Safety Officer (HSO) and the Langan Health and Safety Manager (HSM). Contractors operating on the site shall designate their own FTL, HSO and HSM. The content of this CHASP may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the work plan.

### **1.2 Site Location and Background**

The Site is located at 244-04 North Conduit Avenue (Borough of Queens, Block 13265, Lot 30) in the Rosedale neighborhood of Queens. The eastern portion of the Site is used as a parking lot for the 105<sup>th</sup> Precinct Satellite Office, which is located on the western half of the Site. The surface of the Site, outside of the existing building footprint, is covered with asphalt, concrete and landscaped areas. The perimeter of the Site is surrounded by vegetation, landscaped areas, and paved sidewalks. The total extent of the Site encompasses about 127,000 square feet; the parking lot located on the eastern half of the Site encompasses about 60,000 square feet, the 105<sup>th</sup> Precinct Satellite Office located on the western half of the Site encompasses about 19,000 square feet, and the remainder of the western portion of the Site encompasses about 48,000 square feet. A site location map is included as Figure 1.

### **1.3 Summary of Work Tasks**

#### **1.3.1 Excavation and Soil Screening**

As part of future excavation activities, Langan personnel will screen excavated material for visual, olfactory, and instrumental indicators suggestive of a potential chemical or petroleum release. Instrument screening for the presence of volatile organic compounds (VOCs) may be performed with a calibrated photoionization detector (PID). Contractors will excavate for utilities, foundation components and potential grading using heavy equipment and hand tools. Contractors will notify Langan personnel if they identify indications suggestive of a potential chemical or petroleum release. Contaminated material shall be handled and properly disposed in accordance with federal, state and city regulations, criteria and guidelines.

#### **1.3.2 Soil Screening**

As part of future excavation activities, Langan personnel will report when they have observed visual and olfactory indications of possible soil impact. When necessary, Langan personnel will also report concentrations of VOCs above background using a properly calibrated hand held photoionization detector (PID, or equivalent).

#### **1.3.3 Stockpiling**

As part of future excavation activities, potentially impacted soil may be stockpiled pending laboratory analysis and determining proper off-site disposal. Visibly contaminated soil, if encountered, shall be segregated and stockpiled on at least 8 millimeters of plastic sheeting; reusable soil and fill shall be segregated and stockpiled separately from unusable fill, concrete and other debris; the stockpiles shall be kept covered with 6 millimeters thick plastic sheeting; the plastic sheeting covering the stockpiles shall be anchored firmly in place by weights, stakes, or both; the Contractor shall maintain the plastic sheeting.

#### **1.3.4 Soil Sampling**

Soil samples (waste characterization, excavation endpoint, delineation, or quality assurance/quality control [QA/QC]) may be collected during construction, as required. Langan personnel will coordinate with the contractor in sampling soil (in accordance with the Remedial Action Plan [RAP], where applicable). If stockpile soil sampling is required from above ground level, suitable excavation equipment (i.e., excavator, front-end loader) should be used to collect the sample. Soil samples for excavation endpoint or delineation sampling (along with QA/QC samples) may be collected into laboratory-supplied batch-certified clean glassware and submitted to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval

Program (ELAP).

### **1.3.5 Characterization of Excavated Material**

When required by the work plan, Langan personnel will characterize excavated soil or clean backfill in accordance with Langan standards.

### **1.3.6 Excavation Backfill**

Areas of the site that were excavated may be backfilled to development grade (i.e., the grade required to complete construction of the foundation and sidewalk extension) in accordance with the New York City Department of Environmental Protection (DECP)-approved RAP. Imported material will consist of clean fill that meets the 6 New York Codes, Rules and Regulations (NYCRR) Part 375-6.8(a) Restricted Commercial Soil Cleanup Objectives (SCOs) or other acceptable fill material such as virgin stone from a permitted mine or quarry or recycled concrete aggregate (RCA), from a New York State Department of Environmental Conservation (NYSDEC)-registered facility in compliance with 6 NYCRR Part 360 registration and permitting requirements for the period of RCA acquisition. Imported RCA must be derived from recognizable and uncontaminated concrete. RCA is not acceptable for, and will not be used as, site cover or drainage material.

### **1.3.7 Decommissioning and Removal of On-Site Underground Storage Tanks**

If an underground storage tank (UST) is encountered, a UST decommissioning and removal contractor shall furnish all labor and materials, equipment and incidentals required for the proper decontamination, removal and closure of any UST in accordance with federal, state and local regulations. Langan personnel will monitor VOCs with a calibrated PID downwind from the UST excavation and record the PID readings.

### **1.3.8 Construction Dewatering**

If dewatering is necessary, the dewatering contractor shall be responsible for handling contaminated dewatering fluids in accordance with federal, state and local regulations. Dewatering fluids are to be discharged to the local sanitary sewer system after treatment and under approved regulatory permit. Alternatively, the contractor may provide containerized storage to allow for testing of groundwater prior to, and after, treatment and before disposal. If required, Langan field personnel may sample dewatering treatment system liquids from either a discharge standpipe or a storage tank. Dewatering samples will be submitted to an ELAP-certified laboratory for analysis.

### **1.3.9 Construction Activity Inspections and Observations**

Langan may observe construction activities including the installation of piles, caissons and rock anchors. In addition, Langan may observe and record data from a lateral load test. These activities are to be done in accordance with the work plan. The installation and assembly activities performed by the contractor in accordance with the construction documents, remedial plan, and special inspection requirements administered by the New York City Department of Buildings. Materials used for construction will be inspected by Langan for conformance to the design documents.

#### **1.3.10 Drum Sampling**

Excess or impacted soil and water that is drummed during activities must be labeled in accordance with the Langan Drum Labeling Standard Operating Procedure (SOP-#9). Langan personnel may collect drum samples, if required, prior to off-site drum disposal. If collected, samples will be placed into laboratory-supplied batch-certified clean glassware and submitted to a NYSDOH ELAP-certified laboratory.

## **2.0 IDENTIFICATION OF KEY PERSONNEL/HEALTH AND SAFETY PERSONNEL**

The following briefly describes the health and safety (H&S) designations and general responsibilities that may be employed for this site. The titles have been established to accommodate the project needs and requirements and ensure the safe conduct of site activities. The H&S personnel requirements for a given work location are based upon the proposed site activities.

### **2.1 Langan Project Manager**

The Langan Environmental Project Managers (PM) is Emily Snead. The Geotechnical Project Manager is Jared Green. Their responsibilities include:

- Ensuring that this CHASP is developed, current, and approved prior to on-site activities.
- Ensuring that all the tasks in the project are performed in a manner consistent with Langan's comprehensive *Health and Safety Program for Hazardous Waste Operations* and this CHASP.

### **2.2 Langan Corporate Health and Safety Manager**

The Langan Corporate Health and Safety Manager (HSM) is Tony Moffa. His responsibilities include:

- Updating the *Construction Health and Safety Program for Hazardous Waste Operations*.
- Assisting the site Health and Safety Officer (HSO) with development of the CHASP, updating CHASP as dictated by changing conditions, jobsite inspection results, etc. and approving changes to this CHASP.
- Assisting the HSO in the implementation of this CHASP and conducting Jobsite Safety Inspections and assisting with communication of results and correction of shortcomings found.
- Maintaining records on personnel (medical evaluation results, training and certifications, accident investigation results, etc.).

### **2.3 Langan Site Health & Safety Officer**

The Langan site HSO is William Bohrer. His responsibilities include:

- Participating in the development and implementation of this CHASP.
- When on-site, assisting the Langan Field Team Leader in conducting Tailgate Safety Meetings and Jobsite Safety Inspections and correcting any shortcomings in a timely manner.
- Ensuring that proper PPE is available, worn by employees, and properly stored and maintained.
- Controlling entry into and exit from the site contaminated areas or zones.
- Monitoring employees for signs of stress, such as heat stress, fatigue, and cold exposure.
- Monitoring site hazards and conditions.
- Knowing (and ensuring that all site personnel also know) emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department.
- Resolving conflicts that may arise concerning safety requirements and working conditions.
- Reporting all incidents, injuries and near misses to the Langan Incident/Injury Hotline immediately and the client representative.

### **2.4 Langan Field Team Leader Responsibilities**

The Langan Field Team Leader (FTL) is to be determined prior to the start of the start of field activities. The Field Team Leader's responsibilities include:

- The management of the day-to-day site activities and implementation of this CHASP in the field.
- Participating in and/or conducting Tailgate Safety Meetings and Jobsite Safety Inspections and correcting any shortcomings in a timely manner.



- When a Community Air Monitoring Operating Program (CAMP) is part of the scope, the FTL will set up and maintaining community air monitoring activities and instructing the responsible contractor to implement organic vapor or dust mitigation when necessary.
- Overseeing the implementation of activities specified in the work plan.

## **2.5 Contractor Responsibilities**

The contractor shall develop and implement their own CHASP for their employees, lower-tier subcontractors, and consultants. The contractor is responsible for their own health and safety and that of their subcontractors. Contractors operating on the site shall designate their own FTL, HSO and HSM. The contractor's CHASP will be at least as stringent as this Langan CHASP. The contractor must be familiar with and abide by the requirements outlined in their own CHASP. A contractor may elect to adopt Langan's CHASP as its own provided that it has given written notification to Langan, but where Langan's CHASP excludes provisions pertinent to the contractor's work (i.e., confined space entry); the contractor must provide written addendums to this CHASP. Additionally, the contractor must:

- Ensure their employees are trained in the use of all appropriate PPE for the tasks involved;
- Notify Langan of any hazardous material brought onto the job site or site related area, the hazards associated with the material, and must provide a material safety data sheet (MSDS) or safety data sheet (SDS) for the material;
- Have knowledge of, understand, and abide by all current federal, state, and local health and safety regulations pertinent to the work;
- Ensure their employees handling hazardous materials, if identified at the Site, have received current training in the appropriate levels of 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response* (HAZWOPER) if hazardous waste is identified at the Site;
- Ensure their employees handling hazardous materials, if identified at the Site, have been fit-tested within the year on the type respirator they will wear; and
- Ensure all air monitoring is in place pertaining to the health and safety of their employees as required by OSHA 1910.120; and
- All contractors must adhere to all federal, state, and local regulatory requirements.

## **3.0 TASK/OPERATION SAFETY AND HEALTH RISK ANALYSES**

A Task-Hazard Analysis (Table 1) was completed for general construction hazards that may be encountered at the Site. The potential contaminants that might be encountered during the field activities and the exposure limits are listed in Table 2 and a complete inventory of MSDS/SDS for potential contaminants/chemical products used on site is included as Attachment E.

### **3.1 Specific Task Safety Analysis**

#### **3.1.1 Soil Screening and Sampling**

Sampling the soil requires the donning of chemical resistant gloves in addition to the standard PPE. Langan personnel are not to operate drilling or excavation equipment nor open sampling devices (acetate liners, sonic sample bags, etc.). These tasks are to be completed by the driller or excavation contractor.

#### **3.1.2 Stockpile Sampling**

The Langan personnel are not to scale or otherwise climb stockpiles. If the soil sampling plan requires sampling from the stockpile above ground level, samples are to be obtained using suitable excavation equipment operated by the contractor (i.e. front end loader).

#### **3.1.3 Removal of Underground Storage Tank**

If UST excavation and removal activity is initiated, Langan personnel will conduct air monitoring for lower explosion limit (LEL) conditions within the UST excavation itself. This task is to be performed using calibrated air monitoring equipment designed to sound an audio alarm when atmospheric concentrations of VOC are within 10% of the LEL. In normal atmospheric oxygen concentrations, the LEL monitoring may be done with a Wheatstone bridge/catalytic bead type sensor (i.e. MultiRAE). However in oxygen depleted atmospheres (confined space), only an LEL designed to work in low oxygen environments may be used. Best practices require that the LEL monitoring unit be equipped with a long sniffer tube to allow the LEL unit to remain outside the UST excavation. Langan personnel are not to enter the UST excavation nor enter an excavated UST.

In addition to monitoring LEL, Langan personnel will monitor atmospheric VOC concentrations directly downwind of the UST excavation in accordance with standard CAMP procedures using calibrated air monitoring equipment.

#### **3.1.4 Construction Dewatering**

If construction dewatering is initiated, Langan may sample dewatering treatment system liquids from either the direct discharge standpipe or from a sample port or valve built into the storage tank, Langan will don the necessary PPE including nitrile gloves and if necessary, facial splash guard. Sample ports and valves may only be sampled if they are accessible at ground level. Sampling from heights over 6 feet is prohibited unless Langan field personnel are fully accredited in fall protection and is wearing approved fall protection safety apparatus. The discharge samples

will be submitted to an ELAP-certified laboratory for analysis in accordance with the work plan.

### **3.3.5 Backfilling of Excavated Areas to Development Grade**

The backfilling contractor will provide their employees with equivalent PPE to protect them from the specific hazards likely to be encountered on-site. Selection of the appropriate PPE must take into consideration: (1) identification of the hazards or suspected hazards; (2) potential exposure routes; and, (3) the performance of the PPE construction (materials and seams) in providing a barrier to these hazards. Langan personnel may survey backfilling material with a calibrated PID; however, as they are not permitted to climb the material delivery truck, the contractor must provide samples from each truck as required.

### **3.1.6 Construction Activity Inspection**

The contractor will operate equipment used to install sheet piles, caissons and/or rock anchors, as necessary. In addition, the contractor will assemble and install the equipment to perform lateral load-test. Langan personnel will inspect in accordance with specification in the work plan and record the data the work plan requires. The installation of the sheet piles, caissons and/or rock anchors is to be done exclusively by the contractor following their own health and safety specifications outlined in their HASPs. Other activities assigned to Langan as part of construction activities are limited to inspection and observations as specified in the work plan. Langan personnel are not to operate or assist in the operation of equipment used in construction activities unless defined as part of an inspection or observation in the work plan.

### **3.1.7 Drum Sampling**

Drilling fluid, rinse water, grossly-contaminated soils samples and cuttings may be containerized in 55-gallon drums for transport and disposal off site. Each drum must be labeled in accordance with the Langan Drum Labeling Standard Operating Procedure (SOP-#9). Langan may collect drum samples, as required, prior to off-site drum disposal. Samples will be placed into laboratory-supplied batch-certified clean glassware and submitted to a NYSDOH ELAP-certified laboratory.

Langan employees and contractors are not to move or open any orphaned (unlabeled) drum found on the site without approval of the project manager.

## **3.2 Radiation Hazards**

No radiation hazards are known or expected at the site.

### 3.3 Physical Hazards

Physical hazards, which may be encountered during site operations for this project, are detailed in Table 1.

#### 3.3.1 Explosion

No explosion hazards are expected for the scope of work at this site.

#### 3.3.2 Heat Stress

The use of Level C protective equipment, or greater, may create heat stress. Monitoring of personnel wearing personal protective clothing should commence when the ambient temperature is 72°F or above. Table 6 presents the suggested frequency for such monitoring. Monitoring frequency should increase as ambient temperature increases or as slow recovery rates are observed. Refer to the Table 7 to assist in assessing when the risk for heat related illness is likely. To use this table, the ambient temperature and relative humidity must be obtained (a regional weather report should suffice). Heat stress monitoring should be performed by the HSO or the FTL, who shall be able to recognize symptoms related to heat stress.

To monitor the workers, be familiar with the following heat-related disorders and their symptoms:

- **Heat Cramps:** Painful spasm of arm, leg or abdominal muscles, during or after work
- **Heat Exhaustion:** Headache, nausea, dizziness; cool, clammy, moist skin; heavy sweating; weak, fast pulse; shallow respiration, normal temperature
- **Heat Stroke:** Headache, nausea, weakness, hot dry skin, fever, rapid strong pulse, rapid deep respirations, loss of consciousness, convulsions, coma. *This is a life threatening condition.*

Do not permit a worker to wear a semi-permeable or impermeable garment when they are showing signs or symptoms of heat-related illness.

To monitor the worker, measure:

- **Heart rate:** Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 100 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 100 beats per minute at the next rest period, shorten the following work cycle by one-third. A worker cannot return to work after a rest period until their heart rate is below 100 beats per minute.
- **Oral temperature:** Use a clinical thermometer (3 minutes under the tongue) or similar

device to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period. A worker cannot return to work after a rest period until their oral temperature is below 99.6°F. If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following cycle by one-third. Do not permit a worker to wear a semi-permeable or impermeable garment when oral temperature exceeds 100.6°F (38.1°C).

Prevention of Heat Stress - Proper training and preventative measures will aid in averting loss of worker productivity and serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illness. To avoid heat stress the following steps should be taken:

- Adjust work schedules.
- Mandate work slowdowns as needed.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., eight fluid ounces (0.23 liters) of water must be ingested for approximately every eight ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:
  - Maintain water temperature 50° to 60°F (10° to 16.6°C).
  - Provide small disposal cups that hold about four ounces (0.1 liter).
  - Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.
  - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
  - Train workers to recognize the symptoms of heat related illness.

### **3.3.3 Cold-Related Illness**

If work on this project begins in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Systemic cold exposure is referred to as hypothermia. Local cold exposure is generally called frostbite.

- **Hypothermia** - Hypothermia is defined as a decrease in the patient core temperature below 96°F. The body temperature is normally maintained by a combination of central (brain and spinal cord) and peripheral (skin and muscle) activity. Interference with any of these mechanisms can result in hypothermia, even in the absence of what normally is considered a "cold" ambient temperature. Symptoms of hypothermia include: shivering, apathy, listlessness, sleepiness, and unconsciousness.
- **Frostbite** - Frostbite is both a general and medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 20°F. Symptoms of frostbite are: a sudden blanching or whitening of the skin; the skin has a waxy or white appearance and is firm to the touch; tissues are cold, pale, and solid.

Prevention of Cold-Related Illness - To prevent cold-related illness:

- Educate workers to recognize the symptoms of frostbite and hypothermia
- Identify and limit known risk factors:
- Assure the availability of enclosed, heated environment on or adjacent to the site.
- Assure the availability of dry changes of clothing.
- Assure the availability of warm drinks.
- Start (oral) temperature recording at the job site:
- At the FSO or Field Team Leader's discretion when suspicion is based on changes in a worker's performance or mental status.
- At a worker's request.
- As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind-chill less than 20°F, or wind-chill less than 30°F with precipitation).
- As a screening measure whenever anyone worker on the site develops hypothermia.

Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours.

### **3.3.4 Noise**

Work activities during the proposed activities may be conducted at locations with high noise levels from the operation of equipment. Hearing protection will be used as necessary.

### **3.3.5 Hand and Power Tools**

The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. All hand and power tools should be inspected for health and safety hazards prior to use. If deemed

unserviceable/un-operable, notify supervisor and tag equipment out of service. Ground Fault Circuit Interrupters (GFCIs) are required for all power tools requiring direct electrical service.

### **3.3.6 Slips, Trips and Fall Hazards**

Care should be exercised when walking at the site, especially when carrying equipment. The presence of surface debris, uneven surfaces, pits, facility equipment, and soil piles contribute to tripping hazards and fall hazards. To the extent possible, all hazards should be identified and marked on the site, with hazards communicated to all workers in the area.

### **3.3.7 Utilities (Electrocution and Fire Hazards)**

The possibility of encountering underground utilities poses fire, explosion, and electrocution hazards. All excavation work will be preceded by review of available utility drawings and by notification of the subsurface work to the N.Y. One-Call-Center. Potential adverse effects of electrical hazards include burns and electrocution, which could result in death.

## **3.4 Biological Hazards**

### **3.4.1 Animals**

No animals are expected to be encountered during site operations.

### **3.4.2 Insects**

Insects are not expected to be encountered during site operations.

## **3.5 Additional Safety Analysis**

### **3.5.1 Presence of Non-Aqueous Phase Liquids (NAPL)**

There is potential for exposure to NAPL at this site. Special care and PPE should be considered when NAPL is observed as NAPL is a typically flammable fluid and releases VOCs known to be toxic and/or carcinogenic. If NAPL is present in a monitoring well, vapors from the well casing may contaminate the work area breathing zone with concentrations of VOCs potentially exceeding health and safety action levels. In addition, all equipment used to monitor or sample NAPL (or ground water from wells containing NAPL) must be intrinsically safe. Equipment that directly contacts NAPL must also be resistant to organic solvents.

At a minimum, a PID should be used to monitor for VOCs when NAPL is observed. If NAPL is expected to be observed in an excavation or enclosed area, air monitoring must be started using

calibrated air monitoring equipment designed to sound an audio alarm when atmospheric concentrations of VOC are within 10% of the LEL. In normal atmospheric oxygen concentrations, the LEL monitoring may be done with a Wheatstone bridge/catalytic bead type sensor (i.e. MultiRAE). However in oxygen depleted atmospheres (confined space), only an LEL designed to work in low oxygen environments may be used. Best practices require that the LEL monitoring unit be equipped with a long sniffer tube to allow the LEL unit to remain outside the UST excavation.

When NAPL is present, Langan personnel are required to use disposable nitrile gloves at all times to prevent skin contact with contaminated materials. They should also consider having available a respirator and protective clothing (Tyvek® overalls), especially if NAPL is in abundance and there are high concentrations of VOCs.

All contaminated disposables including PPE and sampling equipment must be properly disposed of in labeled 55-gallon drums

### **3.6 Job Safety Analysis**

A Job Safety Analysis (JSA) is a process to identify existing and potential hazards associated with each job or task so these hazards can be eliminated, controlled or minimized. A JSA will be performed at the beginning of each work day, and additionally whenever an employee begins a new task or moves to a new location. All JSAs must be developed and reviewed by all parties involved. A blank JSA form and documentation of completed JSAs are in Attachment G.

## **4.0 PERSONNEL TRAINING**

### **4.1 Basic Training**

Completion of an initial 40-hour HAZWOPER training program as detailed in OSHA's 29 CFR 1910.120(e) is required for all employees working on a site engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances, health hazards, or safety hazards as defined by 29 CFR 1910.120(a). Annual 8-hour refresher training is also required to maintain competencies to ensure a safe work environment. In addition to these training requirements, all employees must complete the OSHA 10 hour Construction Safety and Health training and supervisory personnel must also receive eight additional hours of specialized management training. Training records are maintained by the HSM.

### **4.2 Initial Site-Specific Training**

Training will be provided to specifically address the activities, procedures, monitoring, and



equipment for site operations at the beginning of each field mobilization and the beginning of each discrete phase of work. The training will include the site and facility layout, hazards, and emergency services at the site, and will detail all the provisions contained within this CHASP. For a HAZWOPER operation, training on the site must be for a minimum of 3 days. Specific issues that will be addressed include the hazards described in Section 3.0.

### **4.3 Tailgate Safety Briefings**

Before starting work each day or as needed, the Langan HSO will conduct a brief tailgate safety meeting to assist site personnel in conducting their activities safely. Tailgate meetings will be documented in Attachment H. Briefings will include the following:

- Work plan for the day;
- Review of safety information relevant to planned tasks and environmental conditions;
- New activities/task being conducted;
- Results of Jobsite Safety Inspection Checklist;
- Changes in work practices;
- Safe work practices; and
- Discussion and remedies for noted or observed deficiencies.

## **5.0 MEDICAL SURVEILLANCE**

All personnel who will be performing field work involving potential exposure to toxic and hazardous substances (defined by 29 CFR 1910.120(a)) will be required to have passed an initial baseline medical examination, with follow-up medical exams thereafter, consistent with 29 CFR 1910.120(f). Medical evaluations will be performed by, or under the direction of, a physician board-certified in occupational medicine.

Additionally, personnel who may be required to perform work while wearing a respirator must receive medical clearance as required under CFR 1910.134(e), *Respiratory Protection*. Medical evaluations will be performed by, or under the direction of, a physician board-certified in occupational medicine. Results of medical evaluations are maintained by the HSM.

## **6.0 PERSONAL PROTECTIVE EQUIPMENT**

### **6.1 Levels of Protection**

Langan will provide PPE to Langan employees to protect them from the specific hazards they are likely to encounter on-site. Direct hired contractors will provide their employees with equivalent PPE to protect them from the specific hazards likely to be encountered on-site. Selection of the

appropriate PPE must take into consideration: (1) identification of the hazards or suspected hazards; (2) potential exposure routes; and, (3) the performance of the PPE construction (materials and seams) in providing a barrier to these hazards.

Based on anticipated site conditions and the proposed work activities to be performed at the site, Level D protection will be used. The upgrading/downgrading of the level of protection will be based on continuous air monitoring results as described in Section 6.0 (when applicable). The decision to modify standard PPE will be made by the site HSO or FTL after conferring with the PM. The levels of protection are described below.

**Level D Protection (as needed)**

- Safety glasses with side shields or chemical splash goggles
- Safety boots/shoes
- Coveralls (Tyvek® or equivalent)
- Hard hat
- Long sleeve work shirt and work pants
- Nitrile gloves
- Hearing protection
- Reflective safety vest

**Level D Protection (Modified, as needed)**

- Safety glasses with sideshields or chemical splash goggles
- Safety boots/shoes (toe-protected)
- Disposable chemical-resistant boot covers
- Coveralls (polycoated Tyvek or equivalent to be worn when contact with wet contaminated soil, groundwater, or non-aqueous phase liquids is anticipated)
- Hard hat
- Long sleeve work shirt and work pants
- Nitrile gloves
- Hearing protection (as needed)
- Personal floatation device (for work within 5 feet of the water)
- Reflective traffic vest

**Level C Protection (as needed)**

- Full or Half face, air-purifying respirator, with NIOSH approved HEPA filter
- Inner (latex) and outer (nitrile) chemical-resistant gloves
- Safety glasses with side shields or chemical splash goggles

- Chemical-resistant safety boots/shoes
- Hard hat
- Long sleeve work shirt and work pants
- Coveralls (Tyvek® or equivalent)
- Hearing protection (as needed)
- Reflective safety vest

The action levels used in determining the necessary levels of respiratory protection and upgrading to Level C are summarized in Table 4. The written Respiratory Protection Program is maintained by the HSM and is available if needed. The monitoring procedures and equipment are outlined in Section 6.0 (when applicable).

## **6.2 Respirator Fit-Test**

All Langan employees who may be exposed to hazardous substances at the work site are in possession of a full or half face-piece, air-purifying respirator and have been successfully fit-tested within the past year. Fit-test records are maintained by the HSM.

## **6.3 Respirator Cartridge Change-Out Schedule**

Respiratory protection is required to be worn when certain action levels (table 2) are reached. A respirator cartridge change-out schedule has been developed in order to comply with 29 CFR 1910.134. The respirator cartridge change-out schedule for this project is as follows:

- Cartridges shall be removed and disposed of at the end of each shift, when cartridges become wet or wearer experiences breakthrough, whichever occurs first.
- If the humidity exceeds 85%, then cartridges shall be removed and disposed of after 4 hours of use.

Respirators shall not be stored at the end of the shift with contaminated cartridges left on. Cartridges shall not be worn on the second day, no matter how short the time period was the previous day they were used.

## **7.0 AIR QUALITY MONITORING AND ACTIONS LEVELS**

### **7.1 Monitoring During Site Operations**

Atmospheric air monitoring results may be collected and used to provide data to determine when exclusion zones need to be established and when certain levels of personal protective equipment are required. For all instruments there are Site-specific action level criteria which are used in

making field health and safety determinations. Other data, such as the visible presence of contamination or the steady state nature of air contaminant concentration, are also used in making field health and safety decisions. Therefore, the HSO may establish an exclusion zone or require a person to wear a respirator even though atmospheric air contaminant concentrations are below established CHASP action levels.

During site work involving disturbance of petroleum-impacted or fill material, real time air monitoring may be conducted for volatile organic compounds (VOCs). A photoionization detector (PID) and/or flame ionization detector (FID) will be used to monitor concentrations of VOCs at personnel breathing-zone height. Air monitoring will be the responsibility of the HSO or designee. Air monitoring may be conducted during intrusive activities associated with the completion of excavation, debris removal, and soil grading. All manufacturers' instructions for instrumentation and calibration will be available onsite.

Subcontractors' air monitoring plans must be equal or more stringent as the Langan plan.

An air monitoring calibration log is provided in Attachment D of this CHASP.

#### **7.1.1 Volatile Organic Compounds**

Monitoring with a PID, such as a MiniRAE 2000 (10.6v) or equivalent may occur during intrusive work in the AOCs. Colormetric Indicator Tubes for benzene may be used as backup for the PID, if measurements remain above background monitor every 2 hours. The HSO will monitor the employee breathing zone at least every 30 minutes, or whenever there is any indication that concentrations may have changed (odors, visible gases, etc.) since the last measurement. If VOC levels are observed above 5 ppm for longer than 5 minutes or if the site PPE is upgraded to Level C, the HSO will begin monitoring the site perimeter at a location downwind of the AOC every 30 minutes in addition to the employee breathing zone. Instrument action levels for monitored gases are provided in Table 4.

#### **7.1.2 Metals**

Based upon the site historical fill, there is a potential for the soils to contain PAHs and metals. During invasive procedures which have the potential for creating airborne dust, such as excavation of dry soils, a real time airborne dust monitor such as a Mini-Ram may be used to monitor for air particulates. The HSO will monitor the employee breathing zone at least every 30 minutes, or whenever there is any indication that concentrations may have changed (appearance of visible dust) since the last measurement. If dust levels are observed to be greater than 0.100 mg/m<sup>3</sup> or visible dust is observed for longer than 15 minutes or if the site PPE is upgraded to Level C, the HSO will begin monitoring the site perimeter at a location downwind of the AOC

every 30 minutes in addition to the employee breathing zone. Instrument action levels for dust monitoring are provided in Table 4.

## **7.2 Monitoring Equipment Calibration and Maintenance**

Instrument calibration shall be documented and included in a dedicated safety and health logbook or on separate calibration pages of the field book. All instruments shall be calibrated before and after each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

All instruments shall be operated in accordance with the manufacturers' specifications. Manufacturers' literature, including an operations manual for each piece of monitoring equipment will be maintained on site by the HSO for reference.

## **7.3 Determination of Background Levels**

Background (BKD) levels for VOCs and dust will be established prior to intrusive activities within the AOC at an upwind location. A notation of BKD levels will be referenced in the daily monitoring log. BKD levels are a function of prevailing conditions. BKD levels will be taken in an appropriate upwind location as determined by the HSO.

Table 4 lists the instrument action levels.

## **8.0 COMMUNITY AIR MONITORING PROGRAM**

Community air monitoring may be conducted in compliance with the NYSDOH Generic CAMP outlined below:

Monitoring for dust and odors will be conducted during all ground intrusive activities by the FTL. Continuous monitoring on the perimeter of the work zones for odor, VOCs, and dust may be required for all ground intrusive activities such as soil excavation and handling activities. The work zone is defined as the general area in which machinery is operating in support of remediation activities. A portable PID will be used to monitor the work zone and for periodic monitoring for VOCs during activities such as soil and groundwater sampling and soil excavation. The site perimeter will be monitored for fugitive dust emissions by visual observations as well as instrumentation measurements (if required). When required, particulate or dust will be monitored continuously with real-time field instrumentation that will meet, at a minimum, the performance standards from DER-10 Appendix 1B.

If VOC monitoring is required, the following actions will be taken based on VOC levels measured:

- If total VOC levels exceed 5 ppm above background for the 15-minute average at the perimeter, work activities will be temporarily halted and monitoring continued. If levels readily decrease (per instantaneous readings) below 5 ppm above background, work activities will resume with continued monitoring.
- If total VOC levels at the downwind perimeter of the hot zone persist at levels in excess of 5 ppm above background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps work activities will resume provided that the total organic vapor level 200 feet downwind of the hot zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less – but in no case less than 20 feet, is below 5 ppm above background for the 15-minute average.
- If the total VOC level is above 25 ppm at the perimeter of the hot zone, activities will be shut down.

If dust monitoring with field instrumentation is required, the following actions will be taken based on instrumentation measurements:

- If the downwind particulate level is 100 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression must be employed. Work may continue with dust suppression techniques provided that downwind PM10 levels do not exceed  $150 \mu\text{g}/\text{m}^3$  above the background level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM10 levels are greater than  $150 \mu\text{g}/\text{m}^3$  above the background level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM10 concentration to within  $150 \mu\text{g}/\text{m}^3$  of the upwind level and in preventing visible dust migration.

## **8.1 Vapor Emission Response Plan**

This section applies if VOC monitoring is required. If the ambient air concentration of organic vapors exceeds 5 ppm above background at the perimeter of the hot zone, boring and well installation, and excavation activities will be halted or odor controls will be employed, and monitoring continued. When work shut-down occurs, downwind air monitoring as directed by the HSO or FTL will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission section.

If the organic vapor level decreases below 5 ppm above background, sampling and boring and well installation can resume, provided:

- The organic vapor level 200 feet downwind of the hot zone or half the distance to the nearest residential or commercial structure, whichever is less, is below 1 ppm over background, and
- More frequent intervals of monitoring, as directed by the HSO or FTL, are conducted.

## **8.2 Major Vapor Emission**

This section applies if VOC monitoring is required. If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work site, or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted or odor controls must be implemented.

If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the hot zone, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone).

If either of the following criteria is exceeded in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be implemented.

- Sustained organic vapor levels approaching 5 ppm above background for a period of more than 30 minutes, or
- Organic vapor levels greater than 5 ppm above background for any time period.

## **8.3 Major Vapor Emission Response Plan**

Upon activation, the following activities will be undertaken:

- The local police authorities will immediately be contacted by the HSO or FTL and advised of the situation;
- Frequent air monitoring will be conducted at 30-minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the HSO or FTL; and
- All Emergency contacts will go into effect as appropriate.

## **8.4 Dust Suppression Techniques**

Preventative measures for dust generation may include wetting site fill and soil, construction of an engineered construction entrance with gravel pad, a truck wash area, covering soils with tarps, and limiting vehicle speeds to five miles per hour.

Work practices to minimize odors and vapors include limiting the time that the excavations remain open, minimizing stockpiling of contaminated-source soil, and minimizing the handling of contaminated material. Offending odor and organic vapor controls may include the application of foam suppressants or tarps over the odor or VOC source areas. Foam suppressants may include biodegradable foams applied over the source material for short-term control of the odor and VOCs.

If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: direct load-out of soils to trucks for off-site disposal; use of chemical odorants in spray or misting systems; and, use of staff to monitor odors in surrounding neighborhoods.

Where odor nuisances have developed during remedial work and cannot be corrected, or where the release of nuisance odors cannot otherwise be avoided due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering excavation and handling areas under tented containment structures equipped with appropriate air venting/filtering systems.

## **9.0 WORK ZONES AND DECONTAMINATION**

### **9.1 Site Control**

Work zones are intended to control the potential spread of contamination throughout the site and to assure that only authorized individuals are permitted into potentially hazardous areas.

Any person working in an area where the potential for exposure to site contaminants exists will only be allowed access after providing the HSO with proper training and medical documentation.

**Exclusion Zone (EZ)** - All activities which may involve exposure to site contaminants, hazardous materials and/or conditions should be considered an EZ. Decontamination of field equipment will also be conducted in the Contaminant Reduction Zone (CRZ) which will be located on the perimeter of the EZ. The EZ and the CRZ will be clearly delineated by cones, tapes or other means. The HSO may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ shall be determined by the HSO allowing



adequate space for the activity to be completed, field members and emergency equipment.

## **9.2 Contamination Zone**

### **9.2.1 Personnel Decontamination Station**

Personal hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure.

### **9.2.2 Minimization of Contact with Contaminants**

During completion of all site activities, personnel should attempt to minimize the chance of contact with contaminated materials. This involves a conscientious effort to keep "clean" during site activities. All personnel should minimize kneeling, splash generation, and other physical contact with contamination as PPE is intended to minimize accidental contact. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

Field procedures will be developed to control over spray and runoff and to ensure that unprotected personnel working nearby are not affected.

### **9.2.3 Personnel Decontamination Sequence**

Decontamination may be performed by removing all PPE used in EZ and placing it in drums/trash cans at the CRZ. Baby wipes should be available for wiping hands and face. Drums/trash cans will be labeled by the field crews in accordance with all local, state, and federal requirements. Management plans for contaminated PPE, and tools are provided below.

### **9.2.4 Emergency Decontamination**

If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination and wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment. If the injured person can be moved, he/she will be decontaminated by site personnel as described above before emergency responders handle the victim. If the person cannot be moved because of the extent of the injury (a back or neck injury), provisions shall be made to ensure that emergency response personnel will be able to respond to the victim without being exposed to potentially hazardous atmospheric conditions. If the potential for inhalation hazards exist, such as with open excavation, this area will be covered with polyethylene sheeting to eliminate any potential inhalation hazards. All emergency personnel are to be immediately informed of the injured person's condition, potential

contaminants, and provided with all pertinent data.

### **9.2.5 Hand-Held Equipment Decontamination**

Hand-held equipment includes all monitoring instruments as stated earlier, samples, hand tools, and notebooks. The hand-held equipment is dropped at the first decontamination station to be decontaminated by one of the decontamination team members. These items must be decontaminated or discarded as waste prior to removal from the CRZ.

To aid in decontamination, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident. Sampling equipment, hand tools, etc. will be cleaned with non-phosphorous soap to remove any potentially contaminated soil, and rinsed with deionized water. All decontamination fluids will be containerized and stored on-site pending waste characterization sampling and appropriate off-site disposal.

### **9.2.6 Heavy Equipment Decontamination**

All heavy equipment and vehicles arriving at the work site will be free from contamination from offsite sources. Any vehicles arriving to work that are suspected of being impacted will not be permitted on the work site. Potentially contaminated heavy equipment will not be permitted to leave the EZ unless it has been thoroughly decontaminated and visually inspected by the HSO or his designee.

## **9.3 Support Zone**

The support zone or cold zone will include the remaining areas of the job site. Break areas and support facilities (include equipment storage and maintenance areas) will be located in this zone. No equipment or personnel will be permitted to enter the cold zone from the hot zone without passing through the decontamination station in the warm zone (if necessitated). Eating, smoking, and drinking will be allowed only in this area.

## **9.4 Communications**

The following communications equipment will be utilized as appropriate.

- Telephones - A cellular telephone will be located with the HSO for communication with the HSM and emergency support services/facilities.
- Hand Signals - Hand signals shall be used by field teams, along with the buddy system.

The entire field team shall know them before operations commence and their use covered during site-specific training. Typical hand signals are the following:

Hand Signal	Meaning
Hand gripping throat	Out of air; cannot breathe
Grip partners wrists or place both hands around waist	Leave immediately without debate
Hands on top of head	Need assistance
Thumbs up	OK; I'm alright; I understand
Thumbs down	No; negative
Simulated "stick" break with fists	Take a break; stop work

## 9.5 The Buddy System

When working in teams of two or more, workers will use the "buddy system" for all work activities to ensure that rapid assistance can be provided in the event of an emergency. This requires work groups to be organized such that workers can remain close together and maintain visual contact with one another. Workers using the "buddy system" have the following responsibilities:

- Provide his/her partner with assistance.
- Observe his/her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his/her partner's PPE.
- Notify the HSO or other site personnel if emergency service is needed.

## 10.0 NEAREST MEDICAL ASSISTANCE

The address and telephone number of the nearest hospital:

Franklin Hospital  
900 Franklin Avenue  
Valley Stream, New York  
516-256-6000

Map with directions to the hospital are shown in Figure 2. This information will either be posted prominently at the site or will be available to all personnel all of the time. Further, all field personnel, including the HSO & FTL, will know the directions to the hospital.

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## **11.0 STANDING ORDERS/SAFE WORK PRACTICES**

The standing orders, which consist of a description of safe work practices that must always be followed while on-site by Langan employees and contractors, are shown in Attachment A. The site HSO and FTL each have the responsibility for enforcing these practices. The standing orders will be posted prominently at the site, or are made available to all personnel at all times. Those who do not abide by these safe work practices will be removed from the site.

## **12.0 SITE SECURITY**

No unauthorized personnel shall be permitted access to the work areas.

## **13.0 UNDERGROUND UTILITIES**

As provided in Langan's Underground Utility Clearance Guidelines, the following safe work practices should be followed by Langan personnel and the contractor before and during subsurface work in accordance with federal, state and local regulations:

- Obtain available utility drawings from the property owner/client or operator.
- Provide utility drawings to the project team.
- In the field, mark the proposed area of subsurface disturbance (when possible).
- Ensure that the utility clearance system has been notified.
- Ensure that utilities are marked before beginning subsurface work.
- Discuss subsurface work locations with the owner/client and contractors.
- Obtain approval from the owner/client and operators for proposed subsurface work locations.
- Use safe digging procedures when applicable.
- Stay at least 10 feet from all equipment performing subsurface work.

## **14.0 SITE SAFETY INSPECTION**

The Langan HSO or alternate will check the work area daily, at the beginning and end of each work shift or more frequently to ensure safe work conditions. The HSO or alternate must complete the Jobsite Safety Inspection Checklist, found in Attachment F. Any deficiencies shall be shared with the FTL, HSM and PM and will be discussed at the daily tailgate meeting.

## **15.0 HAND AND POWER TOOLS**

All hand- and electric-power tools and similar equipment shall be maintained in a safe operating condition. All electric-power tools must be inspected before initial use. Damaged tools shall be

removed immediately from service or repaired. Tools shall be used only for the purpose for which they were designed. All users must be properly trained in their safe operation.

## **16.0 EMERGENCY RESPONSE**

### **16.1 General**

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly, and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures that are addressed in the following subsections include communications, local emergency support units, and preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures. In case of emergency, in addition to 911, when a Langan employee is injured, contact the Langan contractor Incident Intervention at 888-449-7787 as soon as possible. When a non-injury incident occurs, contact the Langan Incident Hotline at **(800) 9-LANGAN** (800-952-6426) extension 4699 as soon as possible.

### **16.2 Responsibilities**

#### **16.2.1 Health and Safety Officer (HSO)**

The HSO is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. The HSO is responsible for ensuring the HSM are notified of all incidents, all injuries, near misses, fires, spills, releases or equipment damage. The HSO is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized) so that the HSM can notify OSHA within the required time frame.

#### **16.2.2 Emergency Coordinator**

The HSO or their designated alternate will serve as the Emergency Coordinator. The Emergency Coordinator is responsible for ensuring that all personnel are evacuated safely and that machinery and processes are shut down or stabilized in the event of a stop work order or evacuation. They are also responsible for ensuring the HSM are notified of all incidents, all injuries, near misses, fires, spills, releases or equipment damage. The Emergency Coordinator is required to immediately notify the HSM of any fatalities or catastrophes (three or more workers injured and hospitalized).

The Emergency Coordinator shall locate emergency phone numbers and identify hospital routes

prior to beginning work on the sites. The Emergency Coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator is responsible for implementing the Emergency Response Plan.

### **16.2.3 Site Personnel**

Project site personnel are responsible for knowing the Emergency Response Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency. Project site personnel, including all subcontractors will be trained in the Emergency Response Plan.

## **16.3 Communications**

Once an emergency situation has been stabilized, or as soon as practically possible, the HSO will contact the Langan Incident/Injury Hotline (1-800-952-6426) or (973-560-4699) and Project Manager of identify any emergency situation.

## **16.4 Local Emergency Support Units**

In order to be able to deal with any emergency that might occur during investigative activities at the site, the Emergency Notification Numbers (Table 5) will be posted and provided to all personnel conducting work within the EZ.

Figure 2 shows the hospital route map. Outside emergency number 911 and local ambulance should be relied on for response to medical emergencies and transport to emergency rooms. Always contact first responders when there are serious or life threatening emergencies on the site. Project personnel are instructed not to drive injured personnel to the Hospital. In the event of an injury, provide first aid and keep the injured party calm and protected from the elements and treat for shock when necessary.

## **16.5 Pre-Emergency Planning**

Langan will communicate directly with administrative personnel from the emergency room at the hospital in order to determine whether the hospital has the facilities and personnel needed to treat cases of trauma resulting from any of the contaminants expected to be found on the site. Instructions for finding the hospital will be posted conspicuously in the site office and in each site vehicle.

## **16.6 Emergency Medical Treatment**

The procedures and rules in this CHASP are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the HSO immediately. First-aid equipment will be available on site at the following locations:

- First Aid Kit: Contractor Mobile Office or Vehicles
- Emergency Eye Wash: Contractor Mobile office or Vehicles

During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

## **16.7 Personnel with current first aid and CPR certification will be identified.**

Only in non-emergency situations may an injured person be transported to an urgent care facility. Due to hazards that may be present at the site and the conditions under which operations are conducted, it is possible that an emergency situation may develop. Emergency situations can be characterized as injury or acute chemical exposure to personnel, fire or explosion, environmental release, or hazardous weather conditions.

## **16.8 Emergency Site Evacuation Routes and Procedures**

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs as a result of the site investigation activities, including but not limited to fire, explosion or significant release of toxic gas into the atmosphere, the Langan Project Manager will be verbally notified immediately. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at the nearest intersection to be accounted for and to receive further instructions.

## **16.9 Fire Prevention and Protection**

In the event of a fire or explosion, procedures will include immediately evacuating the site and notification of the Langan Project Manager of the investigation activities. Portable fire extinguishers will be provided at the work zone. The extinguishers located in the various locations should also be identified prior to the start of work. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

### **16.9.1 Fire Prevention**

Fires will be prevented by adhering to the following precautions:

- Good housekeeping and storage of materials.
- Storage of flammable liquids and gases away from oxidizers.
- Shutting off engines to refuel.
- Grounding and bonding metal containers during transfer of flammable liquids.
- Use of UL approved flammable storage cans.
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers and near all hot work activities.

The person responsible for the control of fuel source hazards and the maintenance of fire prevention and/or control equipment is the HSO.

### **16.10 Significant Vapor Release**

Based on the proposed tasks, the potential for a significant vapor release is low. However, if a release occurs, the following steps will be taken:

- Move all personnel to an upwind location. All non-essential personnel shall evacuate.
- Upgrade to Level C Respiratory Protection.
- Downwind perimeter locations shall be monitored for volatile organics..
- If the release poses a potential threat to human health or the environment in the community, the Emergency Coordinator shall notify the Langan Project Manager.
- Local emergency response coordinators will be notified.

### **16.11 Overt Chemical Exposure**

The following are standard procedures to treat chemical exposures. Other, specific procedures detailed on the Material Safety Data Sheet (MSDS) will be followed, when necessary.

**SKIN AND EYE:** Use copious amounts of soap and water from eye-wash kits and portable hand wash stations.

**CONTACT:** Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Skin shall also be rinsed for 15 minutes if contact with caustics, acids or hydrogen peroxide occurs. Affected items of clothing shall also be removed from contact with skin.

Providing wash water and soap will be the responsibility of each individual contractor or subcontractor on-site.



## **16.12 Decontamination during Medical Emergencies**

If emergency life-saving first aid and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or omitted. The HSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on site, a plastic barrier placed between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

## **16.13 Adverse Weather Conditions**

In the event of adverse weather conditions, the HSO will determine if work will continue without potentially risking the safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries.
- Potential for cold stress and cold-related injuries.
- Treacherous weather-related working conditions (hail, rain, snow, ice, high winds).
- Limited visibility (fog).
- Potential for electrical storms.
- Earthquakes.
- Other major incidents.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The HSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

## **16.14 Spill Control and Response**

All small spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining proper waste characterization and the best means of containment and cleanup. For small spills, sorbent

materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. All spill containment materials will be properly disposed. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill.

All contractor vehicles shall have spill kits on them with enough material to contain and absorb the worst-case spill from that vehicle. All vehicles and equipment shall be inspected prior to be admitted on site. Any vehicle or piece of equipment that develops a leak will be taken out of service and removed from the job site.

The following seven steps shall be taken by the Emergency Coordinator:

1. Determine the nature, identity and amounts of major spills.
2. Make sure all unnecessary persons are removed from the spill area.
3. Notify the HSO immediately.
4. Use proper PPE in consultation with the HSO.
5. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosion-proof equipment to contain or clean up the spill (diesel-only vehicles, air-operated pumps, etc.)
6. If possible, try to stop the leak with appropriate material.
7. Remove all surrounding materials that can react or compound with the spill.

In addition to the spill control and response procedures described in this CHASP, Langan personnel will coordinate with the designated project manager relative to spill response and control actions. Notification to the Project Manager must be immediate and, to the extent possible, include the following information:

- Time and location of the spill.
- Type and nature of the material spilled.
- Amount spilled.
- Whether the spill has affected or has a potential to affect a waterway or sewer.
- A brief description of affected areas/equipment.
- Whether the spill has been contained.
- Expected time of cleanup completion. If spill cleanup cannot be handled by Langan's on-site personnel alone, such fact must be conveyed to the Project Manager immediately.

Langan shall not make any notification of spills to outside agencies. The client will notify

regulatory agencies as per their reporting procedures.

### **16.15 Emergency Equipment**

The following minimum emergency equipment shall be kept and maintained on site:

- Industrial first aid kit.
- Fire extinguishers (one per site).

### **16.16 Restoration and Salvage**

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed are:

- Refilling fire extinguishers.
- Refilling medical supplies.
- Recharging eyewashes and/or showers.
- Replenishing spill control supplies.

### **16.17 Documentation**

Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan Incident/Injury Hotline at 1-(800)-9-LANGAN (ext. #4699) and the client representative to report the incident or near miss. For emergencies involving personnel injury and/or exposure, the HSO and affected employee will complete and submit an Employee Exposure/Injury Incident Report (Attachment C) to the Langan Corporate Health and Safety Manager as soon as possible following the incident.

## **17.0 RECORDKEEPING**

The following is a summary of required health and safety logs, reports and recordkeeping.

### **17.1 Field Change Authorization Request**

Any changes to the work to be performed that is not included in the CHASP will require an addendum that is approved by the Langan project manager and Langan HSM to be prepared. Approved changes will be reviewed with all field personnel at a safety briefing.

## **17.2 Medical and Training Records**

Copies or verification of training (40-hour, 8-hour, supervisor, site-specific training, documentation of three-day OJT, and respirator fit-test records) and medical clearance for site work and respirator use will be maintained in the office and available upon request. Records for all subcontractor employees must also be available upon request. All employee medical records will be maintained by the HSM.

## **17.3 Onsite Log**

A log of personnel on site each day will be kept by the HSO or designee.

## **17.4 Daily Safety Meetings ("Tailgate Talks")**

Completed safety briefing forms will be maintained by the HSO.

## **17.5 Exposure Records**

All personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be maintained by the HSO during site work. At the end of the project they will be maintained according to 29 CFR 1910.1020.

## **17.6 Hazard Communication Program/MSDS-SDS**

Material safety data sheets (MSDS) or Safety Data Sheets (SDS) have been obtained for applicable substances and potential contaminants and are included in this CHASP (Attachment E). Langan's written hazard communication program, in compliance with 29 CFR 1910.1200, is maintained by the HSM.

## **17.7 Documentation**

Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan incident/injury hotline at 1-800-952-6426, extension 4699 and the Project Manager to report the incident or near miss. The Project Manager will contact the client or client representative. A written report must be completed and submitted HSM within 24 hours of the incident. For emergencies involving personnel injury and/or exposure, employee will complete and submit the Langan incident/injury report to the Langan corporate health and safety manager as soon as possible following the incident. Accidents will be investigated in-depth to identify all causes and to recommend hazard control measures.

## **18.0    CONFINED SPACE ENTRY**

Confined spaces are not anticipated at the site during planned construction activities. If confined spaces are identified, the contractor must implement their own confined space program that all applicable federal, state and local regulations. Confined spaces **will not** be entered by Langan personnel.

## **19.0    CHASP ACKNOWLEDGEMENT FORM**

All Langan personnel and contractors will sign this CHASP Compliance Agreement indicating that they have become familiar with this CHASP and that they understand it and agree to abide by it.

[illegible]

[illegible]

[illegible]



[illegible]

[illegible]

[illegible]

## TABLES

**TABLE 1**  
**TASK HAZARD ANALYSES**

<b>Task</b>	<b>Hazard</b>	<b>Description</b>	<b>Control Measures</b>	<b>First Aid</b>
1.3.1 – 1.3.10	Contaminated Soil or Groundwater- Dermal Contact	Contaminated water spills on skin, splashes in eyes; contact with contaminated soil/fill during construction activities or sampling.	Wear proper PPE; follow safe practices, maintain safe distance from construction activities	See Table 2, seek medical attention as required
1.3.1 – 1.3.10	Lacerations, abrasions, punctures	Cutting bailer twine, pump tubing, acetate liners, etc. with knife; cuts from sharp site objects or previously cut piles, tanks, etc.; Using tools in tight spaces	Wear proper PPE; follow safe practices	Clean wound, apply pressure and/or bandages; seek medical attention as required.
1.3.1 – 1.3.10	Contaminated Media Inhalation	Opening drums, tanks, wells; vapors for non-aqueous phase liquids or other contaminated site media; dust inhalation during excavation; vapor accumulation in excavation	Follow air monitoring plan; have quick access to respirator, do not move or open unlabeled drums found at the site, maintain safe distance from construction activities	See Table 2, seek medical attention as required
1.3.1 – 1.3.10	Lifting	Improper lifting/carrying of equipment and materials causing strains	Follow safe lifting techniques; Langan employees are not to carry contractor equipment or materials	Rest, ice, compression, elevation; seek medical attention as required
1.3.1 – 1.3.10	Slips, trips, and falls	Slips, trips and falls due to uneven surfaces, cords, steep slopes, debris and equipment in work areas	Good housekeeping at site; constant awareness and focus on the task; avoid climbing on stockpiles; maintain safe distance from construction activities and excavations; avoid elevated areas over six feet unless fully accredited in fall protection and wearing an approved fall protection safety apparatus	Rest, ice, compression, elevation; seek medical attention as required
1.3.1 – 1.3.10	Noise	Excavation equipment, hand tools, drilling equipment.	Wear hearing protection; maintain safe distance from construction activities	Seek medical attention as required
1.3.1 – 1.3.10	Falling objects	Soil material, tools, etc. dropping from drill rigs, front-end loaders, etc.	Hard hats to be worn at all times while in work zones; maintain safe distance from construction activities and excavations	Seek medical attention as required
1.3.1 – 1.3.10	Underground/ overhead utilities	Excavation equipment, drill rig auger makes contact with underground object; boom touches overhead utility	"One Call" before dig; follow safe practices; confirm utility locations with contractor; wear proper PPE; maintain safe distance from construction activities and excavations	Seek medical attention as required
1.3.1 – 1.3.10	Insects (bees, wasps, hornet, mosquitoes, and spider)	Sings, bites	Insect Repellent; wear proper protective clothing (work boots, socks and light colored pants);field personnel who may have insect allergies (e.g., bee sting) should provide this information to the HSO or FSO prior to commencing work, and will have allergy medication on site.	Seek medical attention as required
1.3.1 – 1.3.10	Vehicle traffic / Heavy Equipment Operation	Vehicles unable to see workers on site, operation of heavy equipment in tight spaces, equipment failure, malfunctioning alarms	Wear proper PPE, especially visibility vest; use a buddy system to look for traffic; rope off area of work with cones and caution tape or devices at points of hazard, maintain safe distance from construction activities and equipment	Seek medical attention as required

**TABLE 2**  
**CONTAMINANT HAZARDS OF CONCERN**

<b>Task</b>	<b>Contaminant</b>	<b>CAS Number</b>	<b>Monitoring Device</b>	<b>PEL/ IDLH</b>	<b>Source of Concentration on Site</b>	<b>Route of Exposure</b>	<b>Symptoms</b>	<b>First Aid</b>
1.3.1 – 1.3.10	1,2,4-Trimethylbenzene	95-63-6	PID	None None	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	1,3,5-Trimethylbenzene Mesitylene sym-Trimethylbenzene	108-67-8	PID	None None	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	1,3-Dichlorobenzene m-Dichlorobenzol; m-Phenylene dichloride m-dichlorobenzene	541-73-1	PID	None None	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; in animals: liver, kidney injury; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	2,2,4-Trimethylpentane	540-84-1	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; bronchitis; hypochromic anemia; headache, drowsiness, lassitude (weakness, exhaustion), dizziness, nausea, incoordination; vomiting, confusion; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	2-Butanone Ethyl methyl ketone MEK Methyl acetone Methyl ethyl ketone	78-93-3	PID	200 ppm 3000 ppm	Soil Groundwater Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose; headache; dizziness; vomiting; dermatitis	Eye: Irrigate immediately Skin: Water wash immediately Breathing: Fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Acetone Dimethyl ketone Ketone propane 2-Propanone	67-64-1	PID	1000 ppm 2500 ppm	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Aluminum	7429-90-5	None	0.5 mg/m3 50 mg/m3	Soil	inhalation, skin and/or eye contact	irritation to the eyes, skin, respiratory system	Eye: Irrigate immediately Breathing: Fresh air

<b>Task</b>	<b>Contaminant</b>	<b>CAS Number</b>	<b>Monitoring Device</b>	<b>PEL/ IDLH</b>	<b>Source of Concentration on Site</b>	<b>Route of Exposure</b>	<b>Symptoms</b>	<b>First Aid</b>
1.3.1 – 1.3.10	Antimony	7440-36-0	None	0.5 mg/m <sup>3</sup> 50 mg/m <sup>3</sup>	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation skin, possible dermatitis; resp distress; diarrhea; muscle tremor, convulsions; possible gastrointestinal tract	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Aroclor 1262	37324-23-5	None	0.5 mg/m <sup>3</sup> 5 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, chloracne	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Arsenic	NA	None	0.5 mg/m <sup>3</sup> NA	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation skin, possible dermatitis; resp distress; diarrhea; muscle tremor, convulsions; possible gastrointestinal tract	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Barium	10022-31-8	None	0.5 mg/m <sup>3</sup> 50 mg/m <sup>3</sup>	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, upper respiratory system; skin burns; gastroenteritis; muscle spasm; slow pulse	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately



Task	Contaminant	CAS Number	Monitoring Device	PEL/IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Benzene Benzol Phenyl hydride	71-43-2	PID	3.19 mg/m <sup>3</sup> 1,595 mg/mg <sup>a</sup>	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; lassitude (weakness, exhaustion) [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Benzo(a)anthracene Benzanthracene Benzanthrene 1,2-Benzanthracene Benzo[b]phenanthrene Tetraphene	56-55-3	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	dermatitis, bronchitis, [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Benzo(a)pyrene	50-32-8	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	dermatitis, bronchitis, [potential occupational carcinogen]	Eye: Irrigate immediately, seek medical attention Skin: Soap wash immediately; Breathing: move to fresh air; Swallow: Induce vomiting if conscious, seek medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Benzo(b)fluoranthene	205-99-2	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Benzo(g,h,i)perylene Benzo(ghi)perylene	191-24-2	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	NA	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Benzo(k)fluoranthene	207-08-9	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation (dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Beryllium	7440-41-7	None	0.002 mg/m <sup>3</sup> 4 mg/m <sup>3</sup>	Soil	inhalation, skin and/or eye contact	berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation to the eyes; dermatitis; [potential occupational carcinogen]	Eye: Irrigate immediately Breathing: Fresh air
1.3.1 – 1.3.10	Bis(2-ethylhexyl)phthalate Bis(2-Ethylhexyl) Phthalate Di-sec octyl phthalate DEHP Di(2-ethylhexyl)phthalate Octyl phthalate	117-81-7	None	5 mg/m <sup>3</sup> 5000 mg/m <sup>3</sup>	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen]	Eye: Irrigate immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Cadmium	7440-43-9	None	0.005 mg/m <sup>3</sup> 9 mg/m <sup>3</sup>	Soil	inhalation, ingestion	pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Calcium	7440-70-2	None	NA	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, upper resp tract; ulcer, perforation nasal septum; pneumonitis; dermatitis	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Carbon disulfide	75-15-0	PID	20 ppm 500 ppm	Soil Groundwater Vapor	inhalation, skin or eye contact, ingestion	irritation to the eyes, skin, respiratory system	Eye: Irrigate immediately (liquid) Skin: Water flush immediately (liquid) Breathing: Respiratory support
1.3.1 – 1.3.10	Carbon tetrachloride Carbon chloride Carbon tet Freon® 10 Halon® 104 Tetrachloromethane	56-23-5	PID	10 ppm 200 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Chlordane Chlordan Chlordano 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane	57-74-9	None	0.5 mg/m³ 100 mg/m³	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea; irritability, tremor, convulsions; anuria	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Chloroform Methane trichloride Trichloromethane	67-66-3	None	50 ppm 500 ppm	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Chromium Total Chromium	7440-47-3	None	1.0 mg/m <sup>3</sup> 250 mg/m <sup>3</sup>	Groundwater Soil	inhalation absorption ingestion	irritation to eye, skin, and respiratory	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Chrysene Benzo[a]phenanthrene 1,2-Benzphenanthrene	218-01-9	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Groundwater Soil	inhalation, absorption, ingestion, consumption	irritation to eye, skin, and respiratory, gastrointestinal irritation nausea, vomit, diarrhea [potential occupational carcinogen]	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	cis-1,2-Dichloroethene	156-59-2	PID	200 ppm 1000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, respiratory system; central nervous system depression	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Cis-Chlordane Cis-Chlordane α-Chlordane alpha Chlordane alpha-chlordane cis-Chlordane CIS-CHLORDANE Chlordane cis-Chlordane cis-ALPHA-CHLORDAN Chlordane, cis-ALPHA-CHLORDANE alpha(cis)-chlordane α-chlordane solution	5102-71-9	None	0.5 mg/m <sup>3</sup> 100 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea; irritability, tremor, convulsions; anuria	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Cobalt	7440-48-4	None	0.1mg/m <sup>3</sup> 20 mg/m <sup>3</sup>	Soil	inhalation, ingestion, skin and/or eye contact	Cough, dyspnea (breathing difficulty), wheezing, decreased pulmonary function; weight loss; dermatitis; diffuse nodular fibrosis; resp hypersensitivity, asthma	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Copper	7440-50-8	None	1.0 mg/m <sup>3</sup> 100 mg/m <sup>3</sup>	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose, metallic taste; dermatitis; anemia	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Cyclohexane Benzene hexahydride Hexahydrobenzene Hexamethylene Hexanaphthene	110-82-7	PID	300 ppm 1300 ppm	Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, respiratory system; drowsiness; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	DDE 4,4-DDE 4,4'-DDE 1,1-bis-(4-chlorophenyl)-2,2-dichloroethene Dichlorodiphenyldichloroethene	72-55-9	None	NA NA	Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	Oral ingestion of food is the primary source of exposure for the general population. Acute and chronic ingestion may cause nausea, vomiting, diarrhea, stomach pain, headache, dizziness, disorientation, tingling sensation, kidney damage, liver damage, convulsions, coma, and death. 4,4' DDE may cross the placenta and can be excreted in breast milk	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	DDT 4,4-DDT 4,4'-DDT p,p'-DDT Dichlorodiphenyltrichloroethane 1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane	50-29-3	None	1 mg/m <sup>3</sup> 500 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; paresthesia tongue, lips, face; tremor; anxiety, dizziness, confusion, malaise (vague feeling of discomfort), headache, lassitude (weakness, exhaustion); convulsions; paresis hands; vomiting; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Dichlorodifluoromethane Difluorodichloromethane, Fluorocarbon 12 Freon 12 Freon® 12 Genetron® 12 Halon® 122 Propellant 12 Refrigerant 12 Dichlorodifluoromethane	75-71-8	None	1000 pp, 15,000 ppm	Groundwater Soil Vapor	inhalation, skin and/or eye contact (liquid)	dizziness, tremor, asphyxia, unconsciousness, cardiac arrhythmias, cardiac arrest; liquid: frostbite	Eye: Frostbite Skin: Frostbite Breathing: Respiratory support
1.3.1 – 1.3.10	Dieldrin HEOD 1,2,3,4,10,10-Hexachloro-6,7- epoxy-1,4,4a,5,6,7,8,8a- octahydro-1,4-endo exo-5,8-dimethanonaphthalene	60-57-1	PID	0.25 mg/m <sup>3</sup> 50 mg/m <sup>3</sup>	Groundwater Soil Water	inhalation, skin absorption, ingestion, skin and/or eye contact	headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort), sweating; myoclonic limb jerks; clonic, tonic convulsions; coma; [potential occupational carcinogen]; in animals: liver, kidney damage	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Diesel Fuel automotive diesel fuel oil No. 2 distillate diesoline diesel oil diesel oil light diesel oil No. 1-D summer diesel	68334- 30-5	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; burning sensation in chest; headache, nausea, lassitude (weakness, exhaustion), restlessness, incoordination, confusion, drowsiness; vomiting, diarrhea; dermatitis; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately



Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Di-N-Octylphthalate	117-84-0	None	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, upper respiratory system, stomach	Eye: Irrigate immediately Skin: Wash regularly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Ethanol Absolute alcohol Alcohol cologne spirit drinking alcohol ethane monoxide ethylic alcohol EtOH ethyl alcohol ethyl hydrate ethyl hydroxide ethylol grain alcohol hydroxyethane methylcarbinol	64-17-5	PID	1000 ppm 3300 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Ethyl benzene Ethylbenzene Ethylbenzol Phenylethane	100-40-4	PID	435 mg/m <sup>3</sup> 3,472 mg/m <sup>3</sup>	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately

<b>Task</b>	<b>Contaminant</b>	<b>CAS Number</b>	<b>Monitoring Device</b>	<b>PEL/ IDLH</b>	<b>Source of Concentration on Site</b>	<b>Route of Exposure</b>	<b>Symptoms</b>	<b>First Aid</b>
1.3.1 – 1.3.10	Fluoranthene Benzo(j, k)fluorene	206-44-0	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Fuel Oil No. 2	68476-30-2	PID	NA NA	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; burning sensation in chest; headache, nausea, lassitude (weakness, exhaustion), restlessness, incoordination, confusion, drowsiness; vomiting, diarrhea; dermatitis; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Gasoline	8006-61-9	PID	NA NA	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Helium	7440-59-7	Helium Detector	NA NA	NA	inhalation	dizziness, headache, and nausea	Breathing: Respiratory support

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Heptane n-Heptane	142-82-5	PID	500 ppm 750 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	dizziness, stupor, incoordination; loss of appetite, nausea; dermatitis; chemical pneumonitis (aspiration liquid); unconsciousness	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Indeno(1,2,3-cd)pyrene Indeno(1,2,3-c,d)Pyrene	193-39-5	None	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Groundwater Soil	inhalation, absorption, ingestion, consumption	irritation to eyes, skin, respiratory, and digestion [potential occupational carcinogen]	Eyes: Irrigate immediately Skin: Soap wash promptly. Breath: Respiratory support Swallow: Medical attention immediately, wash mouth with water
1.3.1 – 1.3.10	Iron	7439-89- 6	None	10 mg/m <sup>3</sup> NA	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; abdominal pain, diarrhea, vomiting	Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Isopropyl alcohol Iso-Propyl Alcohol Carbinol IPA Isopropanol 2-Propanol sec-Propyl alcohol Rubbing alcohol Isopropylalcohol	67-63-0	PID	400 ppm 2000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose, throat; drowsiness, dizziness, headache; dry cracking skin; in animals: narcosis	Eye: Irrigate immediately Skin: Water flush Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Lead	7439-92-1	None	0.050 mg/m <sup>3</sup> 100 mg/m <sup>3</sup>	Groundwater Soil	inhalation, ingestion, skin and/or eye contact	lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation to the eyes; hypertension	Eye: Irrigate immediately Skin: Soap flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Magnesium	7439-95-4	None	15 mg/m <sup>3</sup> NA	Soil	inhalation, skin and/or eye contact	irritation to the eyes, skin, respiratory system; cough	Eye: Irrigate immediately Breathing: Fresh air
1.3.1 – 1.3.10	Manganese	7439-96-5	None	5 mg/m <sup>3</sup> 500 mg/m <sup>3</sup>	Groundwater Soil	inhalation, ingestion	aerosol is irritating to the respiratory tract	Eye: Irrigate immediately Skin: Soap flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Mercury	7439-97-6	None	0.1 mg/m <sup>3</sup> 10 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Methyl Chloride Chloromethane Monochloromethane	74-87-3	NA	100 ppm 2000 ppm	Groundwater Soil	inhalation, skin and/or eye contact	dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects; [potential occupational carcinogen]	Eye: Frostbite Skin: Frostbite Breathing: Respiratory support
1.3.1 – 1.3.10	Methyl methacrylate Methacrylate monomer Methyl ester of methacrylic acid Methyl-2-methyl-2-propenoate	80-62-6	PID	100 ppm 1000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation eyes, skin, nose, throat; dermatitis	Eye: Irrigate immediately Skin: Water wash immediately Breathing: Fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Methylene Chloride Dichloromethane Methylene dichloride	75-09-2	PID	25 ppm 2300 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numb, tingle limbs; nausea; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	m-Xylenes 1,3-Dimethylbenzene m-Xylol Metaxylene	108-38-3	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Naphthalene Naphthalin Tar camphor White tar	91-20-3	PID	50 mg/m <sup>3</sup> 250 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; hematuria (blood in the urine); dermatitis, optical neuritis	Eye: Irrigate immediately Skin: Molten flush immediately/solid- liquid soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	n-Butane Normal Butane Methyl ethyl methane Butyl Hydride Diethyl Quartane	106-97-8	PID	NA NA	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; lassitude (weakness, exhaustion) [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	n-Hexane Hexane, Hexyl hydride, normal-Hexane	110-54-3	PID	500 ppm 1100 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, nose; nausea, headache; peripheral neuropathy: numb extremities, muscle weak; dermatitis; dizziness; chemical pneumonitis (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Nickel	7440-02- 0	None	NA 10 mg/m <sup>3</sup>	Groundwater Soil	ion, ingestion, skin and/or eye contact	sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Non-Flammable Gas Mixture CALGAS (Equipment Calibration Gas : Oxygen Methane Hydrogen Sulfide Carbon Monoxide Nitrogen	7782-44- 7 74-82-8 7783-08- 4 830-08-0 7727-37- 9	Multi-Gas PID	NA/NA NA/NA 10/100 ppm 50/1200 ppm NA/NA	NA	inhalation	dizziness, headache, and nausea	Breathing: Respiratory support
1.3.1 – 1.3.10	Non-Flammable Gas Mixture CALGAS (Equipment Calibration Gas : Oxygen Isobutylene Nitrogen	7782-44- 7 115-11-7 7727-37- 9	PID	NA/NA NA/NA NA/NA	NA	inhalation	dizziness, headache, and nausea	Breathing: Respiratory support
1.3.1 – 1.3.10	o-Xylenes 1,2-Dimethylbenzene ortho-Xylene o-Xylol	95-47-6	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	p-Ethyltoluene 4-Ethyltoluene 1-ethyl-4-methyl-benzene 1-methyl-4-ethylbenzene	622-96-8	NA	NA NA	Soil	ingestion, skin and/or eye contact	irritation to the eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Phenanthrene	85-01-8	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Potassium	7440-09-7	None	NA NA	Soil	inhalation, skin absorption, ingestion, skin and/or eye contact inhalation, ingestion, skin and/or eye contact	eye: Causes eye burns. Skin: Causes skin burns. Reacts with moisture in the skin to form potassium hydroxide and hydrogen with much heat. ingestion: Causes gastrointestinal tract burns. inhalation: May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema.	Eyes: Get medical aid immediately Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Ingestion: If victim is conscious and alert, give 2-4 full cups of milk or water. Get medical aid immediately. inhalation: Get medical aid immediately.



Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	p-Xylenes 1,4-Dimethylbenzene para-Xylene p-Xylol	106-42-3	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Pyrene benzo[def]phenanthrene	129-00-0	PID	0.2 mg/m <sup>3</sup> 80 mg/m <sup>3</sup> (Coal Pitch Tar)	Groundwater Soil	inhalation, skin or eye contact, ingestion	irritation to eyes and skin, respiratory irritation(dizziness, weakness, fatigue, nausea, headache)	Eye: Irrigate immediately, refer to medical attention Skin: Soap wash immediately Breathing: move to fresh air Swallow: Medical attention immediately
1.3.1 – 1.3.10	Selenium	7782-49-2	None	1 mg/m <sup>3</sup> 0.2 mg/m <sup>3</sup>	Soil	inhalation, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; eye, skin burns; in animals: anemia; liver necrosis, cirrhosis; kidney, spleen damage	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Silver	7440-22-4	None	0.01mg/ m <sup>3</sup> 10 mg/m <sup>3</sup>	Soil	inhalation, ingestion, skin and/or eye contact	blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Eye: Irrigate immediately Skin: Water flush Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Sodium	7440-23-5	None	NA NA	Groundwater Soil	ion, ingestion, skin and/or eye contact	sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Tetrachloroethylene Perchloroethylene Perchloroethylene PCE Perk Tetrachloroethylene Tetrachloroethene	127-18-4	PID	100 ppm 150 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Tetrahydrofuran Diethylene oxide 1,4-Epoxybutane Tetramethylene oxide THF	109-99-9	PID	200 ppm 2000 ppm	Groundwater Soil Vapor	inhalation, skin and/or eye contact, ingestion	irritation to the eyes, upper respiratory system; nausea, dizziness, headache, central nervous system depression	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immedi

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Thallium	7440-28-0	None	0.1 mg/m <sup>3</sup> 15 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Toluene Methyl benzene Methyl benzol Phenyl methane Toluol	108-88-3	PID	200 ppm 500 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, paresthesia; dermatitis	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Total PCBs Chlorodiphenyl (42% chlorine) Aroclor® 1242 PCB Polychlorinated biphenyl	53469-21-9	None	0.5 mg/m <sup>3</sup> 5 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, chloracne	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Total Xylenes Dimethylbenzene Xylol	1330-20-7	PID	100 ppm 900 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Trans-Chlordane gamma-Chlordane Gamma Chlordane	5103-74-2	None	0.5 mg/m <sup>3</sup> 100 mg/m <sup>3</sup>	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	Blurred vision; confusion; ataxia, delirium; cough; abdominal pain, nausea, vomiting, diarrhea; irritability, tremor, convulsions; anuria	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Trichloroethylene Ethylene trichloride TCE Trichloroethene Trilene	79-01-6	PID	100 ppm 1000 ppm	Groundwater Soil Vapor	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation to the eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Trichlorofluoromethane Fluorotrichloromethane Freon® 11 Monofluorotrichloromethane  Refrigerant 11 Trichloromonofluoromethane	75-69-4	PID	1000 ppm 2000 ppm	Groundwater Soil Vapor	inhalation, ingestion, skin and/or eye contact	incoordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia; liquid: frostbite	Eye: Irrigate immediately Skin: Water flush immediately Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Vanadium	7440-62-2	None	0.1 mg/m3 15 mg/m3	Groundwater Soil	inhalation, skin absorption, ingestion, skin and/or eye contact	nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eye: Irrigate immediately Skin: Water flush promptly Breathing: Respiratory support Swallow: Medical attention immediately
1.3.1 – 1.3.10	Vinyl Chloride Chloroethene Chloroethylen Ethylene monochloride Monochloroethene Monochloroethylene VC Vinyl chloride monomer (VCM)	75-01-4	PID	1 ppm NA	Groundwater Soil Vapor	inhalation, skin and/or eye contact (liquid)	lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]	Eye: Frostbite Skin: Frostbite Breathing: Respiratory support

Task	Contaminant	CAS Number	Monitoring Device	PEL/ IDLH	Source of Concentration on Site	Route of Exposure	Symptoms	First Aid
1.3.1 – 1.3.10	Zinc	7440-62-2	None	15 mg/m <sup>3</sup> 500 mg/m <sup>3</sup>	Groundwater Soil	inhalation	chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function	Breathing: Respiratory support

#### EXPLANATION OF ABBREVIATIONS

PID = Photoionization Detector

PEL = Permissible Exposure Limit (8-hour Time Weighted Average)

IDLH = Immediately Dangerous to Life and Health

ppm = parts per million

mg/m<sup>3</sup> = milligrams per cubic meter

**TABLE 3**  
**Summary of Monitoring Equipment**

Instrument	Operation Parameters
Photoionization Detector (PID)	<p><b>Hazard Monitored:</b> Many organic and some inorganic gases and vapors.</p> <p><b>Application:</b> Detects total concentration of many organic and some inorganic gases and vapors. Some identification of compounds is possible if more than one probe is measured.</p> <p><b>Detection Method:</b> Ionizes molecules using UV radiation; produces a current that is proportional to the number of ions.</p> <p><b>General Care/Maintenance:</b> Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories.</p> <p><b>Typical Operating Time:</b> 10 hours. 5 hours with strip chart recorder.</p>
Oxygen Meter	<p><b>Hazard Monitored:</b> Oxygen (O<sub>2</sub>).</p> <p><b>Application:</b> Measures the percentage of O<sub>2</sub> in the air.</p> <p><b>Detection Method:</b> Uses an electrochemical sensor to measure the partial pressure of O<sub>2</sub> in the air, and converts the reading to O<sub>2</sub> concentration.</p> <p><b>General Care/Maintenance:</b> Replace detector cell according to manufacturer's recommendations. Recharge or replace batteries prior to expiration of the specified interval. If the ambient air is less than 0.5% C O<sub>2</sub>, replace the detector cell frequently.</p> <p><b>Typical Operating Time:</b> 8 – 12 hours.</p>
Additional equipment (if needed, based on site conditions)	
Combustible Gas Indicator (CGI)	<p><b>Hazard Monitored:</b> Combustible gases and vapors.</p> <p><b>Application:</b> Measures the concentration of combustible gas or vapor.</p> <p><b>Detection Method:</b> A filament, usually made of platinum, is heated by burning the combustible gas or vapor. The increase in heat is measured. Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present.</p> <p><b>General Care/Maintenance:</b> Recharge or replace battery. Calibrate immediately before use.</p> <p><b>Typical Operating Time:</b> Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.</p>
Flame Ionization Detector (FID) with Gas Chromatography Option (i.e., Foxboro Organic Vapor Analyzer (OVA))	<p><b>Hazard Monitored:</b> Many organic gases and vapors (approved areas only).</p> <p><b>Application:</b> In survey mode, detects the concentration of many organic gases and vapors. In gas chromatography (GC) mode, identifies and measures specific compounds. In survey mode, all the organic compounds are ionized and detected at the same time. In GC mode, volatile species are separated.</p> <p><b>General Care/Maintenance:</b> Recharge or replace battery. Monitor fuel and/or combustion air supply gauges. Perform routine maintenance as described in the manual. Check for leaks.</p> <p><b>Typical Operating Time:</b> 8 hours; 3 hours with strip chart recorder.</p>
Potable Infrared (IR) Spectrophotometer	<p><b>Hazard Monitored:</b> Many gases and vapors.</p> <p><b>Application:</b> Measures concentration of many gases and vapors in air. Designed to quantify one or two component mixtures.</p> <p><b>Detection Method:</b> Passes different frequencies of IR through the sample. The frequencies absorbed are specific for each compound.</p> <p><b>General Care/Maintenance:</b> As specified by the manufacturer.</p>

Instrument	Operation Parameters
Direct Reading Colorimetric Indicator Tube	<p><b>Hazard Monitored:</b> Specific gas and vapors.</p> <p><b>Application:</b> Measures concentration of specific gases and vapors.</p> <p><b>Detection Method:</b> The compound reacts with the indicator chemical in the tube, producing a stain whose length or color change is proportional to the compound's concentration.</p> <p><b>General Care/Maintenance:</b> Do not use a previously opened tube even if the indicator chemical is not stained. Check pump for leaks before and after use. Refrigerate before use to maintain a shelf life of about 2 years. Check expiration dates of tubes. Calibrate pump volume at least quarterly. Avoid rough handling which may cause channeling.</p>
Aerosol Monitor	<p><b>Hazard Monitored:</b> Airborne particulate (dust, mist, fume) concentrations</p> <p><b>Application:</b> Measures total concentration of semi-volatile organic compounds, PCBs, and metals.</p> <p><b>Detection Method:</b> Based on light-scattering properties of particulate matter. Using an internal pump, air sample is drawn into the sensing volume where near infrared light scattering is used to detect particles.</p> <p><b>General Care/Maintenance:</b> As specified by the mfr. Also, the instrument must be calibrated with particulates of a size and refractive index similar to those to be measured in the ambient air.</p>
Monitox	<p><b>Hazard Monitored:</b> Gases and vapors.</p> <p><b>Application:</b> Measures specific gases and vapors.</p> <p><b>Detection Method:</b> Electrochemical sensor relatively specific for the chemical species in question.</p> <p><b>General Care/Maintenance:</b> Moisten sponge before use; check the function switch; change the battery when needed.</p>
Gamma Radiation Survey Instrument	<p><b>Hazard Monitored:</b> Gamma Radiation.</p> <p><b>Application:</b> Environmental radiation monitor.</p> <p><b>Detection Method:</b> Scintillation detector.</p> <p><b>General Care/Maintenance:</b> Must be calibrated annually at a specialized facility.</p> <p><b>Typical Operating Time:</b> Can be used for as long as the battery lasts, or for the recommended interval between calibrations, whichever is less.</p>



**TABLE 4**  
**INSTRUMENTATION ACTION LEVELS**

<b><u>Photoionization Detector Action Levels</u></b>	<b><u>Action Required</u></b>
Background to 5 ppm	No respirator; no further action required
> 1 ppm but < 5 ppm for > 5 minutes	<ol style="list-style-type: none"> <li>1. Temporarily discontinue all activities and evaluate potential causes of the excessive readings. If these levels persist and cannot be mitigated (i.e., by slowing drilling or excavation activities), contact HSO to review conditions and determine source and appropriate response action.</li> <li>2. If PID readings remain above 1 ppm, temporarily discontinue work and upgrade to Level C protection.</li> <li>3. If sustained PID readings fall below 1 ppm, downgrading to Level D protection may be permitted.</li> </ol>
> 5 ppm but < 150 ppm for > 5 minutes	<ol style="list-style-type: none"> <li>1. Discontinue all work; all workers shall move to an area upwind of the jobsite.</li> <li>2. Evaluate potential causes of the excessive readings and allow work area to vent until VOC concentrations fall below 5 ppm.</li> <li>3. Level C protection will continue to be used until PID readings fall below 1 ppm.</li> </ol>
> 150 ppm	Evacuate the work area

**Notes:**

1. 1 ppm level based on OSHA Permissible Exposure Limit (PEL) for benzene.
2. 5 ppm level based on OSHA Short Term Exposure Limit (STEL) maximum exposure for benzene for any 15 minute period.
3. 150 ppm level based on NIOSH Immediately Dangerous to Life and Health (IDLH) for tetrachloroethylene.

**TABLE 5  
EMERGENCY NOTIFICATION LIST**

<b>ORGANIZATION</b>	<b>CONTACT</b>	<b>TELEPHONE</b>
Local Police Department	NYPD	911
Local Fire Department	NYFD	911
Ambulance/Rescue Squad	NYFD	911
Hospital	Franklin Hospital	911 or 516-256-6000
Langan Incident / Injury Hotline		800-952-6426 ex 4699
Langan Environmental Project Manager	Emily Snead	508-918-8558 (cell)
Langan Geotechnical Project Manager	Jared Green	914-720-3920 (cell)
Langan Health and Safety Manager (HSM)	Tony Moffa	215-756-2523 (cell)
Langan Health & Safety Officer (HSO)	William Bohrer	410-984-3068 (cell)
Langan Field Team Leader (FTL)	To Be Determined	
Client's Representative	Lucy Wong, NYCDDC	718-391-1162
National Response Center (NRC)		800-424-8802
Chemical Transportation Emergency Center (Chemtrec)		800-424-9300
Center for Disease Control (CDC)		404-639-3534
EPA (RCRA Superfund Hotline)		800-424-9346
TSCA Hotline		202-554-1404
Poison Control Center		800-222-1222

***Immediately following an incident or near miss, unless emergency medical treatment is required, either the employee or a coworker must contact the Langan Incident/Injury Hotline at 1-(800)-9-LANGAN (ext. #4699).***

**TABLE 6**  
**SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING**  
**FOR FIT AND ACCLIMATED WORKERS<sup>A</sup>**

<b>Adjusted Temperature<sup>b</sup></b>	<b>Normal Work Ensemble<sup>c</sup></b>	<b>Impermeable Ensemble</b>
90°F or above (32.2°C) or above	After each 45 min. of work	After each 15 min. of work
87.5°F (30.8°-32.2°C)	After each 60 min. of work	After each 30 min. of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 min. of work	After each 60 min. of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 min. of work	After each 90 min. of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 min. of work	After each 120 min. of work

a For work levels of 250 kilocalories/hour.

b Calculate the adjusted air temperature (ta adj) by using this equation:  $ta\ adj\ ^\circ F = ta\ ^\circ F + (13 \times \% \text{ sunshine})$ . Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

c A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

**TABLE 7**  
**HEAT INDEX**

RELATIVE HUMIDITY	ENVIRONMENTAL TEMPERATURE (Fahrenheit)										
	70	75	80	85	90	95	100	105	110	115	120
	APPARENT TEMPERATURE*										
0%	64	69	73	78	83	87	91	95	99	103	107
10%	65	70	75	80	85	90	95	100	105	111	116
20%	66	72	77	82	87	93	99	105	112	120	130
30%	67	73	78	84	90	96	104	113	123	135	148
40%	68	74	79	86	93	101	110	123	137	151	
50%	69	75	81	88	96	107	120	135	150		
60%	70	76	82	90	100	114	132	149			
70%	70	77	85	93	106	124	144				
80%	71	78	86	97	113	136					
90%	71	79	88	102	122						
100%	72	80	91	108							

\*Combined Index of Heat and Humidity...what it "feels like" to the body

Source: National Oceanic and Atmospheric Administration

How to use Heat Index:

1. Across top locate Environmental Temperature
2. Down left side locate Relative Humidity
3. Follow across and down to find Apparent Temperature
4. Determine Heat Stress Risk on chart at right

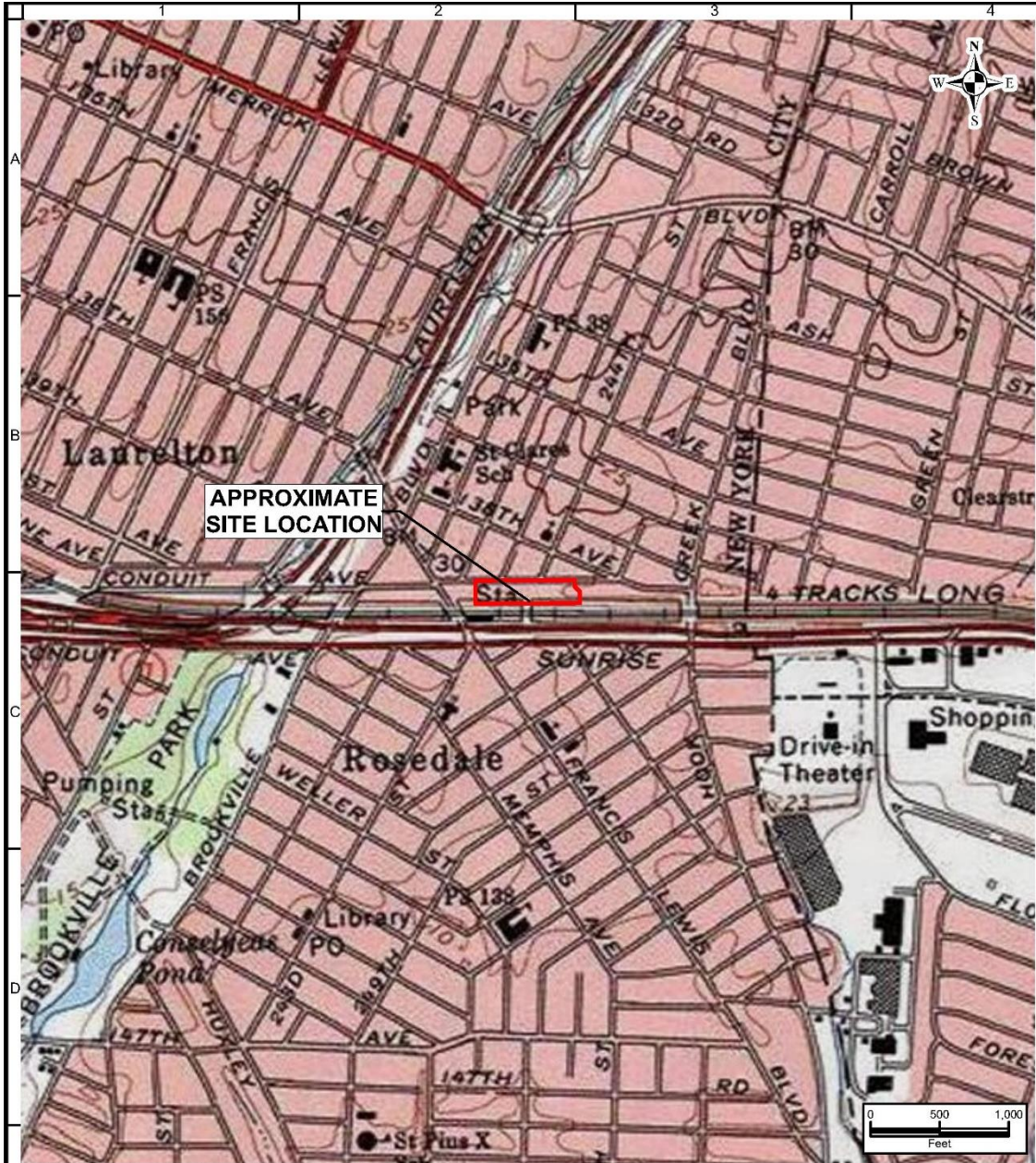
Note: Exposure to full sunshine can increase Heat Index values by up to 15 degrees F.

Apparent Temperature	Heat Stress Risk with Physical Activity and/or Prolonged Exposure
90-105	Heat Cramps or Heat Exhaustion Possible
105-130	Heat Cramps or Heat Exhaustion Likely, Heat Stroke Possible
>130	Heatstroke Highly Likely

## FIGURES

# FIGURE 1

## Site Location Map



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<b>LANGAN</b> 21 Penn Plaza, 360 West 31st Street, 8th Floor New York, NY 10001-2727 T: 212.479.5400 F: 212.479.5444 www.langan.com Langan Engineering & Environmental Services, Inc. Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C. Langan International Collectively known as Langan	Project	116th NYPD Precinct	SITE LOCATION	Project No.	170495201	Figure  1
				Date	4/22/2019	
				Scale	1:1,000	
				Drawn By	Site Analyzer	
				Submission Date	04/22/2019	Sheet 1 of 1

Disclaimer: This information is produced by an automated system and may not be complete. The absence of a feature is not a confirmation that the feature is not present at the subject location. Information produced is in the public domain and unless noted has not been field verified or provided for any specific use. Users are also cautioned to confirm the information shown is suitable for their intended use.



## FIGURE 2

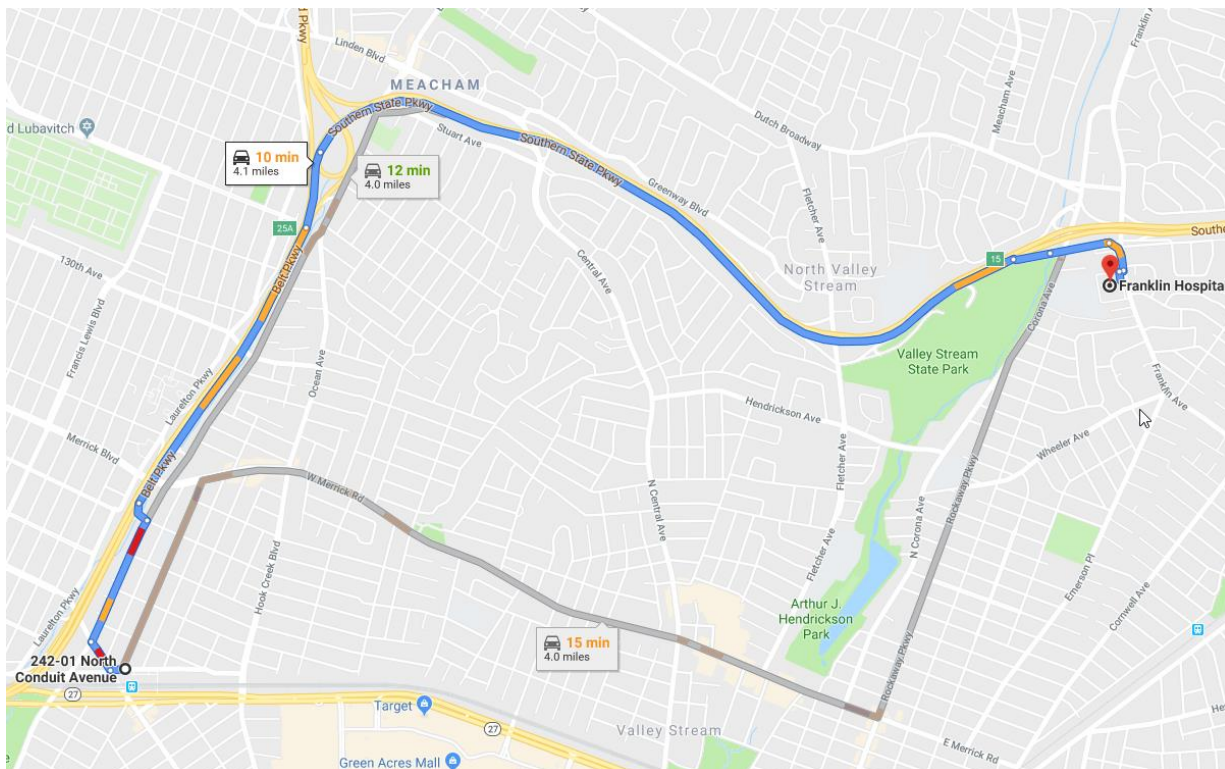
### HOSPITAL ROUTE PLAN

**Hospital Location:**     **Franklin Hospital**  
**900 Franklin Avenue**  
**Valley Stream, New York**  
**516-256-6000**

**START: 242-40 North Conduit Avenue, Rosedale, NY.**

1. Head west on North Conduit Avenue toward 242<sup>nd</sup> Street
2. Turn right onto Francis Lewis Boulevard
3. Turn right onto Brookville Boulevard
4. Turn left onto the ramp to Cross Island Parkway N/Whitestone Bridge
5. Merge onto Belt Parkway/Laurelton Parkway
6. Use the left 2 lanes to take exit 15A for Southern State Parkway toward Eastern Long Island
7. Continue onto Southern State Parkway
8. Take exit 15 for Corona Avenue toward Franklin Avenue
9. Continue straight onto Blakeman Drive
10. Turn right onto Franklin Avenue
11. Turn right
12. Turn left, destination will be on the right.

**END: Franklin Hospital, 900 Franklin Avenue, Valley Stream, NY**



**ATTACHMENT A**

**STANDING ORDERS**



## **STANDING ORDERS**

### **GENERAL**

- No smoking, eating, or drinking in this work zone.
- Upon leaving the work zone, personnel will thoroughly wash their hands and face.
- Minimize contact with contaminated materials through proper planning of work areas and decontamination areas, and by following proper procedures. Do not place equipment on the ground. Do not sit on contaminated materials.
- No open flames in the work zone.
- Only properly trained and equipped personnel are permitted to work in potentially contaminated areas.
- Always use the appropriate level of personal protective equipment (PPE).
- Maintain close contact with your buddy in the work zone
- Contaminated material will be contained in the Exclusion Zone (EZ).
- Report any unusual conditions.
- Work areas will be kept clear and uncluttered. Debris and other slip, trip, and fall hazards will be removed as frequently as possible.
- The number of personnel and equipment in the work zone will be kept to an essential minimum.
- Be alert to the symptoms of fatigue and heat/cold stress, and their effects on the normal caution and judgment of personnel.
- Conflicting situations which may arise concerning safety requirements and working conditions must be addressed and resolved quickly by the site HSO.

### **TOOLS AND HEAVY EQUIPMENT**

- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other device not specifically designed to carrying passengers.
- Loose-fitting clothing or loose long hair is prohibited around moving machinery.
- Ensure that heavy equipment operators and all other personnel in the work zone are using the same hand signals to communicate.
- Drilling/excavating within 10 feet in any direction of overhead power lines is prohibited.
- The locations of all underground utilities must be identified and marked out prior to initiating any subsurface activities.
- Check to insure that the equipment operator has lowered all blades and buckets to the ground before shutting off the vehicle.
- If the equipment has an emergency stop device, have the operator show all personnel its location and how to activate it.
- Help the operator ensure adequate clearances when the equipment must negotiate in tight quarters; serve as a signalman to direct backing as necessary.
- Ensure that all heavy equipment that is used in the Exclusion Zone is kept in that zone until the job is done, and that such equipment is completely decontaminated before moving it into the clean area of the work zone.
- Samplers must not reach into or get near rotating equipment such as the drill rig. If personnel must work near any tools that could rotate, the equipment operator must completely shut down the rig prior to initiating such work. It may be necessary to use a remote sampling device.

## **ATTACHMENT B**

# **DECONTAMINATION PROCEDURES**

## PERSONNEL DECONTAMINATION

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### LEVEL C DECONTAMINATION

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Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Canister or Mask Change	4. If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.
Station 5:	Boot, Gloves and Outer Garment Removal	5. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 6:	Face piece Removal	6. Face piece is removed (avoid touching face with fingers). Face piece deposited on plastic sheets.
Station 7:	Field Wash	7. Hands and face are thoroughly washed. Shower as soon as possible.

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### LEVEL D DECONTAMINATION

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Station 1:	Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, cool down stations may be set up within this area.
Station 2:	Outer Garment, Boots, and Gloves Wash and Rinse	2. Scrub outer boots, outer gloves and chemical-resistant splash suit with decon solution or detergent and water. Rinse off using copious amounts of water.
Station 3:	Outer Boot and Glove Removal	3. Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4:	Boot, Gloves and Outer Garment Removal	4. Boots, chemical-resistant splash suit, inner gloves removed and deposited in separate containers lined with plastic.
Station 5:	Field Wash	5. Hands and face are thoroughly washed. Shower as soon as possible.

## **EQUIPMENT DECONTAMINATION**

### **GENERAL:**

Equipment to be decontaminated during the project may include tools, monitoring equipment, respirators, sampling containers, laboratory equipment and drilling equipment.

All decontamination will be done by personnel in protective gear, appropriate for the level of decontamination, as determined by the site HSO. The decontamination work tasks will be split or rotated among support and work crews.

Depending on site conditions, backhoe and pumps may be decontaminated over a portable decontamination pad to contain wash water; or, wash water may be allowed to run off into a storm sewer system. Equipment needed may include a steam generator with high-pressure water, empty drums, screens, screen support structures, and shovels. Drums will be used to hold contaminated wash water pumped from the lined pit. These drums will be labeled as such.

Miscellaneous tools and equipment will be dropped into a plastic pail, tub, or other container. They will be brushed off and rinsed with a detergent solution, and finally rinsed with clean water.

### **MONITORING EQUIPMENT:**

Monitoring equipment will be protected as much as possible from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The PID, HNu or OVA meter, for example, can be placed in a clear plastic bag, which allows reading of the scale and operation of knobs. The probes can be partially wrapped keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe.

### **RESPIRATORS:**

Respirators will be cleaned and disinfected after every use. Taken from the drop area, the masks (with the cartridges removed and disposed of with other used disposable gear) will be immersed in a cleaning solution and scrubbed gently with a soft brush, followed by a rinse in plain warm water, and then allowed to air dry. In the morning, new cartridges will be installed. Personnel will inspect their own masks for serviceability prior to donning them. And, once the mask is on, the wearer will check the respirator for leakage using the negative and positive pressure fit check techniques.

## **ATTACHMENT C**

### **EMPLOYEE EXPOSURE/ INJURY INCIDENT REPORT**

# EMPLOYEE INCIDENT/INJURY REPORT

## LANGAN ENGINEERING & ENVIRONMENTAL SERVICES

*(Complete and return to Tony Moffa in the Doylestown Office)*

Affected Employee Name: \_\_\_\_\_

Date: \_\_\_\_\_

Incident type: ☐ Injury ☐ Report Only/No Injury  
☐ Near Miss ☐ Other: \_\_\_\_\_  
\_\_\_\_\_

---

### **EMPLOYEE INFORMATION** (Person completing Form)

Employee Name: \_\_\_\_\_

Employee

No: \_\_\_\_\_

Title: \_\_\_\_\_

Office

Location: \_\_\_\_\_

Length of time employed or date of hire: \_\_\_\_\_

Mailing address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sex: M ☐ F ☐ Birth date: \_\_\_\_\_

Business phone & extension: \_\_\_\_\_

Residence/cell

phone: \_\_\_\_\_  
\_\_\_\_\_

---

### **ACCIDENT INFORMATION**

Project: \_\_\_\_\_

Project

#: \_\_\_\_\_

Date & time of incident: \_\_\_\_\_ Time work started & ended: \_\_\_\_\_  
\_\_\_\_\_

Site location: \_\_\_\_\_  
\_\_\_\_\_

Incident Type: Possible Exposure ☐ Exposure ☐ Physical Injury ☐

Names of person(s) who witnessed the incident: \_\_\_\_\_

Exact location incident occurred: \_\_\_\_\_

Describe work being done: \_\_\_\_\_

Describe what affected employee was doing prior to the incident occurring: \_\_\_\_\_

Describe in detail how the incident occurred: \_\_\_\_\_

Nature of the incident (List the parts of the body affected): \_\_\_\_\_

Person(s) to whom incident was reported (Time and Date): \_\_\_\_\_

List the names of other persons affected during this incident: \_\_\_\_\_

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Possible causes of the incident (equipment, unsafe work practices, lack of PPE, etc.):

Weather conditions during incident:

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### **MEDICAL CARE INFORMATION**

Did affected employee receive medical care? Yes ☐ No ☐

If Yes, when and where was medical care received: \_\_\_\_\_

\_\_\_\_\_

Provide name of facility (hospital, clinic, etc.):

\_\_\_\_\_

Length of stay at the facility? \_\_\_\_\_

Did the employee miss any work time? Yes ☐ No ☐ Undetermined ☐

Date employee last worked: \_\_\_\_\_ Date employee returned to work: \_\_\_\_\_

Has the employee returned to work? Yes ☐ No ☐

Does the employee have any work limitations or restrictions from the injury? : Yes ☐ No ☐

If Yes, please describe:

\_\_\_\_\_

\_\_\_\_\_

Did the exposure/injury result in permanent disability? Yes ☐ No ☐ Unknown ☐

If Yes, please describe:

\_\_\_\_\_

---



**HEALTH & SAFETY INFORMATION**

Was the operation being conducted under an established site specific CONSTRUCTION HEALTH AND SAFETY PLAN?

Yes ☐      No ☐      Not Applicable: ☐

Describe protective equipment and clothing used by the employee:

Did any limitations in safety equipment or protective clothing contribute to or affect exposure / injury? If so, explain:

Employee Signature

Date

Langan Representative

Date

**ATTACHMENT D**

**CALIBRATION LOG**

**DATE:** \_\_\_\_\_

**PROJECT:**\_\_\_\_\_

## CALIBRATION LOG

[illegible]

DATE: \_\_\_\_\_

**PROJECT:**\_\_\_\_\_

## CALIBRATION LOG

[illegible]

**DATE:** \_\_\_\_\_

**PROJECT:**\_\_\_\_\_

## CALIBRATION LOG

[illegible]

DATE: \_\_\_\_\_

**PROJECT:**\_\_\_\_\_

## CALIBRATION LOG

[illegible]

# **ATTACHMENT E**

## **MATERIAL SAFETY DATA SHEETS**

### **SAFETY DATA SHEETS**

*In addition to the enclosed Material Safety Data Sheet (MSDs) / Safety Data Sheet (SDSs), all Langan Field Personnel Completing This Work Plan Are To Have Real Time Accessibility To Material Safety Data Sheet (MSDs) or Safety Data Sheet (SDSs) Through Their Smart Phone.*

*The link is <http://www.msds.com/>*

*The login name is "drapehead"*

*The password is "2angan987"*

*In addition to the digital versions, printed copies of the MSDs/SDSs will be brought to the Site and included in a bounded version of the CHASP.*

**SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION**

Company: AccuStandard, Inc.  
125 Market Street  
New Haven, CT 06513

Date MSDS Printed: 4/21/2006  
Preparation Date: 4/21/2006  
Information Phone Number: 203-786-5290  
Emergency Phone Number: 203-786-5290  
Hours: Mon. to Fri. 8am-5pm EDT

MSDS Number: V-029

Product Name: 1,2,4-Trimethylbenzene

Synonyms: 1,2,4-Trimethylbenzene; Pseudocumene; psi-Cumene; Assymetrical trimethylbenzene

Formula: C<sub>9</sub>H<sub>12</sub>

Molecular Weight: 120.19

**SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS**

Component(s) ( 1 )	CAS #	Appr. %	ACGIH-TLV (mg/m3)		OSHA-PEL (mg/m3)	
			TWA	STEL skin	TWA	STEL skin
1,2,4-Trimethylbenzene	95-63-6	100	123			

**SECTION 3 - HAZARDS IDENTIFICATION****Symptoms of Exposure:**

Irritating to eyes, skin, mucous membranes and upper respiratory system.

Narcotic in high concentrations.

May cause headache, dizziness, nausea, and narcosis.

May cause stomach cramps and gastro-intestinal disturbances.

To the best of our knowledge the chemical, physical and toxicological properties of the component ingredients have not been thoroughly investigated.

**Potential Health Effects:**

Harmful if inhaled.

May be harmful if absorbed through skin or swallowed

May cause central nervous system damage.

**Routes of Entry:**

Inhalation, ingestion or skin contact.

**Carcinogenicity:**

This product is or contains a component that is not listed (ACGIH, IARC, NTP, OSHA) as a cancer causing agent.



## SECTION 4 - FIRST AID MEASURES

---

### Emergency First Aid:

Get medical assistance for all cases of overexposure.

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

Eye contact: Immediately flush with plenty of water. After initial flushing, remove and contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

Ingestion: Call a physician or poison control center immediately. ONLY induce vomiting at the instructions of a physician. Never give anything by mouth to an unconscious person.

## SECTION 5 - FIRE FIGHTING MEASURES

---

### Flammable Properties:

Flash Point: 118.4 °F (48 °C) (cc)

Flammable Limits LEL (%): 0.9

Flammable Limits UEL (%): 6.4

Autoignition Temperature: 515 °C

Flammable liquid and vapor.

Vapors can travel to a source of ignition and flash back.

Containers can build up pressure if exposed to heat.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

### Extinguishing Media:

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

### Fire Fighting Procedures:

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

## SECTION 6 - ACCIDENTAL RELEASE MEASURES

---

### Spill Response:

Wear a self-contained breathing apparatus and appropriate Personal protection. Stop leak if you can do so without risk. Ventilate area. Neutralize spill with soda ash or lime. Take up and containerize for proper disposal. Flush spill area with water. Keep combustibles away from spilled material. Comply with Federal, State, and local regulations.

## SECTION 7 - HANDLING AND STORAGE

---

Store in a tightly closed container.

Store in a cool area away from ignition sources and oxidizers.

Do not breathe vapor.

Do not get in eyes, on skin or clothing.

Avoid prolonged or repeated exposure.

This product should only be used by persons trained in the safe handling of hazardous chemicals.

## SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

---

### Engineering Controls and Personal Protection Equipment (PPE):

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), a NIOSH/MSHA approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other

NIOSH/MSHA respirators (negative pressure type) under specified conditions (see your safety equipment supplier). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Compatible chemical-resistant protective gloves must be worn to prevent skin contact.

Safety glasses with side shields must be worn at all times.

#### **General Hygiene Considerations:**

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

### **SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES**

---

Appearance: Clear, colorless liquid

Odor: Aromatic

pH: N/A

Vapor Pressure: 7 mmHg (44.4 °C)

Vapor Density (Air = 1): 4.2 g/l

Boiling Point: 168 - 169 °C

Melting Point: -43.7 °C

Solubility in Water (%): Insoluble

Specific Gravity (H<sub>2</sub>O = 1): 0.876 g/cm<sup>3</sup>

Flash Point: 118.4 °F (48 °C) (cc)

Explosion Limits (%): 0.9 to 6.4

Autoignition Temperature: 515 °C

Percent Volatile: N/A

Evaporation Rate (BuAc = 1): N/A

Molecular Weight: 120.19

Molecular Formula: C<sub>9</sub>H<sub>12</sub>

### **SECTION 10 - STABILITY AND REACTIVITY**

---

Stability: Stable

Conditions To Avoid: Heat; Contact with ignition sources

Materials To Avoid: Oxidizers

Hazardous Decomposition: Carbon oxides

Hazardous Polymerization: Will not occur

### **SECTION 11 - TOXICOLOGICAL INFORMATION**

---

See section 3 for specific toxicological information for the ingredients of this product.

### **SECTION 12 - ECOLOGICAL INFORMATION**

---

By complying with sections 6 and 7 there will be no release to the environment.

### **SECTION 13 - DISPOSAL CONSIDERATIONS**

---

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

### **SECTION 14 - TRANSPORT INFORMATION**

---

**DOT**   UN Number:   UN3295   Shipping Class: 3   Packing Group: III   FLAMMABLE

### **SECTION 15 - REGULATORY INFORMATION**

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In addition to Federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

### **SECTION 16 - OTHER INFORMATION**

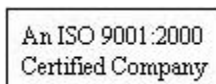
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This document has been designed to meet the requirements of OSHA, ANSI and CHIPs regulations.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. It is intended for use only by persons having the necessary technical skill and at their own discretion and risk. Since conditions and manner of use are outside our control, we make  
NO WARRANTY, EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE.

Legend : N/A = Not Available   ND = Not Determined   NR = Not Regulated

\* \* \* End of Document \* \* \*



THE POWER OF THREE<sup>3</sup>

**PHARMCO-AAPER**

AND COMMERCIAL ALCOHOLS

**Product Information (203) 740-3471 / Emergency Assistance CHEMTREC 1-800-424-9300**

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# MATERIAL SAFETY DATA SHEETS

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Manufacturer: PHARMCO-AAPER  
58 Vale Road  
Brookfield, Connecticut 06804, USA  
Phone (203) 740-3471  
Fax (203) 740-3481

1101 Isaac Shelby Drive  
Shelbyville, KY 40065  
Phone (502) 633-0650  
Fax (502) 633-0685

---

## 1,3,5-Trimethylbenzene

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### 1. CHEMICAL PRODUCT IDENTIFICATION

Product Name: 1,3,5-Trimethylbenzene  
Synonym(s): Mesitylene; 3,5-Dimethyltoluene; Trimethylbenzol  
Molecular Formula:  $C_6H_3(CH_3)_3$   
Molecular Weight: 120.20

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS	Weight % -
1,2,4-Trimethylbenzene	108-67-8	98%

### 3. HAZARDS IDENTIFICATION

WARNING! FLAMMABLE LIQUID. HARMFUL IF INHALED, IN CONTACT WITH SKIN AND IF SWALLOWED. IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.

NFPA Hazard Ratings: Health - 0, Flammability - 2, Reactivity - 0

NOTE: NFPA ratings involve data and interpretations that may vary from company to company. They are intended only for rapid, general identification of the magnitude of the specific hazard. To deal adequately with the safe

handling of this material, all the information contained in this MSDS must be considered.

#### Potential Health Effects

Eye: Causes eye irritation.

Skin: Causes skin irritation. Prolonged and/or repeated contact may cause defatting of the skin and dermatitis.

Ingestion: Aspiration hazard. May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, and nausea.

Inhalation: Inhalation of high concentrations may cause central nervous system effects characterized by nausea, headache, and dizziness.

Target Organs: Nerves and blood.

### **4. FIRST-AID MEASURES**

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid.

Skin: Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation: Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician: Treat symptomatically and supportively.

### **5. FIRE FIGHTING MEASURES**

Flash Point: 44 C

Explosion Limits: Lower: 0.88

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors can travel to a source of ignition and flash back. Liquid will float and may reignite on the surface of water.

Extinguishing Media: Use water spray to cool fire-exposed containers. This material is lighter than water and insoluble in water. The fire could easily be spread by the use of water in an area where the water cannot be contained. Use dry chemical, carbon dioxide, or alcohol-resistant foam.

### **6. ACCIDENTAL RELEASE MEASURES**

Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Avoid runoff into storm sewers and ditches, which lead to waterways. Remove all sources of ignition. Use a spark-proof tool.

## **7. HANDLING AND STORAGE**

Handling: Use only in a well ventilated area. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Avoid contact with heat, sparks and flame. Avoid ingestion and inhalation. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Keep from contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances.

## **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

Local exhaust ventilation may be necessary to control any air contaminants to within their TLVs during the use of this product. Ventilation fans and other electrical service must be non-sparking and have an explosion-proof design.

### **Personal Protective Equipment**

Eyes: Wear safety glasses and chemical goggles if splashing is possible.

Skin: Wear impervious gloves.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A NIOSH/MSHA approved or European Standard EN 149 air purifying respirator with an organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected. A respiratory protection program that meets OSHA's 29 CFR '1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

Physical State: Liquid

Appearance: clear, colorless

Vapor Density: 4.1 (air=1)

Boiling Point: 162-164 C

Freezing/Melting Point: -45 C

Specific Gravity/Density: 0.864

## **10. STABILITY AND REACTIVITY**

Chemical Stability: Stable.

Conditions to Avoid: Ignition sources, excess heat, electrical sparks and oxidizers.

Incompatibilities with Other Materials: Strong oxidizing agents

Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.

Hazardous Polymerization: Has not been reported.

## **11. TOXICOLOGICAL INFORMATION**

RTECS#: OX6825000

Irritation Date  
SKN-RBT 20 MG/24H MOD 85JCAE -,34,1986  
EYE-RBT 500 MG/24H MLD 85JCAE -,34,1986

Toxicity Date  
IHL-RAT LC50:24 GM/M3/4H GISAAA 44(5),15,1979

## **12. ECOLOGICAL INFORMATION**

Ecotoxicity: Not available.  
Environmental Fate: Not available.  
Physical/Chemical: Not available.  
Other: Not available.

## **13. DISPOSAL CONSIDERATIONS**

Dispose of in a manner consistent with federal, state, and local regulations.  
RCRA D-Series Maximum Concentration of Contaminants: None listed.  
RCRA D-Series Chronic Toxicity Reference Levels: None listed.  
RCRA F-Series: None listed.  
RCRA P-Series: None listed.  
RCRA U-Series: None listed.

## **14. TRANSPORT INFORMATION**

Domestic (Land, D.O.T.)  
Proper Shipping Name: 1,3,5-Trimethylbenzene  
Hazard Class: 3  
UN/NA: UN2325  
Packing Group: III

International (Water, I.M.O.)  
Proper Shipping Name: Flammable Liquid, N.O.S. (1,2,4-Trimethylbenzene)  
Hazard Class: 3.3  
UN/NA: UN2325  
Packing Group: III

## **15. REGULATORY INFORMATION**

EUROPEAN INFORMATION  
EC INDEX NO: 601-025-00-5

### **REVIEWS, STANDARDS, AND REGULATIONS**

OEL=MAK  
OEL-DENMARK: TWA 25 PPM (120 MG/M3), JAN1999  
OEL-GERMANY: NO MAK ESTABLISHED, JAN1999  
OEL-JAPAN: OEL 25 PPM (120 MG/M3), JAN1999  
OEL-NORWAY: TWA 20 PPM (100 MG/M3), JAN1999  
OEL-SWEDEN: NGV 25 PPM (120 MG/M3), KTV 35 PPM (170 MG/M3), JAN1999

OEL-SWITZERLAND: MAK-W 25 PPM (125 MG/M3), JAN1999  
OEL IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV;  
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV  
NOES 1983: HZD T1998; NIS 4; TNF 495; NOS 6; TNE 12997; TFE 231  
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY  
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES  
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001

## **16. OTHER INFORMATION**

The information contained herein is based on current knowledge and experience; no responsibility is accepted that the information is sufficient or correct in all cases. Users should consider these data only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials and the safety and health of employees and customers and the protection of the environment.





## SAFETY DATA SHEET

Date of issue: 29/10/02

### 1. Identification of the substance/preparation and of the company/undertaking

#### *Identification of the product*

Catalogue No: P23348

ID No.: 2808300

Product name: **1,3-Dichlorobenzene**

Use of the substance/preparation: General chemical reagent

#### *Manufacturer/supplier identification*

Company: VWR International Ltd., Merck House, Poole, Dorset, BH15 1TD, England  
Telephone : + 44 (0) 1202 669700      Telefax : + 44 (0) 1202 665599

Emergency telephone No.: + 44 (0) 1202 669700

### 2. Composition/information on ingredients

#### *Chemical characterization*

Halogenated solvent

Product name: 1,3-Dichlorobenzene

CAS number: 541-73-1

EC-No.: 208-792-1

EC Index No.: 602-067-00-7

Molecular formula:  $C_6H_4Cl_2$ , = 147.00 g/mol

### 3. Hazards identification

Harmful if swallowed. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

### 4. First aid measures

- Eye contact: Irrigate thoroughly with water for at least 10 minutes. OBTAIN MEDICAL ATTENTION.
- Inhalation: Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
- Skin contact: Wash off skin thoroughly with water. Remove contaminated clothing and wash before re-use. Unless contact has been slight, OBTAIN MEDICAL ATTENTION.
- Ingestion: Wash out mouth thoroughly with water and give plenty of water to drink. OBTAIN MEDICAL ATTENTION.

### 5. Fire-fighting measures

#### *Special risks:*

Combustible. May evolve toxic fumes in fire. (HCl)

#### *Suitable extinguishing media:*

Water spray, foam, dry powder or carbon dioxide

Do not stay in dangerous zone without respiratory protective equipment. Prevent fire fighting water entering watercourses or ground-water.

## **6. Accidental release measures**

Wear appropriate protective clothing. Inform others to keep at a safe distance. Ensure supply of fresh air in enclosed rooms. Do not allow to enter sewerage system.

Absorb on an inert absorbent, (e.g. BDH Spillage absorption granules), transfer to a suitable container and arrange removal by disposal company. Wash site of spillage thoroughly with water and detergent.

For large spillages liquids should be contained with sand or earth and both liquids and solids transferred to salvage containers. Any residues should be treated as for small spillages.

## **7. Handling and storage**

### ***Handling:***

Wash hands and face thoroughly after working with material. Contaminated clothing should be removed and washed before re-use. Do not empty into drains.

### ***Storage:***

Store at room temperature (15 to 25°C recommended). Keep well closed and protected from direct sunlight and moisture.

## **8. Exposure controls/personal protection**

### ***UK Exposure Limits:***

None assigned

### ***Personal protective equipment:***

Goggles or face-shield

As appropriate to the situation and the quantity handled.

- Ventilation: Fume cupboard, flameproof
- Respirator: Self-contained breathing apparatus
- Gloves: Viton™. Gloves subject to permeation or any sign of degradation must be removed and replaced immediately.
- Eye Protection: Goggles or face-shield
- Other Precautions: Plastic apron, sleeves, boots - if handling large quantities

### ***Environmental exposure controls:***

Do not allow to enter drinking water supplies, waste water, or soil!

## **9. Physical and chemical properties**

### ***General information:***

Form:	liquid
Colour:	colourless
Odour:	aromatic

**Health, safety and environmental information:**

Melting temperature	-25°C
Boiling temperature	173°C
Density(g/ml)	1.29
Vapour pressure	2 hPa (20°C)
Relative vapour density:	5.08 (air = 1)
Solubility in water	0.11 mg/l (20°C)
Flash point	65°C
Auto-ignition temperature	>500°C
Log P(o/w):	3.38-3.44
Additional data:	Refractive index: 1.5457 (20°C, 589 nm)

**10. Stability and reactivity**

Stable.

Substances to be avoided: alkali metals and alkaline earth metals.

**11. Toxicological information**

- After inhalation of vapours: drowsiness, nausea.
  - After skin contact: Irritation. Degreasing effect on the skin, possibly followed by secondary inflammation.
  - After eye contact: Severe irritation.
  - After ingestion: Irritation of mucous membranes in the mouth, pharynx, oesophagus, and gastrointestinal tract.
- After absorption: Cannot be excluded: changes in the blood picture

Further hazardous properties cannot be excluded. The product should be handled with the care usual when dealing with chemicals.

**Further data**

LD50 (oral, rat): 580 mg/kg

We have no evidence of carcinogenic effects. We have no evidence of mutagenic or teratogenic effects.

**12. Ecological information**

Bioaccumulation potential: medium (Log Pow 2-4). Toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

**Further ecological data:**

Fish toxicity:  
L. indus LC: 24.7 mg/l/48h  
L.macrochirus LC: 5mg/l

**Remarks:**

Adverse ecological effects cannot be excluded in the event of improper handling or disposal.

**13. Disposal considerations**

Chemical residues are generally classified as special waste, and as such are covered by regulations which vary according to location. Contact your local waste disposal authority for advice, or pass to a chemical disposal company. Rinse out empty containers thoroughly before returning for recycling.

#### **14. Transport information**

UN-No.: 2810

Class: 6.1

Packaging group: III

Proper shipping name: TOXIC LIQUID, ORGANIC, N.O.S. (1,3-DICHLOROBENZENE)

#### **15. Regulatory information**

##### ***Labelling according to EC directives***

Symbol(s): Xn N Harmful. Dangerous for the environment.

R-phrases: R22-51/53

Harmful if swallowed. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrases: S61

Avoid release to the environment. Refer to special instructions/Safety data sheets.

EC-No.: 208-792-1

##### ***Local Regulations***

U.K. Transport Category 3

#### **16. Other information**

Revision.

Supersedes edition of: 04/11/97

Reason for alteration: General update.

Date of issue: 29/10/02

Date of print: 13/07/05

**SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION**

Manufacturer: AccuStandard, Inc.  
125 Market Street  
New Haven, CT 06513

Date MSDS Printed: 11/7/2005  
Preparation Date: 11/7/2005  
Information Phone Number: 203-786-5290  
Emergency Phone Number: 203-786-5290  
Hours: Mon. to Fri. 8am-5pm EDT

MSDS Number: PS-221D-10

Product Name: 2,2,4-Trimethylpentane

Synonyms: Isooctane; 2,2,4-Trimethylpentane; Isobutyltrimethylmethane

Formula: C<sub>8</sub>H<sub>18</sub>

Molecular Weight: 114.23

**SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS**

Component(s) ( 1 )	CAS #	Appr. %	ACGIH-TLV (mg/m3)		OSHA-PEL (mg/m3)	
			TWA	STEL	skin	skin
Isooctane	540-84-1	100				

**SECTION 3 - HAZARDS IDENTIFICATION****Symptoms of Exposure:**

Irritating to eyes, skin, mucous membranes and upper respiratory system.

Inhalation may cause dizziness, nausea, lack of coordination, narcosis, unconsciousness. Ingestion may cause diarrhea, slight central nervous system depression, difficulty with breathing and fatigue.

**Potential Health Effects:**

Harmful if swallowed.

May be harmful if inhaled or absorbed through the skin.

Isooctane has produced kidney damage in rats in a subchronic oral laboratory study.

**Routes of Entry:**

Inhalation, ingestion or skin contact.

**Carcinogenicity:**

This product is or contains a component that is not listed (ACGIH, IARC, NTP, OSHA) as a cancer causing agent.

**SECTION 4 - FIRST AID MEASURES****Emergency First Aid:**

Get medical assistance for all cases of overexposure.

Skin contact: Wash thoroughly with soap and water.

Eye contact: Immediately flush with plenty of water. After initial flushing, remove and contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

Ingestion: Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to and unconscious person.

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## SECTION 5 - FIRE FIGHTING MEASURES

### Flammable Properties:

Flash Point: 18 °F (-7 °C) (cc)

Flammable Limits LEL (%): 1.00

Flammable Limits UEL (%): 6.00

Autoignition Temperature: 396 °C

Dangerous fire hazard.

Containers can build up pressure if exposed to heat.

Vapors can travel to a source of ignition and flash back.

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

### Extinguishing Media:

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

### Fire Fighting Procedures:

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

---

## SECTION 6 - ACCIDENTAL RELEASE MEASURES

### Spill Response:

Wear self-contained breathing apparatus and full protective clothing. Neutralize spill with an activated carbon adsorbent. Prevent contact with skin or eyes. Take up and containerize for proper disposal. Ventilate area. Flush spill area with water. Comply with Federal, State, and local regulations.

---

## SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container.

Store in a cool area away from ignition sources and oxidizers.

Do not breathe vapor.

Do not get in eyes, on skin, or on clothing.

Electrically ground all equipment when handling this product.

This product should only be used by persons trained in the safe handling of hazardous chemicals.

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## SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

### Engineering Controls and Personal Protection Equipment (PPE):

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), a NIOSH/MSHA approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions (see your safety equipment supplier). Engineering and/or administrative controls should be implemented to reduce exposure.

Material must be handled or transferred in an approved fume hood or with equivalent ventilation.

Compatible chemical-resistant protective gloves must be worn to prevent skin contact.

Safety glasses with side shields must be worn at all times.

#### **General Hygiene Considerations:**

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

### **SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES**

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Appearance: Clear liquid  
Odor: Mild odor  
pH: N/A  
Vapor Pressure: 41 mmHg (21 °C)  
Vapor Density (Air = 1): 3.9 g/L  
Boiling Point: 99.2 °C  
Melting Point: -107.3 °C  
Solubility in Water (%): Insoluble  
Specific Gravity (H<sub>2</sub>O = 1): 0.691 g/cm<sup>3</sup>  
Flash Point: 18 °F (-7 °C) (cc)  
Explosion Limits (%): 1.00 to 6.00  
Autoignition Temperature: 396 °C  
Percent Volatile: 99+ %  
Evaporation Rate (BuAc = 1): >1  
Molecular Weight: 114.23  
Molecular Formula: C<sub>8</sub>H<sub>18</sub>

### **SECTION 10 - STABILITY AND REACTIVITY**

---

Stability: Stable  
Conditions To Avoid: Heat; Contact with ignition sources  
Materials To Avoid: Oxidizers  
  
Hazardous Decomposition: Carbon oxides  
Hazardous Polymerization: Does not occur

### **SECTION 11 - TOXICOLOGICAL INFORMATION**

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See section 3 for specific toxicological information for the ingredients of this product.

### **SECTION 12 - ECOLOGICAL INFORMATION**

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By complying with sections 6 and 7 there will be no release to the environment.

### **SECTION 13 - DISPOSAL CONSIDERATIONS**

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Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

### **SECTION 14 - TRANSPORT INFORMATION**

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<b>DOT</b>	UN Number: UN1262	Shipping Class: 3	Packing Group: II	FLAMMABLE
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## **SECTION 15 - REGULATORY INFORMATION**

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In addition to Federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

The following regulations apply:

None.

## **SECTION 16 - OTHER INFORMATION**

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This document has been designed to meet the requirements of OSHA, ANSI and CHIPs regulations.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. It is intended for use only by persons having the necessary technical skill and at their own discretion and risk. Since

conditions and manner of use are outside our control, we make

**NO WARRANTY, EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE.**

Legend : N/A = Not Available    ND = Not Determined    NR = Not regulated

\* \* \* End of Document \* \* \*



## SAFETY DATA SHEET

Version 5.4  
Revision Date 03/07/2015  
Print Date 05/11/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : 2-Propanol

Product Number : PHR1072  
Brand : Sigma-Aldrich  
Index-No. : 603-117-00-0

CAS-No. : 67-63-0

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225

Eye irritation (Category 2A), H319

Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H225

Highly flammable liquid and vapour.

H319

Causes serious eye irritation.

H336

May cause drowsiness or dizziness.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.

P241

Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242

Use only non-sparking tools.

P243

Take precautionary measures against static discharge.

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P312	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

May form explosive peroxides.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>3</sub> H <sub>8</sub> O
Molecular weight	: 60.10 g/mol
CAS-No.	: 67-63-0
EC-No.	: 200-661-7
Index-No.	: 603-117-00-0

#### Hazardous components

Component	Classification	Concentration
<b>2-Propanol</b>		
	Flam. Liq. 2; Eye Irrit. 2A; STOT SE 3; H225, H319, H336	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

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## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Handle and store under inert gas. hygroscopic Store at Room Temperature.

Storage class (TRGS 510): Flammable liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
2-Propanol	67-63-0	TWA	200.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices		

		(see BEI® section) Not classifiable as a human carcinogen		
		TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	400 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	400.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	500.000000 ppm 1,225.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
2-Propanol	67-63-0	Acetone	40.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 60 min

Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |  |
|---|--|
| a) Appearance                                   | Form: liquid<br>Colour: colourless   |
| b) Odour  | alcohol-like   |
| c) Odour Threshold                              | No data available  |
| d) pH   | No data available  |
| e) Melting point/freezing point                 | -89.49 °C (-129.08 °F)   |
| f) Initial boiling point and boiling range      | 81.0 - 83.0 °C (177.8 - 181.4 °F)  |
| g) Flash point                                  | 12.0 °C (53.6 °F) - closed cup   |
| h) Evaporation rate                             | 3.0  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 12.7 %(V)<br>Lower explosion limit: 2 %(V)                      |
| k) Vapour pressure                              | 43.2 hPa (32.4 mmHg) at 20.0 °C (68.0 °F)<br>58.7 hPa (44.0 mmHg) at 25.0 °C (77.0 °F) |
| l) Vapour density                               | No data available  |

m) Relative density	0.78 g/cm <sup>3</sup>
n) Water solubility	completely soluble
o) Partition coefficient: n-octanol/water	log Pow: 0.05
p) Auto-ignition temperature	425.0 °C (797.0 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

Surface tension	20.8 mN/m at 25.0 °C (77.0 °F)
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## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Test for peroxide formation before distillation or evaporation. Test for peroxide formation or discard after 1 year.  
Stable under recommended storage conditions.  
Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air. Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Oxidizing agents, Acid anhydrides, Aluminium, Halogenated compounds, Acids

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 5,045 mg/kg

Remarks: Behavioral: Altered sleep time (including change in righting reflex). Behavioral: Somnolence (general depressed activity).

LC50 Inhalation - Rat - 8 h - 16000 ppm

LD50 Dermal - Rabbit - 12,800 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Mild skin irritation

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Eye irritation - 24 h

#### Respiratory or skin sensitisation

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (2-Propanol)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

Inhalation, Oral - May cause drowsiness or dizziness.

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: NT8050000

Central nervous system depression, prolonged or repeated exposure can cause:, Nausea, Headache, Vomiting, narcosis, Drowsiness, Overexposure may cause mild, reversible liver effects., Aspiration may lead to:, Lung oedema, Pneumonia

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Kidney - Irregularities - Based on Human Evidence

Kidney - Irregularities - Based on Human Evidence

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**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 9,640.00 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 5,102.00 mg/l - 24 h

Immobilization EC50 - Daphnia magna (Water flea) - 6,851 mg/l - 24 h

Toxicity to algae EC50 - Desmodesmus subspicatus (green algae) - > 2,000.00 mg/l - 72 h  
EC50 - Algae - > 1,000.00 mg/l - 24 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No bioaccumulation is to be expected (log Pow <= 4).

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1219      Class: 3      Packing group: II  
Proper shipping name: Isopropanol  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 1219      Class: 3      Packing group: II      EMS-No: F-E, S-D  
Proper shipping name: ISOPROPANOL

### IATA

UN number: 1219      Class: 3      Packing group: II  
Proper shipping name: Isopropanol

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.



---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
STOT SE	Specific target organ toxicity - single exposure

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.4

Revision Date: 03/07/2015

Print Date: 05/11/2016

## SAFETY DATA SHEET

Version 5.3  
Revision Date 01/02/2015  
Print Date 05/11/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : 4,4'-DDE

Product Number : 35487

Brand : Sigma-Aldrich

CAS-No. : 72-55-9

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Carcinogenicity (Category 2), H351  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)

H302

Harmful if swallowed.

H351

Suspected of causing cancer.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P264

Wash skin thoroughly after handling.

P270

Do not eat, drink or smoke when using this product.

P273

Avoid release to the environment.

P281

Use personal protective equipment as required.

P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P330	Rinse mouth.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : 1,1-Dichloro-2,2-bis(4-chlorophenyl)ethene

Formula : C<sub>14</sub>H<sub>8</sub>Cl<sub>4</sub>

Molecular weight : 318.03 g/mol

CAS-No. : 72-55-9

EC-No. : 200-784-6

#### Hazardous components

Component	Classification	Concentration
<b>2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene</b>		
	Acute Tox. 4; Carc. 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: solid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	88.0 - 90.0 °C (190.4 - 194.0 °F)
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	< 0.00001 hPa (< 0.00001 mmHg)
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	log Pow: 6.51
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

**10.4 Conditions to avoid**

No data available

**10.5 Incompatible materials**

Strong oxidizing agents, Strong bases

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 880.0 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that has been reported to be possibly carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish                      LC50 - *Lepomis macrochirus* (Bluegill) - 0.2 - 0.3 mg/l - 96.0 h  
   LC50 - *Oncorhynchus mykiss* (rainbow trout) - 0.03 - 0.04 mg/l - 96.0 h  
   LC50 - *Salmo salar* (Atlantic salmon) - 0.05 - 0.18 mg/l - 96.0 h

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

Bioaccumulation                      *Gambusia affinis* (Mosquito fish) - 33 d  
   - 3.84 µg/l

Bioconcentration factor (BCF): 12,037

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077                      Class: 9                                      Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene)  
Reportable Quantity (RQ): 1 lbs  
Marine pollutant: yes  
Poison Inhalation Hazard: No

### IMDG

UN number: 3077                      Class: 9                                      Packing group: III                                      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene)  
Marine pollutant: yes

### IATA

UN number: 3077                      Class: 9                                      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene)

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

#### **SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

#### **Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

#### **Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene	72-55-9	1993-04-24

#### **New Jersey Right To Know Components**

	CAS-No.	Revision Date
2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene	72-55-9	1993-04-24

#### **California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene	72-55-9	2010-06-11

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

	CAS-No.	Revision Date
2,2-bis(p-Chlorophenyl)-1,1-dichloroethylene	72-55-9	2010-06-11

---

## **16. OTHER INFORMATION**

### **Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

#### **HMIS Rating**

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

#### **NFPA Rating**

Health hazard:	1
Fire Hazard:	0
Reactivity Hazard:	0

#### **Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.3

Revision Date: 01/02/2015

Print Date: 05/11/2016

## SAFETY DATA SHEET

Version 5.4  
Revision Date 02/28/2015  
Print Date 05/11/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : 4,4'-DDT

Product Number : 31041  
Brand : Sigma-Aldrich  
Index-No. : 602-045-00-7

CAS-No. : 50-29-3

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 3), H301  
Acute toxicity, Dermal (Category 3), H311  
Carcinogenicity (Category 2), H351  
Specific target organ toxicity - repeated exposure, Oral (Category 1), H372  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H301 + H311

Toxic if swallowed or in contact with skin

H351

Suspected of causing cancer.

H372

Causes damage to organs through prolonged or repeated exposure if swallowed.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and

	understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing.
P281	Use personal protective equipment as required.
P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician. Rinse mouth.
P302 + P352 + P312	IF ON SKIN: Wash with plenty of soap and water. Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P361	Remove/Take off immediately all contaminated clothing.
P363	Wash contaminated clothing before reuse.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : 1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane  
1,1-Bis(4-chlorophenyl)-2,2,2-trichloroethane

Formula : C<sub>14</sub>H<sub>9</sub>Cl<sub>5</sub>  
Molecular weight : 354.49 g/mol  
CAS-No. : 50-29-3  
EC-No. : 200-024-3  
Index-No. : 602-045-00-7

#### Hazardous components

Component	Classification	Concentration
<b>1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane</b>		
	Acute Tox. 3; Carc. 2; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H301 + H311, H351, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Liver damage Confirmed animal carcinogen with unknown relevance to humans		

		TWA	0.500000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation		

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                    |                   |
|--------------------|-------------------|
| a) Appearance      | Form: solid       |
| b) Odour           | No data available |
| c) Odour Threshold | No data available |

d) pH	No data available
e) Melting point/freezing point	Melting point/range: 107 - 110 °C (225 - 230 °F) - lit.
f) Initial boiling point and boiling range	260.0 °C (500.0 °F)
g) Flash point	72.0 - 77.0 °C (161.6 - 170.6 °F)
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	0.0000021 hPa (0.0000016 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density	No data available
m) Relative density	0.99 g/cm3
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	log Pow: 6.91
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Oxidizing agents, Iron and iron salts.

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 87.0 mg/kg

Inhalation: No data available

LD50 Dermal - Rabbit - 300.0 mg/kg

Remarks: Behavioral:Tremor. Behavioral:Muscle weakness. Behavioral:Ataxia.

No data available

**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)

NTP: Reasonably anticipated to be a human carcinogen (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

Ingestion - Causes damage to organs through prolonged or repeated exposure.

**Aspiration hazard**

No data available

**Additional Information**

RTECS: KJ3325000

CNS stimulation.

Pancreas. -

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 0.01 mg/l - 96.0 h
	LC50 - Lepomis macrochirus (Bluegill) - 0.01 mg/l - 96.0 h
	LC50 - Oncorhynchus mykiss (rainbow trout) - 0.003400 mg/l - 96.0 h
	LOEC - Oncorhynchus mykiss (rainbow trout) - 150 mg/l - 3.0 d
	NOEC - Oncorhynchus mykiss (rainbow trout) - 113 mg/l - 3.0 d
Toxicity to daphnia and other aquatic invertebrates	Immobilization EC50 - Daphnia magna (Water flea) - 0.00108 mg/l - 48 h
Toxicity to algae	LC100 - Scenedesmus quadricauda (Green algae) - > 20 mg/l - 7 d

## 12.2 Persistence and degradability

## 12.3 Bioaccumulative potential

Bioaccumulation      Oncorhynchus mykiss (rainbow trout) - 20 d  
- 0.001 mg/l

Bioconcentration factor (BCF): 46,670

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 2811      Class: 6.1      Packing group: III  
Proper shipping name: Toxic solids, organic, n.o.s. (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)  
Reportable Quantity (RQ): 1 lbs  
Marine pollutant: yes  
Poison Inhalation Hazard: No

### IMDG

UN number: 2811      Class: 6.1      Packing group: III      EMS-No: F-A, S-A  
Proper shipping name: TOXIC SOLID, ORGANIC, N.O.S. (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)  
Marine pollutant: yes

### IATA

UN number: 2811      Class: 6.1      Packing group: III  
Proper shipping name: Toxic solid, organic, n.o.s. (1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane)

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane	50-29-3	1993-04-24



**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane

CAS-No.  
50-29-3

Revision Date  
2008-06-17

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane

CAS-No.  
50-29-3

Revision Date  
2008-06-17

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H301	Toxic if swallowed.
H301 + H311	Toxic if swallowed or in contact with skin
H311	Toxic in contact with skin.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if swallowed.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	2
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.4

Revision Date: 02/28/2015

Print Date: 05/11/2016

## SAFETY DATA SHEET

Version 3.6  
Revision Date 06/30/2014  
Print Date 05/23/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : 4-Ethyltoluene

Product Number : 04943

Brand : Sigma-Aldrich

CAS-No. : 622-96-8

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 3), H226

Aspiration hazard (Category 1), H304

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H226

Flammable liquid and vapour.

H304

May be fatal if swallowed and enters airways.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.

P241

Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242

Use only non-sparking tools.

P243

Take precautionary measures against static discharge.

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.

P301 + P310

IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.

P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P331	Do NOT induce vomiting.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>9</sub> H <sub>12</sub>
Molecular Weight	: 120.19 g/mol
CAS-No.	: 622-96-8
EC-No.	: 210-761-2

#### Hazardous components

Component	Classification	Concentration
<b>4-Ethyltoluene</b>		
	Flam. Liq. 3; Asp. Tox. 1; H226, H304	-

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

no data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray; solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

## 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

##### Splash contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: clear, liquid<br>Colour: light yellow |
| b) Odour  | no data available                           |
| c) Odour Threshold                              | no data available                           |
| d) pH   | no data available                           |
| e) Melting point/freezing point                 | no data available                           |
| f) Initial boiling point and boiling range      | 162 °C (324 °F) - lit.                      |
| g) Flash point                                  | 43 °C (109 °F) - closed cup                 |
| h) Evapouration rate                            | no data available                           |
| i) Flammability (solid, gas)                    | no data available                           |
| j) Upper/lower flammability or explosive limits | no data available                           |
| k) Vapour pressure                              | no data available                           |
| l) Vapour density                               | no data available                           |
| m) Relative density                             | 0.861 g/mL at 25 °C (77 °F)                 |
| n) Water solubility                             | no data available                           |
| o) Partition coefficient: n-octanol/water       | no data available                           |
| p) Auto-ignition temperature                    | no data available                           |
| q) Decomposition temperature                    | no data available                           |
| r) Viscosity                                    | no data available                           |
| s) Explosive properties                         | no data available                           |

t) Oxidizing properties      no data available

## 9.2 Other safety information

no data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

no data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

no data available

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - no data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - rat - 4,850 mg/kg

Remarks: Behavioral:Convulsions or effect on seizure threshold. Behavioral:Ataxia.

Inhalation: no data available

Dermal: no data available

no data available

#### Skin corrosion/irritation

no data available

#### Serious eye damage/eye irritation

no data available

#### Respiratory or skin sensitisation

no data available

#### Germ cell mutagenicity

mouse

Sister chromatid exchange

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

no data available

Reproductive toxicity - rat - Oral

Maternal Effects: Other effects. Effects on Fertility: Post-implantation mortality (e.g., dead and/or resorbed implants per total number of implants).

no data available

**Specific target organ toxicity - single exposure**

no data available

**Specific target organ toxicity - repeated exposure**

no data available

**Aspiration hazard**

The substance or mixture is known to cause human aspiration toxicity hazards or has to be regarded as if it causes a human aspiration toxicity hazard.

**Additional Information**

RTECS: XT2550000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

no data available

### 12.2 Persistence and degradability

no data available

### 12.3 Bioaccumulative potential

no data available

### 12.4 Mobility in soil

no data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

no data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

**DOT (US)**

UN number: 3295      Class: 3      Packing group: III

Proper shipping name: Hydrocarbons, liquid, n.o.s.

Marine pollutant: No

Poison Inhalation Hazard: No

**IMDG**

UN number: 3295      Class: 3      Packing group: III

EMS-No: F-E, S-D

Proper shipping name: HYDROCARBONS, LIQUID, N.O.S.

Marine pollutant: No

**IATA**

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Fire Hazard

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
4-Ethyltoluene	622-96-8	

### New Jersey Right To Know Components

	CAS-No.	Revision Date
4-Ethyltoluene	622-96-8	

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Asp. Tox.	Aspiration hazard
Flam. Liq.	Flammable liquids
H226	Flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.

### HMIS Rating

Health hazard:	1
Chronic Health Hazard:	
Flammability:	2
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	2
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956







# SAFETY DATA SHEET

Creation Date 28-Apr-2009

Revision Date 12-Mar-2014

Revision Number 1

## 1. Identification

**Product Name** Acetone

**Cat No. :** AC167640000; AC167640025; AC167645000

**Synonyms** 2-Propanone

**Recommended Use** Laboratory chemicals.

**Uses advised against** No Information available

**Details of the supplier of the safety data sheet**

**Company**

Fisher Scientific  
One Reagent Lane  
Fair Lawn, NJ 07410  
Tel: (201) 796-7100

**Entity / Business Name**

Acros Organics  
One Reagent Lane  
Fair Lawn, NJ 07410

**Emergency Telephone Number**

For information **US** call: 001-800-ACROS-01  
/ **Europe** call: +32 14 57 52 11  
Emergency Number **US**:001-201-796-7100 /  
**Europe**: +32 14 57 52 99  
**CHEMTREC** Tel. No.**US**:001-800-424-9300 /  
**Europe**:001-703-527-3887

## 2. Hazard(s) identification

**Classification**

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, spleen, Blood.	

**Label Elements**

**Signal Word**

Danger

**Hazard Statements**

Highly flammable liquid and vapor  
Causes serious eye irritation  
May cause drowsiness or dizziness  
May cause damage to organs through prolonged or repeated exposure

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling  
Do not breathe dust/fume/gas/mist/vapors/spray  
Use only outdoors or in a well-ventilated area  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking  
Keep container tightly closed  
Ground/bond container and receiving equipment  
Use explosion-proof electrical/ventilating/lighting/equipment  
Use only non-sparking tools  
Take precautionary measures against static discharge  
Wear protective gloves/protective clothing/eye protection/face protection  
Keep cool

**Response**

Get medical attention/advice if you feel unwell

**Inhalation**

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
Call a POISON CENTER or doctor/physician if you feel unwell

**Skin**

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

**Eyes**

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
If eye irritation persists: Get medical advice/attention

**Fire**

In case of fire: Use CO<sub>2</sub>, dry chemical, or foam for extinction

**Storage**

Store in a well-ventilated place. Keep container tightly closed  
Store locked up

**Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)**

Repeated exposure may cause skin dryness or cracking

### 3. Composition / information on ingredients

Component	CAS-No	Weight %
Acetone	67-64-1	>95

### 4. First-aid measures

**Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.  
Obtain medical attention.

**Skin Contact**

Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

**Inhalation**

Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur.

**Ingestion**

Do not induce vomiting. Obtain medical attention.

<b>Most important symptoms/effects</b>	Breathing difficulties. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: May cause pulmonary edema: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
<b>Notes to Physician</b>	Treat symptomatically

### 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	CO <sub>2</sub> , dry chemical, dry sand, alcohol-resistant foam. Water spray. Cool closed containers exposed to fire with water spray.
<b>Unsuitable Extinguishing Media</b>	Water may be ineffective
<b>Flash Point</b>	-20 °C / -4 °F
<b>Method -</b>	Closed cup
<b>Autoignition Temperature</b>	465 °C / 869 °F
<b>Explosion Limits</b>	
<b>Upper</b>	12.8 vol %
<b>Lower</b>	2.5 vol %
<b>Oxidizing Properties</b>	Not oxidising
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	No information available

#### Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

#### Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO<sub>2</sub>) Formaldehyde Methanol

#### Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

#### NFPA

<b>Health</b>	<b>Flammability</b>	<b>Instability</b>	<b>Physical hazards</b>
1	3	0	N/A

### 6. Accidental release measures

<b>Personal Precautions</b>	Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges. Keep people away from and upwind of spill/leak. Avoid contact with skin, eyes and inhalation of vapors.
<b>Environmental Precautions</b>	Should not be released into the environment.
<b>Methods for Containment and Clean Up</b>	Remove all sources of ignition. Take precautionary measures against static discharges. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Use spark-proof tools and explosion-proof equipment.

### 7. Handling and storage

<b>Handling</b>	Wear personal protective equipment. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharges. Use only non-sparking tools. Use explosion-proof equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.
<b>Storage</b>	Flammables area. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Keep container tightly closed in a dry and well-ventilated place.

## 8. Exposure controls / personal protection

### Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Acetone	TWA: 500 ppm STEL: 750 ppm	(Vacated) TWA: 750 ppm (Vacated) TWA: 1800 mg/m <sup>3</sup> (Vacated) STEL: 2400 mg/m <sup>3</sup> (Vacated) STEL: 1000 ppm TWA: 1000 ppm TWA: 2400 mg/m <sup>3</sup>	IDLH: 2500 ppm TWA: 250 ppm TWA: 590 mg/m <sup>3</sup>
Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Acetone	TWA: 500 ppm TWA: 1190 mg/m <sup>3</sup> STEL: 1000 ppm STEL: 2380 mg/m <sup>3</sup>	TWA: 1000 ppm TWA: 2400 mg/m <sup>3</sup> STEL: 1260 ppm STEL: 3000 mg/m <sup>3</sup>	TWA: 500 ppm STEL: 750 ppm

### Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

### Engineering Measures

Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment.

### Personal Protective Equipment

#### Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

#### Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

#### Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

#### Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

## 9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	sweet
Odor Threshold	19.8 ppm
pH	7
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	56 °C / 132.8 °F
Flash Point	-20 °C / -4 °F
Method -	Closed cup
Evaporation Rate	5.6 (Butyl Acetate = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	12.8 vol %
Lower	2.5 vol %
Vapor Pressure	247 mbar @ 20 °C
Vapor Density	2.0
Relative Density	0.790
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	465 °C / 869 °F
Decomposition Temperature	> 4°C
Viscosity	0.32 mPa.s @ 20 °C
Molecular Formula	C3 H6 O
Molecular Weight	58.08
Refractive index	1.358 - 1.359

## 10. Stability and reactivity

<b>Reactive Hazard</b>	None known, based on information available
<b>Stability</b>	Stable under normal conditions.
<b>Conditions to Avoid</b>	Heat, flames and sparks. Incompatible products. Keep away from open flames, hot surfaces and sources of ignition.
<b>Incompatible Materials</b>	Strong oxidizing agents, Strong reducing agents, Strong bases, Peroxides, Halogenated compounds, Alkali metals, Amines
<b>Hazardous Decomposition Products</b>	Carbon monoxide (CO), Carbon dioxide (CO <sub>2</sub> ), Formaldehyde, Methanol
<b>Hazardous Polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous Reactions</b>	None under normal processing.

## 11. Toxicological information

### Acute Toxicity

#### Product Information

#### Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acetone	5800 mg/kg ( Rat )	> 15800 mg/kg (rabbit) > 7400 mg/kg (rat)	76 mg/l, 4 h, (rat)

**Toxicologically Synergistic Products** Carbon tetrachloride; Chloroform; Trichloroethylene; Bromodichloromethane; Dibromochloromethane; N-nitrosodimethylamine; 1,1,2-Trichloroethane; Styrene; Acetonitrile, 2,5-Hexanedione; Ethanol; 1,2-Dichlorobenzene

### Delayed and immediate effects as well as chronic effects from short and long-term exposure

<b>Irritation</b>	Irritating to eyes and skin
<b>Sensitization</b>	No information available
<b>Carcinogenicity</b>	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Acetone	67-64-1	Not listed	Not listed	Not listed	Not listed	Not listed

**Mutagenic Effects** No information available

**Reproductive Effects** No information available.

**Developmental Effects** No information available.

**Teratogenicity** No information available.

**STOT - single exposure** Central nervous system (CNS)

**STOT - repeated exposure** Kidney Liver spleen Blood

**Aspiration hazard** No information available

**Symptoms / effects, both acute and** Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting:

<b>delayed</b>	May cause pulmonary edema: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
<b>Endocrine Disruptor Information</b>	No information available
<b>Other Adverse Effects</b>	Neurotoxic effects have occurred in experimental animals.

## 12. Ecological information

### Ecotoxicity

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Acetone	NOEC = 430 mg/l (algae; 96 h)	Oncorhynchus mykiss: LC50 = 5540 mg/l 96h Alburnus alburnus: LC50 = 11000 mg/l 96h Leuciscus idus: LC50 = 11300 mg/L/48h Salmo gairdneri: LC50 = 6100 mg/L/24h	EC50 = 14500 mg/L/15 min	EC50 = 8800 mg/L/48h EC50 = 12700 mg/L/48h EC50 = 12600 mg/L/48h

**Persistence and Degradability** Persistence is unlikely based on information available.  
**Bioaccumulation/ Accumulation** No information available.

**Mobility** Will likely be mobile in the environment due to its volatility.

Component	log Pow
Acetone	-0.24

## 13. Disposal considerations

**Waste Disposal Methods** Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Acetone - 67-64-1	U002	-

## 14. Transport information

### DOT

UN-No UN1090  
 Proper Shipping Name ACETONE  
 Hazard Class 3  
 Packing Group II

### TDG

UN-No UN1090  
 Proper Shipping Name ACETONE  
 Hazard Class 3  
 Packing Group II

### IATA

UN-No UN1090  
 Proper Shipping Name ACETONE  
 Hazard Class 3  
 Packing Group II

### IMDG/IMO

UN-No UN1090  
 Proper Shipping Name ACETONE  
 Hazard Class 3  
 Packing Group II

## 15. Regulatory information

### International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Acetone	X	X	-	200-662-2	-		X	X	X	X	X

**Legend:**

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

**U.S. Federal Regulations**

TSCA 12(b) Not applicable

SARA 313 Not applicable

**SARA 311/312 Hazardous Categorization**

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act Not applicable

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration  
Not applicable**CERCLA**

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Acetone	5000 lb	-

**California Proposition 65** This product does not contain any Proposition 65 chemicals**State Right-to-Know**

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Acetone	X	X	X	-	X

**U.S. Department of Transportation**

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

**U.S. Department of Homeland Security**

This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Acetone	2000 lb STQ



Other International Regulations

Mexico - Grade

Serious risk, Grade 3

## Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class

B2 Flammable liquid  
D2B Toxic materials

**16. Other information**

Prepared By

Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

Creation Date

28-Apr-2009

Revision Date

12-Mar-2014

Print Date

12-Mar-2014

Revision Summary

This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

## Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**



# SAFETY DATA SHEET

Creation Date 28-Apr-2009

Revision Date 12-Mar-2014

Revision Number 1

## 1. Identification

**Product Name** Acetone

**Cat No. :** AC167640000; AC167640025; AC167645000

**Synonyms** 2-Propanone

**Recommended Use** Laboratory chemicals.

**Uses advised against** No Information available

**Details of the supplier of the safety data sheet**

**Company**  
Fisher Scientific  
One Reagent Lane  
Fair Lawn, NJ 07410  
Tel: (201) 796-7100

**Entity / Business Name**  
Acros Organics  
One Reagent Lane  
Fair Lawn, NJ 07410

**Emergency Telephone Number**  
For information **US** call: 001-800-ACROS-01  
/ **Europe** call: +32 14 57 52 11  
Emergency Number **US**:001-201-796-7100 /  
**Europe**: +32 14 57 52 99  
**CHEMTREC** Tel. No.**US**:001-800-424-9300 /  
**Europe**:001-703-527-3887

## 2. Hazard(s) identification

### **Classification**

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, spleen, Blood.	

### **Label Elements**

#### **Signal Word**

Danger

#### **Hazard Statements**

Highly flammable liquid and vapor  
Causes serious eye irritation  
May cause drowsiness or dizziness  
May cause damage to organs through prolonged or repeated exposure

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling  
Do not breathe dust/fume/gas/mist/vapors/spray  
Use only outdoors or in a well-ventilated area  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking  
Keep container tightly closed  
Ground/bond container and receiving equipment  
Use explosion-proof electrical/ventilating/lighting/equipment  
Use only non-sparking tools  
Take precautionary measures against static discharge  
Wear protective gloves/protective clothing/eye protection/face protection  
Keep cool

**Response**

Get medical attention/advice if you feel unwell

**Inhalation**

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
Call a POISON CENTER or doctor/physician if you feel unwell

**Skin**

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

**Eyes**

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
If eye irritation persists: Get medical advice/attention

**Fire**

In case of fire: Use CO<sub>2</sub>, dry chemical, or foam for extinction

**Storage**

Store in a well-ventilated place. Keep container tightly closed  
Store locked up

**Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)**

Repeated exposure may cause skin dryness or cracking

### 3. Composition / information on ingredients

Component	CAS-No	Weight %
Acetone	67-64-1	>95

### 4. First-aid measures

**Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.  
Obtain medical attention.

**Skin Contact**

Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

**Inhalation**

Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately if symptoms occur.

**Ingestion**

Do not induce vomiting. Obtain medical attention.

<b>Most important symptoms/effects</b>	Breathing difficulties. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: May cause pulmonary edema: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
<b>Notes to Physician</b>	Treat symptomatically

### 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	CO <sub>2</sub> , dry chemical, dry sand, alcohol-resistant foam. Water spray. Cool closed containers exposed to fire with water spray.
<b>Unsuitable Extinguishing Media</b>	Water may be ineffective
<b>Flash Point</b>	-20 °C / -4 °F
<b>Method -</b>	Closed cup
<b>Autoignition Temperature</b>	465 °C / 869 °F
<b>Explosion Limits</b>	
<b>Upper</b>	12.8 vol %
<b>Lower</b>	2.5 vol %
<b>Oxidizing Properties</b>	Not oxidising
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	No information available

#### Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

#### Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO<sub>2</sub>) Formaldehyde Methanol

#### Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

#### NFPA

<b>Health</b>	<b>Flammability</b>	<b>Instability</b>	<b>Physical hazards</b>
1	3	0	N/A

### 6. Accidental release measures

<b>Personal Precautions</b>	Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges. Keep people away from and upwind of spill/leak. Avoid contact with skin, eyes and inhalation of vapors.
<b>Environmental Precautions</b>	Should not be released into the environment.
<b>Methods for Containment and Clean Up</b>	Remove all sources of ignition. Take precautionary measures against static discharges. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Use spark-proof tools and explosion-proof equipment.

### 7. Handling and storage

<b>Handling</b>	Wear personal protective equipment. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharges. Use only non-sparking tools. Use explosion-proof equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.
<b>Storage</b>	Flammables area. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Keep container tightly closed in a dry and well-ventilated place.

## 8. Exposure controls / personal protection

### Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Acetone	TWA: 500 ppm STEL: 750 ppm	(Vacated) TWA: 750 ppm (Vacated) TWA: 1800 mg/m <sup>3</sup> (Vacated) STEL: 2400 mg/m <sup>3</sup> (Vacated) STEL: 1000 ppm TWA: 1000 ppm TWA: 2400 mg/m <sup>3</sup>	IDLH: 2500 ppm TWA: 250 ppm TWA: 590 mg/m <sup>3</sup>
Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Acetone	TWA: 500 ppm TWA: 1190 mg/m <sup>3</sup> STEL: 1000 ppm STEL: 2380 mg/m <sup>3</sup>	TWA: 1000 ppm TWA: 2400 mg/m <sup>3</sup> STEL: 1260 ppm STEL: 3000 mg/m <sup>3</sup>	TWA: 500 ppm STEL: 750 ppm

### Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

### Engineering Measures

Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment.

### Personal Protective Equipment

#### Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

#### Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

#### Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

#### Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

## 9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	sweet
Odor Threshold	19.8 ppm
pH	7
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	56 °C / 132.8 °F
Flash Point	-20 °C / -4 °F
Method -	Closed cup
Evaporation Rate	5.6 (Butyl Acetate = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	12.8 vol %
Lower	2.5 vol %
Vapor Pressure	247 mbar @ 20 °C
Vapor Density	2.0
Relative Density	0.790
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	465 °C / 869 °F
Decomposition Temperature	> 4°C
Viscosity	0.32 mPa.s @ 20 °C
Molecular Formula	C3 H6 O
Molecular Weight	58.08
Refractive index	1.358 - 1.359

## 10. Stability and reactivity

<b>Reactive Hazard</b>	None known, based on information available
<b>Stability</b>	Stable under normal conditions.
<b>Conditions to Avoid</b>	Heat, flames and sparks. Incompatible products. Keep away from open flames, hot surfaces and sources of ignition.
<b>Incompatible Materials</b>	Strong oxidizing agents, Strong reducing agents, Strong bases, Peroxides, Halogenated compounds, Alkali metals, Amines
<b>Hazardous Decomposition Products</b>	Carbon monoxide (CO), Carbon dioxide (CO <sub>2</sub> ), Formaldehyde, Methanol
<b>Hazardous Polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous Reactions</b>	None under normal processing.

## 11. Toxicological information

### Acute Toxicity

#### Product Information

#### Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acetone	5800 mg/kg ( Rat )	> 15800 mg/kg (rabbit) > 7400 mg/kg (rat)	76 mg/l, 4 h, (rat)

**Toxicologically Synergistic Products** Carbon tetrachloride; Chloroform; Trichloroethylene; Bromodichloromethane; Dibromochloromethane; N-nitrosodimethylamine; 1,1,2-Trichloroethane; Styrene; Acetonitrile, 2,5-Hexanedione; Ethanol; 1,2-Dichlorobenzene

### Delayed and immediate effects as well as chronic effects from short and long-term exposure

<b>Irritation</b>	Irritating to eyes and skin
<b>Sensitization</b>	No information available
<b>Carcinogenicity</b>	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Acetone	67-64-1	Not listed	Not listed	Not listed	Not listed	Not listed

**Mutagenic Effects** No information available

**Reproductive Effects** No information available.

**Developmental Effects** No information available.

**Teratogenicity** No information available.

**STOT - single exposure** Central nervous system (CNS)

**STOT - repeated exposure** Kidney Liver spleen Blood

**Aspiration hazard** No information available

**Symptoms / effects, both acute and** Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting:

<b>delayed</b>	May cause pulmonary edema: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
<b>Endocrine Disruptor Information</b>	No information available
<b>Other Adverse Effects</b>	Neurotoxic effects have occurred in experimental animals.

## 12. Ecological information

### Ecotoxicity

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Acetone	NOEC = 430 mg/l (algae; 96 h)	Oncorhynchus mykiss: LC50 = 5540 mg/l 96h Alburnus alburnus: LC50 = 11000 mg/l 96h Leuciscus idus: LC50 = 11300 mg/L/48h Salmo gairdneri: LC50 = 6100 mg/L/24h	EC50 = 14500 mg/L/15 min	EC50 = 8800 mg/L/48h EC50 = 12700 mg/L/48h EC50 = 12600 mg/L/48h

<b>Persistence and Degradability</b>	Persistence is unlikely based on information available.
<b>Bioaccumulation/ Accumulation</b>	No information available.

<b>Mobility</b>	Will likely be mobile in the environment due to its volatility.
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Component	log Pow
Acetone	-0.24

## 13. Disposal considerations

<b>Waste Disposal Methods</b>	Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.
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Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Acetone - 67-64-1	U002	-

## 14. Transport information

### DOT

UN-No	UN1090
Proper Shipping Name	ACETONE
Hazard Class	3
Packing Group	II

### TDG

UN-No	UN1090
Proper Shipping Name	ACETONE
Hazard Class	3
Packing Group	II

### IATA

UN-No	UN1090
Proper Shipping Name	ACETONE
Hazard Class	3
Packing Group	II

### IMDG/IMO

UN-No	UN1090
Proper Shipping Name	ACETONE
Hazard Class	3
Packing Group	II

## 15. Regulatory information

### International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Acetone	X	X	-	200-662-2	-		X	X	X	X	X

**Legend:**

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

**U.S. Federal Regulations**

TSCA 12(b) Not applicable

SARA 313 Not applicable

**SARA 311/312 Hazardous Categorization**

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act Not applicable

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration  
Not applicable**CERCLA**

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Acetone	5000 lb	-

**California Proposition 65** This product does not contain any Proposition 65 chemicals**State Right-to-Know**

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Acetone	X	X	X	-	X

**U.S. Department of Transportation**

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

**U.S. Department of Homeland Security**

This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Acetone	2000 lb STQ



Other International Regulations

Mexico - Grade Serious risk, Grade 3

**Canada**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class B2 Flammable liquid  
D2B Toxic materials

**16. Other information**

Prepared By Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

Creation Date 28-Apr-2009

Revision Date 12-Mar-2014

Print Date 12-Mar-2014

Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

**Disclaimer**

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**

## SAFETY DATA SHEET

Version 4.6  
Revision Date 01/26/2016  
Print Date 05/01/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name :  $\alpha$ -Chlordane

Product Number : 442449  
Brand : Supelco

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 4), H332  
Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H302 + H332

Harmful if swallowed or if inhaled

H315

Causes skin irritation.

H319

Causes serious eye irritation.

H335

May cause respiratory irritation.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P264

Wash skin thoroughly after handling.

P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear eye protection/ face protection.
P280	Wear protective gloves.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Molecular weight : 208.29 g/mol  
EC-No. : 225-825-5

#### Hazardous components

Component	Classification	Concentration
<b>Chlordane</b>		
	Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, H315, H319, H335, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non Combustible Solids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### **Components with workplace control parameters**

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### **Appropriate engineering controls**

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### **Personal protective equipment**

##### **Eye/face protection**

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Full contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

**Splash contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: crystalline<br>Colour: colourless |
| b) Odour  | No data available                       |
| c) Odour Threshold                              | No data available                       |
| d) pH   | No data available                       |
| e) Melting point/freezing point                 | 93.0 - 94.0 °C (199.4 - 201.2 °F)       |
| f) Initial boiling point and boiling range      | No data available                       |
| g) Flash point                                  | No data available                       |
| h) Evaporation rate                             | No data available                       |
| i) Flammability (solid, gas)                    | No data available                       |
| j) Upper/lower flammability or explosive limits | No data available                       |
| k) Vapour pressure                              | No data available                       |
| l) Vapour density                               | No data available                       |
| m) Relative density                             | No data available                       |

- |    |  |                   |
|----|--|-------------------|
| n) | Water solubility                       | No data available |
| o) | Partition coefficient: n-octanol/water | No data available |
| p) | Auto-ignition temperature              | No data available |
| q) | Decomposition temperature              | No data available |
| r) | Viscosity                              | No data available |
| s) | Explosive properties                   | No data available |
| t) | Oxidizing properties                   | No data available |

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 500 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Chlordane)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - Lepomis macrochirus (Bluegill) - 0.0074 mg/l - 96 h

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

Bioaccumulation Lepomis macrochirus (Bluegill) - 24 h  
- 0.005 mg/l

Bioconcentration factor (BCF): 322

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

**DOT (US)**

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Chlordane)  
Reportable Quantity (RQ): 1 lbs  
Marine pollutant: yes  
Poison Inhalation Hazard: No

**IMDG**

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Chlordane)  
Marine pollutant:yes

**IATA**

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chlordane)

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Chlordane	5103-71-9	

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Chlordane	5103-71-9	

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Eye Irrit.	Eye irritation
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H332	Harmful if inhaled.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0



**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.6

Revision Date: 01/26/2016

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 5.2  
Revision Date 07/09/2015  
Print Date 05/01/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Alcohol

Product Number : PHR1373  
Brand : Sigma-Aldrich  
Index-No. : 603-002-00-5

CAS-No. : 64-17-5

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Eye irritation (Category 2A), H319

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H225

Highly flammable liquid and vapour.

H319

Causes serious eye irritation.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.

P241

Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242

Use only non-sparking tools.

P243

Take precautionary measures against static discharge.

P264

Wash skin thoroughly after handling.

P280

Wear protective gloves/ eye protection/ face protection.

P303 + P361 + P353

IF ON SKIN (or hair): Take off immediately all contaminated clothing.

P305 + P351 + P338	Rinse skin with water/shower. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P235	Store in a well-ventilated place. Keep cool.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Molecular weight	: 46.07 g/mol
CAS-No.	: 64-17-5
EC-No.	: 200-578-6
Index-No.	: 603-002-00-5

#### Hazardous components

Component	Classification	Concentration
<b>Ethanol</b>		
	Flam. Liq. 2; Eye Irrit. 2A; H225, H319	>= 90 - <= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Store at Room Temperature.

Storage class (TRGS 510): Flammable liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Ethanol	64-17-5	TWA	1,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Confirmed animal carcinogen with unknown relevance to humans		
		TWA	1,000 ppm 1,900 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	1,000 ppm 1,900 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	1,000.000000 ppm 1,900.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

		TWA	1,000.000000 ppm 1,900.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		STEL	1,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Confirmed animal carcinogen with unknown relevance to humans		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min

Material tested: Dermatrill® P (KCL 743 / Aldrich Z677388, Size M)

### Body Protection

impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |               |   |
|---------------|---|
| a) Appearance | Form: liquid, clear<br>Colour: colourless |
| b) Odour      | No data available                         |

c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	-143.99 °C (-227.18 °F)
f) Initial boiling point and boiling range	78.0 - 80.0 °C (172.4 - 176.0 °F)
g) Flash point	14 °C (57 °F)
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 19 %(V) Lower explosion limit: 3.3 %(V)
k) Vapour pressure	59.5 hPa (44.6 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density	No data available
m) Relative density	0.7974 g/cm <sup>3</sup>
n) Water solubility	completely soluble
o) Partition coefficient: n-octanol/water	log Pow: -0.349 at 24 °C (75 °F)
p) Auto-ignition temperature	363.0 °C (685.4 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Alkali metals, Oxidizing agents, Peroxides

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1170      Class: 3      Packing group: II  
Proper shipping name: Ethanol  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 1170      Class: 3      Packing group: II      EMS-No: F-E, S-D  
Proper shipping name: ETHANOL

### IATA

UN number: 1170      Class: 3      Packing group: II  
Proper shipping name: Ethanol

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids



H225                      Highly flammable liquid and vapour.  
H319                      Causes serious eye irritation.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.2

Revision Date: 07/09/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.8  
Revision Date 12/02/2015  
Print Date 05/01/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Aluminum

Product Number : 310360

Brand : Sigma-Aldrich

CAS-No. : 7429-90-5

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Warning

Hazard statement(s)  
H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273 : Avoid release to the environment.

P391 : Collect spillage.

P501 : Dispose of contents/ container to an approved waste disposal plant.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS**

Combustible dust

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Formula : Al

Molecular weight : 26.98 g/mol  
CAS-No. : 7429-90-5  
EC-No. : 231-072-3

#### Hazardous components

Component	Classification	Concentration
<b>Aluminum</b>		
	Aquatic Acute 1; H400	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Aluminum oxide

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Store under inert gas. Air and moisture sensitive.  
Storage class (TRGS 510): Non Combustible Solids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Aluminum	7429-90-5	TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	10.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	15.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Lower Respiratory Tract irritation Pneumoconiosis Neurotoxicity Not classifiable as a human carcinogen		
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	15.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Lower Respiratory Tract irritation Pneumoconiosis Neurotoxicity Not classifiable as a human carcinogen varies		

		TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Lower Respiratory Tract irritation Pneumoconiosis Neurotoxicity Not classifiable as a human carcinogen varies		
		TWA	15 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Lower Respiratory Tract irritation Pneumoconiosis Neurotoxicity Not classifiable as a human carcinogen varies		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: Wire
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 660.37 °C (1,220.67 °F) - lit.
f) Initial boiling point and boiling range	2,460 °C (4,460 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	May form combustible dust concentrations in air
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	2.7 g/cm <sup>3</sup> at 25 °C (77 °F)
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

#### 10.4 Conditions to avoid

No data available

#### 10.5 Incompatible materials

Oxidizing agents

#### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

##### Skin corrosion/irritation

No data available

##### Serious eye damage/eye irritation

No data available

##### Respiratory or skin sensitisation

No data available

##### Germ cell mutagenicity

No data available

##### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

No data available

No data available

##### Specific target organ toxicity - single exposure

No data available

##### Specific target organ toxicity - repeated exposure

No data available

##### Aspiration hazard

No data available

##### Additional Information

RTECS: BD0330000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

### 12. ECOLOGICAL INFORMATION

#### 12.1 Toxicity

Toxicity to fish

LC50 - Oncorhynchus mykiss (rainbow trout) - 0.12 mg/l - 96 h

mortality LOEC - Ctenopharyngodon idella - 0.1 mg/l - 96 h

## 12.2 Persistence and degradability

Biodegradability Result: - Readily biodegradable

## 12.3 Bioaccumulative potential

Bioaccumulation Salvelinus fontinalis - 56 d  
- 268 µg/l

Bioconcentration factor (BCF): 36

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

Not dangerous goods

### IMDG

UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Aluminum)  
Marine pollutant: yes

### IATA

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Aluminum)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Aluminum	7429-90-5	1994-04-01

### SARA 311/312 Hazards

No SARA Hazards

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Aluminum	7429-90-5	1994-04-01

### Pennsylvania Right To Know Components

CAS-No.	Revision Date
---------	---------------



Aluminum 7429-90-5 1994-04-01

**New Jersey Right To Know Components**

Aluminum	CAS-No. 7429-90-5	Revision Date 1994-04-01
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**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.8

Revision Date: 12/02/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 5.2  
Revision Date 02/27/2015  
Print Date 05/11/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Aroclor 1262

Product Number : 442463  
Brand : Supelco  
Index-No. : 602-039-00-4

CAS-No. : 37324-23-5

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Carcinogenicity (Category 1B), H350

Specific target organ toxicity - repeated exposure (Category 2), H373

Acute aquatic toxicity (Category 3), H402

Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H350

May cause cancer.

H373

May cause damage to organs through prolonged or repeated exposure.

H412

Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P260

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

P273

Avoid release to the environment.

P280

Wear protective gloves/ protective clothing/ eye protection/ face

P308 + P313  
P405  
P501

protection.  
IF exposed or concerned: Get medical advice/ attention.  
Store locked up.  
Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

CAS-No. : 37324-23-5  
Index-No. : 602-039-00-4

#### Hazardous components

Component	Classification	Concentration
<b>PCB - Aroclor 1262</b>		
	Carc. 1B; STOT RE 2; Aquatic Acute 3; Aquatic Chronic 3; H350, H373, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Nature of decomposition products not known.

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

## 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

## 6.4 Reference to other sections

For disposal see section 13.

---

# 7. HANDLING AND STORAGE

## 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.  
For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.  
Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

# 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

## 8.1 Control parameters

### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
PCB - Aroclor 1262	37324-23-5	TWA	0.001000 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	Potential Occupational Carcinogen		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: liquid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

**10.4 Conditions to avoid**

No data available

**10.5 Incompatible materials**

Strong oxidizing agents

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 11,300 mg/kg

Inhalation: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

Carcinogen

Possible human carcinogen

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

May cause damage to organs through prolonged or repeated exposure.

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: TQ1364000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - Oncorhynchus clarki - 50 mg/l - 96 h

### 12.2 Persistence and degradability

Biodegradability Result: - According to the results of tests of biodegradability this product is not readily biodegradable.  
Remarks: No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life with long lasting effects.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 2315 Class: 9 Packing group: II  
Proper shipping name: Polychlorinated biphenyls, liquid  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 2315 Class: 9 Packing group: II EMS-No: F-A, S-A  
Proper shipping name: POLYCHLORINATED BIPHENYLS, LIQUID  
Marine pollutant: yes

### IATA

UN number: 2315 Class: 9 Packing group: II  
Proper shipping name: Polychlorinated biphenyls, liquid

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

CAS-No.

Revision Date

PCB - Aroclor 1262

37324-23-5

1989-08-11

### New Jersey Right To Know Components

PCB - Aroclor 1262

CAS-No.  
37324-23-5

Revision Date  
1989-08-11

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

PCB - Aroclor 1262

CAS-No.  
37324-23-5

Revision Date  
2008-08-01

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

PCB - Aroclor 1262

CAS-No.  
37324-23-5

Revision Date  
2008-08-01

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H350	May cause cancer.
H373	May cause damage to organs through prolonged or repeated exposure.
H402	Harmful to aquatic life.

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.2

Revision Date: 02/27/2015

Print Date: 05/11/2016



## SAFETY DATA SHEET

Version 4.7  
Revision Date 11/11/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Aroclor 1242

Product Number : 48585  
Brand : Supelco  
Index-No. : 602-039-00-4

CAS-No. : 53469-21-9

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Specific target organ toxicity - repeated exposure (Category 1), H372

Acute aquatic toxicity (Category 1), H400

Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H372

Causes damage to organs through prolonged or repeated exposure.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P260

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

P264

Wash skin thoroughly after handling.

P270

Do not eat, drink or smoke when using this product.

P273

Avoid release to the environment.

P314

Get medical advice/ attention if you feel unwell.

P391

Collect spillage.

P501

Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

CAS-No. : 53469-21-9  
Index-No. : 602-039-00-4

##### Hazardous components

Component	Classification	Concentration
<b>Aroclor 1242</b>		
	STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.  
Storage class (TRGS 510): Non Combustible Liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Aroclor 1242	53469-21-9	TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Eye irritation Liver damage Chloracne Danger of cutaneous absorption		
		TWA	0.001000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation		
		TWA	1 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Eye irritation Liver damage Chloracne Danger of cutaneous absorption		
		TWA	0.001 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation		

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: liquid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available

t) Oxidizing properties      No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 4,250 mg/kg

Remarks: Sense Organs and Special Senses (Nose, Eye, Ear, and Taste):Eye:Chromodacryorrhea. Diarrhoea  
Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

**Specific target organ toxicity - repeated exposure**

Causes damage to organs through prolonged or repeated exposure.

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 0.015 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates LC50 - Daphnia magna (Water flea) - 0.23 mg/l - 48 h

Toxicity to algae LC50 - Algae - 0.006 mg/l - 28 h

**12.2 Persistence and degradability**

Biodegradability Result: - According to the results of tests of biodegradability this product is not readily biodegradable.

Remarks: No data available

**12.3 Bioaccumulative potential**

Bioaccumulation Pimephales promelas (fathead minnow) - 8.5 Months  
- 0.86 µg/l

Bioconcentration factor (BCF): 274,000

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 2315 Class: 9 Packing group: II

Proper shipping name: Polychlorinated biphenyls, liquid

Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 2315      Class: 9      Packing group: II      EMS-No: F-A, S-A  
Proper shipping name: POLYCHLORINATED BIPHENYLS, LIQUID  
Marine pollutant: yes  
**IATA**  
UN number: 2315      Class: 9      Packing group: II  
Proper shipping name: Polychlorinated biphenyls, liquid

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Aroclor 1242	53469-21-9	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Aroclor 1242	53469-21-9	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Aroclor 1242	53469-21-9	1993-04-24

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Aroclor 1242	53469-21-9	2008-08-01

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

	CAS-No.	Revision Date
Aroclor 1242	53469-21-9	2008-08-01

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
STOT RE	Specific target organ toxicity - repeated exposure

### HMIS Rating

Health hazard:	1
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 11/11/2015

Print Date: 05/01/2016





## SAFETY DATA SHEET

Revision Date 10-Feb-2015

Revision Number 1

### 1. Identification

**Product Name** Barium

**Cat No. :** AC317860000; AC317860250; AC317861000; AC317865000

**Synonyms** None Known.

**Recommended Use** Laboratory chemicals.

**Uses advised against** No Information available

**Details of the supplier of the safety data sheet**

Company	Entity / Business Name	Emergency Telephone Number
Fisher Scientific	Acros Organics	For information <b>US</b> call: 001-800-ACROS-01
One Reagent Lane	One Reagent Lane	/ <b>Europe</b> call: +32 14 57 52 11
Fair Lawn, NJ 07410	Fair Lawn, NJ 07410	Emergency Number <b>US</b> :001-201-796-7100 /
Tel: (201) 796-7100		<b>Europe</b> : +32 14 57 52 99
		<b>CHEMTREC</b> Tel. No. <b>US</b> :001-800-424-9300 /
		<b>Europe</b> :001-703-527-3887

### 2. Hazard(s) identification

#### **Classification**

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable solids	Category 2
Acute oral toxicity	Category 3
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

#### **Label Elements**

##### **Signal Word**

Danger

##### **Hazard Statements**

Flammable solid  
Toxic if swallowed  
Causes skin irritation  
Causes serious eye irritation  
May cause respiratory irritation

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling  
Do not eat, drink or smoke when using this product  
Wear protective gloves/protective clothing/eye protection/face protection  
Avoid breathing dust/fume/gas/mist/vapors/spray  
Use only outdoors or in a well-ventilated area  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking  
Keep container tightly closed  
Ground/bond container and receiving equipment  
Use explosion-proof electrical/ventilating/lighting/equipment  
Use only non-sparking tools  
Take precautionary measures against static discharge

**Response**

Call a POISON CENTER or doctor/physician if you feel unwell

**Inhalation**

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

**Skin**

IF ON SKIN: Wash with plenty of soap and water  
If skin irritation occurs: Get medical advice/attention  
Take off contaminated clothing and wash before reuse

**Eyes**

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
If eye irritation persists: Get medical advice/attention

**Ingestion**

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician  
Rinse mouth

**Fire**

Explosion risk in case of fire  
Fight fire with normal precautions from a reasonable distance  
Evacuate area

**Storage**

Store locked up  
Store in a closed container  
Store in a well-ventilated place. Keep cool

**Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)**

None identified

### 3. Composition / information on ingredients

Component	CAS-No	Weight %
Barium	7440-39-3	99.9

### 4. First-aid measures

**Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.  
Obtain medical attention.

<b>Skin Contact</b>	Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.
<b>Inhalation</b>	Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention.
<b>Ingestion</b>	Do not induce vomiting. Call a physician or Poison Control Center immediately.
<b>Most important symptoms/effects</b>	No information available.
<b>Notes to Physician</b>	Treat symptomatically

## 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	Dry chemical.
<b>Unsuitable Extinguishing Media</b>	No information available
<b>Flash Point</b>	No information available
<b>Method -</b>	No information available
<b>Autoignition Temperature</b>	No information available
<b>Explosion Limits</b>	
<b>Upper</b>	No data available
<b>Lower</b>	No data available
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	No information available

### Specific Hazards Arising from the Chemical

Contact with water liberates toxic gas. Water reactive. Combustible material. Produce flammable gases on contact with water.

### Hazardous Combustion Products

None known

### Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

### NFPA

**Health**  
3

**Flammability**  
3

**Instability**  
0

**Physical hazards**  
W

## 6. Accidental release measures

<b>Personal Precautions</b>	Ensure adequate ventilation. Use personal protective equipment.
<b>Environmental Precautions</b>	See Section 12 for additional ecological information.

**Methods for Containment and Clean Up** Sweep up or vacuum up spillage and collect in suitable container for disposal.

## 7. Handling and storage

<b>Handling</b>	Avoid contact with skin and eyes. Do not breathe dust. Do not breathe vapors or spray mist. Handle under inert gas, protect from moisture. Wear personal protective equipment.
<b>Storage</b>	Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Protect from moisture. Never allow product to get in contact with water during storage. Store under an inert atmosphere.

## 8. Exposure controls / personal protection

### Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Barium	TWA: 0.5 mg/m <sup>3</sup>	(Vacated) TWA: 0.5 mg/m <sup>3</sup>	

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Barium			TWA: 0.5 mg/m <sup>3</sup>

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

**Engineering Measures**

Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

**Personal Protective Equipment****Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

**Skin and body protection**

Wear appropriate protective gloves and clothing to prevent skin exposure.

**Respiratory Protection**

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

## 9. Physical and chemical properties

Physical State	Solid
Appearance	Grey
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	725 °C / 1337 °F
Boiling Point/Range	1640 °C / 2984 °F
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	10 mmHg @ 1094 °C
Vapor Density	No information available
Relative Density	3.51 @ 20 °C
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	Ba
Molecular Weight	137.34

## 10. Stability and reactivity

Reactive Hazard	Yes
Stability	Moisture sensitive. Air sensitive.
Conditions to Avoid	Exposure to air. Incompatible products. Exposure to moisture.
Incompatible Materials	Acids, Water, Alcohols, Halogens

**Hazardous Decomposition Products** None under normal use conditions

**Hazardous Polymerization** Hazardous polymerization does not occur.

**Hazardous Reactions** None under normal processing.

## 11. Toxicological information

### Acute Toxicity

#### Product Information

**Oral LD50** Category 3. ATE = 50 - 300 mg/kg.

#### Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Barium	132 mg/kg ( Rat )	Not listed	Not listed

**Toxicologically Synergistic Products** No information available

### Delayed and immediate effects as well as chronic effects from short and long-term exposure

**Irritation** Irritating to eyes, respiratory system and skin

**Sensitization** No information available

**Carcinogenicity** The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Barium	7440-39-3	Not listed	Not listed	Not listed	Not listed	Not listed

**Mutagenic Effects** No information available

**Reproductive Effects** No information available.

**Developmental Effects** No information available.

**Teratogenicity** No information available.

**STOT - single exposure** Respiratory system

**STOT - repeated exposure** None known

**Aspiration hazard** No information available

**Symptoms / effects, both acute and delayed** No information available

**Endocrine Disruptor Information** No information available

**Other Adverse Effects** The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information.

## 12. Ecological information

### Ecotoxicity

Do not empty into drains.

**Persistence and Degradability** No information available

**Bioaccumulation/ Accumulation** No information available.

**Mobility** No information available.

## 13. Disposal considerations

**Waste Disposal Methods** Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

## 14. Transport information

**DOT**

UN-No UN1400  
 Proper Shipping Name BARIUM  
 Hazard Class 4.3  
 Packing Group II

**TDG**

UN-No UN1400  
 Proper Shipping Name BARIUM  
 Hazard Class 4.3  
 Packing Group II

**IATA**

UN-No UN1400  
 Proper Shipping Name Barium  
 Hazard Class 4.3  
 Packing Group II

**IMDG/IMO**

UN-No UN1400  
 Proper Shipping Name Barium  
 Hazard Class 4.3  
 Packing Group II

## 15. Regulatory information

**International Inventories**

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Barium	X	X	-	231-149-1	-		X	-	X	X	X

**Legend:**

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

**U.S. Federal Regulations**

TSCA 12(b) Not applicable

**SARA 313**

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Barium	7440-39-3	99.9	1.0

**SARA 311/312 Hazardous Categorization**

Acute Health Hazard Yes  
 Chronic Health Hazard No  
 Fire Hazard Yes  
 Sudden Release of Pressure Hazard No  
 Reactive Hazard Yes

Clean Water Act Not applicable

**Clean Air Act** Not applicable

**OSHA** Occupational Safety and Health Administration  
Not applicable

**CERCLA**  
Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Barium	1000 lb	-

**California Proposition 65** This product does not contain any Proposition 65 chemicals

**State Right-to-Know**

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Barium	X	X	X	-	X

**U.S. Department of Transportation**

Reportable Quantity (RQ): N  
DOT Marine Pollutant N  
DOT Severe Marine Pollutant N

**U.S. Department of Homeland Security**

This product does not contain any DHS chemicals.

**Other International Regulations**

**Mexico - Grade** No information available

**Canada**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

**WHMIS Hazard Class**  
B4 Flammable solid  
B6 Reactive flammable material  
D2B Toxic materials  
D1A Very toxic materials



**16. Other information**

**Prepared By** Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

**Revision Date** 10-Feb-2015  
**Print Date** 10-Feb-2015  
**Revision Summary** This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

**Disclaimer**

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage,

transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**



# SAFETY DATA SHEET

## Benzene

### Section 1. Identification

<b>GHS product identifier</b>	: Benzene
<b>Chemical name</b>	: benzene
<b>Other means of identification</b>	: benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>Synonym</b>	: benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol
<b>SDS #</b>	: 001062
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>Emergency telephone number (with hours of operation)</b>	: 1-866-734-3438

### Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: FLAMMABLE LIQUIDS - Category 2 SKIN CORROSION/IRRITATION - Category 2 SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2 GERM CELL MUTAGENICITY - Category 1B CARCINOGENICITY - Category 1 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (bone marrow) - Category 1

#### GHS label elements

##### Hazard pictograms



##### Signal word

: Danger

##### Hazard statements

: Highly flammable liquid and vapor.  
May form explosive mixtures with air.  
Causes serious eye irritation.  
Causes skin irritation.  
May cause genetic defects.  
May cause cancer.  
Causes damage to organs through prolonged or repeated exposure. (bone marrow)

#### Precautionary statements

##### General

: Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

## Section 2. Hazards identification

- Prevention** : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Do not breathe vapor. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling.
- Response** : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF SWALLOWED: Call a POISON CENTER or physician if you feel unwell. Rinse mouth. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.
- Storage** : Store locked up. Store in a well-ventilated place. Keep cool.
- Disposal** : Dispose of contents and container in accordance with all local, regional, national and international regulations.
- Hazards not otherwise classified** : None known.

## Section 3. Composition/information on ingredients

- Substance/mixture** : Substance
- Chemical name** : benzene
- Other means of identification** : benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol

### CAS number/other identifiers

- CAS number** : 71-43-2
- Product code** : 001062

Ingredient name	%	CAS number
benzene	100	71-43-2

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

## Section 4. First aid measures

### Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

## Section 4. First aid measures

- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If necessary, call a poison center or physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

### Most important symptoms/effects, acute and delayed

#### Potential acute health effects

- Eye contact** : Causes serious eye irritation.
- Inhalation** : No known significant effects or critical hazards.
- Skin contact** : Causes skin irritation.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : Harmful if swallowed. Irritating to mouth, throat and stomach.

#### Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:  
pain or irritation  
watering  
redness
- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following:  
irritation  
redness
- Ingestion** : No specific data.

### Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

## Section 5. Fire-fighting measures

### Extinguishing media

**Suitable extinguishing media** : Use dry chemical, CO<sub>2</sub>, water spray (fog) or foam.

**Unsuitable extinguishing media** : Do not use water jet.

**Specific hazards arising from the chemical** : Highly flammable liquid and vapor. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard.

**Hazardous thermal decomposition products** : Decomposition products may include the following materials:  
carbon dioxide  
carbon monoxide

**Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

**Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

## Section 6. Accidental release measures

### Personal precautions, protective equipment and emergency procedures

**For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

**For emergency responders** : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

**Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

### Methods and materials for containment and cleaning up

**Small spill** : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

**Large spill** : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

## Section 7. Handling and storage

### Precautions for safe handling

**Protective measures** : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

**Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

**Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

## Section 8. Exposure controls/personal protection

### Control parameters

#### Occupational exposure limits

Ingredient name	Exposure limits
benzene	<p><b>ACGIH TLV (United States, 3/2012).</b>  <b>Absorbed through skin.</b>            STEL: 8 mg/m<sup>3</sup> 15 minutes.            STEL: 2.5 ppm 15 minutes.            TWA: 1.6 mg/m<sup>3</sup> 8 hours.            TWA: 0.5 ppm 8 hours.</p> <p><b>NIOSH REL (United States, 1/2013).</b>            STEL: 1 ppm 15 minutes.            TWA: 0.1 ppm 10 hours.</p> <p><b>OSHA PEL (United States, 6/2010).</b>            STEL: 5 ppm 15 minutes.            TWA: 1 ppm 8 hours.</p> <p><b>OSHA PEL 1989 (United States, 3/1989).</b>            STEL: 5 ppm 15 minutes.            TWA: 1 ppm 8 hours.</p> <p><b>OSHA PEL Z2 (United States, 11/2006).</b>            AMP: 50 ppm 10 minutes.            CEIL: 25 ppm            TWA: 10 ppm 8 hours.</p>

## Section 8. Exposure controls/personal protection

<b>Appropriate engineering controls</b>	: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
<b>Environmental exposure controls</b>	: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.
<b>Individual protection measures</b>	
<b>Hygiene measures</b>	: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
<b>Eye/face protection</b>	: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.
<b>Skin protection</b>	
<b>Hand protection</b>	: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
<b>Body protection</b>	: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.
<b>Other skin protection</b>	: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
<b>Respiratory protection</b>	: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

## Section 9. Physical and chemical properties

### Appearance

<b>Physical state</b>	: Liquid. [Watery liquid.]
<b>Color</b>	: Colorless. Yellowish.
<b>Molecular weight</b>	: 78.12 g/mole
<b>Molecular formula</b>	: C <sub>6</sub> H <sub>6</sub>
<b>Boiling/condensation point</b>	: 80.09°C (176.2°F)
<b>Melting/freezing point</b>	: 5.49°C (41.9°F)
<b>Critical temperature</b>	: 288.95°C (552.1°F)
<b>Odor</b>	: Characteristic.
<b>Odor threshold</b>	: Not available.

## Section 9. Physical and chemical properties

<b>pH</b>	: Not available.
<b>Flash point</b>	: Closed cup: -11°C (12.2°F)
<b>Burning time</b>	: Not applicable.
<b>Burning rate</b>	: Not applicable.
<b>Evaporation rate</b>	: 3.5 (butyl acetate = 1)
<b>Flammability (solid, gas)</b>	: Not available.
<b>Lower and upper explosive (flammable) limits</b>	: Lower: 1.2% Upper: 7.8%
<b>Vapor pressure</b>	: 10 kPa (75.006094245 mm Hg) [room temperature]
<b>Vapor density</b>	: 2.7 (Air = 1)
<b>Specific Volume (ft<sup>3</sup>/lb)</b>	: 1.1403
<b>Gas Density (lb/ft<sup>3</sup>)</b>	: 0.877 (20°C / 68 to °F)
<b>Relative density</b>	: 0.88
<b>Solubility</b>	: Not available.
<b>Solubility in water</b>	: 1.88 g/l
<b>Partition coefficient: n-octanol/water</b>	: 2.13
<b>Auto-ignition temperature</b>	: 498°C (928.4°F)
<b>Decomposition temperature</b>	: Not available.
<b>SADT</b>	: Not available.
<b>Viscosity</b>	: Dynamic (room temperature): 0.604 mPa·s (0.604 cP)

## Section 10. Stability and reactivity

<b>Reactivity</b>	: No specific test data related to reactivity available for this product or its ingredients.
<b>Chemical stability</b>	: The product is stable.
<b>Possibility of hazardous reactions</b>	: Under normal conditions of storage and use, hazardous reactions will not occur.
<b>Conditions to avoid</b>	: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.
<b>Incompatibility with various substances</b>	: Highly reactive or incompatible with the following materials: oxidizing materials.
<b>Hazardous decomposition products</b>	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
<b>Hazardous polymerization</b>	: Under normal conditions of storage and use, hazardous polymerization will not occur.



## Section 11. Toxicological information

### Information on toxicological effects

#### Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
benzene	LC50 Inhalation Gas. LD50 Oral	Rat Rat	10000 ppm 930 mg/kg	7 hours -

#### Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
benzene	Eyes - Moderate irritant	Rabbit	-	88 milligrams	-
	Eyes - Severe irritant	Rabbit	-	24 hours 2 milligrams	-
	Skin - Mild irritant	Rat	-	8 hours 60 microliters	-
	Skin - Mild irritant	Rabbit	-	24 hours 15 milligrams	-
	Skin - Moderate irritant	Rabbit	-	24 hours 20 milligrams	-

#### Sensitization

Not available.

#### Mutagenicity

Not available.

#### Carcinogenicity

Not available.

#### Classification

Product/ingredient name	OSHA	IARC	NTP
benzene	+	1	Known to be a human carcinogen.

#### Reproductive toxicity

Not available.

#### Teratogenicity

Not available.

#### Specific target organ toxicity (single exposure)

Not available.

#### Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
benzene	Category 1	Not determined	bone marrow

#### Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

#### Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : No known significant effects or critical hazards.



## Section 11. Toxicological information

- Skin contact** : Causes skin irritation.
- Ingestion** : Harmful if swallowed. Irritating to mouth, throat and stomach.

### Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : Adverse symptoms may include the following:  
pain or irritation  
watering  
redness
- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following:  
irritation  
redness
- Ingestion** : No specific data.

### Delayed and immediate effects and also chronic effects from short and long term exposure

#### Short term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

#### Long term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

#### Potential chronic health effects

Not available.

- General** : Causes damage to organs through prolonged or repeated exposure.
- Carcinogenicity** : May cause cancer. Risk of cancer depends on duration and level of exposure.
- Mutagenicity** : May cause genetic defects.
- Teratogenicity** : No known significant effects or critical hazards.
- Developmental effects** : No known significant effects or critical hazards.
- Fertility effects** : No known significant effects or critical hazards.

### Numerical measures of toxicity

#### Acute toxicity estimates

Not available.

## Section 12. Ecological information

### Toxicity

Not available.

### Persistence and degradability

Not available.

### Bioaccumulative potential

## Section 12. Ecological information

Product/ingredient name	LogP <sub>ow</sub>	BCF	Potential
benzene	2.13	11	low

### Mobility in soil

Soil/water partition coefficient (K<sub>oc</sub>) : Not available.

Other adverse effects : No known significant effects or critical hazards.






## Section 13. Disposal considerations

**Disposal methods** : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

### United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Benzene (I,T)	71-43-2	Listed	U019

## Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
<b>UN number</b>	UN1114	UN1114	UN114	UN1114	UN1114
<b>UN proper shipping name</b>	BENZENE	BENZENE	BENZENE	BENZENE	BENZENE
<b>Transport hazard class(es)</b>	3 	3 	3 	3 	3 
<b>Packing group</b>	II	II	II	II	II
<b>Environment</b>	No.	No.	No.	No.	No.
<b>Additional information</b>	<b>Reportable quantity</b> 10 lbs / 4.54 kg [1.3675 gal / 5.1767 L] Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.	<b>Explosive Limit and Limited Quantity Index</b> 1  <b>Passenger Carrying Road or Rail Index</b> 5	-	-	<b>Passenger and Cargo Aircraft</b> Quantity limitation: 5 L <b>Cargo Aircraft Only</b> Quantity limitation: 60 L <b>Limited Quantities - Passenger Aircraft</b> Quantity limitation: 1 L

Date of issue/Date of revision

: 4/26/2015.

Date of previous issue

: 10/16/2014.

Version : 0.03

10/14

## Section 14. Transport information

	<p><b>Limited quantity</b> Yes.</p> <p><b>Packaging instruction</b> <b>Passenger aircraft</b> Quantity limitation: 5 L</p> <p><b>Cargo aircraft</b> Quantity limitation: 60 L</p> <p><b>Special provisions</b> IB2, T4, TP1</p>				
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“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

**Special precautions for user** : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

**Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code** : Not available.

## Section 15. Regulatory information

**U.S. Federal regulations** : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined  
**United States inventory (TSCA 8b):** This material is listed or exempted.  
**Clean Water Act (CWA) 307:** benzene  
**Clean Water Act (CWA) 311:** benzene

**Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs)** : Listed

**Clean Air Act Section 602 Class I Substances** : Not listed

**Clean Air Act Section 602 Class II Substances** : Not listed

**DEA List I Chemicals (Precursor Chemicals)** : Not listed

**DEA List II Chemicals (Essential Chemicals)** : Not listed

### SARA 302/304

#### Composition/information on ingredients

No products were found.

**SARA 304 RQ** : Not applicable.

### SARA 311/312

**Classification** : Fire hazard  
Immediate (acute) health hazard  
Delayed (chronic) health hazard

#### Composition/information on ingredients

## Section 15. Regulatory information

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
benzene	100	Yes.	No.	No.	Yes.	Yes.

### SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	benzene	71-43-2	100
Supplier notification	benzene	71-43-2	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

### State regulations

- Massachusetts** : This material is listed.  
**New York** : This material is listed.  
**New Jersey** : This material is listed.  
**Pennsylvania** : This material is listed.

### California Prop. 65

**WARNING:** This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
benzene	Yes.	Yes.	6.4 µg/day (ingestion) 13 µg/day (inhalation)	24 µg/day (ingestion) 49 µg/day (inhalation)

- Canada inventory** : This material is listed or exempted.

### International regulations

- International lists** : **Australia inventory (AICS)**: This material is listed or exempted.  
**China inventory (IECSC)**: This material is listed or exempted.  
**Japan inventory**: This material is listed or exempted.  
**Korea inventory**: This material is listed or exempted.  
**Malaysia Inventory (EHS Register)**: Not determined.  
**New Zealand Inventory of Chemicals (NZIoC)**: This material is listed or exempted.  
**Philippines inventory (PICCS)**: This material is listed or exempted.  
**Taiwan inventory (CSNN)**: Not determined.

- Chemical Weapons Convention List Schedule I Chemicals** : Not listed

- Chemical Weapons Convention List Schedule II Chemicals** : Not listed

- Chemical Weapons Convention List Schedule III Chemicals** : Not listed

### Canada

## Section 15. Regulatory information

**WHMIS (Canada)** : Class B-2: Flammable liquid  
 Class D-2A: Material causing other toxic effects (Very toxic).  
 Class D-2B: Material causing other toxic effects (Toxic).  
**CEPA Toxic substances:** This material is listed.  
**Canadian ARET:** This material is not listed.  
**Canadian NPRI:** This material is listed.  
**Alberta Designated Substances:** This material is not listed.  
**Ontario Designated Substances:** This material is not listed.  
**Quebec Designated Substances:** This material is not listed.

## Section 16. Other information

**Canada Label requirements** : Class B-2: Flammable liquid  
 Class D-2A: Material causing other toxic effects (Very toxic).  
 Class D-2B: Material causing other toxic effects (Toxic).

### Hazardous Material Information System (U.S.A.)

Health	*	2
Flammability		3
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

### National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

### History

**Date of printing** : 4/26/2015.  
**Date of issue/Date of revision** : 4/26/2015.  
**Date of previous issue** : 10/16/2014.  
**Version** : 0.03

## Section 16. Other information

### Key to abbreviations

- : ATE = Acute Toxicity Estimate
- BCF = Bioconcentration Factor
- GHS = Globally Harmonized System of Classification and Labelling of Chemicals
- IATA = International Air Transport Association
- IBC = Intermediate Bulk Container
- IMDG = International Maritime Dangerous Goods
- LogPow = logarithm of the octanol/water partition coefficient
- MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
- UN = United Nations
- ACGIH – American Conference of Governmental Industrial Hygienists
- AIHA – American Industrial Hygiene Association
- CAS – Chemical Abstract Services
- CEPA – Canadian Environmental Protection Act
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
- CFR – United States Code of Federal Regulations
- CPR – Controlled Products Regulations
- DSL – Domestic Substances List
- GWP – Global Warming Potential
- IARC – International Agency for Research on Cancer
- ICAO – International Civil Aviation Organisation
- Inh – Inhalation
- LC – Lethal concentration
- LD – Lethal dosage
- NDSL – Non-Domestic Substances List
- NIOSH – National Institute for Occupational Safety and Health
- TDG – Canadian Transportation of Dangerous Goods Act and Regulations
- TLV – Threshold Limit Value
- TSCA – Toxic Substances Control Act
- WEEL – Workplace Environmental Exposure Level
- WHMIS – Canadian Workplace Hazardous Material Information System

### References

- : Not available.

 Indicates information that has changed from previously issued version.

### Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

## SAFETY DATA SHEET

Version 5.5  
Revision Date 04/24/2015  
Print Date 05/12/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Benz[a]anthracene

Product Number : 48563  
Brand : Supelco  
Index-No. : 601-033-00-9

CAS-No. : 56-55-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Carcinogenicity (Category 1B), H350  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

H350 : May cause cancer.

H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 : Obtain special instructions before use.

P202 : Do not handle until all safety precautions have been read and understood.

P273 : Avoid release to the environment.

P281 : Use personal protective equipment as required.

P308 + P313 : IF exposed or concerned: Get medical advice/ attention.

P391 : Collect spillage.

P405 : Store locked up.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none****3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Synonyms : 1,2-Benzanthracene  
Tetraphene

Formula : C<sub>18</sub>H<sub>12</sub>  
Molecular weight : 228.29 g/mol  
CAS-No. : 56-55-3  
EC-No. : 200-280-6  
Index-No. : 601-033-00-9

**Hazardous components**

Component	Classification	Concentration
<b>Benz[a]anthracene</b>		
	Carc. 1B; Aquatic Acute 1; Aquatic Chronic 1; H350, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

**4. FIRST AID MEASURES****4.1 Description of first aid measures****General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Carbon oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available



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## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### **Body Protection**

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |  |
|---|--|
| a) Appearance                                   | Form: solid                                      |
| b) Odour  | No data available                                |
| c) Odour Threshold                              | No data available                                |
| d) pH   | No data available                                |
| e) Melting point/freezing point                 | Melting point/range: 157 - 159 °C (315 - 318 °F) |
| f) Initial boiling point and boiling range      | 437.6 °C (819.7 °F)                              |
| g) Flash point                                  | No data available                                |
| h) Evaporation rate                             | No data available                                |
| i) Flammability (solid, gas)                    | No data available                                |
| j) Upper/lower flammability or explosive limits | No data available                                |
| k) Vapour pressure                              | No data available                                |
| l) Vapour density                               | No data available                                |
| m) Relative density                             | No data available                                |
| n) Water solubility                             | No data available                                |
| o) Partition coefficient: n-octanol/water       | No data available                                |
| p) Auto-ignition temperature                    | No data available                                |
| q) Decomposition temperature                    | No data available                                |
| r) Viscosity                                    | No data available                                |
| s) Explosive properties                         | No data available                                |

t) Oxidizing properties      No data available

## 9.2 Other safety information

No data available

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## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

LD50 Intravenous - Rat - > 200 mg/kg

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that has been reported to be probably carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Possible human carcinogen

IARC:      2B - Group 2B: Possibly carcinogenic to humans (Benz[a]anthracene)

NTP:      Reasonably anticipated to be a human carcinogen (Benz[a]anthracene)

OSHA:      No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

Not dangerous goods

**IMDG**

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Benz[a]anthracene)  
Marine pollutant: yes

**IATA**

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Benz[a]anthracene)

**Further information**

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

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## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Benz[a]anthracene	56-55-3	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Benz[a]anthracene	56-55-3	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Benz[a]anthracene	56-55-3	1993-04-24

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Benz[a]anthracene	56-55-3	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H350	May cause cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.5

Revision Date: 04/24/2015

Print Date: 05/12/2016

## SAFETY DATA SHEET

Version 5.5  
Revision Date 04/24/2015  
Print Date 05/12/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Benzo[*b*]fluoranthene

Product Number : 48490  
Brand : Supelco  
Index-No. : 601-034-00-4

CAS-No. : 205-99-2

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Carcinogenicity (Category 1B), H350  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

H350 : May cause cancer.

H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 : Obtain special instructions before use.

P202 : Do not handle until all safety precautions have been read and understood.

P273 : Avoid release to the environment.

P281 : Use personal protective equipment as required.

P308 + P313 : IF exposed or concerned: Get medical advice/ attention.

P391 : Collect spillage.

P405 : Store locked up.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Synonyms : 3,4-Benzofluoranthene

Formula : C<sub>20</sub>H<sub>12</sub>

Molecular weight : 252.31 g/mol

CAS-No. : 205-99-2

EC-No. : 205-911-9

Index-No. : 601-034-00-4

**Hazardous components**

Component	Classification	Concentration
<b>Benz[e]acephenanthrylene</b>		
	Carc. 1B; Aquatic Acute 1; Aquatic Chronic 1; H350, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

**4. FIRST AID MEASURES****4.1 Description of first aid measures****General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Carbon oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available



---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Recommended storage temperature 2 - 8 °C

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber  
Minimum layer thickness: 0.11 mm  
Break through time: 480 min  
Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: solid   |
| b) Odour  | No data available                                       |
| c) Odour Threshold                              | No data available                                       |
| d) pH   | No data available                                       |
| e) Melting point/freezing point                 | Melting point/range: 163 - 165 °C (325 - 329 °F) - lit. |
| f) Initial boiling point and boiling range      | No data available                                       |
| g) Flash point                                  | No data available                                       |
| h) Evaporation rate                             | No data available                                       |
| i) Flammability (solid, gas)                    | No data available                                       |
| j) Upper/lower flammability or explosive limits | No data available                                       |
| k) Vapour pressure                              | No data available                                       |
| l) Vapour density                               | No data available                                       |
| m) Relative density                             | No data available                                       |
| n) Water solubility                             | No data available                                       |
| o) Partition coefficient: n-octanol/water       | No data available                                       |
| p) Auto-ignition temperature                    | No data available                                       |
| q) Decomposition temperature                    | No data available                                       |
| r) Viscosity                                    | No data available                                       |

- s) Explosive properties      No data available  
t) Oxidizing properties      No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

TDLo Oral - Mouse - 7.57 mg/kg

Remarks: Liver:Changes in liver weight. Endocrine:Changes in thymus weight.

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that has been reported to be probably carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Possible human carcinogen

IARC:      2B - Group 2B: Possibly carcinogenic to humans (Benz[e]acephenanthrylene)

NTP:      Reasonably anticipated to be a human carcinogen (Benz[e]acephenanthrylene)

OSHA:      No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to daphnia and other aquatic invertebrates      Immobilization EC50 - Daphnia magna (Water flea) - > 1.024 mg/l - 24 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

Not dangerous goods

**IMDG**

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.  
(Benz[e]acephenanthrylene)  
Marine pollutant: yes

**IATA**

UN number: 3077      Class: 9      Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Benz[e]acephenanthrylene)

#### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Benz[e]acephenanthrylene	205-99-2	2007-03-01

### SARA 311/312 Hazards

Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Benz[e]acephenanthrylene	205-99-2	2007-03-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Benz[e]acephenanthrylene	205-99-2	2007-03-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Benz[e]acephenanthrylene	205-99-2	2007-03-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Benz[e]acephenanthrylene	205-99-2	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H350	May cause cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the

product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.5

Revision Date: 04/24/2015

Print Date: 05/12/2016

## SAFETY DATA SHEET

Version 5.8  
Revision Date 11/24/2015  
Print Date 05/12/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Benzo[ghi]perylene

Product Number : 55488  
Brand : Sigma-Aldrich

CAS-No. : 191-24-2

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute aquatic toxicity (Category 1), H400

Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Warning

Hazard statement(s)  
H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273 : Avoid release to the environment.

P391 : Collect spillage.

P501 : Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Formula : C<sub>22</sub>H<sub>12</sub>

Molecular weight : 276.33 g/mol  
CAS-No. : 191-24-2  
EC-No. : 205-883-8

#### Hazardous components

Component	Classification	Concentration
<b>Benzo[ghi]perylene</b>		
	Aquatic Acute 1; Aquatic Chronic 1; H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.



---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Handle under argon.

Moisture sensitive.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

##### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

##### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: solid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 277 - 279 °C (531 - 534 °F) - lit.
f) Initial boiling point and boiling range	> 500 °C (> 932 °F) - lit.
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	log Pow: 6.63
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

**10.4 Conditions to avoid**

No data available

**10.5 Incompatible materials**

Strong oxidizing agents

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Benzo[ghi]perylene)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

Very toxic to aquatic life with long lasting effects.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

Not dangerous goods

### IMDG

UN number: 3077

Class: 9

Packing group: III

EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Benzo[ghi]perylene)

Marine pollutant:yes

### IATA

UN number: 3077

Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Benzo[ghi]perylene)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Chronic Health Hazard

### Massachusetts Right To Know Components

Benzo[ghi]perylene

CAS-No.  
191-24-2

Revision Date  
2007-07-01

**Pennsylvania Right To Know Components**

Benzo[ghi]perylene

CAS-No.  
191-24-2Revision Date  
2007-07-01**New Jersey Right To Know Components**

Benzo[ghi]perylene

CAS-No.  
191-24-2Revision Date  
2007-07-01**California Prop. 65 Components**WARNING! This product contains a chemical known to the  
State of California to cause cancer.CAS-No.  
191-24-2Revision Date  
2007-09-28

Benzo[ghi]perylene

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.8

Revision Date: 11/24/2015

Print Date: 05/12/2016

## SAFETY DATA SHEET

Version 3.9  
Revision Date 02/28/2015  
Print Date 05/12/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Benzo[k]fluoranthene

Product Number : BCR048R  
Brand : Sigma-Aldrich  
Index-No. : 601-036-00-5

CAS-No. : 207-08-9

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Carcinogenicity (Category 1B), H350  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H350

May cause cancer.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P273

Avoid release to the environment.

P281

Use personal protective equipment as required.

P308 + P313

IF exposed or concerned: Get medical advice/ attention.

P391

Collect spillage.

P405

Store locked up.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Formula : C<sub>20</sub>H<sub>12</sub>  
Molecular weight : 252.31 g/mol  
CAS-No. : 207-08-9  
EC-No. : 205-916-6  
Index-No. : 601-036-00-5

**Hazardous components**

Component	Classification	Concentration
<b>Benzo[k]fluoranthene</b>		
	Carc. 1B; Aquatic Acute 1; Aquatic Chronic 1; H350, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

**4. FIRST AID MEASURES****4.1 Description of first aid measures****General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Carbon oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

## **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## **6.3 Methods and materials for containment and cleaning up**

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

## **6.4 Reference to other sections**

For disposal see section 13.

---

# **7. HANDLING AND STORAGE**

## **7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

## **7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

Recommended storage temperature 2 - 8 °C

## **7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

# **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

## **8.1 Control parameters**

### **Components with workplace control parameters**

Contains no substances with occupational exposure limit values.

## **8.2 Exposure controls**

### **Appropriate engineering controls**

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### **Personal protective equipment**

#### **Eye/face protection**

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### **Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### **Full contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

##### **Splash contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an



industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

a) Appearance	Form: crystalline Colour: yellow
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 215 - 217 °C (419 - 423 °F)
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### **9.2 Other safety information**

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

Carcinogenicity - Rat - Implant

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Lungs, Thorax, or Respiration: Tumors.

Tumorigenic: Tumors at site or application.

Carcinogenicity - Mouse - Skin

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Skin and Appendages: Other: Tumors.

Tumorigenic: Tumors at site or application.

This product is or contains a component that has been reported to be probably carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Possible human carcinogen

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Benzo[k]fluoranthene)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: Reasonably anticipated to be a human carcinogen (Benzo[k]fluoranthene)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: DF6350000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

**DOT (US)**

UN number: 3077 Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Benzo[k]fluoranthene)

Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 3077 Class: 9

Packing group: III

EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Benzo[k]fluoranthene)

Marine pollutant:yes

**IATA**

UN number: 3077      Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Benzo[k]fluoranthene)

**Further information**

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

**15. REGULATORY INFORMATION**

**SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Benzo[k]fluoranthene	207-08-9	1994-04-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Benzo[k]fluoranthene	207-08-9	1994-04-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Benzo[k]fluoranthene	207-08-9	1994-04-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Benzo[k]fluoranthene	207-08-9	1994-04-01

**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Benzo[k]fluoranthene	207-08-9	2007-09-28

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H350	May cause cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.9

Revision Date: 02/28/2015

Print Date: 05/12/2016

## SAFETY DATA SHEET

Version 4.6  
Revision Date 12/29/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Beryllium

Product Number : 378135  
Brand : Aldrich

CAS-No. : 7440-41-7

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 3), H301  
Acute toxicity, Inhalation (Category 2), H330  
Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Skin sensitisation (Category 1), H317  
Carcinogenicity (Category 1B), H350  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Specific target organ toxicity - repeated exposure (Category 1), H372

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H301 Toxic if swallowed.  
H315 Causes skin irritation.  
H317 May cause an allergic skin reaction.  
H319 Causes serious eye irritation.  
H330 Fatal if inhaled.  
H335 May cause respiratory irritation.  
H350 May cause cancer.

H372	Causes damage to organs through prolonged or repeated exposure.
Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P272	Contaminated work clothing should not be allowed out of the workplace.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P284	Wear respiratory protection.
P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician. Rinse mouth.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: Be
Molecular weight	: 9.01 g/mol
CAS-No.	: 7440-41-7
EC-No.	: 231-150-7

#### Hazardous components

Component	Classification	Concentration
<b>Beryllium foil</b>		
	Acute Tox. 3; Acute Tox. 2; Skin Irrit. 2; Eye Irrit. 2A; Skin Sens. 1; Carc. 1B; STOT SE 3; STOT RE 1; H301, H315, H317, H319, H330, H335, H350, H372	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Beryllium oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

**6.3 Methods and materials for containment and cleaning up**

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters****Components with workplace control parameters**



Component	CAS-No.	Value	Control parameters	Basis
Beryllium foil	7440-41-7	TWA	2.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		CEIL	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Peak	25.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	2.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
	Remarks	Z27.29-1970		
		CEIL	5.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		Peak	25.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		TWA	0.000050 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Beryllium sensitization Chronic beryllium disease (berylliosis) Confirmed human carcinogen Danger of cutaneous absorption Sensitizer		
		C	0.000500 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		See Table Z-2		
		TWA	2.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		TWA	2.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		CEIL	5.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		CEIL	5.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		Peak	25.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		Peak	25.000000 microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		TWA	0.000050 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Beryllium sensitization		

		Chronic beryllium disease (berylliosis) Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Confirmed human carcinogen Danger of cutaneous absorption Sensitizer		
		C	0.000500 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		See Table Z-2		
		TWA	2microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		CEIL	5microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		Peak	25microgram per cubic meter	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z27.29-1970		
		C	0.0005 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: powder Colour: grey
b) Odour	odourless
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 1,278 °C (2,332 °F) - lit.
f) Initial boiling point and boiling range	2,970 °C (5,378 °F) - lit.
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	1.85 g/cm <sup>3</sup> at 25 °C (77 °F)
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

#### 10.4 Conditions to avoid

No data available

#### 10.5 Incompatible materials

Alkali metals

#### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

LD50 Intravenous - Rat - 0.496 mg/kg

Remarks: Liver:Hepatitis (hepatocellular necrosis), zonal.

##### Skin corrosion/irritation

No data available

##### Serious eye damage/eye irritation

No data available

##### Respiratory or skin sensitisation

No data available

##### Germ cell mutagenicity

Hamster

Lungs

Result: negative

##### Carcinogenicity

Carcinogenicity - Rat - Intratracheal

Tumorigenic:Neoplastic by RTECS criteria. Lungs, Thorax, or Respiration:Tumors. Lungs, Thorax, or Respiration:Bronchiogenic carcinoma.

Carcinogenicity - Rabbit - Intravenous

Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Musculoskeletal:Tumors.

Possible human carcinogen

IARC: 1 - Group 1: Carcinogenic to humans (Beryllium foil)

NTP: Known to be human carcinogen (Beryllium foil)

Known to be human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Beryllium foil)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

No data available

No data available

##### Specific target organ toxicity - single exposure

No data available

##### Specific target organ toxicity - repeated exposure

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: DS1750000

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1567      Class: 6.1 (4.1)      Packing group: II  
Proper shipping name: Beryllium, powder  
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 1567      Class: 6.1 (4.1)      Packing group: II      EMS-No: F-G, S-G  
Proper shipping name: BERYLLIUM POWDER

**IATA**

UN number: 1567      Class: 6.1 (4.1)      Packing group: II  
Proper shipping name: Beryllium powder

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Beryllium foil	7440-41-7	1993-04-24

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

#### Massachusetts Right To Know Components

Beryllium foil	CAS-No. 7440-41-7	Revision Date 1993-04-24
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#### Pennsylvania Right To Know Components

Beryllium foil	CAS-No. 7440-41-7	Revision Date 1993-04-24
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#### New Jersey Right To Know Components

Beryllium foil	CAS-No. 7440-41-7	Revision Date 1993-04-24
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#### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

Beryllium foil	CAS-No. 7440-41-7	Revision Date 2008-10-10
----------------	----------------------	-----------------------------

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## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H301	Toxic if swallowed.
H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H319	Causes serious eye irritation.
H330	Fatal if inhaled.
H335	May cause respiratory irritation.
H350	May cause cancer.
H372	Causes damage to organs through prolonged or repeated exposure.
Skin Irrit.	Skin irritation
Skin Sens.	Skin sensitisation

### HMIS Rating

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	4
Fire Hazard:	3
Reactivity Hazard:	3

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956



## 1 Identification

### Product identifier

**Product name:** Bis(2-ethylhexyl) phthalate

**Stock number:** A10415

**CAS Number:**

117-81-7

**EC number:**

204-211-0

**Index number:**

607-317-00-9

**Relevant identified uses of the substance or mixture and uses advised against.**

**Identified use:** SU24 Scientific research and development

### Details of the supplier of the safety data sheet

**Manufacturer/Supplier:**

Alfa Aesar

Thermo Fisher Scientific Chemicals, Inc.

30 Bond Street

Ward Hill, MA 01835-8099

Tel: 800-343-0660

Fax: 800-322-4757

Email: tech@alfa.com

www.alfa.com

**Information Department:** Health, Safety and Environmental Department

**Emergency telephone number:**

During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660. After normal business hours, call Carechem 24 at (866) 928-0789.

## 2 Hazard(s) identification

**Classification of the substance or mixture in accordance with 29 CFR 1910 (OSHA HCS)**



GHS08 Health hazard

Repr. 1B H360 May damage fertility or the unborn child.

**Hazards not otherwise classified** No information known.

### Label elements

**GHS label elements** The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)

### Hazard pictograms



GHS08

### Signal word

**Danger**

### Hazard statements

H360 May damage fertility or the unborn child.

### Precautionary statements

P281 Use personal protective equipment as required.

P201 Obtain special instructions before use.

P202 Do not handle until all safety precautions have been read and understood.

P308+P313 IF exposed or concerned: Get medical advice/attention.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

### WHMIS classification

D2A - Very toxic material causing other toxic effects



### Classification system

**HMIS ratings (scale 0-4)**

**(Hazardous Materials Identification System)**

HEALTH 1 Health (acute effects) = 1

FIRE 1 Flammability = 1

REACTIVITY 1 Physical Hazard = 1

### Other hazards

**Results of PBT and vPvB assessment**

PBT: Not applicable.

vPvB: Not applicable.

## 3 Composition/information on ingredients

**Chemical characterization:** Substances

**CAS# Description:**

117-81-7 Bis(2-ethylhexyl) phthalate

**Identification number(s):**

EC number: 204-211-0

Index number: 607-317-00-9

## 4 First-aid measures

### Description of first aid measures

#### After inhalation

Supply fresh air. If required, provide artificial respiration. Keep patient warm.

Seek immediate medical advice.

#### After skin contact

Immediately wash with water and soap and rinse thoroughly.

Seek immediate medical advice.



**Product name: Bis(2-ethylhexyl) phthalate**

(Contd. of page)

**After eye contact** Rinse opened eye for several minutes under running water. Then consult a doctor.**After swallowing** Seek medical treatment.**Information for doctor****Most important symptoms and effects, both acute and delayed** No further relevant information available.**Indication of any immediate medical attention and special treatment needed** No further relevant information available.**Fire-fighting measures****Extinguishing media****Suitable extinguishing agents** Carbon dioxide, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.**Special hazards arising from the substance or mixture**

If this product is involved in a fire, the following can be released:

Carbon monoxide and carbon dioxide

**Advice for firefighters****Protective equipment:**

Wear self-contained respirator.

Wear fully protective impervious suit.

**Accidental release measures****Personal precautions, protective equipment and emergency procedures**

Wear protective equipment. Keep unprotected persons away.

Ensure adequate ventilation

**Environmental precautions:** Do not allow material to be released to the environment without proper governmental permits.**Methods and material for containment and cleaning up:**

Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).

Dispose of contaminated material as waste according to section 13.

**Prevention of secondary hazards:** No special measures required.**Reference to other sections**

See Section 7 for information on safe handling

See Section 8 for information on personal protection equipment.

See Section 13 for disposal information.

**Handling and storage****Handling****Precautions for safe handling**

Keep container tightly sealed.

Store in cool, dry place in tightly closed containers.

Ensure good ventilation at the workplace.

Open and handle container with care.

**Information about protection against explosions and fires:** No information known.**Conditions for safe storage, including any incompatibilities****Storage****Requirements to be met by storerooms and receptacles:** No special requirements.**Information about storage in one common storage facility:** Store away from oxidizing agents.**Further information about storage conditions:**

Keep container tightly sealed.

Store in cool, dry conditions in well sealed containers.

**Specific end use(s)** No further relevant information available.**Exposure controls/personal protection****Additional information about design of technical systems:**

Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

**Control parameters****Components with limit values that require monitoring at the workplace:****117-81-7 Bis(2-ethylhexyl) phthalate (100.0%)**PEL (USA) Long-term value: 5 mg/m<sup>3</sup>REL (USA) Short-term value: 10 mg/m<sup>3</sup>Long-term value: 5 mg/m<sup>3</sup>

See Pocket Guide App. A

TLV (USA) Long-term value: 5 mg/m<sup>3</sup>EL (Canada) Long-term value: 5 mg/m<sup>3</sup>EV (Canada) Short-term value: 5 mg/m<sup>3</sup>Long-term value: 3 mg/m<sup>3</sup>**Additional information:** No data**Exposure controls****Personal protective equipment****General protective and hygienic measures**

The usual precautionary measures for handling chemicals should be followed.

Keep away from foodstuffs, beverages and feed.

Remove all soiled and contaminated clothing immediately.

Wash hands before breaks and at the end of work.

Store protective clothing separately.

Maintain an ergonomically appropriate working environment.

**Breathing equipment:** Use suitable respirator when high concentrations are present.**Recommended filter device for short term use:**

Use a respirator with organic vapor/acid gas cartridges as a backup to engineering controls. Risk assessment should be performed to determine if air-purifying respirators are appropriate. Only use equipment tested and approved under appropriate government standards such as NIOSH (USA) or CEN (EU).

**Protection of hands:**

Impervious gloves

Check protective gloves prior to each use for their proper condition.

The selection of suitable gloves not only depends on the material, but also on quality. Quality will vary from manufacturer to manufacturer.

**Material of gloves** Nitrile rubber, NBR**Penetration time of glove material (in minutes)** 480**Glove thickness** 0.2 mm**Eye protection:** Safety glasses**Body protection:** Protective work clothing.

Product name: **Bis(2-ethylhexyl) phthalate**

(Contd. of page)

**1) Physical and chemical properties****Information on basic physical and chemical properties****General Information****Appearance:**

<b>Form:</b>	Liquid
<b>Color:</b>	Colorless
<b>Odor:</b>	Odorless
<b>Odor threshold:</b>	Not determined.
<b>pH-value:</b>	Not determined.

**Change in condition**

<b>Melting point/Melting range:</b>	-55 °C (-67 °F)
<b>Boiling point/Boiling range:</b>	230 °C (446 °F)
<b>Sublimation temperature / start:</b>	Not determined

<b>Flash point:</b>	207 °C (405 °F)
<b>Flammability (solid, gaseous)</b>	Not applicable.
<b>Ignition temperature:</b>	390 °C (734 °F)
<b>Decomposition temperature:</b>	Not determined
<b>Auto igniting:</b>	Not determined.

**Danger of explosion:** Product does not present an explosion hazard.**Explosion limits:**

<b>Lower:</b>	0.3 Vol %
<b>Upper:</b>	2.4 Vol %
<b>Vapor pressure at 20 °C (68 °F):</b>	<0.001 hPa (<0 mm Hg)
<b>Density at 20 °C (68 °F):</b>	0.985 g/cm <sup>3</sup> (8.22 lbs/gal)
<b>Relative density</b>	Not determined.
<b>Vapor density</b>	Not determined.
<b>Evaporation rate</b>	Not determined.

**Solubility in / Miscibility with**

<b>Water at 20 °C (68 °F):</b>	<0.1 g/l
<b>Partition coefficient (n-octanol/water):</b>	Not determined.

**Viscosity:**

<b>dynamic:</b>	Not determined.
<b>kinematic:</b>	Not determined.

**Other information** No further relevant information available.**2) Stability and reactivity****Reactivity** No information known.**Chemical stability** Stable under recommended storage conditions.**Thermal decomposition / conditions to be avoided:** Decomposition will not occur if used and stored according to specifications.**Possibility of hazardous reactions** Reacts with strong oxidizing agents**Conditions to avoid** No further relevant information available.**Incompatible materials:** Oxidizing agents**Hazardous decomposition products:** Carbon monoxide and carbon dioxide**3) Toxicological information****Information on toxicological effects****Acute toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains acute toxicity data for this substance.**LD/LC50 values that are relevant for classification:**

<b>Oral</b>	<b>LD50</b>	30000 mg/kg (rat)
<b>Dermal</b>	<b>LD50</b>	25000 mg/kg (rabbit)

**Skin irritation or corrosion:** May cause irritation**Eye irritation or corrosion:** May cause irritation**Sensitization:** No sensitizing effects known.**Germ cell mutagenicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains mutation data for this substance.**Carcinogenicity:**

EPA-B2: Probable human carcinogen, sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies.

IARC-2B: Possibly carcinogenic to humans: limited evidence in humans in the absence of sufficient evidence in experimental animals.

NTP-R: Reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

ACGIH A3: Animal carcinogen: Agent is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), of histologic type(s) or by mechanism(s) not considered relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans.

Available evidence suggests that the agent is not likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains tumorigenic and/or carcinogenic and/or neoplastic data for this substance.

**Reproductive toxicity:**

May damage fertility or the unborn child.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains reproductive data for this substance.

**Specific target organ system toxicity - repeated exposure:** No effects known.**Specific target organ system toxicity - single exposure:** No effects known.**Aspiration hazard:** No effects known.**Subacute to chronic toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains multiple dose toxicity data for this substance.**Additional toxicological information:** To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.**4) Ecological information****Toxicity****Aquatic toxicity:** No further relevant information available.**Persistence and degradability** No further relevant information available.**Bioaccumulative potential** No further relevant information available.**Mobility in soil** No further relevant information available.**Additional ecological information:****General notes:**

Do not allow material to be released to the environment without proper governmental permits.

Do not allow undiluted product or large quantities to reach ground water, water course or sewage system.

Avoid transfer into the environment.

**Results of PBT and vPvB assessment****PBT:** Not applicable.**vPvB:** Not applicable.**Other adverse effects** No further relevant information available.

Product name: **Bis(2-ethylhexyl) phthalate**

(Contd. of page 1)

**Disposal considerations****Waste treatment methods****Recommendation** Consult state, local or national regulations to ensure proper disposal.**Uncleaned packagings:****Recommendation:** Disposal must be made according to official regulations.**Transport information****UN-Number**

DOT, ADN, IMDG, IATA

Not applicable

**UN proper shipping name**

DOT, ADN, IMDG, IATA

Not applicable

**Transport hazard class(es)**

DOT, ADR, ADN, IMDG, IATA

**Class**

Not applicable

**Packing group**

DOT, IMDG, IATA

Not applicable

**Environmental hazards:**

Not applicable.

**Special precautions for user**

Not applicable.

**Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.**Transport/Additional information:****DOT****Marine Pollutant (DOT):**

No

**UN "Model Regulation":**

-

**Regulatory information****Safety, health and environmental regulations/legislation specific for the substance or mixture****GHS label elements** The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)**Hazard pictograms**

GHS08

**Signal word** Danger**Hazard statements**

H360 May damage fertility or the unborn child.

**Precautionary statements**

P281 Use personal protective equipment as required.

P201 Obtain special instructions before use.

P202 Do not handle until all safety precautions have been read and understood.

P308+P313 IF exposed or concerned: Get medical advice/attention.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

**National regulations**

All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance inventory.

All components of this product are listed on the Canadian Domestic Substances List (DSL).

**SARA Section 313 (specific toxic chemical listings)**

117-81-7 | Bis(2-ethylhexyl) phthalate

**California Proposition 65****Prop 65 - Chemicals known to cause cancer**

117-81-7 | Bis(2-ethylhexyl) phthalate

**Prop 65 - Developmental toxicity**

117-81-7 | Bis(2-ethylhexyl) phthalate

**Prop 65 - Developmental toxicity, female** Substance is not listed.**Prop 65 - Developmental toxicity, male**

117-81-7 | Bis(2-ethylhexyl) phthalate

**Information about limitation of use:** For use only by technically qualified individuals.**Other regulations, limitations and prohibitive regulations****Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006.**

This substance is included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH).

**The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.**

Substance is not listed.

**Annex XIV of the REACH Regulations (requiring Authorisation for use)** Substance is listed.**Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.**Other information**

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

**Department issuing SDS:** Global Marketing Department**Date of preparation / last revision** 11/23/2015 / -**Abbreviations and acronyms:**

RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)

ICAO: International Civil Aviation Organization

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

DOT: US Department of Transportation

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

HMIS: Hazardous Materials Identification System (USA)

WHMIS: Workplace Hazardous Materials Information System (Canada)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

vPvB: very Persistent and very Bioaccumulative

ACGIH: American Conference of Governmental Industrial Hygienists (USA)

(Contd. on page 2)

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Product name: **Bis(2-ethylhexyl) phthalate**

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OSHA: Occupational Safety and Health Administration (USA)  
NTP: National Toxicology Program (USA)  
IARC: International Agency for Research on Cancer  
EPA: Environmental Protection Agency (USA)

(Contd. of page

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US





## SAFETY DATA SHEET

Revision Date 11-Dec-2014

Revision Number 1

### 1. Identification

**Product Name** Cadmium

**Cat No. :** AC612130000; AC612135000

**Synonyms** None.

**Recommended Use** Laboratory chemicals.

**Uses advised against** No Information available

**Details of the supplier of the safety data sheet**

**Company**  
Fisher Scientific  
One Reagent Lane  
Fair Lawn, NJ 07410  
Tel: (201) 796-7100

**Entity / Business Name**  
Acros Organics  
One Reagent Lane  
Fair Lawn, NJ 07410

**Emergency Telephone Number**  
For information **US** call: 001-800-ACROS-01  
/ **Europe** call: +32 14 57 52 11  
Emergency Number **US**:001-201-796-7100 /  
**Europe**: +32 14 57 52 99  
**CHEMTREC** Tel. No.**US**:001-800-424-9300 /  
**Europe**:001-703-527-3887

### 2. Hazard(s) identification

#### **Classification**

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable solids	Category 2
Acute oral toxicity	Category 4
Acute dermal toxicity	Category 4
Acute Inhalation Toxicity - Dusts and Mists	Category 2
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Reproductive Toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	
Specific target organ toxicity - (repeated exposure)	Category 1
Target Organs - Kidney, Blood.	

#### **Label Elements**

**Signal Word**  
Danger

**Hazard Statements**  
Flammable solid  
Fatal if inhaled  
Harmful if swallowed  
Harmful in contact with skin

May cause respiratory irritation  
Suspected of causing genetic defects  
May cause cancer  
Suspected of damaging fertility. Suspected of damaging the unborn child  
Causes damage to organs through prolonged or repeated exposure



### Precautionary Statements

#### Prevention

Obtain special instructions before use  
Do not handle until all safety precautions have been read and understood  
Use personal protective equipment as required  
Wash face, hands and any exposed skin thoroughly after handling  
Do not eat, drink or smoke when using this product  
Do not breathe dust/fume/gas/mist/vapors/spray  
Use only outdoors or in a well-ventilated area  
Ground/bond container and receiving equipment  
Use explosion-proof electrical/ventilating/lighting/equipment

#### Response

IF exposed or concerned: Get medical attention/advice

#### Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing  
Immediately call a POISON CENTER or doctor/physician

#### Skin

IF ON SKIN: Wash with plenty of soap and water  
Wash contaminated clothing before reuse  
Call a POISON CENTER or doctor/physician if you feel unwell

#### Ingestion

IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell  
Rinse mouth

#### Fire

Fight fire with normal precautions from a reasonable distance  
Evacuate area

#### Storage

Store locked up  
Store in a well-ventilated place. Keep container tightly closed

#### Disposal

Dispose of contents/container to an approved waste disposal plant

#### Hazards not otherwise classified (HNOC)

Very toxic to aquatic life with long lasting effects  
May form combustible dust concentrations in air

#### Other hazards

WARNING! This product contains a chemical known in the State of California to cause cancer. WARNING! This product contains a chemical known in the State of California to cause birth defects or other reproductive harm.

### 3. Composition / information on ingredients

Component	CAS-No	Weight %
Cadmium	7440-43-9	100

### 4. First-aid measures

<b>General Advice</b>	Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.
<b>Eye Contact</b>	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.
<b>Skin Contact</b>	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
<b>Inhalation</b>	Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.
<b>Ingestion</b>	Do not induce vomiting. Call a physician or Poison Control Center immediately. Never give anything by mouth to an unconscious person.
<b>Most important symptoms/effects Notes to Physician</b>	Causes eye burns. Kidney disorders: May cause harm to the unborn child: Blood disorders Treat symptomatically

### 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
<b>Unsuitable Extinguishing Media</b>	No information available
<b>Flash Point</b>	No information available
<b>Method -</b>	No information available
<b>Autoignition Temperature</b>	No information available
<b>Explosion Limits</b>	
<b>Upper</b>	No data available
<b>Lower</b>	No data available
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	No information available

#### Specific Hazards Arising from the Chemical

Thermal decomposition can lead to release of irritating gases and vapors. Fine dust dispersed in air may ignite. Dust can form an explosive mixture in air. Pyrophoric properties of solids and liquids.

#### Hazardous Combustion Products

Highly toxic fumes

#### Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

#### NFPA

**Health**  
4

**Flammability**  
1

**Instability**  
0

**Physical hazards**  
N/A

### 6. Accidental release measures

<b>Personal Precautions</b>	Ensure adequate ventilation. Use personal protective equipment. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas. Avoid dust formation.
<b>Environmental Precautions</b>	Should not be released into the environment. Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
<b>Methods for Containment and Clean Up</b>	Sweep up or vacuum up spillage and collect in suitable container for disposal. Avoid dust formation. Do not let this chemical enter the environment. Use spark-proof tools and explosion-proof equipment.



## 7. Handling and storage

**Handling** Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid dust formation. Do not breathe vapors/dust. Do not ingest. Fine dust dispersed in air may ignite. Handle under inert gas, protect from moisture. Ensure adequate ventilation.

**Storage** Keep containers tightly closed in a dry, cool and well-ventilated place. Store under an inert atmosphere.

## 8. Exposure controls / personal protection

### Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Cadmium	TWA: 0.01 mg/m <sup>3</sup> TWA: 0.002 mg/m <sup>3</sup>	Ceiling: 0.3 mg/m <sup>3</sup> Ceiling: 0.6 mg/m <sup>3</sup> (Vacated) STEL: 0.3 ppm TWA: 0.1 mg/m <sup>3</sup> TWA: 0.2 mg/m <sup>3</sup> TWA: 5 µg/m <sup>3</sup>	IDLH: 9 mg/m <sup>3</sup>

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Cadmium	TWA: 0.025 mg/m <sup>3</sup>	TWA: 0.01 mg/m <sup>3</sup> TWA: 0.002 mg/m <sup>3</sup>	TWA: 0.01 mg/m <sup>3</sup> TWA: 0.002 mg/m <sup>3</sup>

### Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

**Engineering Measures** Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location.

### Personal Protective Equipment

**Eye/face Protection** Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

**Skin and body protection** Wear appropriate protective gloves and clothing to prevent skin exposure.

**Respiratory Protection** Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

**Hygiene Measures** When using, do not eat, drink or smoke. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. Keep away from food, drink and animal feeding stuffs.

## 9. Physical and chemical properties

Physical State	Solid
Appearance	Silver
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	321 °C / 609.8 °F

Boiling Point/Range	765 °C / 1409 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	No information available
Relative Density	8.64 @ 25°C
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	Cd
Molecular Weight	112.40

## 10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under recommended storage conditions. Moisture sensitive. Air sensitive.
Conditions to Avoid	Incompatible products. Excess heat. Avoid dust formation. Exposure to air or moisture over prolonged periods.
Incompatible Materials	Strong oxidizing agents, Strong acids, Sulfur oxides
Hazardous Decomposition Products	Highly toxic fumes
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

## 11. Toxicological information

### Acute Toxicity

#### Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Cadmium	1140 mg/kg ( Rat )	Not listed	25 mg/m <sup>3</sup> ( Rat ) 30 min

**Toxicologically Synergistic Products** No information available

#### Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	No information available
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Cadmium	7440-43-9	Group 1	Known	A2	X	A2

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)

Group 1 - Carcinogenic to Humans

Group 2A - Probably Carcinogenic to Humans

Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

Known - Known Carcinogen

Reasonably Anticipated - Reasonably Anticipated to be a Human

NTP: (National Toxicity Program)

ACGIH: (American Conference of Governmental Industrial Hygienists)

**Carcinogen**

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

<b>Mutagenic Effects</b>	Possible risk of irreversible effects
<b>Reproductive Effects</b>	Possible risk of impaired fertility. May cause harm to the unborn child.
<b>Developmental Effects</b>	No information available.
<b>Teratogenicity</b>	No information available.
<b>STOT - single exposure</b>	Respiratory system
<b>STOT - repeated exposure</b>	Kidney Blood
<b>Aspiration hazard</b>	No information available
<b>Symptoms / effects, both acute and delayed</b>	Kidney disorders: May cause harm to the unborn child: Blood disorders
<b>Endocrine Disruptor Information</b>	No information available
<b>Other Adverse Effects</b>	The toxicological properties have not been fully investigated.

## 12. Ecological information



### Ecotoxicity

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Cadmium	Not listed	0.0004 - 0.003 mg/L LC50 96 h 0.016 mg/L LC50 96 h 21.1 mg/L LC50 96 h 0.24 mg/L LC50 96 h 4.26 mg/L LC50 96 h 0.002 mg/L LC50 96 h 0.006 mg/L LC50 96 h 0.003 mg/L LC50 96 h	Not listed	0.0244 mg/L EC50 = 48 h

<b>Persistence and Degradability</b>	No information available
<b>Bioaccumulation/ Accumulation</b>	No information available.

<b>Mobility</b>	No information available.
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## 13. Disposal considerations

<b>Waste Disposal Methods</b>	Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.
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## 14. Transport information

**DOT**

UN-No UN2930  
 Proper Shipping Name TOXIC SOLIDS, FLAMMABLE, ORGANIC, N.O.S.  
 Proper technical name (CADMIUM)  
 Hazard Class 6.1  
 Subsidiary Hazard Class 4.1  
 Packing Group I

**TDG**

UN-No UN2930  
 Proper Shipping Name TOXIC SOLIDS, FLAMMABLE, ORGANIC, N.O.S.  
 Hazard Class 6.1  
 Subsidiary Hazard Class 4.1  
 Packing Group I

**IATA**

UN-No UN2930  
 Proper Shipping Name TOXIC SOLIDS, FLAMMABLE, ORGANIC, N.O.S.  
 Hazard Class 6.1  
 Subsidiary Hazard Class 4.1  
 Packing Group I

**IMDG/IMO**

UN-No UN2930  
 Proper Shipping Name TOXIC SOLIDS, FLAMMABLE, ORGANIC, N.O.S.  
 Hazard Class 6.1  
 Subsidiary Hazard Class 4.1  
 Packing Group I

## 15. Regulatory information

**International Inventories**

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Cadmium	X	X	-	231-152-8	-		X	-	X	X	X

**Legend:**

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

**U.S. Federal Regulations****TSCA 12(b)**

Not applicable

**SARA 313**

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Cadmium	7440-43-9	100	0.1

**SARA 311/312 Hazardous Categorization**

Acute Health Hazard Yes  
 Chronic Health Hazard Yes  
 Fire Hazard Yes  
 Sudden Release of Pressure Hazard No

## Reactive Hazard

No

## Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Cadmium	-	-	X	X

## Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Cadmium	X		-

## OSHA Occupational Safety and Health Administration

Not applicable

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Cadmium	5 µg/m³ TWA 2.5 µg/m³ Action Level	-

## CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Cadmium	10 lb	-

## California Proposition 65

This product contains the following Proposition 65 chemicals:

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Cadmium	7440-43-9	Carcinogen Developmental Male Reproductive	0.05 µg/day	Developmental Carcinogen

## State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Cadmium	X	X	X	X	X

## U.S. Department of Transportation

Reportable Quantity (RQ): Y  
 DOT Marine Pollutant N  
 DOT Severe Marine Pollutant N

## U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

## Other International Regulations

## Mexico - Grade

No information available

## Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

## WHMIS Hazard Class

D2A Very toxic materials  
 E Corrosive material  
 D1B Toxic materials  
 B4 Flammable solid



## 16. Other information

**Prepared By**

Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

**Revision Date**

11-Dec-2014

**Print Date**

11-Dec-2014

**Revision Summary**

This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

**Disclaimer**

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**

Creation Date 22-Sep-2009

Revision Date 02-Jan-2014

Revision Number 4

## SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

### 1.1. Product identifier

<b>Product Description:</b>	<b>Calcium</b>
<b>Cat No. :</b>	<b>201180000; 201180050; 201181000; 201185000</b>
<b>Synonyms</b>	Calcium Metal.; Calciat
<b>CAS-No</b>	7440-70-2
<b>EC-No.</b>	231-179-5
<b>Molecular Formula</b>	Ca

### 1.2. Relevant identified uses of the substance or mixture and uses advised against

<b>Recommended Use</b>	Laboratory chemicals
<b>Uses advised against</b>	No Information available

### 1.3. Details of the supplier of the safety data sheet

<b>Company</b>	Acros Organics BVBA Janssen Pharmaceuticaaan 3a 2440 Geel, Belgium
<b>E-mail address</b>	begel.sdsdesk@thermofisher.com

### 1.4. Emergency telephone number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11  
Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99  
**CHEMTREC** Tel. No.**US**:001-800-424-9300 / **Europe**:001-703-527-3887

## SECTION 2: HAZARDS IDENTIFICATION

### 2.1. Classification of the substance or mixture

#### CLP Classification - Regulation (EC) No 1272/2008

##### **Physical hazards**

Substances/mixtures which, in contact with water, emit flammable gases Category 2

##### **Health hazards**

Based on available data, the classification criteria are not met

##### **Environmental hazards**

Based on available data, the classification criteria are not met

#### Classification according to EU Directives 67/548/EEC or 1999/45/EC

<b>Symbol(s)</b>	F - Highly flammable
<b>R-phrases(s)</b>	R15 - Contact with water liberates extremely flammable gases

For the full text of the R-phrases and H-Statements mentioned in this Section, see Section 16

### 2.2. Label elements

**Signal Word****Danger****Hazard Statements**

H261 - In contact with water releases flammable gases

**Precautionary Statements**

P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection

P231 + P232 - Handle under inert gas. Protect from moisture

P223 - Keep away from any possible contact with water, because of violent reaction and possible flash fire

P335 + P334 - Brush off loose particles from skin. Immerse in cool water/ wrap in wet bandages

P370 + P378 - In case of fire: Use carbon dioxide for extinction

P402 + P404 - Store in a dry place. Store in a closed container

**2.3. Other hazards**

No information available.

**SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS****3.1. Substances**

Component	CAS-No	EC-No.	Weight %	CLP Classification - Regulation (EC) No 1272/2008	DSD Classification - 67/548/EEC
Calcium	7440-70-2	EEC No. 231-179-5	99	Water-react. 2 (H261)	F; R15

*For the full text of the R-phrases and H-Statements mentioned in this Section, see Section 16***SECTION 4: FIRST AID MEASURES****4.1. Description of first aid measures****Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention if symptoms occur..

**Skin Contact**

Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention if symptoms occur..

**Ingestion**

Clean mouth with water. Get medical attention.

**Inhalation**

Remove from exposure, lie down. Move to fresh air.

**Protection of First-aiders**

No special precautions required.

**4.2. Most important symptoms and effects, both acute and delayed**

None reasonably foreseeable.

**4.3. Indication of any immediate medical attention and special treatment needed****Notes to Physician**

Treat symptomatically



**SECTION 5: FIREFIGHTING MEASURES****5.1. Extinguishing media****Suitable Extinguishing Media**

Carbon dioxide (CO<sub>2</sub>). Dry chemical. chemical foam.

**Extinguishing media which must not be used for safety reasons**

Water.

**5.2. Special hazards arising from the substance or mixture**

Water reactive. Produce flammable gases on contact with water.

**Hazardous Combustion Products**

Hydrogen, Calcium oxides.

**5.3. Advice for firefighters**

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

**SECTION 6: ACCIDENTAL RELEASE MEASURES****6.1. Personal precautions, protective equipment and emergency procedures**

Ensure adequate ventilation

**6.2. Environmental precautions**

See Section 12 for additional ecological Information.

**6.3. Methods and material for containment and cleaning up**

Sweep up or vacuum up spillage and collect in suitable container for disposal. Do not expose spill to water. Do not let this chemical enter the environment.

**6.4. Reference to other sections**

Refer to protective measures listed in Sections 8 and 13.

**SECTION 7: HANDLING AND STORAGE****7.1. Precautions for safe handling**

Do not allow contact with water. Avoid contact with skin and eyes. Avoid contact with clothing. Do not ingest. Protect from moisture.

**7.2. Conditions for safe storage, including any incompatibilities**

Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Protect from moisture. Never allow product to get in contact with water during storage.

**7.3. Specific end use(s)**

Use in laboratories

**SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1. Control parameters****Exposure limits**

List source(s):

## Calcium

Component	Latvia	Lithuania	Luxembourg	Malta	Romania
Calcium	TWA: 0.5 mg/m <sup>3</sup>				

**Biological limit values**

This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

**Monitoring methods**

BS EN 14042:2003 Title Identifier: Workplace atmospheres. Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents.

MDHS14/3 General methods for sampling and gravimetric analysis of respirable and inhalable dust

**Derived No Effect Level (DNEL)** No information available.

Route of exposure	Acute effects (local)	Acute effects (systemic)	Chronic effects (local)	Chronic effects (systemic)
Oral				
Dermal				
Inhalation				

**Predicted No Effect Concentration (PNEC)** No information available.

**8.2. Exposure controls****Engineering Measures**

None under normal use conditions..

**Personal protective equipment**

**Eye Protection** Goggles (European standard - EN 166)

**Hand Protection** Protective gloves

Glove material	Breakthrough time	Glove thickness	EU standard	Glove comments
Natural rubber	See manufacturers	-	EN 374	(minimum requirement)
Nitrile rubber	recommendations			
Neoprene				
PVC				

Inspect gloves before use.

Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. (Refer to manufacturer/supplier for information)

Ensure gloves are suitable for the task: Chemical compatability, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion. Remove gloves with care avoiding skin contamination.

**Skin and body protection** Wear appropriate protective gloves and clothing to prevent skin exposure

**Respiratory Protection** No special protective equipment required.

**Large scale/emergency use** Use a NIOSH/MSHA or European Standard EN 136 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced..  
**Recommended Filter type:** Particulates filter conforming to EN 143.

**Small scale/Laboratory use** No personal respiratory protective equipment normally required

**Hygiene Measures** Handle in accordance with good industrial hygiene and safety practice

Environmental exposure controls No information available.

## SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

### 9.1. Information on basic physical and chemical properties

Appearance	Grey	
Physical State	Solid.	
Odor	odorless	
Odor Threshold	No data available	
pH	14	
Melting Point/Range	845°C / 1553°F	
Softening Point	No data available	
Boiling Point/Range	1484°C / 2703.2°F	@ 760 mmHg
Flash Point	No information available.	<b>Method -</b> No information available.
Evaporation Rate	Not applicable	Solid
Flammability (solid,gas)	No information available.	
Explosion Limits	No data available.	
Vapor Pressure	No data available	
Vapor Density	Not applicable	Solid
Specific Gravity / Density	No data available	
Bulk Density	No data available	
Water Solubility	Reacts with water	
Solubility in other solvents	No information available.	
Partition Coefficient (n-octanol/water)		
Autoignition Temperature	Not applicable	
Decomposition temperature	No data available	
Viscosity	Not applicable	Solid
Explosive Properties	No information available.	
Oxidizing Properties	No information available.	

### 9.2. Other information

Molecular Formula	Ca
Molecular Weight	40.07

## SECTION 10: STABILITY AND REACTIVITY

### 10.1. Reactivity

Yes  
Reacts violently with water

### 10.2. Chemical stability

Moisture sensitive.

### 10.3. Possibility of hazardous reactions

Hazardous Polymerization	No information available.
Hazardous Reactions	No information available.

### 10.4. Conditions to avoid

Incompatible products, Exposure to moist air or water.

**10.5. Incompatible materials**

Acids. Strong oxidizing agents. Alcohols. Ammonia. Halogens. oxygen.

**10.6. Hazardous decomposition products**

Hydrogen, Calcium oxides.

**SECTION 11: TOXICOLOGICAL INFORMATION****11.1. Information on toxicological effects**

<b>Product Information</b>	No acute toxicity information is available for this product
<b>(a) acute toxicity;</b>	
Oral	No data available
Dermal	No data available
Inhalation	No data available
<b>(b) skin corrosion/irritation;</b>	No data available
<b>(c) serious eye damage/irritation;</b>	No data available
<b>(d) respiratory or skin sensitization;</b>	
Respiratory	No data available
Skin	No data available
<b>(e) germ cell mutagenicity;</b>	No data available
<b>(f) carcinogenicity;</b>	No data available
	There are no known carcinogenic chemicals in this product
<b>(g) reproductive toxicity;</b>	No data available
<b>(h) STOT-single exposure;</b>	No data available
<b>(i) STOT-repeated exposure;</b>	No data available
Target Organs	No information available.
<b>(j) aspiration hazard;</b>	Not applicable Solid
<b>Other Adverse Effects</b>	See actual entry in RTECS for complete information
<b>Symptoms / effects,</b>	No information available.
<b>both acute and delayed</b>	

**SECTION 12: ECOLOGICAL INFORMATION****12.1. Toxicity****Ecotoxicity effects**

Reacts with water so no ecotoxicity data for the substance is available. Do not empty into drains.

**12.2. Persistence and degradability****Persistence**

Persistence is unlikely, based on information available.

**Degradability**

Not relevant for inorganic substances.

**Degradation in sewage treatment plant**

Water reactive.

**SECTION 12: ECOLOGICAL INFORMATION**

<b>12.3. Bioaccumulative potential</b>	Product does not bioaccumulate due to reaction with water
<b>12.4. Mobility in soil</b>	Reacts with water. Is not likely mobile in the environment.
<b>12.5. Results of PBT and vPvB assessment</b>	No data available for assessment
<b>12.6. Other adverse effects</b>	
<b>Endocrine Disruptor Information</b>	This product does not contain any known or suspected endocrine disruptors
<b>Persistent Organic Pollutant</b>	This product does not contain any known or suspected substance
<b>Ozone Depletion Potential</b>	This product does not contain any known or suspected substance

**SECTION 13: DISPOSAL CONSIDERATIONS****13.1. Waste treatment methods**

<b>Waste from Residues / Unused Products</b>	Waste is classified as hazardous. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations.
<b>Contaminated Packaging</b>	Dispose of this container to hazardous or special waste collection point..
<b>European Waste Catalogue (EWC)</b>	According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.
<b>Other Information</b>	Waste codes should be assigned by the user based on the application for which the product was used. Do not empty into drains. Solutions with high pH-value must be neutralized before discharge.

**SECTION 14: TRANSPORT INFORMATION****IMDG/IMO**

<b>14.1. UN number</b>	1401
<b>14.2. UN proper shipping name</b>	CALCIUM
<b>14.3. Transport hazard class(es)</b>	4.3
<b>14.4. Packing group</b>	II

**ADR**

<b>14.1. UN number</b>	1401
<b>14.2. UN proper shipping name</b>	CALCIUM
<b>14.3. Transport hazard class(es)</b>	4.3
<b>14.4. Packing group</b>	II

**IATA**

<b>14.1. UN number</b>	1401
<b>14.2. UN proper shipping name</b>	CALCIUM
<b>14.3. Transport hazard class(es)</b>	4.3
<b>14.4. Packing group</b>	II

<b>14.5. Environmental hazards</b>	No hazards identified
<b>14.6. Special precautions for user</b>	No special precautions required
<b>14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code</b>	Not applicable, packaged goods

**SECTION 15: REGULATORY INFORMATION**

## SECTION 15: REGULATORY INFORMATION

### 15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

#### International Inventories

X = listed

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	CHINA	AICS	KECL
Calcium	231-179-5	-		X	X	-	X	-	X	X	X

#### National Regulations

Take note of Control of Substances Hazardous to Health Regulations (COSHH) 2002 and 2005 Amendment

Take note of Dir 94/33/EC on the protection of young people at work

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

### 15.2. Chemical safety assessment

A Chemical Safety Assessment/Report (CSA/CSR) has not been conducted

## SECTION 16: OTHER INFORMATION

#### Full text of R-phrases referred to under sections 2 and 3

R15 - Contact with water liberates extremely flammable gases

#### Full text of H-Statements referred to under sections 2 and 3

H261 - In contact with water releases flammable gases

#### Legend

**CAS** - Chemical Abstracts Service

**EINECS/ELINCS** - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

**PICCS** - Philippines Inventory of Chemicals and Chemical Substances

**IECSC** - China Inventory of Existing Chemical Substances

**KECL** - Existing and Evaluated Chemical Substances

**WEL** - Workplace Exposure Limit

**ACGIH** - American Conference of Industrial Hygiene

**DNEL** - Derived No Effect Level

**RPE** - Respiratory Protective Equipment

**LC50** - Lethal Concentration 50%

**NOEC** - No Observed Effect Concentration

**PBT** - Persistent, Bioaccumulative, Toxic

**ADR** - European Agreement Concerning the International Carriage of Dangerous Goods by Road

**IMO/IMDG** - International Maritime Organization/International Maritime Dangerous Goods Code

**OECD** - Organisation for Economic Co-operation and Development

**BCF** - Bioconcentration factor

**TSCA** - United States Toxic Substances Control Act Section 8(b) Inventory

**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List

**ENCS** - Japan Existing and New Chemical Substances

**AICS** - Australian Inventory of Chemical Substances

**NZIoC** - New Zealand Inventory of Chemicals

**TWA** - Time Weighted Average

**IARC** - International Agency for Research on Cancer

**PNEC** - Predicted No Effect Concentration

**LD50** - Lethal Dose 50%

**EC50** - Effective Concentration 50%

**POW** - Partition coefficient Octanol:Water

**vPvB** - very Persistent, very Bioaccumulative

**ICAO/IATA** - International Civil Aviation Organization/International Air Transport Association

**MARPOL** - International Convention for the Prevention of Pollution from Ships

**ATE** - Acute Toxicity Estimate

**VOC** - Volatile Organic Compounds

#### Key literature references and sources for data

Suppliers safety data sheet,

Chemadvisor - LOLI,

Merck index,

RTECS

#### Training Advice

Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene.

Use of personal protective equipment, covering appropriate selection, compatibility, breakthrough thresholds, care, maintenance, fit and standards.

First aid for chemical exposure, including the use of eye wash and safety showers.

Creation Date 22-Sep-2009  
Revision Date 02-Jan-2014  
Revision Summary  
Reason for revision Update to Format, (M)SDS sections updated, 4, 6, 7, 8, 10, 12, 16.

**This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006**

**Disclaimer**

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of Safety Data Sheet**



## SAFETY DATA SHEET

Creation Date 11-Nov-2010

Revision Date 23-Jul-2014

Revision Number 1

### 1. Identification

**Product Name** Carbon disulfide

**Cat No. :** AC445660000; AC445660010; AC445660025; AC445661000

**Synonyms** No information available

**Recommended Use** Laboratory chemicals.

**Uses advised against** No Information available

**Details of the supplier of the safety data sheet**

Company	Entity / Business Name	Emergency Telephone Number
Fisher Scientific One Reagent Lane Fair Lawn, NJ 07410 Tel: (201) 796-7100	Acros Organics One Reagent Lane Fair Lawn, NJ 07410	For information <b>US</b> call: 001-800-ACROS-01 / <b>Europe</b> call: +32 14 57 52 11 Emergency Number <b>US</b> :001-201-796-7100 / <b>Europe</b> : +32 14 57 52 99 <b>CHEMTREC</b> Tel. No. <b>US</b> :001-800-424-9300 / <b>Europe</b> :001-703-527-3887

### 2. Hazard(s) identification

#### Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute Inhalation Toxicity - Vapors	Category 4
Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Reproductive Toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 1
Target Organs - Liver, Kidney.	

#### Label Elements

##### Signal Word

Danger

##### Hazard Statements

Highly flammable liquid and vapor  
Harmful if inhaled  
Causes skin irritation  
Causes serious eye irritation  
Suspected of damaging fertility. Suspected of damaging the unborn child  
May cause drowsiness or dizziness  
Causes damage to organs through prolonged or repeated exposure



**Precautionary Statements****Prevention**

Obtain special instructions before use  
Do not handle until all safety precautions have been read and understood  
Use personal protective equipment as required  
Use only outdoors or in a well-ventilated area  
Wash face, hands and any exposed skin thoroughly after handling  
Wear eye/face protection  
Do not breathe dust/fume/gas/mist/vapors/spray  
Do not eat, drink or smoke when using this product  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking  
Keep container tightly closed  
Ground/bond container and receiving equipment  
Use explosion-proof electrical/ventilating/lighting/equipment  
Use only non-sparking tools  
Take precautionary measures against static discharge  
Keep cool

**Response**

IF exposed or concerned: Get medical attention/advice

**Inhalation**

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

**Skin**

If skin irritation occurs: Get medical advice/attention

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower  
Wash contaminated clothing before reuse

**Eyes**

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
If eye irritation persists: Get medical advice/attention

**Fire**

In case of fire: Use CO<sub>2</sub>, dry chemical, or foam for extinction

**Storage**

Store locked up  
Store in a well-ventilated place. Keep container tightly closed

**Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)**

None identified

**Other hazards**

WARNING! This product contains a chemical known in the State of California to cause birth defects or other reproductive harm.

### 3. Composition / information on ingredients

Component	CAS-No	Weight %
Carbon disulfide	75-15-0	>95

### 4. First-aid measures

**General Advice**

Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

**Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.  
Obtain medical attention.

<b>Skin Contact</b>	Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.
<b>Inhalation</b>	Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.
<b>Ingestion</b>	Do not induce vomiting. Call a physician or Poison Control Center immediately.
<b>Most important symptoms/effects</b>	Breathing difficulties. . Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting; Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
<b>Notes to Physician</b>	Treat symptomatically

### 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	CO <sub>2</sub> , dry chemical, dry sand, alcohol-resistant foam. Cool closed containers exposed to fire with water spray.
<b>Unsuitable Extinguishing Media</b>	Water may be ineffective
<b>Flash Point</b>	-30 °C / -22 °F
<b>Method -</b>	No information available
<b>Autoignition Temperature</b>	100 °C / 212 °F
<b>Explosion Limits</b>	
<b>Upper</b>	60 vol %
<b>Lower</b>	1 vol %
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	No information available

#### Specific Hazards Arising from the Chemical

Flammable. Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

#### Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO<sub>2</sub>) Sulfur oxides

#### Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

#### NFPA

**Health**  
3

**Flammability**  
4

**Instability**  
0

**Physical hazards**  
N/A

### 6. Accidental release measures

<b>Personal Precautions</b>	Use personal protective equipment. Evacuate personnel to safe areas. Remove all sources of ignition. Take precautionary measures against static discharges. Do not get in eyes, on skin, or on clothing.
<b>Environmental Precautions</b>	Should not be released into the environment. See Section 12 for additional ecological information.
<b>Methods for Containment and Clean Up</b>	Remove all sources of ignition. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Use spark-proof tools and explosion-proof equipment.

### 7. Handling and storage

<b>Handling</b>	Use only under a chemical fume hood. Use spark-proof tools and explosion-proof equipment. Wear personal protective equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Do not ingest. Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharges.
-----------------	---

**Storage**

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

## 8. Exposure controls / personal protection

**Exposure Guidelines**

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Carbon disulfide	TWA: 1 ppm Skin	(Vacated) TWA: 4 ppm (Vacated) TWA: 12 mg/m <sup>3</sup> Ceiling: 30 ppm (Vacated) STEL: 12 ppm (Vacated) STEL: 36 mg/m <sup>3</sup> Skin TWA: 20 ppm	IDLH: 500 ppm TWA: 1 ppm TWA: 3 mg/m <sup>3</sup> STEL: 10 ppm STEL: 30 mg/m <sup>3</sup>

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Carbon disulfide	TWA: 4 ppm TWA: 12 mg/m <sup>3</sup> STEL: 12 ppm STEL: 36 mg/m <sup>3</sup> Skin	TWA: 10 ppm TWA: 30 mg/m <sup>3</sup>	TWA: 1 ppm Skin

**Engineering Measures**

Use only under a chemical fume hood. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

**Personal Protective Equipment****Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

**Skin and body protection**

Wear appropriate protective gloves and clothing to prevent skin exposure.

**Respiratory Protection**

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice.

## 9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Stench
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-111 °C / -167.8 °F
Boiling Point/Range	46 °C / 114.8 °F @ 760 mmHg
Flash Point	-30 °C / -22 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	60 vol %
Lower	1 vol %
Vapor Pressure	400 hPa @ 20 °C
Vapor Density	2.67 (Air = 1.0)
Relative Density	1.262
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	100 °C / 212 °F
Decomposition Temperature	No information available
Viscosity	0.363 cP at 20 °C
Molecular Formula	C S <sub>2</sub>
Molecular Weight	76.13

## 10. Stability and reactivity

**Reactive Hazard**

None known, based on information available

<b>Stability</b>	Stable under normal conditions.
<b>Conditions to Avoid</b>	Excess heat. Incompatible products. Keep away from open flames, hot surfaces and sources of ignition.
<b>Incompatible Materials</b>	Oxidizing agents, Amines, Halogens, Fluorine, Metals, copper, Butyl rubber
<b>Hazardous Decomposition Products</b>	Carbon monoxide (CO), Carbon dioxide (CO <sub>2</sub> ), Sulfur oxides
<b>Hazardous Polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous Reactions</b>	None under normal processing.

## 11. Toxicological information

### Acute Toxicity

#### Product Information

##### Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Carbon disulfide	3020 mg/kg ( Rat )	Not listed	25 g/m <sup>3</sup> ( Rat ) 2 h

**Toxicologically Synergistic Products** No information available

### Delayed and immediate effects as well as chronic effects from short and long-term exposure

<b>Irritation</b>	Irritating to eyes and skin
<b>Sensitization</b>	No information available
<b>Carcinogenicity</b>	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Carbon disulfide	75-15-0	Not listed	Not listed	Not listed	Not listed	Not listed

**Mutagenic Effects** Substances which cause concern for man owing to possible mutagenic effects but for which the available information is not adequate for making a satisfactory assessment

**Reproductive Effects** No information available.

**Developmental Effects** No information available.

**Teratogenicity** No information available.

**STOT - single exposure** Central nervous system (CNS)  
**STOT - repeated exposure** Liver Kidney

**Aspiration hazard** No information available

**Symptoms / effects, both acute and delayed** Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

#### Endocrine Disruptor Information

Component	EU - Endocrine Disruptors Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Carbon disulfide	Group II Chemical	Not applicable	Not applicable

**Other Adverse Effects** See actual entry in RTECS for complete information. Teratogenic effects have occurred in experimental animals.

## 12. Ecological information

### Ecotoxicity

The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
-----------	------------------	-----------------	----------	------------

Carbon disulfide	21 mg/L EC50 = 96 h	4 mg/L LC50 96 h 3 - 5.8 mg/L LC50 96 h	EC50 = 260 mg/L 15 min	2.1 mg/L EC50 = 48 h
------------------	---------------------	---	------------------------	----------------------

**Persistence and Degradability** Persistence is unlikely based on information available.

**Bioaccumulation/ Accumulation** No information available.

**Mobility** Will likely be mobile in the environment due to its volatility.

Component	log Pow
Carbon disulfide	1.9

### 13. Disposal considerations

**Waste Disposal Methods** Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

### 14. Transport information

#### DOT

UN-No UN1131  
 Proper Shipping Name CARBON DISULFIDE  
 Hazard Class 3  
 Subsidiary Hazard Class 6.1  
 Packing Group I

#### TDG

UN-No UN1131  
 Proper Shipping Name CARBON DISULFIDE  
 Hazard Class 3  
 Subsidiary Hazard Class 6.1  
 Packing Group I

#### IATA

UN-No UN1131  
 Proper Shipping Name CARBON DISULPHIDE FORBIDDEN FOR IATA TRANSPORT  
 Hazard Class 3  
 Subsidiary Hazard Class 6.1  
 Packing Group I

#### IMDG/IMO

UN-No UN1131  
 Proper Shipping Name CARBON DISULPHIDE  
 Hazard Class 3  
 Subsidiary Hazard Class 6.1  
 Packing Group I

### 15. Regulatory information

#### International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Carbon disulfide	X	X	-	200-843-6	-		X	X	X	X	X

#### Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

#### U.S. Federal Regulations

## TSCA 12(b)

## SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Carbon disulfide	75-15-0	>95	1.0

## SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

## Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Carbon disulfide	X	100 lb	-	-

## Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Carbon disulfide	X		-

OSHA Occupational Safety and Health Administration  
Not applicable

## CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Carbon disulfide	100 lb	100 lb

**California Proposition 65** This product contains the following Proposition 65 chemicals:

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Carbon disulfide	75-15-0	Developmental Female Reproductive Male Reproductive	-	Developmental

## State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Carbon disulfide	X	X	X	X	X

## U.S. Department of Transportation

Reportable Quantity (RQ): N  
DOT Marine Pollutant N  
DOT Severe Marine Pollutant N

## U.S. Department of Homeland Security

This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Carbon disulfide	15000 lb STQ

## Other International Regulations

**Mexico - Grade** Serious risk, Grade 3

## Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

## WHMIS Hazard Class

B2 Flammable liquid  
D1B Toxic materials  
D2A Very toxic materials  
D2B Toxic materials



## 16. Other information

## Prepared By

Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

## Creation Date

11-Nov-2010

## Revision Date

23-Jul-2014

## Print Date

23-Jul-2014

## Revision Summary

This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

## Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**

## SAFETY DATA SHEET

Version 3.8  
Revision Date 02/24/2016  
Print Date 04/30/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Carbon monoxide

Product Number : 295116  
Brand : Aldrich  
Index-No. : 006-001-00-2

CAS-No. : 630-08-0

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable gases (Category 1), H220  
Gases under pressure (Compressed gas), H280  
Acute toxicity, Inhalation (Category 3), H331  
Reproductive toxicity (Category 1A), H360  
Specific target organ toxicity - repeated exposure, Inhalation (Category 1), H372

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H220 : Extremely flammable gas.  
H280 : Contains gas under pressure; may explode if heated.  
H331 : Toxic if inhaled.  
H360 : May damage fertility or the unborn child.  
H372 : Causes damage to organs through prolonged or repeated exposure if inhaled.

Precautionary statement(s)

P201 : Obtain special instructions before use.



P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P281	Use personal protective equipment as required.
P304 + P340 + P311	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381	Eliminate all ignition sources if safe to do so.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P410 + P403	Protect from sunlight. Store in a well-ventilated place.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: CO
Molecular weight	: 28.01 g/mol
CAS-No.	: 630-08-0
EC-No.	: 211-128-3
Index-No.	: 006-001-00-2

#### Hazardous components

Component	Classification	Concentration
<b>Carbon monoxide</b>		
	Flam. Gas 1; Press. Gas Compr. Gas; Acute Tox. 3; Repr. 1A; STOT RE 1; H220, H280, H331, H360, H372	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations.

Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Clean up promptly by sweeping or vacuum.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

Storage class (TRGS 510): Gases

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Carbon monoxide	630-08-0	TWA	50.000000 ppm 55.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
	Remarks	The value in mg/m3 is approximate.		
		TWA	25 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section)		

		TWA	25.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section)		
		TWA	35.000000 ppm 40.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	200.000000 ppm 229.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Carbon monoxide	630-08-0	Carboxyhemoglobin	3.500 %	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			
		Carbon monoxide	20ppm	In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

#### Splash contact

Material: Chloroprene

Minimum layer thickness: 0.6 mm

Break through time: 30 min

Material tested: Camapren® (KCL 722 / Aldrich Z677493, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: Compressed gas
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -205 °C (-337 °F) - lit.
f) Initial boiling point and boiling range	-191.5 °C (-312.7 °F) - lit.
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 74 %(V) Lower explosion limit: 12.5 %(V)
k) Vapour pressure	No data available
l) Vapour density	0.97 - (Air = 1.0)
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

Relative vapour density	0.97 - (Air = 1.0)
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**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

#### 10.4 Conditions to avoid

Heat, flames and sparks.

#### 10.5 Incompatible materials

Sodium/sodium oxides, Potassium, Strong oxidizing agents

#### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

LC50 Inhalation - Rat - 4 h - 1807 ppm

Dermal: No data available

No data available

##### Skin corrosion/irritation

No data available

##### Serious eye damage/eye irritation

No data available

##### Respiratory or skin sensitisation

No data available

##### Germ cell mutagenicity

No data available

##### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

Known human reproductive toxicant

No data available

##### Specific target organ toxicity - single exposure

No data available

##### Specific target organ toxicity - repeated exposure

Inhalation - Causes damage to organs through prolonged or repeated exposure.

##### Aspiration hazard

No data available

##### Additional Information

RTECS: FG3500000

Blood disorders

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

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### 12. ECOLOGICAL INFORMATION

#### 12.1 Toxicity

No data available

## 12.2 Persistence and degradability

No data available

## 12.3 Bioaccumulative potential

No data available

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1016      Class: 2.3 (2.1)  
Proper shipping name: Carbon monoxide, compressed  
Reportable Quantity (RQ):

Poison Inhalation Hazard: Hazard zone D

### IMDG

UN number: 1016      Class: 2.3 (2.1)  
Proper shipping name: CARBON MONOXIDE, COMPRESSED

EMS-No: F-D, S-U

### IATA

UN number: 1016      Class: 2.3 (2.1)  
Proper shipping name: Carbon monoxide, compressed  
IATA Passenger: Not permitted for transport  
IATA Cargo: Not permitted for transport

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Fire Hazard, Sudden Release of Pressure Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

Carbon monoxide	CAS-No. 630-08-0	Revision Date 1993-04-24
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### Pennsylvania Right To Know Components

Carbon monoxide	CAS-No. 630-08-0	Revision Date 1993-04-24
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### New Jersey Right To Know Components

Carbon monoxide

CAS-No.  
630-08-0

Revision Date  
1993-04-24

**California Prop. 65 Components**

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

Carbon monoxide

CAS-No.  
630-08-0

Revision Date  
2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Flam. Gas	Flammable gases
H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.
H331	Toxic if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure if inhaled.
Press. Gas	Gases under pressure
Repr.	Reproductive toxicity
STOT RE	Specific target organ toxicity - repeated exposure

### HMIS Rating

Health hazard:	3
Chronic Health Hazard:	*
Flammability:	4
Physical Hazard	0

### NFPA Rating

Health hazard:	3
Fire Hazard:	4
Reactivity Hazard:	0

### Further information

Copyright 2016 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.8

Revision Date: 02/24/2016

Print Date: 04/30/2016

Creation Date 24-Nov-2010

Revision Date 01-May-2012

Revision Number 5

## SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

### Product Identifier

#### Product Description:

Carbon tetrachloride

#### Reach Registration Number

01-2119486131-44

#### Cat No.

167720000; 167720010; 167720025; 167720100; 167721000; 167725000

#### Synonyms

Tetrachloromethane

### Relevant identified uses of the substance or mixture and uses advised against

#### Recommended Use

Laboratory chemicals

#### Uses advised against

No Information available

### Details of the supplier of the safety data sheet

#### Company

Acros Organics BVBA  
Janssen Pharmaceuticaal 3a  
2440 Geel, Belgium

#### E-mail address

begel.sdsdesk@thermofisher.com

### Emergency Telephone Number

For information in the US, call: 001-800-ACROS-01

For information in Europe, call: +32 14 57 52 11

Emergency Number, Europe: +32 14 57 52 99

Emergency Number, US: 001-201-796-7100

CHEMTREC Phone Number, US: 001-800-424-9300

CHEMTREC Phone Number, Europe: 001-703-527-3887

## SECTION 2. HAZARDS IDENTIFICATION

### Classification of the substance or mixture

#### REGULATION (EC) No 1272/2008

Acute oral toxicity	Category 3
Acute dermal toxicity	Category 3
Acute Inhalation Toxicity - Vapors	Category 3
Carcinogenicity	Category 2
Specific target organ toxicity - (repeated exposure)	Category 1
Chronic aquatic toxicity	Category 3

### Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases and H-Statements mentioned in this Section, see Section 16

#### Symbol(s)

T - Toxic

N - Dangerous for the environment

#### R-phrases(s)

R40 - Limited evidence of a carcinogenic effect

R59 - Dangerous for the ozone layer



Carbon tetrachloride

Revision Date 01-May-2012

## SECTION 2. HAZARDS IDENTIFICATION

### Risk Combination Phrases

R23/24/25 - Toxic by inhalation, in contact with skin and if swallowed  
R48/23 - Toxic: danger of serious damage to health by prolonged exposure through inhalation  
R52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

### Label Elements



### Signal Word

**Danger**

### Hazard Statements

H412 - Harmful to aquatic life with long lasting effects  
H311 - Toxic in contact with skin  
H351 - Suspected of causing cancer  
H372 - Causes damage to organs through prolonged or repeated exposure  
H331 - Toxic if inhaled  
H301 - Toxic if swallowed  
H420 - Harms public health and the environment by destroying ozone in the upper atmosphere

### Precautionary Statements - EU (§28, 1272/2008)

P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician  
P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection  
P302 + P350 - IF ON SKIN: Gently wash with plenty of soap and water  
P304 + P340 - IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing  
P260 - Do not breathe dust/fume/gas/mist/vapors/spray  
P273 - Avoid release to the environment

### Other Hazards

No information available.

## SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	EC-No.	Weight %	CAS-No	67/548/EEC Classification	CLP Classification - Regulation (EC) No 1272/2008	REACH No.

Carbon tetrachloride

Revision Date 01-May-2012

## SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Carbon tetrachloride 56-23-5	EEC No. 200-262-8	>95	56-23-5	T; R23/24/25-48/23 Carc.Cat.3; R40 R52-53 N; R59	Acute Tox. 3 (H301) Acute Tox. 3 (H311) Acute Tox. 3 (H331) Carc. 2 (H351) STOT RE 1 (H372) Aquatic Chronic 3 (H412) Ozone 1 (H420)	01-211948613-44
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For the full text of the R-phrases and H-Statements mentioned in this Section, see Section 16

## SECTION 4. FIRST AID MEASURES

### Description of first aid measures

#### Eye Contact

Immediate medical attention is required. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

#### Skin Contact

Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Immediate medical attention is required.

#### Ingestion

Call a physician immediately. Clean mouth with water.

#### Inhalation

Remove from exposure, lie down. Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Immediate medical attention is required.

#### Notes to Physician

Treat symptomatically

## SECTION 5. FIRE-FIGHTING MEASURES

### Extinguishing media

#### Suitable Extinguishing Media

Water spray. Carbon dioxide (CO<sub>2</sub>). Dry chemical. chemical foam.

#### Extinguishing media which must not be used for safety reasons

No information available.

#### Special hazards arising from the substance or mixture

Thermal decomposition can lead to release of irritating gases and vapors

#### Advice for fire-fighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Carbon tetrachloride

Revision Date 01-May-2012

## SECTION 6. ACCIDENTAL RELEASE MEASURES

### Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation

### Environmental precautions

Prevent further leakage or spillage if safe to do so

### Methods and material for containment and cleaning up

Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal.. Wear self-contained breathing apparatus and protective suit. Do not let this chemical enter the environment.

## SECTION 7. HANDLING AND STORAGE

### Precautions for Safe Handling

Do not breathe dust. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Do not ingest. Use only in area provided with appropriate exhaust ventilation.

### Conditions for safe storage, including any incompatibilities

Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

### Specific End Uses

## SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### Control parameters

#### Exposure limits

#### Component

Carbon tetrachloride

European Union	The United Kingdom	France	Belgium	Spain
	STEL: 6 ppm 15 min STEL: 39 mg/m <sup>3</sup> 15 min TWA: 2 ppm 8 hr TWA: 13 mg/m <sup>3</sup> 8 hr Skin	VME: 2 ppm 8 heures. VME: 12 mg/m <sup>3</sup> 8 heures. VLCT: 10 ppm VLCT: 60 mg/m <sup>3</sup>	TWA: 5 ppm 8 uren TWA: 31 mg/m <sup>3</sup> 8 uren STEL: 10 ppm 15 minuten STEL: 64 mg/m <sup>3</sup> 15 minuten Skin	Skin VLA-EC: 10 ppm 15 minutos VLA-EC: 64 mg/m <sup>3</sup> 15 minutos VLA-ED: 5 ppm 8 horas VLA-ED: 32 mg/m <sup>3</sup> 8 horas

## Carbon tetrachloride

Revision Date 01-May-2012

### Component

Carbon tetrachloride

Italy	Germany	Portugal	The Netherlands	Finland
	MAK: 0.5 ppm 8 Stunden. MAK: 3.2 mg/m <sup>3</sup> 8 Stunden. skin notation Skin Peak: 1 ppm Peak: 6.4 mg/m <sup>3</sup> TWA: 0.5 ppm 8 Stunden. exposure factor 2 TWA: 3.2 mg/m <sup>3</sup> 8 Stunden. exposure factor 2	STEL: 10 ppm 15 minutos TWA: 5 ppm 8 horas Skin		TWA: 1 ppm 8 tunteina TWA: 6.3 mg/m <sup>3</sup> 8 tunteina STEL: 5 ppm 15 minuutteina STEL: 31 mg/m <sup>3</sup> 15 minuutteina Skin

### Component

Carbon tetrachloride

Austria	Denmark	Switzerland	Poland	Norway
Skin STEL: 40 ppm 15 Minuten STEL: 260 mg/m <sup>3</sup> 15 Minuten TWA: 10 ppm 8 Stunden TWA: 65 mg/m <sup>3</sup> 8 Stunden	TWA: 1 ppm 8 timer TWA: 6.3 mg/m <sup>3</sup> 8 timer Skin	Skin STEL: 1.0 ppm 15 Minuten STEL: 6.4 mg/m <sup>3</sup> 15 Minuten MAK: 0.5 ppm 8 Stunden MAK: 3.2 mg/m <sup>3</sup> 8 Stunden	NDS: 20 mg/m <sup>3</sup> 8 godzinach	TWA: 2 ppm 8 timer TWA: 13 mg/m <sup>3</sup> 8 timer STEL: 4 ppm 15 minutter. STEL: 19.5 mg/m <sup>3</sup> 15 minutter. Skin

### Component

Carbon tetrachloride

Bulgaria	Croatia	Ireland	Cyprus	Czech Republic
TWA: 12.6 mg/m <sup>3</sup>	Skin Notation TWA: 2 ppm 8 satima. TWA: 13 mg/m <sup>3</sup> 8 satima.	TWA: 2 ppm 8 hr. TWA: 12.6 mg/m <sup>3</sup> 8 hr. Skin		TWA: 10 mg/m <sup>3</sup> 8 hodinách. Potential for cutaneous absorption Ceiling: 20 mg/m <sup>3</sup>

### Component

Carbon tetrachloride

Estonia	Gibraltar	Greece	Hungary	Iceland
Skin notation TWA: 2 ppm 8 tundides. TWA: 13 mg/m <sup>3</sup> 8 tundides. STEL: 3 ppm 15 minutites. STEL: 19 mg/m <sup>3</sup> 15 minutites.		skin - potential for cutaneous absorption TWA: 10 ppm TWA: 65 mg/m <sup>3</sup>		TWA: 1 ppm 8 klukkustundum. TWA: 6.3 mg/m <sup>3</sup> 8 klukkustundum. Skin notation Ceiling: 2 ppm Ceiling: 12.6 mg/m <sup>3</sup>

### Component

Carbon tetrachloride

Latvia	Lithuania	Luxembourg	Malta	Romania
TWA: 20 mg/m <sup>3</sup>	TWA: 2 ppm TWA: 13 mg/m <sup>3</sup> Skin notation STEL: 3 ppm STEL: 19 mg/m <sup>3</sup>			Skin notation TWA: 5 ppm 8 ore TWA: 30 mg/m <sup>3</sup> 8 ore STEL: 8 ppm 15 minute STEL: 50 mg/m <sup>3</sup> 15 minute

## Carbon tetrachloride

Revision Date 01-May-2012

### Component

Carbon tetrachloride

Russia - TWA	Slovak Republic	Slovenia	Sweden	Turkey
TWA: 10 mg/m <sup>3</sup> STEL: 20 mg/m <sup>3</sup> vapor	Potential for cutaneous absorption Ceiling: 6.8 mg/m <sup>3</sup>	TWA: 10 ppm 8 urah TWA: 64 mg/m <sup>3</sup> 8 urah Potential for cutaneous absorption STEL: 40 ppm 15 minutah STEL: 256 mg/m <sup>3</sup> 15 minutah	STV: 3 ppm 15 minuter STV: 19 mg/m <sup>3</sup> 15 minuter LLV: 2 ppm 8 timmar. LLV: 13 mg/m <sup>3</sup> 8 timmar. Skin notation	

### Biological limit values

#### Component

Carbon tetrachloride

European Union	United Kingdom	France	Spain	Germany
				Tetrachloromethane: 70 µg/L whole blood end of shift Tetrachloromethane: 70 µg/L whole blood end of several shifts for long-term exposures

#### Component

Carbon tetrachloride

Slovak Republic	Turkey
Tetrachloromethane: 3.5 µg/L blood end of exposure or work shift Tetrachloromethane: 3.5 µg/L blood after all work shifts for long-term exposure	

#### Derived No Effect Level (DNEL)

No information available.

#### Predicted No Effect Concentration (PNEC)

No information available.

### Exposure controls

#### Engineering Measures

Ensure adequate ventilation, especially in confined areas

#### Personal protective equipment

##### Eye Protection

Goggles

##### Hand Protection

Protective gloves

##### Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure

##### Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

#### Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice

#### Environmental exposure controls

No information available.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

#### Physical State

Liquid

Carbon tetrachloride

Revision Date 01-May-2012

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Colorless
Vapor Pressure	121 mbar @ 20 °C
Viscosity	0.97 mPa.s at 20 °C
Boiling Point/Range	76°C / 168.8°F
Melting Point/Range	-23°C / -9.4°F
Decomposition temperature	> 100°C
Flash Point	No information available.
Autoignition Temperature	982°C / 1799.6°F
Water Solubility	0.8 g/L (20°C)
Specific Gravity	1.594
Molecular Formula	C Cl <sub>4</sub>
Molecular Weight	153.82

## SECTION 10. STABILITY AND REACTIVITY

### Reactivity

### Chemical Stability

Stable under normal conditions

### Possibility of Hazardous Reactions

<b>Hazardous Polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous Reactions .</b>	No information available.

### Conditions to Avoid

Incompatible products.

### Incompatible Materials

Strong oxidizing agents, Fluorine, Metals.

### Hazardous Decomposition Products

Hydrogen chloride gas. Carbon monoxide (CO). Carbon dioxide (CO<sub>2</sub>). Phosgene.

## SECTION 11. TOXICOLOGICAL INFORMATION

### Information on Toxicological Effects

### Acute Toxicity

### Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
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Carbon tetrachloride

Revision Date 01-May-2012

## SECTION 11. TOXICOLOGICAL INFORMATION

Carbon tetrachloride	2350 mg/kg ( Rat )	5070 mg/kg ( Rat )	8000 ppm ( Rat ) 4 h
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### Chronic Toxicity

#### Carcinogenicity

The table below indicates whether each agency has listed any ingredient as a carcinogen  
Limited evidence of a carcinogenic effect

#### Component

Carbon tetrachloride

IARC	UK
Group 2B	

#### Sensitization

No information available.

#### Mutagenic Effects

Not mutagenic in AMES Test

#### Reproductive Effects

No information available.

#### Developmental Effects

No information available.

#### Target Organs

No information available.

#### Other Adverse Effects

See actual entry in RTECS for complete information

#### Endocrine Disruptor Information

None known

## SECTION 12. ECOLOGICAL INFORMATION

### Toxicity

#### Ecotoxicity effects

Do not empty into drains

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Carbon tetrachloride	830 mg/L EC50 = 24 h	9.68-11.3 mg/L LC50 96 h 23-33 mg/L LC50 96 h 36.3-47.3 mg/L LC50 96 h	EC50 = 34 mg/L 10 min EC50 = 5.6 mg/L 5 min	28 mg/L EC50 = 24 h 29 mg/L EC50 = 48 h

### Persistence and degradability

No information available

### Bioaccumulative potential

No information available.

Component	log Pow
Carbon tetrachloride	2.75

### Mobility in soil

Carbon tetrachloride

Revision Date 01-May-2012

## Results of PBT and vPvB assessment

### Other adverse effects

No information available

## SECTION 13. DISPOSAL CONSIDERATIONS

### Waste treatment methods

**Waste from Residues / Unused Products** Dispose of in accordance with local regulations

**Contaminated Packaging** Empty containers should be taken to local recyclers for disposal

## SECTION 14. TRANSPORT INFORMATION

### IMDG/IMO

UN-No	1846
Hazard Class	6.1
Packing Group	II
Proper Shipping Name	CARBON TETRACHLORIDE

### ADR

UN-No	1846
Hazard Class	6.1
Packing Group	II
Proper Shipping Name	CARBON TETRACHLORIDE

### IATA

UN-No	1846
Hazard Class	6.1
Packing Group	II
Proper Shipping Name	CARBON TETRACHLORIDE

## SECTION 15. REGULATORY INFORMATION

### Safety, health and environmental regulations/legislation specific for the substance or mixture

**Water contaminating class (Germany):** Hazardous to water/Class 3

### International Inventories



Carbon tetrachloride

Revision Date 01-May-2012

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	CHINA	AICS	KECL
Carbon tetrachloride	200-262-8	-		X	X	-	X	X	X	X	X

## Legend

**TSCA** - United States Toxic Substances Control Act Section 8(b) Inventory

**EINECS/ELINCS** - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List

**PICCS** - Philippines Inventory of Chemicals and Chemical Substances

**ENCS** - Japan Existing and New Chemical Substances

**CHINA** - China Inventory of Existing Chemical Substances

**AICS** - Inventory of Chemical Substances

**KECL** - Existing and Evaluated Chemical Substances

## Chemical Safety Assessment

### SECTION 16. OTHER INFORMATION

#### Full text of R-phrases referred to under sections 2 and 3

R40 - Limited evidence of a carcinogenic effect

R59 - Dangerous for the ozone layer

R23/24/25 - Toxic by inhalation, in contact with skin and if swallowed

R48/23 - Toxic: danger of serious damage to health by prolonged exposure through inhalation

R52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Revision Date 01-May-2012

#### Revision Summary

Reason for revision (M)SDS sections updated, 15.

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

#### Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of Safety Data Sheet



## SAFETY DATA SHEET

Creation Date 06-Oct-2009

Revision Date 13-Feb-2014

Revision Number 1

### 1. Identification

**Product Name** Cyclohexane

**Cat No. :** AC111110000; AC111110010; AC111110025; AC111110050;  
AC111110100; AC111110250

**Synonyms** Hexahydrobenzene; Benzene hexahydride; Hexamethylene.

**Recommended Use** Laboratory chemicals

**Uses advised against** No Information available

#### Details of the supplier of the safety data sheet

**Company**  
Fisher Scientific  
One Reagent Lane  
Fair Lawn, NJ 07410  
Tel: (201) 796-7100

**Entity / Business Name**  
Acros Organics  
One Reagent Lane  
Fair Lawn, NJ 07410

**Emergency Telephone Number**  
For information **US** call: 001-800-ACROS-01 /  
**Europe** call: +32 14 57 52 11  
Emergency Number **US**:001-201-796-7100 /  
**Europe**: +32 14 57 52 99  
**CHEMTREC** Tel. No.**US**:001-800-424-9300 /  
**Europe**:001-703-527-3887

### 2. Hazard(s) identification

#### Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Aspiration Toxicity	Category 1

#### Label Elements

**Signal Word**

Danger

**Hazard Statements**

Highly flammable liquid and vapor

May be fatal if swallowed and enters airways

Causes skin irritation

Causes eye irritation

May cause drowsiness or dizziness

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling

Wear protective gloves/protective clothing/eye protection/face protection

Do not breathe dust/fume/gas/mist/vapors/spray

Use only outdoors or in a well-ventilated area

Keep away from heat/sparks/open flames/hot surfaces. - No smoking

Keep container tightly closed

Ground/bond container and receiving equipment

Use explosion-proof electrical/ventilating/lighting/equipment

Use only non-sparking tools

Take precautionary measures against static discharge

Keep cool

**Response**

Get medical attention/advice if you feel unwell

**Inhalation**

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Call a POISON CENTER or doctor/physician if you feel unwell

**Skin**

If skin irritation occurs: Get medical advice/attention

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

Wash contaminated clothing before reuse

**Eyes**

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

If eye irritation persists: Get medical advice/attention.

**Ingestion**

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician

Do NOT induce vomiting

**Fire**In case of fire: Use CO<sub>2</sub>, dry chemical, or foam for extinction**Storage**

Store locked up

Store in a well-ventilated place. Keep container tightly closed

**Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)**Very toxic to aquatic life with long lasting effects

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### 3. Composition / Information on ingredients

**Haz/Non-haz**

Component	CAS-No	Weight %
Cyclohexane	110-82-7	>95

### 4. First-aid measures

<b>Eye Contact</b>	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.
<b>Skin Contact</b>	Wash off immediately with soap and plenty of water for at least 15 minutes.. Obtain medical attention.
<b>Inhalation</b>	Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Aspiration into lungs can produce severe lung damage. Get medical attention immediately if symptoms occur.
<b>Ingestion</b>	Do not induce vomiting. Aspiration hazard. Call a physician or Poison Control Center immediately.
<b>Most important symptoms/effects</b>	Breathing difficulties. . Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting.
<b>Notes to Physician</b>	Treat symptomatically.

### 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	CO <sub>2</sub> , dry chemical, dry sand, alcohol-resistant foam. Cool closed containers exposed to fire with water spray.
<b>Unsuitable Extinguishing Media</b>	Water may be ineffective, This material is lighter than water and insoluble in water. The fire could easily be spread by the use of water in an area where the water cannot be contained.
<b>Flash Point</b>	-18°C / -0.4°F
<b>Method -</b>	Closed cup
<b>Autoignition Temperature</b>	260°C / 500°F
<b>Explosion Limits</b>	
<b>Upper</b>	8.0 vol %
<b>Lower</b>	1.3 vol %
<b>Sensitivity to mechanical impact</b>	No information available.
<b>Sensitivity to static discharge</b>	No information available.

**Specific Hazards Arising from the Chemical**

Flammable. Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Do not allow run-off from fire fighting to enter drains or water courses.

**Hazardous Combustion Products** Carbon monoxide (CO), Carbon dioxide (CO<sub>2</sub>).

**Protective Equipment and Precautions for Firefighters**

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

**NFPA**Health  
1Flammability  
3Instability  
0Physical hazards  
N/A**6. Accidental release measures****Personal Precautions**

Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges.

**Environmental Precautions**

Avoid release to the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information.

**Methods for Containment and Clean Up**

Remove all sources of ignition. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Use spark-proof tools and explosion-proof equipment. Take precautionary measures against static discharges.

**7. Handling and storage****Handling**

Wear personal protective equipment. Ensure adequate ventilation. Do not breathe vapors or spray mist. Avoid contact with skin, eyes and clothing. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges.

**Storage**

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

**8. Exposure controls / personal protection****Exposure Guidelines**

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Cyclohexane	TWA: 100 ppm	(Vacated) TWA: 300 ppm (Vacated) TWA: 1050 mg/m <sup>3</sup> TWA: 300 ppm TWA: 1050 mg/m <sup>3</sup>	IDLH: 1300 ppm TWA: 300 ppm TWA: 1050 mg/m <sup>3</sup>

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Cyclohexane	TWA: 300 ppm TWA: 1030 mg/m <sup>3</sup>	TWA: 300 ppm TWA: 1050 mg/m <sup>3</sup> STEL: 375 ppm STEL: 1300 mg/m <sup>3</sup>	TWA: 100 ppm

**Legend**

**ACGIH** - American Conference of Industrial Hygiene

**OSHA** - Occupational Safety and Health Administration

**NIOSH IDLH**: Immediately Dangerous to Life or Health

**Engineering Measures**

Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

**Personal Protective Equipment****Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

**Skin and body protection**

Wear appropriate protective gloves and clothing to prevent skin exposure.

**Respiratory Protection**

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

**Hygiene Measures**

Handle in accordance with good industrial hygiene and safety practice

## 9. Physical and chemical properties

<b>Physical State</b>	Liquid
<b>Appearance</b>	Colorless
<b>Odor</b>	sweet
<b>Odor Threshold</b>	No information available.
<b>pH</b>	No information available.
<b>Melting Point/Range</b>	6.5°C / 43.7°F
<b>Boiling Point/Range</b>	81°C / 177.8°F
<b>Flash Point</b>	-18°C / -0.4°F
<b>Method -</b>	Closed cup
<b>Evaporation Rate</b>	6.1
<b>Flammability (solid,gas)</b>	Not applicable
<b>Flammability or explosive limits</b>	
<b>Upper</b>	8.0 vol %
<b>Lower</b>	1.3 vol %
<b>Vapor Pressure</b>	104 mbar @ 20 °C
<b>Vapor Density</b>	2.90
<b>Relative Density</b>	0.770
<b>Solubility</b>	Insoluble in water
<b>Partition coefficient; n-octanol/water</b>	No data available
<b>Autoignition Temperature</b>	260°C / 500°F
<b>Decomposition temperature</b>	No information available.
<b>Viscosity</b>	0.94 mPa.s @ 20 °C
<b>Molecular Formula</b>	C6 H12
<b>Molecular Weight</b>	84.15

## 10. Stability and reactivity

<b>Reactive Hazard</b>	None known, based on information available.
<b>Stability</b>	Stable under normal conditions.
<b>Conditions to Avoid</b>	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
<b>Incompatible Materials</b>	Strong oxidizing agents
<b>Hazardous Decomposition Products</b>	Carbon monoxide (CO), Carbon dioxide (CO <sub>2</sub> )
<b>Hazardous Polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous Reactions</b>	None under normal processing.

## 11. Toxicological information

**Acute Toxicity****Product Information****Component Information**

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Cyclohexane	5000 mg/kg ( Rat )	2000 mg/kg ( Rabbit )	13.9 mg/L ( Rat ) 4 h

**Toxicologically Synergistic Products** No information available.

#### Delayed and immediate effects as well as chronic effects from short and long-term exposure

**Irritation** Irritating to eyes and skin

**Sensitization** No information available.

**Carcinogenicity** The table below indicates whether each agency has listed any ingredient as a carcinogen

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Cyclohexane	110-82-7	Not listed	Not listed	Not listed	Not listed	Not listed

**Mutagenic Effects** Mutagenic effects have occurred in microorganisms.

**Reproductive Effects** No information available.

**Developmental Effects** No information available.

**Teratogenicity** No information available.

**STOT - single exposure** Central nervous system (CNS).

**STOT - repeated exposure** None known.

**Aspiration hazard** No information available.

**Symptoms / effects, both acute and delayed** Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting.

**Endocrine Disruptor Information** No information available

**Other Adverse Effects** See actual entry in RTECS for complete information.

## 12. Ecological information

### **Ecotoxicity**

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Cyclohexane	EC50 >500 mg/L/72h	23.03-42.07 mg/L LC50 96 h 24.99-44.69 mg/L LC50 96 h 3.96-5.18 mg/L LC50 96 h 48.87-68.76 mg/L LC50 96 h	EC50 = 85.5 mg/L 5 min EC50 = 93 mg/L 10 min	EC50 = 400.0 mg/L/48h

**Persistence and Degradability** Persistence is unlikely, based on information available.

**Bioaccumulation/ Accumulation** No information available

**Mobility** Will likely be mobile in the environment due to its volatility.

Component	log Pow
Cyclohexane	3.44

## 13. Disposal considerations

### 13. Disposal considerations

**Waste Disposal Methods** Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Cyclohexane - 110-82-7	U056	-

### 14. Transport information

#### DOT

UN-No UN1145  
 Proper Shipping Name CYCLOHEXANE  
 Hazard Class 3  
 Packing Group II

#### TDG

UN-No UN1145  
 Proper Shipping Name CYCLOHEXANE  
 Hazard Class 3  
 Packing Group II

#### IATA

UN-No UN1145  
 Proper Shipping Name Cyclohexane  
 Hazard Class 3  
 Packing Group II

#### IMDG/IMO

UN-No UN1145  
 Proper Shipping Name Cyclohexane  
 Hazard Class 3  
 Packing Group II

### 15. Regulatory information

#### International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL
Cyclohexane	X	X	-	203-806-2	-		X	X	X	X	X

#### Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

#### U.S. Federal Regulations



TSCA 12(b) Not applicable

## SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Cyclohexane	110-82-7	>95	1.0

## SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

## Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Cyclohexane	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration

## CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Cyclohexane	1000 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals.

## State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Cyclohexane	X	X	X	-	X

## U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

## U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

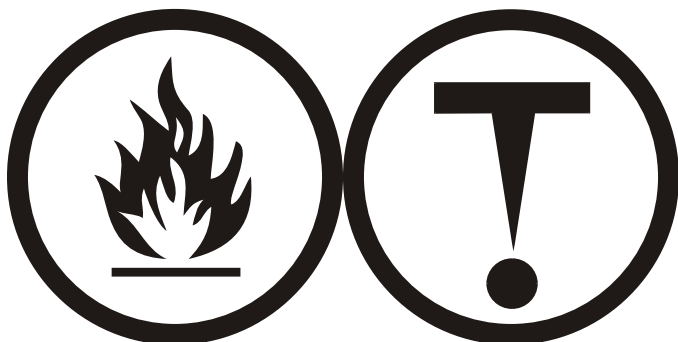
## Other International Regulations

Mexico - Grade Serious risk, Grade 3

## Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class B2 Flammable liquid  
D2B Toxic materials



## 16. Other information

**Prepared By**

Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

**Creation Date**

06-Oct-2009

**Revision Date**

13-Feb-2014

**Print Date**

13-Feb-2014

**Revision Summary**

This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

**Disclaimer**

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**



## Safety Data Sheet

Revision Date: 05/11/15

www.restek.com

### 1. IDENTIFICATION

Catalog Number / Product Name:	32207, 32207-5XX, & 32307 / alpha-Chlordane Standard
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	1-800-424-9300 (CHEMTREC) +1 703-741-5970 (Outside the US)
Email:	sds@restek.com
Revision Number:	6
Intended use:	For Laboratory use only

### 2. HAZARD(S) IDENTIFICATION

#### Emergency Overview:

#### GHS Hazard Symbols:



#### GHS Classification:

Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1  
Flammable Liquid Category 2  
Acute Toxicity - Inhalation Dust / Mist Category 3  
Acute Toxicity - Inhalation Vapour Category 3  
Acute Toxicity - Inhalation Gas Category 3  
Acute Toxicity - Dermal Category 3  
Acute Toxicity - Oral Category 3

#### GHS Signal Word:

Danger

#### GHS Hazard:

Highly flammable liquid and vapour.  
Toxic if swallowed, in contact with skin or if inhaled.  
Toxic if inhaled.  
Causes damage to organs.

#### GHS Precautions:

#### Safety Precautions:

Keep away from heat/sparks/open flames/hot surfaces. – No smoking.  
Ground/bond container and receiving equipment.  
Use explosion-proof electrical/ventilation and lighting equipment.  
Use only non-sparking tools.  
Take precautionary measures against static discharge.  
Do not breathe dust/fume/gas/mist/vapours/spray.  
Wash hands and skin thoroughly after handling.  
Do not eat, drink or smoke when using this product.  
Use only outdoors or in a well-ventilated area.  
Wear protective gloves/protective clothing/eye protection/face protection.

#### First Aid Measures:

IF SWALLOWED: Immediately call a POISON CENTER/doctor/....  
IF ON SKIN: Wash with plenty of soap and water.  
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.  
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.  
IF exposed: Call a POISON CENTER or doctor/physician.  
Call a POISON CENTER or doctor/physician if you feel unwell.  
Specific treatment see section 4.

Specific measures see section 4.  
Rinse mouth.  
Remove/Take off immediately all contaminated clothing.  
Wash contaminated clothing before reuse.  
In case of fire: Use extinguishing media in section 5 for extinction.

**Storage:** Store in a well-ventilated place. Keep container tightly closed.  
Store in a well-ventilated place. Keep cool.  
Store locked up.

**Disposal:** Dispose of contents/container according to section 13 of the SDS.

**Single Exposure Target Organs:** No data available.

**Repeated Exposure Target Organs:** No data available.

### 3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
methanol	67-56-1	200-659-6	99.900000
cis-chlordane	5103-71-9		0.100000

### 4. FIRST-AID MEASURES

**Inhalation:** Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately.

**Eyes:** Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

**Skin Contact:** Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

**Ingestion:** Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

### 5. FIRE- FIGHTING MEASURES

**Extinguishing Media:** Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used to extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

**Fire and/or Explosion Hazards:** Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

**Fire Fighting Methods and Protection:** Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

**Hazardous Combustion Products:** Carbon dioxide, Carbon monoxide

### 6. ACCIDENTAL RELEASE MEASURES

**Personal Precautions and Equipment:** Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

**Methods for Clean-up:** Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal.

evaluation.

## 7. HANDLING AND STORAGE

<b>Handling Technical Measures and Precautions:</b>	Toxic or severely irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
<b>Storage Technical Measures and Conditions:</b>	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

### United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
methanol	67-56-1	6000 ppm IDLH	250 ppm STEL	200 ppm TWA	200 ppm TWA; 260 mg/m <sup>3</sup> TWA
cis-chlordane	5103-71-9	ND		No TLV	No data available.

### Personal Protection:

<b>Engineering Measures:</b>	Local exhaust ventilation is recommended when generating excessive levels of vapors from handling or thermal processing.
<b>Respiratory Protection:</b>	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms. If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection.
<b>Eye Protection:</b>	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
<b>Skin Protection:</b>	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

## 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Appearance, color:</b>	No data available.
<b>Odor:</b>	Mild
<b>Physical State:</b>	No data available.
<b>pH:</b>	No data available
<b>Vapor Density:</b>	1.1 (air = 1)
<b>Melting Point:</b>	-98 °C
<b>Flash Point:</b>	52
<b>Flammability:</b>	Highly Flammable
<b>Upper Flammable/Explosive Limit, % in air:</b>	36.0
<b>Lower Flammable/Explosive Limit, % in air:</b>	6.0
<b>Autoignition Temperature:</b>	464 deg C
<b>Decomposition Temperature:</b>	No data available.
<b>Specific Gravity:</b>	0.791 - 0.792 g/cm <sup>3</sup> at 20 °C
<b>Evaporation Rate:</b>	No data available.
<b>Odor Threshold:</b>	No data available.
<b>Solubility:</b>	Moderate; 50-99%
<b>Partition Coefficient: n-octanol in water:</b>	No data available.
<b>VOC % by weight:</b>	99.90
<b>Molecular Weight:</b>	32.04

## 10. STABILITY AND REACTIVITY

<b>Stability:</b>	Stable under normal conditions.
<b>Conditions to Avoid:</b>	No data available.
<b>Materials to Avoid / Chemical Incompatibility:</b>	Strong oxidizing agents
<b>Hazardous Decomposition Products:</b>	Carbon dioxide Carbon monoxide

## 11. TOXICOLOGICAL INFORMATION

<b>Routes of Entry:</b>	Inhalation, Skin Contact, Eye Contact, Ingestion
<b>Target Organs Potentially Affected By Exposure:</b>	Eyes, Central nervous system stimulation, Skin, GI Tract, Respiratory Tract
<b>Chemical Interactions That Change Toxicity:</b>	None Known

**Immediate (Acute) Health Effects by Route of Exposure:**

<b>Inhalation Irritation:</b>	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
<b>Inhalation Toxicity:</b>	Harmful! Can cause systemic damage (see "Target Organs")Methanol can cause central nervous system depression and overexposure can cause damage to the optic nerve resulting in visual impairment or blindness.
<b>Skin Contact:</b>	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
<b>Eye Contact:</b>	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
<b>Ingestion Irritation:</b>	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Highly toxic and may be fatal if swallowed.
<b>Ingestion Toxicity:</b>	Toxic if swallowed. May cause target organ failure and/or death.May be fatal if swallowed.

**Long-Term (Chronic) Health Effects:**

<b>Carcinogenicity:</b>	No data.
<b>Reproductive and Developmental Toxicity:</b>	Contains a known human reproductive and/or developmental hazard.
<b>Inhalation:</b>	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs")
<b>Skin Contact:</b>	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
<b>Ingestion:</b>	Toxic if swallowed. May cause target organ failure and/or death.

**Component Toxicological Data:****NIOSH:**

Chemical Name	CAS No.	LD50/LC50
Methanol	67-56-1	Oral LD50 Rat 5628 mg/kg (Source: NLM_CIP); Inhalation LC50 Rat 83.2 mg/L 4 h (Source: IUCLID)

**Component Carcinogenic Data:****OSHA:**

Chemical Name	CAS No.
No data available.	

**ACGIH:**

Chemical Name	CAS No.
No data available.	

**NIOSH:**

Chemical Name	CAS No.
No data available.	

**NTP:**

Chemical Name	CAS No.
No data available.	

**IARC:**

Chemical Name	CAS No.	Group No.
No data.		Group 1
No data.		Group 2A
cis-Chlordane	5103-71-9	Group 2B

**12. ECOLOGICAL INFORMATION**

<b>Overview:</b>	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
<b>Mobility:</b>	No data
<b>Persistence:</b>	No data

**Bioaccumulation:** No data  
**Degradability:** Biodegrades slowly.  
**Ecological Toxicity Data:** No data available.

### 13. DISPOSAL CONSIDERATIONS

**Waste Description of Spent Product:** Spent or discarded material is a hazardous waste.  
**Disposal Methods:** Dispose of by incineration following Federal, State, Local, or Provincial regulations.  
**Waste Disposal of Packaging:** Comply with all Local, State, Federal, and Provincial Environmental Regulations.

### 14. TRANSPORTATION INFORMATION

**United States:**  
**DOT Proper Shipping Name:** Methanol  
**UN Number:** UN1230  
**Hazard Class:** 3  
**Packing Group:** II

**International:**  
**IATA Proper Shipping Name:** Methanol  
**UN Number:** UN1230  
**Hazard Class:** 3 (6.1)  
**Packing Group:** II

**Marine Pollutant:** No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available.			

### 15. REGULATORY INFORMATION

**United States:**  

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
methanol	67-56-1	X	X	-	X
cis-chlordane	5103-71-9	X	-	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Methanol	67-56-1	Prop 65 Develop Tox

**State Right To Know Listing:**

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
methanol	67-56-1	X	X	X	X
cis-chlordane	5103-71-9	-	-	-	-

### 16. OTHER INFORMATION

**Prior Version Date:** 04/22/14

**Disclaimer:** Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

## SAFETY DATA SHEET

Version 3.20  
Revision Date 02/26/2015  
Print Date 05/13/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Chloroform

Product Number : 02487  
Brand : Sigma-Aldrich  
Index-No. : 602-006-00-4

CAS-No. : 67-66-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 3), H331  
Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Carcinogenicity (Category 2), H351  
Reproductive toxicity (Category 2), H361  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Specific target organ toxicity - repeated exposure (Category 1), Liver, Kidney, H372  
Acute aquatic toxicity (Category 3), H402

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

H302	Harmful if swallowed.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H331	Toxic if inhaled.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.



H361	Suspected of damaging fertility or the unborn child.
H372	Causes damage to organs (Liver, Kidney) through prolonged or repeated exposure.
H402	Harmful to aquatic life.
Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear eye protection/ face protection.
P280	Wear protective gloves.
P281	Use personal protective equipment as required.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P311	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms	: Trichloromethane Methyldiyne trichloride
Formula	: $\text{CHCl}_3$
Molecular weight	: 119.38 g/mol
CAS-No.	: 67-66-3
EC-No.	: 200-663-8
Index-No.	: 602-006-00-4
Registration number	: 01-2119486657-20-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>Chloroform</b>		
	Acute Tox. 4; Acute Tox. 3; Skin Irrit. 2; Eye Irrit. 2A; Carc. 2; Repr. 2; STOT SE 3; STOT RE 1; Aquatic Acute 3; H302, H315, H319, H331, H336, H351, H361, H372, H402	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Move out of dangerous area. Consult a physician. Show this safety data sheet to the doctor in attendance.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Chloroform	67-66-3	TWA	10.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Liver damage Embryo/fetal damage Confirmed animal carcinogen with unknown relevance to humans		
		ST	2.000000 ppm 9.780000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		C	50.000000 ppm 240.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate. Ceiling limit is to be determined from breathing-zone air samples.		

### 8.2 Exposure controls

#### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

##### Splash contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: liquid, clear<br>Colour: colourless   |
| b) Odour  | No data available                           |
| c) Odour Threshold                              | No data available                           |
| d) pH   | No data available                           |
| e) Melting point/freezing point                 | Melting point/range: -63 °C (-81 °F)        |
| f) Initial boiling point and boiling range      | 60.5 - 61.5 °C (140.9 - 142.7 °F)           |
| g) Flash point                                  | No data available                           |
| h) Evaporation rate                             | No data available                           |
| i) Flammability (solid, gas)                    | No data available                           |
| j) Upper/lower flammability or explosive limits | No data available                           |
| k) Vapour pressure                              | 213.3 hPa (160.0 mmHg) at 20.0 °C (68.0 °F) |
| l) Vapour density                               | No data available                           |
| m) Relative density                             | 1.492 g/mL at 25 °C (77 °F)                 |
| n) Water solubility                             | No data available                           |
| o) Partition coefficient: n-octanol/water       | log Pow: 1.97                               |
| p) Auto-ignition temperature                    | No data available                           |
| q) Decomposition temperature                    | No data available                           |
| r) Viscosity                                    | No data available                           |
| s) Explosive properties                         | No data available                           |
| t) Oxidizing properties                         | No data available                           |

**9.2 Other safety information**

- |                 |                                |
|-----------------|--------------------------------|
| Surface tension | 27.1 mN/m at 20.0 °C (68.0 °F) |
|-----------------|--------------------------------|

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

Contains the following stabiliser(s):

2-Methyl-2-butene (0.003 %)

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents, Strong bases, Magnesium, Sodium/sodium oxides, Lithium

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LD50 Oral - Rat - 908 mg/kg

Remarks: Behavioral:Change in motor activity (specific assay). Behavioral:Ataxia. Lungs, Thorax, or Respiration:Respiratory stimulation.

Inhalation: No data available

LOEC Inhalation - Rat - male - 6 h - 500 ppm

LD50 Dermal - Rabbit - > 20,000 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Irritating to skin. - 24 h

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Irritating to eyes. - 24 h

#### Respiratory or skin sensitisation

Did not cause sensitisation on laboratory animals.

#### Germ cell mutagenicity

Laboratory experiments have shown mutagenic effects.

#### Carcinogenicity

Carcinogenicity - Rat - Oral

Tumorigenic:Carcinogenic by RTECS criteria. Leukaemia

The National Cancer Institute (NCI) has found clear evidence for carcinogenicity. Limited evidence of a carcinogenic effect.

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Chloroform)

NTP: Reasonably anticipated to be a human carcinogen (Chloroform)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

Suspected of damaging the unborn child. Suspected human reproductive toxicant

**Specific target organ toxicity - single exposure**

May cause drowsiness or dizziness.

**Specific target organ toxicity - repeated exposure**

The substance or mixture is classified as specific target organ toxicant, repeated exposure, category 1. - Liver, Kidney

**Aspiration hazard**

No data available

**Additional Information**

RTECS: FS9100000

Vomiting, Gastrointestinal disturbance, Exposure to and/or consumption of alcohol may increase toxic effects.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish	LC50 - Leuciscus idus (Golden orfe) - 162 mg/l - 48 h
	LC100 - Leuciscus idus (Golden orfe) - 220 mg/l - 48 h
	LC50 - other fish - 97 mg/l - 96 h
	LC50 - Danio rerio (zebra fish) - 121 mg/l - 96 h
	NOEC - Oryzias latipes - 122 mg/l - 10 d
	NOEC - Oncorhynchus mykiss (rainbow trout) - 24 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 79.00 mg/l - 24 h
	Immobilization EC50 - Daphnia magna (Water flea) - 51.6 mg/l - 48 h
	NOEC - Daphnia magna (Water flea) - 120 mg/l - 11 d
Toxicity to algae	EC50 - No information available. - 500.00 mg/l - 24 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

Bioaccumulation      Lepomis macrochirus (Bluegill) - 14 d  
   - 0.11 mg/l

Bioconcentration factor (BCF): 6

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Offer surplus and non-recyclable solutions to a licensed disposal company.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1888      Class: 6.1      Packing group: III  
Proper shipping name: Chloroform  
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1888      Class: 6.1      Packing group: III      EMS-No: F-A, S-A  
Proper shipping name: CHLOROFORM

### IATA

UN number: 1888      Class: 6.1      Packing group: III  
Proper shipping name: Chloroform

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Chloroform	67-66-3	2008-11-03

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Chloroform	67-66-3	2008-11-03

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Chloroform	67-66-3	2008-11-03

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Chloroform	67-66-3	2008-11-03

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Chloroform	67-66-3	2008-11-03

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Chloroform	67-66-3	2011-09-01

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

	CAS-No.	Revision Date
	67-66-3	2011-09-01

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H302	Harmful if swallowed.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H331	Toxic if inhaled.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H402	Harmful to aquatic life.
Repr.	Reproductive toxicity
Skin Irrit.	Skin irritation
STOT RE	Specific target organ toxicity - repeated exposure
STOT SE	Specific target organ toxicity - single exposure

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	3
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.20

Revision Date: 02/26/2015

Print Date: 05/13/2016



## SAFETY DATA SHEET

Version 4.8  
Revision Date 02/24/2016  
Print Date 04/30/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Chloromethane

Product Number : 295507  
Brand : Aldrich  
Index-No. : 602-001-00-7

CAS-No. : 74-87-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable gases (Category 1), H220  
Gases under pressure (Liquefied gas), H280  
Carcinogenicity (Category 2), H351  
Reproductive toxicity (Category 2), H361  
Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Eyes, Nervous system, Testes, H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H220 : Extremely flammable gas.  
H280 : Contains gas under pressure; may explode if heated.  
H351 : Suspected of causing cancer.  
H361 : Suspected of damaging fertility or the unborn child.  
H373 : May cause damage to organs (Eyes, Nervous system, Testes) through prolonged or repeated exposure if inhaled.

Precautionary statement(s)

P201 : Obtain special instructions before use.

P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P281	Use personal protective equipment as required.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381	Eliminate all ignition sources if safe to do so.
P405	Store locked up.
P410 + P403	Protect from sunlight. Store in a well-ventilated place.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : Methyl chloride

Formula : CH<sub>3</sub>Cl  
Molecular weight : 50.49 g/mol  
CAS-No. : 74-87-3  
EC-No. : 200-817-4  
Index-No. : 602-001-00-7

#### Hazardous components

Component	Classification	Concentration
<b>Chloromethane</b>		
	Flam. Gas 1; Press. Gas Liquefied gas; Carc. 2; Repr. 2; STOT RE 2; H220, H280, H351, H361, H373	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Clean up promptly by sweeping or vacuum.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure. Moisture sensitive.

Storage class (TRGS 510): Gases

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Chloromethane	74-87-3	TWA	50.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Liver damage Kidney damage Testicular damage Teratogenic effects Not classifiable as a human carcinogen Danger of cutaneous absorption		

		STEL	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Liver damage Kidney damage Testicular damage Teratogenic effects Not classifiable as a human carcinogen Danger of cutaneous absorption		
		Potential Occupational Carcinogen See Appendix A		
		TWA	100.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.18-1969		
		CEIL	200.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.18-1969		
		Peak	300.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.18-1969		
		See Table Z-2		
		TWA	100 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.18-1969		
		CEIL	200 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.18-1969		
		Peak	300 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.18-1969		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

#### Splash contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: compressed liquefied gas                                    |
| b) Odour  | No data available   |
| c) Odour Threshold                              | No data available   |
| d) pH   | No data available   |
| e) Melting point/freezing point                 | Melting point/range: -97 °C (-143 °F) - lit.                      |
| f) Initial boiling point and boiling range      | -24.2 °C (-11.6 °F) - lit.  |
| g) Flash point                                  | No data available   |
| h) Evaporation rate                             | No data available   |
| i) Flammability (solid, gas)                    | No data available   |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 17.4 %(V)<br>Lower explosion limit: 7 %(V) |
| k) Vapour pressure                              | 5,060.9 hPa (3,796.0 mmHg) at 20.0 °C (68.0 °F)                   |
| l) Vapour density                               | No data available   |
| m) Relative density                             | 0.915 g/cm <sup>3</sup> at 25 °C (77 °F)                          |
| n) Water solubility                             | 5.32 g/l at 25 °C (77 °F) - soluble                               |
| o) Partition coefficient: n-octanol/water       | log Pow: 0.91   |
| p) Auto-ignition temperature                    | 632.0 °C (1,169.6 °F)   |
| q) Decomposition temperature                    | No data available   |
| r) Viscosity                                    | No data available   |
| s) Explosive properties                         | No data available   |
| t) Oxidizing properties                         | No data available   |

### **9.2 Other safety information**

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

**10.4 Conditions to avoid**

Heat, flames and sparks.

**10.5 Incompatible materials**

Strong oxidizing agents, Iron

**10.6 Hazardous decomposition products**

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

Other decomposition products - No data available

In the event of fire: see section 5

---

**11. TOXICOLOGICAL INFORMATION****11.1 Information on toxicological effects****Acute toxicity**

LD50 Oral - Rat - 1,800 mg/kg

LC50 Inhalation - Rat - male and female - 4 h - > 21,800 mg/m<sup>3</sup>  
(OECD Test Guideline 403)

Dermal: No data available

No data available

**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

Rat - male

Result: negative

DNA damage DNA repair

**Carcinogenicity**

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Chloromethane)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

Inhalation - May cause damage to organs through prolonged or repeated exposure. - Central nervous system, Liver, Urogenital tract

**Aspiration hazard**

No data available

**Additional Information**

RTECS: PA6300000

Dizziness, Drowsiness, Incoordination., Blurred vision, Headache, Nausea, Vomiting

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - *Lepomis macrochirus* (Bluegill) - 550 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates semi-static test EC50 - *Daphnia magna* (Water flea) - 200 mg/l - 48 h (OECD Test Guideline 202)

**12.2 Persistence and degradability**

Biodegradability aerobic - Exposure time 28 h  
Result: 100 % - Readily biodegradable

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1063 Class: 2.1  
Proper shipping name: Methyl chloride  
Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 1063 Class: 2.1  
Proper shipping name: METHYL CHLORIDE

EMS-No: F-D, S-U

**IATA**

UN number: 1063 Class: 2.1

Proper shipping name: Methyl chloride  
IATA Passenger: Not permitted for transport

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Chloromethane	74-87-3	2007-07-01

### SARA 311/312 Hazards

Fire Hazard, Sudden Release of Pressure Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Chloromethane	74-87-3	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Chloromethane	74-87-3	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Chloromethane	74-87-3	2007-07-01

### California Prop. 65 Components

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

CAS-No.	Revision Date
74-87-3	2009-09-11

Chloromethane

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Carc.	Carcinogenicity
Flam. Gas	Flammable gases
H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure if inhaled.
Press. Gas	Gases under pressure
Repr.	Reproductive toxicity
STOT RE	Specific target organ toxicity - repeated exposure

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	4
Physical Hazard	3

### NFPA Rating

Health hazard:	1
Fire Hazard:	4
Reactivity Hazard:	0



**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.8

Revision Date: 02/24/2016

Print Date: 04/30/2016

## SAFETY DATA SHEET

Version 4.7  
Revision Date 12/02/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Chromium

Product Number : 255610  
Brand : Aldrich

CAS-No. : 7440-47-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute aquatic toxicity (Category 1), H400

Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Warning

Hazard statement(s)  
H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273 : Avoid release to the environment.

P391 : Collect spillage.

P501 : Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Formula : Cr  
Molecular weight : 52.00 g/mol

CAS-No. : 7440-47-3  
EC-No. : 231-157-5

#### **Hazardous components**

Component	Classification	Concentration
<b>Chromium</b>		
	Aquatic Acute 1; Aquatic Chronic 1; H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## **4. FIRST AID MEASURES**

### **4.1 Description of first aid measures**

#### **General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### **If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### **In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

#### **In case of eye contact**

Flush eyes with water as a precaution.

#### **If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### **4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### **4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

## **5. FIREFIGHTING MEASURES**

### **5.1 Extinguishing media**

#### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### **5.2 Special hazards arising from the substance or mixture**

Chromium oxides

### **5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

### **5.4 Further information**

No data available

---

## **6. ACCIDENTAL RELEASE MEASURES**

### **6.1 Personal precautions, protective equipment and emergency procedures**

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### **6.3 Methods and materials for containment and cleaning up**

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### **6.4 Reference to other sections**

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non Combustible Solids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Chromium	7440-47-3	TWA	0.500000 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	See Appendix C		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.500000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Liver impairment Not classifiable as a human carcinogen		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.500000 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		
		TWA	0.500000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Skin irritation Not classifiable as a human carcinogen varies		
		TWA	0.5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Skin irritation Not classifiable as a human carcinogen varies		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: chips<br>Colour: light grey               |
| b) Odour                                   | No data available                               |
| c) Odour Threshold                         | No data available                               |
| d) pH                                      | No data available                               |
| e) Melting point/freezing point            | Melting point/range: 1,857 °C (3,375 °F) - lit. |
| f) Initial boiling point and boiling range | 2,672 °C (4,842 °F) - lit.                      |
| g) Flash point                             | Not applicable                                  |

h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	7.14 g/mL at 25 °C (77 °F)
n)	Water solubility	insoluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong acids, Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

Carcinogenicity - Rabbit - Implant

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Musculoskeletal: Tumors.

Carcinogenicity - Rat - Implant

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Blood: Lymphomas including Hodgkin's disease.

Tumorigenic: Tumors at site of application.

Carcinogenicity - Rat - Intravenous

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Gastrointestinal: Tumors. Blood: Lymphomas including Hodgkin's disease.

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Chromium)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: GB4200000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish	mortality NOEC - Pimephales promelas (fathead minnow) - 12 mg/l - 7 d
	mortality LOEC - Pimephales promelas (fathead minnow) - 2.4 mg/l - 7 d
	LC50 - Cyprinus carpio (Carp) - 14.3 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 0.07 mg/l - 48 h

**12.2 Persistence and degradability**

No data available

### 12.3 Bioaccumulative potential

Bioaccumulation      Oncorhynchus mykiss (rainbow trout) - 30 d  
- 1.33 µg/l

Bioconcentration factor (BCF): 1.03 - 1.22

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Chromium)  
Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Chromium)  
Marine pollutant: yes

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chromium)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Chromium	7440-47-3	2007-07-01

### SARA 311/312 Hazards

Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Chromium	7440-47-3	2007-07-01

### Pennsylvania Right To Know Components

CAS-No.	Revision Date
---------	---------------



Chromium

7440-47-3

2007-07-01

## New Jersey Right To Know Components

Chromium

CAS-No.  
7440-47-3

Revision Date  
2007-07-01

## California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 12/02/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 5.3  
Revision Date 03/04/2015  
Print Date 05/13/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Chrysene

Product Number : 35754  
Brand : Sigma-Aldrich  
Index-No. : 601-048-00-0

CAS-No. : 218-01-9

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Germ cell mutagenicity (Category 2), H341  
Carcinogenicity (Category 1B), H350  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H341 Suspected of causing genetic defects.  
H350 May cause cancer.  
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and understood.  
P273 Avoid release to the environment.  
P281 Use personal protective equipment as required.  
P308 + P313 IF exposed or concerned: Get medical advice/ attention.

P391 Collect spillage.  
P405 Store locked up.  
P501 Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula : C<sub>18</sub>H<sub>12</sub>  
Molecular weight : 228.29 g/mol  
CAS-No. : 218-01-9  
EC-No. : 205-923-4  
Index-No. : 601-048-00-0

#### Hazardous components

Component	Classification	Concentration
<b>Chrysene</b>		
	Muta. 2; Carc. 1B; Aquatic Acute 1; Aquatic Chronic 1; H341, H350, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	Cancer Substances for which there is a Biological Exposure Index or Indices (see BEI® section), see BEI® for Polycyclic Aromatic Hydrocarbons (PAHs) Exposure by all routes should be carefully controlled to levels as low as possible. Confirmed animal carcinogen with unknown relevance to humans		
Chrysene	218-01-9	TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		1910.1002 As used in §1910.1000 (Table Z-1), coal tar pitch volatiles include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum (excluding asphalt), wood, and other organic matter. Asphalt (CAS 8052-42-4, and CAS 64742-93-4) is not covered under the 'coal tar pitch volatiles' standard OSHA specifically regulated carcinogen		
		TWA	0.100000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar		

		products. cyclohexane-extractable fraction See Appendix C See Appendix A
--	--	---

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Chrysene	218-01-9	1-Hydroxypyrene (1-HP)		Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: solid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 252 - 254 °C (486 - 489 °F) - lit.
f) Initial boiling point and boiling range	448 °C (838 °F) - lit.
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	log Pow: 5.73
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

LD50 Intraperitoneal - Mouse - > 320 mg/kg

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Laboratory experiments have shown mutagenic effects.

In vitro tests showed mutagenic effects

#### Carcinogenicity

This product is or contains a component that has been reported to be probably carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Possible human carcinogen

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Chrysene)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: OSHA specifically regulated carcinogen (Chrysene)

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: GC0700000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to daphnia and other aquatic invertebrates      EC50 - Daphnia magna (Water flea) - 1.90 mg/l - 2 h

## 12.2 Persistence and degradability

No data available

## 12.3 Bioaccumulative potential

No data available

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Very toxic to aquatic life.

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077 Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Chrysene)

Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3077 Class: 9

Packing group: III

EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Chrysene)

Marine pollutant:yes

### IATA

UN number: 3077 Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chrysene)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Chrysene	218-01-9	1994-04-01

### SARA 311/312 Hazards

Chronic Health Hazard

### Massachusetts Right To Know Components

CAS-No.	Revision Date
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Chrysene	218-01-9	1994-04-01
<b>Pennsylvania Right To Know Components</b>		
Chrysene	CAS-No. 218-01-9	Revision Date 1994-04-01
<b>New Jersey Right To Know Components</b>		
Chrysene	CAS-No. 218-01-9	Revision Date 1994-04-01
<b>California Prop. 65 Components</b>		
WARNING! This product contains a chemical known to the State of California to cause cancer.	CAS-No. 218-01-9	Revision Date 2007-09-28
Chrysene		

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.3

Revision Date: 03/04/2015

Print Date: 05/13/2016

Revision Date 16-Apr-2012

Revision Number 2

## SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

### Product Identifier

**Product Description:** cis-1,2-Dichloroethylene  
**Cat No.** 113380000; 113380025; 113380100  
**Synonyms** cis-Acetylene dichloride.

### Relevant identified uses of the substance or mixture and uses advised against

**Recommended Use** Laboratory chemicals  
**Uses advised against** No Information available

### Details of the supplier of the safety data sheet

#### Company

Acros Organics BVBA  
 Janssen Pharmaceuticaaan 3a  
 2440 Geel, Belgium

**E-mail address** begel.sdsdesk@thermofisher.com

### Emergency Telephone Number

For information in the US, call: 001-800-ACROS-01  
 For information in Europe, call: +32 14 57 52 11

Emergency Number, Europe: +32 14 57 52 99  
 Emergency Number, US: 001-201-796-7100

CHEMTREC Phone Number, US: 001-800-424-9300  
 CHEMTREC Phone Number, Europe: 001-703-527-3887

## SECTION 2. HAZARDS IDENTIFICATION

### Classification of the substance or mixture

#### REGULATION (EC) No 1272/2008

Acute Inhalation Toxicity - Vapors	Category 4
Chronic aquatic toxicity	Category 3
Flammable liquids.	Category 2

### Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases and H-Statements mentioned in this Section, see Section 16

**Symbol(s)** F - Highly flammable  
 Xn - Harmful

**R-phrases(s)** R11 - Highly flammable  
 R20 - Harmful by inhalation

**Risk Combination Phrases** R52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

## SECTION 2. HAZARDS IDENTIFICATION

### Label Elements



### Signal Word

**Danger**

### Hazard Statements

H332 - Harmful if inhaled

H412 - Harmful to aquatic life with long lasting effects

H225 - Highly flammable liquid and vapor

### Precautionary Statements - EU (§28, 1272/2008)

P273 - Avoid release to the environment

P304 + P340 - IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing

P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking

P240 - Ground/Bond container and receiving equipment

### Other Hazards

No information available.

## SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	EC-No.	Weight %	CAS-No	67/548/EEC Classification	CLP Classification - Regulation (EC) No 1272/2008	REACH No.
cis-1,2-Dichloroethylene 156-59-2	EEC No. 205-859-7	97	156-59-2	F; R11 Xn; R20 R52-53	Acute Tox. 4 (H332)	-

**For the full text of the R-phrases and H-Statements mentioned in this Section, see Section 16**

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

**SECTION 4. FIRST AID MEASURES****Description of first aid measures****Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

**Skin Contact**

Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Obtain medical attention.

**Ingestion**

Clean mouth with water. Get medical attention.

**Inhalation**

Remove from exposure, lie down. Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Obtain medical attention.

**Notes to Physician**

Treat symptomatically

**SECTION 5. FIRE-FIGHTING MEASURES****Extinguishing media****Suitable Extinguishing Media**

Water spray. Carbon dioxide (CO<sub>2</sub>). Dry chemical. Use water spray to cool unopened containers. chemical foam.

**Extinguishing media which must not be used for safety reasons**

No information available.

**Special hazards arising from the substance or mixture**

Flammable. Vapors may travel to source of ignition and flash back.

**Advice for fire-fighters**

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

**SECTION 6. ACCIDENTAL RELEASE MEASURES****Personal precautions, protective equipment and emergency procedures**

Ensure adequate ventilation

**Environmental precautions**

Prevent further leakage or spillage if safe to do so

**Methods and material for containment and cleaning up**

Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal.. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

## SECTION 7. HANDLING AND STORAGE

### Precautions for Safe Handling

Avoid contact with skin and eyes. Do not breathe dust. Do not breathe vapors or spray mist. Use only in area provided with appropriate exhaust ventilation. Use explosion-proof equipment. Use only non-sparking tools.

### Conditions for safe storage, including any incompatibilities

Keep in a dry, cool and well-ventilated place. Keep container tightly closed. Keep away from heat and sources of ignition. Flammables area.

### Specific End Uses

## SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### Control parameters

#### Exposure limits

##### Component

cis-1,2-Dichloroethylene

European Union	The United Kingdom	France	Belgium	Spain
	STEL: 250 ppm 15 min STEL: 1010 mg/m <sup>3</sup> 15 min TWA: 200 ppm 8 hr TWA: 806 mg/m <sup>3</sup> 8 hr			

##### Component

cis-1,2-Dichloroethylene

Italy	Germany	Portugal	The Netherlands	Finland
	MAK: 200 ppm 8 Stunden. MAK: 800 mg/m <sup>3</sup> 8 Stunden. Peak: 400 ppm Peak: 1600 mg/m <sup>3</sup>	TWA: 200 ppm 8 horas		TWA: 200 ppm 8 tunteina TWA: 800 mg/m <sup>3</sup> 8 tunteina STEL: 250 ppm 15 minuutteina STEL: 1000 mg/m <sup>3</sup> 15 minuutteina

##### Component

cis-1,2-Dichloroethylene

Austria	Denmark	Switzerland	Poland	Norway
STEL: 800 ppm 15 Minuten STEL: 3160 mg/m <sup>3</sup> 15 Minuten TWA: 200 ppm 8 Stunden TWA: 790 mg/m <sup>3</sup> 8 Stunden	TWA: 790 mg/m <sup>3</sup> 8 timer TWA: 200 ppm 8 timer	STEL: 400 ppm 15 Minuten STEL: 1580 mg/m <sup>3</sup> 15 Minuten MAK: 200 ppm 8 Stunden MAK: 790 mg/m <sup>3</sup> 8 Stunden	NDS: 700 mg/m <sup>3</sup> 8 godzinach	

##### Component

cis-1,2-Dichloroethylene

Estonia	Gibraltar	Greece	Hungary	Iceland
				TWA: 200 ppm 8 klukkustundum. TWA: 790 mg/m <sup>3</sup> 8 klukkustundum. Ceiling: 400 ppm Ceiling: 1580 mg/m <sup>3</sup>

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

**Component**  
cis-1,2-  
Dichloroethylene

Russia - TWA	Slovak Republic	Slovenia	Sweden	Turkey
		TWA: 200 ppm 8 urah TWA: 800 mg/m <sup>3</sup> 8 urah STEL: 800 ppm 15 minutah STEL: 3200 mg/m <sup>3</sup> 15 minutah		

## Biological limit values

This product, as supplied, does not contain any hazardous materials with biological limits established by the region specific regulatory bodies.

## Derived No Effect Level (DNEL)

No information available.

## Predicted No Effect Concentration (PNEC)

No information available.

## Exposure controls

### Engineering Measures

Ensure adequate ventilation, especially in confined areas

### Personal protective equipment

#### Eye Protection

Goggles

#### Hand Protection

Protective gloves

#### Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure

#### Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

## Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice

## Environmental exposure controls

No information available.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

### Physical State

Liquid

### Appearance

Colorless

### odor

aromatic

### pH

No information available.

### Vapor Pressure

201 mmHg @ 25 °C

### Vapor Density

3.34 (Air = 1.0)

### Boiling Point/Range

60°C / 140°F @ 760 mmHg

### Melting Point/Range

-80°C / -112°F

### Flash Point

6°C / 42.8°F

### Autoignition Temperature

440°C / 824°F

### Specific Gravity

1.280

### Molecular Formula

C<sub>2</sub> H<sub>2</sub> Cl<sub>2</sub>

### Molecular Weight

96.94

## SECTION 10. STABILITY AND REACTIVITY

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

## SECTION 10. STABILITY AND REACTIVITY

### Reactivity

#### Chemical Stability

Stable under normal conditions.

#### Possibility of Hazardous Reactions

**Hazardous Polymerization**  
**Hazardous Reactions .**

Hazardous polymerization does not occur.  
No information available.

#### Conditions to Avoid

Keep away from open flames, hot surfaces and sources of ignition, Exposure to air, Exposure to light, Incompatible products, Exposure to moist air or water.

#### Incompatible Materials

Bases.

#### Hazardous Decomposition Products

Hydrogen chloride gas. Carbon monoxide (CO). Carbon dioxide (CO<sub>2</sub>).

## SECTION 11. TOXICOLOGICAL INFORMATION

### Information on Toxicological Effects

#### Acute Toxicity

#### **Product Information**

No acute toxicity information is available for this product

#### **Component Information**

#### Chronic Toxicity

#### **Carcinogenicity**

There are no known carcinogenic chemicals in this product

#### **Sensitization**

No information available.

#### **Mutagenic Effects**

No information available

#### **Reproductive Effects**

No information available.

#### **Developmental Effects**

No information available.

#### **Target Organs**

No information available.

#### **Other Adverse Effects**

The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information

#### **Endocrine Disruptor Information**

None known

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

## SECTION 12. ECOLOGICAL INFORMATION

### Toxicity

#### Ecotoxicity effects

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
cis-1,2-Dichloroethylene			EC50 = 721 mg/L 5 min EC50 = 905 mg/L 30 min	

### Persistence and degradability

No information available

### Bioaccumulative potential

No information available.

### Mobility in soil

No information available.

### Results of PBT and vPvB assessment

### Other adverse effects

No information available

## SECTION 13. DISPOSAL CONSIDERATIONS

### Waste treatment methods

#### Waste from Residues / Unused Products

Dispose of in accordance with local regulations

#### Contaminated Packaging

Empty containers should be taken to local recyclers for disposal

## SECTION 14. TRANSPORT INFORMATION

### IMDG/IMO

UN-No	1150
Hazard Class	3
Packing Group	II
Proper Shipping Name	1,2-DICHLOROETHYLENE

### ADR



cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

## SECTION 14. TRANSPORT INFORMATION

UN-No 1150  
Hazard Class 3  
Packing Group II  
Proper Shipping Name 1,2-DICHLOROETHYLENE

### IATA

UN-No 1150  
Hazard Class 3  
Packing Group II  
Proper Shipping Name 1,2-DICHLOROETHYLENE

## SECTION 15. REGULATORY INFORMATION

### Safety, health and environmental regulations/legislation specific for the substance or mixture

#### International Inventories

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	CHINA	AICS	KECL
cis-1,2-Dichloroethylene	205-859-7	-		X	-	X	-	X	X	X	X

### Legend

**TSCA** - United States Toxic Substances Control Act Section 8(b) Inventory

**EINECS/ELINCS** - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List

**PICCS** - Philippines Inventory of Chemicals and Chemical Substances

**ENCS** - Japan Existing and New Chemical Substances

**CHINA** - China Inventory of Existing Chemical Substances

**AICS** - Inventory of Chemical Substances

**KECL** - Existing and Evaluated Chemical Substances

### Chemical Safety Assessment

## SECTION 16. OTHER INFORMATION

#### Full text of R-phrases referred to under sections 2 and 3

R11 - Highly flammable

R20 - Harmful by inhalation

R52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment

cis-1,2-Dichloroethylene

Revision Date 16-Apr-2012

**SECTION 16. OTHER INFORMATION**

Revision Date 16-Apr-2012

Revision Summary

Reason for revision Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of Safety Data Sheet



## 1. PRODUCT AND COMPANY IDENTIFICATION

### 1.1 Product identifiers

Product name : cis-Chlordane

Product Number : SCC-003  
Brand : Cerilliant

CAS-No. : 5103-71-9

### 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

### 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

### 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

## 2. HAZARDS IDENTIFICATION

### 2.1 Classification of the substance or mixture

#### GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 4), H332  
Acute toxicity, Dermal (Category 3), H311  
Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H302 + H332	Harmful if swallowed or if inhaled
H311	Toxic in contact with skin.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)	
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312	Call a POISON CENTER or doctor/ physician if you feel unwell.
P322	Specific measures (see supplemental first aid instructions on this label).
P330	Rinse mouth.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P361	Remove/Take off immediately all contaminated clothing.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Molecular weight	: 409.78 g/mol
CAS-No.	: 5103-71-9
EC-No.	: 225-825-5

#### Hazardous components

Component	Classification	Concentration
<b>Chlordane</b>		
	Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, H315, H319, H335, H410	-

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### **4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### **4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

### **5. FIREFIGHTING MEASURES**

#### **5.1 Extinguishing media**

##### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### **5.2 Special hazards arising from the substance or mixture**

No data available

#### **5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

#### **5.4 Further information**

No data available

---

### **6. ACCIDENTAL RELEASE MEASURES**

#### **6.1 Personal precautions, protective equipment and emergency procedures**

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

#### **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### **6.3 Methods and materials for containment and cleaning up**

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### **6.4 Reference to other sections**

For disposal see section 13.

---

### **7. HANDLING AND STORAGE**

#### **7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

#### **7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

#### **7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **8.1 Control parameters**

##### **Components with workplace control parameters**

Contains no substances with occupational exposure limit values.

#### **8.2 Exposure controls**

##### **Appropriate engineering controls**

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

##### **Personal protective equipment**

###### **Eye/face protection**

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: crystalline Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	93.0 - 94.0 °C (199.4 - 201.2 °F)
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 500 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Chlordane)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Lepomis macrochirus (Bluegill) - 0.0074 mg/l - 96 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

Bioaccumulation Lepomis macrochirus (Bluegill) - 24 h  
- 0.005 mg/l

Bioconcentration factor (BCF): 322

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

Very toxic to aquatic life.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chlordane)  
Reportable Quantity (RQ):  
Marine pollutant: No  
Poison Inhalation Hazard: No

**IMDG**

UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Chlordane)  
Marine pollutant: Marine pollutant

**IATA**

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chlordane)

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**



This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

#### **SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

#### **Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

#### **Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Chlordane	5103-71-9	

#### **New Jersey Right To Know Components**

	CAS-No.	Revision Date
Chlordane	5103-71-9	

#### **California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## **16. OTHER INFORMATION**

### **Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Eye Irrit.	Eye irritation
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H311	Toxic in contact with skin.
H315	Causes skin irritation.
H319	Causes serious eye irritation.

### **HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### **NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### **Further information**

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### **Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.4

Revision Date: 08/14/2014

Print Date: 05/13/2016



## 1. PRODUCT AND COMPANY IDENTIFICATION

### 1.1 Product identifiers

Product name : cis-Chlordane

Product Number : SCC-003

Brand : Cerilliant

CAS-No. : 5103-71-9

### 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

### 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

### 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

## 2. HAZARDS IDENTIFICATION

### 2.1 Classification of the substance or mixture

#### GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 4), H302

Acute toxicity, Inhalation (Category 4), H332

Acute toxicity, Dermal (Category 3), H311

Skin irritation (Category 2), H315

Eye irritation (Category 2A), H319

Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

Acute aquatic toxicity (Category 1), H400

Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H302 + H332

Harmful if swallowed or if inhaled

H311

Toxic in contact with skin.

H315

Causes skin irritation.

H319

Causes serious eye irritation.

H335

May cause respiratory irritation.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)	
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312	Call a POISON CENTER or doctor/ physician if you feel unwell.
P322	Specific measures (see supplemental first aid instructions on this label).
P330	Rinse mouth.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P361	Remove/Take off immediately all contaminated clothing.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Molecular weight	: 409.78 g/mol
CAS-No.	: 5103-71-9
EC-No.	: 225-825-5

#### Hazardous components

Component	Classification	Concentration
<b>Chlordane</b>		
	Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, H315, H319, H335, H410	-

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### **4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### **4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

### **5. FIREFIGHTING MEASURES**

#### **5.1 Extinguishing media**

##### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### **5.2 Special hazards arising from the substance or mixture**

No data available

#### **5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

#### **5.4 Further information**

No data available

---

### **6. ACCIDENTAL RELEASE MEASURES**

#### **6.1 Personal precautions, protective equipment and emergency procedures**

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

#### **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### **6.3 Methods and materials for containment and cleaning up**

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### **6.4 Reference to other sections**

For disposal see section 13.

---

### **7. HANDLING AND STORAGE**

#### **7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

#### **7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

#### **7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **8.1 Control parameters**

##### **Components with workplace control parameters**

Contains no substances with occupational exposure limit values.

#### **8.2 Exposure controls**

##### **Appropriate engineering controls**

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

##### **Personal protective equipment**

###### **Eye/face protection**

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: crystalline Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	93.0 - 94.0 °C (199.4 - 201.2 °F)
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 500 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Chlordane)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Lepomis macrochirus (Bluegill) - 0.0074 mg/l - 96 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

Bioaccumulation Lepomis macrochirus (Bluegill) - 24 h  
- 0.005 mg/l

Bioconcentration factor (BCF): 322

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

Very toxic to aquatic life.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chlordane)  
Reportable Quantity (RQ):  
Marine pollutant: No  
Poison Inhalation Hazard: No

**IMDG**

UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Chlordane)  
Marine pollutant: Marine pollutant

**IATA**

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Chlordane)

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

#### **SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

#### **Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

#### **Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Chlordane	5103-71-9	

#### **New Jersey Right To Know Components**

	CAS-No.	Revision Date
Chlordane	5103-71-9	

#### **California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## **16. OTHER INFORMATION**

### **Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Eye Irrit.	Eye irritation
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H311	Toxic in contact with skin.
H315	Causes skin irritation.
H319	Causes serious eye irritation.

### **HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### **NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### **Further information**

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### **Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.4

Revision Date: 08/14/2014

Print Date: 05/13/2016



## SAFETY DATA SHEET

Version 4.7  
Revision Date 03/02/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Cobalt

Product Number : 266639  
Brand : Aldrich  
Index-No. : 027-001-00-9

CAS-No. : 7440-48-4

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Respiratory sensitisation (Category 1), H334  
Skin sensitisation (Category 1), H317

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H317

May cause an allergic skin reaction.

H334

May cause allergy or asthma symptoms or breathing difficulties if inhaled.

Precautionary statement(s)

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P272

Contaminated work clothing should not be allowed out of the workplace.

P280

Wear protective gloves.

P285

In case of inadequate ventilation wear respiratory protection.

P302 + P352

IF ON SKIN: Wash with plenty of soap and water.

P304 + P341

IF INHALED: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing.

P333 + P313

If skin irritation or rash occurs: Get medical advice/ attention.

P342 + P311

If experiencing respiratory symptoms: Call a POISON CENTER or doctor/

P363  
P501

physician.  
Wash contaminated clothing before reuse.  
Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Formula : Co  
Molecular weight : 58.93 g/mol  
CAS-No. : 7440-48-4  
EC-No. : 231-158-0  
Index-No. : 027-001-00-9

#### Hazardous components

Component	Classification	Concentration
<b>Cobalt</b>		
	Resp. Sens. 1; Skin Sens. 1; Aquatic Chronic 4; H317, H334, H413	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Cobalt/cobalt oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Air sensitive. Handle and store under inert gas. Keep in a dry place.  
Storage class (TRGS 510): Flammable solid hazardous materials

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Cobalt	7440-48-4	TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.020000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Pulmonary function Asthma Myocardial effects Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		

		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.020000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Pulmonary function Asthma Myocardial effects Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Cobalt	7440-48-4	Cobalt	15.0000 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			
		Cobalt	1.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Cobalt	15 µg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Cobalt	1 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

Splash contact  
Material: Nitrile rubber  
Minimum layer thickness: 0.11 mm  
Break through time: 480 min  
Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Do not let product enter drains.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |  |
|---|--|
| a) Appearance                                   | Form: powder<br>Colour: light grey                       |
| b) Odour  | No data available  |
| c) Odour Threshold                              | No data available  |
| d) pH   | No data available  |
| e) Melting point/freezing point                 | Melting point/range: 1,493 - 1,495 °C (2,719 - 2,723 °F) |
| f) Initial boiling point and boiling range      | 2,900 °C (5,252 °F) - lit.                               |
| g) Flash point                                  | No data available  |
| h) Evaporation rate                             | No data available  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | No data available  |
| k) Vapour pressure                              | No data available  |
| l) Vapour density                               | No data available  |
| m) Relative density                             | 8.9 g/mL at 25 °C (77 °F)                                |
| n) Water solubility                             | insoluble  |
| o) Partition coefficient: n-octanol/water       | log Pow: 5.0   |
| p) Auto-ignition temperature                    | No data available  |
| q) Decomposition temperature                    | No data available  |
| r) Viscosity                                    | No data available  |

- s) Explosive properties      No data available  
t) Oxidizing properties      No data available

## **9.2 Other safety information**

No data available

---

## **10. STABILITY AND REACTIVITY**

### **10.1 Reactivity**

No data available

### **10.2 Chemical stability**

Stable under recommended storage conditions.

### **10.3 Possibility of hazardous reactions**

No data available

### **10.4 Conditions to avoid**

Air

### **10.5 Incompatible materials**

Oxidizing agents, Mineral acids, Acetylene, Hydrazinium nitrate, Strong oxidizing agents, Material readily reacts with acids generating flammable and/or explosive hydrogen gas.

### **10.6 Hazardous decomposition products**

Other decomposition products - No data available  
In the event of fire: see section 5

---

## **11. TOXICOLOGICAL INFORMATION**

### **11.1 Information on toxicological effects**

#### **Acute toxicity**

LD50 Oral - Rat - male and female - 7,510 mg/kg  
(OECD Test Guideline 401)

Inhalation: No data available

Dermal: No data available

No data available

#### **Skin corrosion/irritation**

Skin - reconstructed human epidermis (RhE)

Result: No skin irritation - 15 min  
(OECD Test Guideline 439)

#### **Serious eye damage/eye irritation**

No data available

#### **Respiratory or skin sensitisation**

No data available

#### **Germ cell mutagenicity**

No data available

Ames test

S. typhimurium

Result: negative

OECD Test Guideline 474

Mouse - male and female

Result: negative

#### **Carcinogenicity**

This product is or contains a component that has been reported to be possibly carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Cobalt)  
2A - Group 2A: Probably carcinogenic to humans (Cobalt)  
2B - Group 2B: Possibly carcinogenic to humans (Cobalt)  
IARC: 2B - Group 2B: Possibly carcinogenic to humans (Cobalt)  
2A - Group 2A: Probably carcinogenic to humans (Cobalt)  
2B - Group 2B: Possibly carcinogenic to humans (Cobalt)  
NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.  
OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

Repeated dose toxicity - Rat - male and female - inhalation (dust/mist/fume)

RTECS: GF8750000

Kidney injury may occur., Damage to the eyes., Lung irritation, Throat., Rash, Vomiting, Diarrhoea

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - Danio rerio (zebra fish) - > 100 mg/l - 96.0 h

Toxicity to algae Remarks: No data available

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3089      Class: 4.1      Packing group: II  
Proper shipping name: Metal powders, flammable, n.o.s.  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 3089      Class: 4.1      Packing group: II      EMS-No: F-G, S-G  
Proper shipping name: METAL POWDER, FLAMMABLE, N.O.S.

### IATA

UN number: 3089      Class: 4.1      Packing group: II  
Proper shipping name: Metal powder, flammable, n.o.s.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Cobalt	7440-48-4	2007-07-01

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Cobalt	7440-48-4	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Cobalt	7440-48-4	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Cobalt	7440-48-4	2007-07-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Cobalt	7440-48-4	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Chronic H317	Chronic aquatic toxicity
H334	May cause an allergic skin reaction.
H413	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
Resp. Sens.	May cause long lasting harmful effects to aquatic life.
Skin Sens.	Respiratory sensitisation
	Skin sensitisation

### HMIS Rating

Health hazard: 0  
Chronic Health Hazard: \*



Flammability: 3  
Physical Hazard 3

**NFPA Rating**

Health hazard: 0  
Fire Hazard: 3  
Reactivity Hazard: 3

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 03/02/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.7  
Revision Date 02/27/2015  
Print Date 05/24/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Copper

Product Number : 12816  
Brand : Aldrich

CAS-No. : 7440-50-8

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

## 2.2 GHS Label elements, including precautionary statements

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Formula : Cu  
Molecular weight : 63.55 g/mol  
CAS-No. : 7440-50-8  
EC-No. : 231-159-6

## Hazardous components

Component	Classification	Concentration
Copper		
		<= 100 %

---

4. FIRST AID MEASURES

## 4.1 Description of first aid measures

## If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration.

## In case of skin contact

Wash off with soap and plenty of water.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Copper oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Avoid dust formation. Avoid breathing vapours, mist or gas.

For personal protection see section 8.

**6.2 Environmental precautions**

No special environmental precautions required.

**6.3 Methods and materials for containment and cleaning up**

Sweep up and shovel. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

Store under inert gas. Air sensitive.

Storage class (TRGS 510): Non Combustible Solids

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters**

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Copper	7440-50-8	TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Irritation Gastrointestinal metal fume fever		
		TWA	0.200000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Irritation Gastrointestinal metal fume fever		
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

## 8.2 Exposure controls

### Appropriate engineering controls

General industrial hygiene practice.

### Personal protective equipment

#### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

No special environmental precautions required.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: Foil Colour: light red
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 1,083.4 °C (1,982.1 °F)
f) Initial boiling point and boiling range	2,567 °C (4,653 °F)
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	8.940 g/cm <sup>3</sup>
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

#### 10.4 Conditions to avoid

No data available

#### 10.5 Incompatible materials

Strong acids, Strong oxidizing agents, Acid chlorides, Halogens

#### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

LD50 Intraperitoneal - Mouse - 3.5 mg/kg

##### Skin corrosion/irritation

No data available

##### Serious eye damage/eye irritation

No data available

##### Respiratory or skin sensitisation

No data available

##### Germ cell mutagenicity

No data available

##### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

No data available

No data available

##### Specific target organ toxicity - single exposure

No data available

##### Specific target organ toxicity - repeated exposure

No data available

##### Aspiration hazard

No data available

##### Additional Information

RTECS: GL5325000

Symptoms of systemic copper poisoning may include: capillary damage, headache, cold sweat, weak pulse, and kidney and liver damage, central nervous system excitation followed by depression, jaundice, convulsions, paralysis, and coma. Death may occur from shock or renal failure. Chronic copper poisoning is typified by hepatic cirrhosis, brain damage and demyelination, kidney defects, and copper deposition in the cornea as exemplified by humans with Wilson's disease. It has also been reported that copper poisoning has lead to hemolytic anemia and accelerates arteriosclerosis.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

Not dangerous goods

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Copper)  
Marine pollutant: yes

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Copper)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

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## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

Copper	CAS-No. 7440-50-8	Revision Date 1989-08-11
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### New Jersey Right To Know Components

Copper	CAS-No. 7440-50-8	Revision Date 1989-08-11
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### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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## 16. OTHER INFORMATION

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 02/27/2015

Print Date: 05/24/2016



# Chem Service Inc. Material Safety Data Sheet

Last Revised On: 11/3/2011

## SECTION 1 - CHEMICAL PRODUCT and COMPANY IDENTIFICATION

Catalog Number: S-10875M1  
Description: 4,4'-DDE  
Product is: Solution  
Other Name(s): 1,1-Dichloro-2,2-bis[p-chlorophenyl]ethylene/p,p'-DDE/1,1  
-(Dichloroethenylidene)bis[4-chlorobenzene]  
Supplied by CHEM SERVICE, Inc. PO BOX 599, WEST CHESTER, PA 19381 (610)-692-3026  
EMERGENCY PHONE: 1-610-692-3026

## SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS

CAS No.: 72-55-9  
Description: 4,4'-DDE Solution  
Concentration: 100ug/mL in Methanol  
EINECS No.: 200-784-6  
Hazard Symbols: XN

## SECTION 3 - HAZARDS IDENTIFICATION

Contact lenses should not be worn in the laboratory. All chemicals should be considered hazardous -  
Avoid direct physical contact!

For the solvent: Methanol

Health Risks: May be fatal if absorbed through the skin! Repeated exposure to vapors and/or dust can cause eye injury. May be fatal if inhaled! Can cause cardiovascular system injury. Exposure can cause liver damage. Exposure can cause kidney damage. May be fatal or cause blindness if swallowed. Can cause gastro-intestinal disturbances. Can cause convulsions.

Property 65: Data Not Available

## SECTION 4 - FIRST AID MEASURES

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

For the solvent: Methanol

First Aid: In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If patient has stopped breathing administer artificial respiration. If patient is in cardiac arrest administer CPR. Continue life supporting measures until medical assistance has arrived. Do not wear shoes or clothing until absolutely free of all chemical odors. Get medical attention if necessary. If no burns have occurred-use soap and water to cleanse skin. If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If swallowed do not induce vomiting.

## SECTION 5 - FIRE AND EXPLOSION DATA

For the solvent: Methanol

Flash Point: 11°C This is a flammable chemical.

Extinguishing Media: Carbon dioxide or dry chemical powder. DO NOT USE WATER!

Upper Explosion Limit: 36%

Lower Explosion Limit: 6.0%

Autoignition Temperature: 464°C

NFPA Scale: 0 - Least, 1 - Slight, 2 - Moderate, 3 - High, 4 - Severe

NFPA Hazard Rating: Health: 1. Reactivity: 0. Flammability: 3. Special: No Data.

## SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spills or Leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area.

Absorb on vermiculite or similar material. Sweep up and place in an appropriate container.

Hold for disposal.

Wash contaminated surfaces to remove any residue.

Remove contaminated clothing and wash before reuse.

## SECTION 7 - HANDLING AND STORAGE

Handling: This chemical should be handled only in a hood. Eye shields should be worn.

Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Avoid ingestion and inhalation. Wash thoroughly after handling.

Storage:

Store in a cool dry place. Store only with compatible chemicals.

Keep tightly closed.

## SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

For the solvent: Methanol

OSHA PEL (TWA): 200 ppm (260 mg/m<sup>3</sup>)

ACGIH TLV (TWA): 200 ppm (262 mg/m<sup>3</sup>)

ACGIH TLV (STEL): Data Not Available

### Personal Protective Equipment

Eyes: Wear Safety Glasses.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to minimize contact with skin.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 requirements must be followed whenever workplace conditions warrant a respirators use.

## SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

For the solvent: Methanol

Color: Colorless

Phase: Liquid

Melting Point: -98°C

Boiling Point: 64.6°C

Specific Gravity: 0.791g/mL

Vapor Density: 1.11

Vapor Pressure: 130.3 hPa @ 20°C

Solubility in Water: Completely miscible.

Odor: Data Not Available

Evaporation Rate (Butyl acetate=1): Data Not Available

Molecular Weight: 32.05  
Molecular Formula: CH<sub>4</sub>O

## SECTION 10 - STABILITY AND REACTIVITY

For the solvent: Methanol

Reacts with Acid halides and anhydrides. Flammable. Incompatible with strong acids. Incompatible with strong reducing agents. Incompatible with strong oxidizing agents. Decomposition liberates toxic fumes. Hygroscopic. Incompatible with active metals (e.g. Sodium).

## SECTION 11 - TOXICOLOGY INFORMATION

The primary hazards for this solution are predominantly from the solvent.

For the solvent: Methanol

RTECS: PC1400000

Oral Rat or Mouse LD<sub>50</sub>: 5628 mg/kg

Dermal Rat or Mouse LD<sub>50</sub>: N/A mg/kg

Rat or Mouse LC<sub>50</sub> : 64000 ppm/8H

### Carcinogenicity

OSHA: NO

IARC: NO

NTP: NO

ACGIH: NO

NIOSH: NO

Other: NO

Property 65: Data Not Available

## SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicity: Not Available

Environmental Fate: Not Available

## SECTION 13 - DISPOSAL CONSIDERATIONS

Disposal: Dispose in accordance with Federal, State and Local regulations.

## SECTION 14 - TRANSPORTATION INFORMATION

For the solvent: Methanol

UN Number: UN1230

Class: 3

Packing Group: II

Proper Shipping Name: Methanol

## SECTION 15 - REGULATORY INFORMATION

For the solvent: Methanol

European Labeling in Accordance with EC Directives

Hazard Symbols: T F

Risk Phrases

R11 Highly Flammable.

R23/25 Toxic by inhalation and if swallowed.

Safety Phrases

S16 Keep away from sources of ignition- No smoking.

S2 Keep out of reach of children.

S24	Avoid contact with the skin.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).
S7	Keep container tightly closed

#### **SECTION 16 - OTHER INFORMATION**

The above information is believed to be correct on the date it was last revised and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. RESPONSIBILITY for updates lies with the employer and not with CHEM SERVICE, Inc.

Persons not specifically and properly trained should not handle this chemical or its container. This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticide products, food additives or as household chemicals.

This Material Safety Data Sheet (MSDS) is intended only for use with Chem Service, Inc. products and should not be relied on for use with materials from any other supplier even if the chemical name(s) on the product are identical! Whenever using an MSDS for a solution or mixture the user should refer to the MSDS for every component of the solution or mixture. Chem Service warrants that this MSDS is based upon the most current information available to Chem Service at the time it was last revised. THIS WARRANTY IS EXCLUSIVE, AND CHEM SERVICE, INC. MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. This MSDS is provided gratis and CHEM SERVICE, INC. SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES. Copyright © 2011 Chem Service, Inc. All rights reserved except that this MSDS may be printed for the use of a customer or prospective customer of Chem Service, Inc provided the entire MSDS is printed. The MSDS may not be placed in any database or otherwise stored or distributed in electronic or any other form.

This product is furnished FOR LABORATORY USE ONLY!



**MATHESON**

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## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE**

**SDS ID: MAT06880**

### Section 1 - PRODUCT AND COMPANY IDENTIFICATION

**Material Name**

DICHLORODIFLUOROMETHANE

**Synonyms**

MTG MSDS 37; CHLOROFLUOROCARBON 12; DICHLORODIFLUOROMETHANE(R-12);  
DICHLORODIFLUOROMETHANE (CCl<sub>2</sub>F<sub>2</sub>); DIFLUORODICHLOROMETHANE; ELECTRO-CF 12; CF 12;  
FC 12; CFC 12; FREON 12; FLUOROCARBON-12; HALON; F 12; HALON 122; R 12; R 12 (REFRIGERANT);  
UN 1028; CCl<sub>2</sub>F<sub>2</sub>

**Chemical Family**

halogenated, Gas

**Product Use**

Industrial and Specialty Gas Applications.

**Restrictions on Use**

None known.

**Details of the supplier of the safety data sheet**

MATHESON TRI-GAS, INC.

150 Allen Road, Suite 302

Basking Ridge, NJ 07920

General Information: 1-800-416-2505

Emergency #: 1-800-424-9300 (CHEMTREC)

Outside the US: 703-527-3887 (Call collect)

### Section 2 - HAZARDS IDENTIFICATION

**Classification in accordance with paragraph (d) of 29 CFR 1910.1200.**

Gases Under Pressure - Liquefied gas

Acute Toxicity - Oral - Category 4

Specific target organ toxicity - Single exposure - Category 3

Specific target organ toxicity - Repeated exposure - Category 1

**GHS Label Elements**

**Symbol(s)**



**Signal Word**

Danger

**Hazard Statement(s)**

Contains gas under pressure; may explode if heated.

May cause drowsiness or dizziness.

Causes damage to nervous system through prolonged or repeated exposure.

**Precautionary Statement(s)**

**Prevention**

Do not breathe gas.

Use only outdoors or in a well-ventilated area.

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## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880**

Wash thoroughly after handling.

Do not eat, drink or smoke when using this product.

**Response**

Get medical advice/attention if you feel unwell.

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

Call a POISON CENTER or doctor/physician if you feel unwell.

**Storage**

Protect from sunlight. Store in a well-ventilated place.

Keep container tightly closed.

Store locked up.

**Disposal**

Dispose in accordance with all applicable regulations.

**Statement(s) of Unknown Acute Toxicity**

Oral 0% of the mixture consists of ingredient(s) of unknown acute toxicity.

**Other Hazards**

May cause frostbite upon sudden release of liquefied gas.

**Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS**

CAS	Component Name	Percent
75-71-8	DICHLORODIFLUOROMETHANE	100

**Section 4 - FIRST AID MEASURES****Inhalation**

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**Skin**

If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115°F; 41-46°C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

**Eyes**

Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Then get immediate medical attention.

**Ingestion**

If swallowed, get medical attention.

**Most Important Symptoms/Effects****Acute**

frostbite, central nervous system depression

**Delayed**

nervous system damage

**Note to Physicians**

For inhalation, consider oxygen.

**Section 5 - FIRE FIGHTING MEASURES****Extinguishing Media****Suitable Extinguishing Media**

regular dry chemical, carbon dioxide, Large fires: Use water spray, fog or regular foam.

**Unsuitable Extinguishing Media**

Do not direct water at source of leak or safety devices; icing may occur.

**MATHESON**

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## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880****Special Hazards Arising from the Chemical**

Negligible fire hazard. Containers may rupture or explode if exposed to heat.

**Hazardous Combustion Products**

Phosgene, halogenated anilines, hydrochloric acid, CARBONYL FLUORIDE, Chlorine, Hydrogen fluoride, fluorocarbons, hydrogen chloride

**Fire Fighting Measures**

Use extinguishing agents appropriate for surrounding fire. Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Apply water from a protected location or from a safe distance. Do not get water directly on material. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile). Reduce vapors with water spray. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Consider downwind evacuation if material is leaking.

**Special Protective Equipment and Precautions for Firefighters**

Wear full protective fire fighting gear including self contained breathing apparatus (SCBA) for protection against possible exposure.

**Section 6 - ACCIDENTAL RELEASE MEASURES****Personal Precautions, Protective Equipment and Emergency Procedures**

Wear personal protective clothing and equipment, see Section 8.

**Methods and Materials for Containment and Cleaning Up**

Stop leak if possible without personal risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas. Do not touch or walk through spilled material. Do not direct water at spill or source of leak. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements, or confined areas. Allow substance to evaporate. Ventilate the area. Consider downwind evacuation if material is leaking. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

**Environmental Precautions**

Avoid release to the environment.

**Section 7 - HANDLING AND STORAGE****Precautions for Safe Handling**

Do not breathe gas. Use only outdoors or in a well-ventilated area. Wash hands thoroughly after handling. Do not eat, drink, or smoke when using this product.

**Conditions for Safe Storage, Including any Incompatibilities**

Protect from sunlight. Store in a well-ventilated place.

Keep container tightly closed.

Store locked up.

Store and handle in accordance with all current regulations and standards. Protect from sunlight. Store in a well-ventilated area. Keep container tightly closed. Keep locked up. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances.

**Incompatible Materials**

metals, combustible materials, aluminum, Acids

**Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION****Component Exposure Limits**

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## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880**

<b>DICHLORODIFLUOROMETHANE</b>	<b>75-71-8</b>
ACGIH:	1000 ppm TWA
NIOSH:	1000 ppm TWA ; 4950 mg/m3 TWA
	15000 ppm IDLH
OSHA (US):	1000 ppm TWA ; 4950 mg/m3 TWA
Mexico:	1000 ppm TWA VLE-PPT ; 4950 mg/m3 TWA VLE-PPT
	1250 ppm STEL [PPT-CT ] ; 6200 mg/m3 STEL [PPT-CT ]

**ACGIH - Threshold Limit Values - Biological Exposure Indices (BEI)**

There are no biological limit values for any of this product's components.

**Engineering Controls**

Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

**Individual Protection Measures, such as Personal Protective Equipment****Eye/face protection**

For the gas: Eye protection not required, but recommended. For the liquid: Wear splash resistant safety goggles. Contact lenses should not be worn. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**Skin Protection**

For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.

**Respiratory Protection**

The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA. 10,000 ppm. Any supplied-air respirator. 15,000 ppm. Any supplied-air respirator operated in a continuous-flow mode. Any self-contained breathing apparatus with a full facepiece. Any supplied-air respirator with a full facepiece. Emergency or planned entry into unknown concentrations or IDLH conditions -. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. Escape -. Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister. Any appropriate escape-type, self-contained breathing apparatus.

**Glove Recommendations**

For the gas: Protective gloves are not required. For the liquid: Wear insulated gloves.

**Section 9 - PHYSICAL AND CHEMICAL PROPERTIES**

<b>Appearance</b>	colorless gas liquefied gas	<b>Physical State</b>	gas
<b>Odor</b>	faint odor ,ether odor	<b>Color</b>	colorless
<b>Odor Threshold</b>	Not available	<b>pH</b>	Not available
<b>Melting Point</b>	-158 °C (-252 °F )	<b>Boiling Point</b>	-29.8 °C (-22 °F )
<b>Boiling Point Range</b>	Not available	<b>Freezing point</b>	Not available





## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880**

<b>Evaporation Rate</b>	380 (Butyl acetate = 1 )	<b>Flammability (solid, gas)</b>	Not available
<b>Autoignition Temperature</b>	Not available	<b>Flash Point</b>	(Not flammable )
<b>Lower Explosive Limit</b>	Not available	<b>Decomposition temperature</b>	Not available
<b>Upper Explosive Limit</b>	Not available	<b>Vapor Pressure</b>	4252.85 mmHg @ 20 °C
<b>Vapor Density (air=1)</b>	4.2	<b>Specific Gravity (water=1)</b>	Not available
<b>Water Solubility</b>	0.33 g/L (@ 20 °C )	<b>Partition coefficient: n-octanol/water</b>	Not available
<b>Viscosity</b>	0.0117 cp	<b>Kinematic viscosity</b>	Not available
<b>Solubility (Other)</b>	Not available	<b>Bioconcentration Factor (BCF)</b>	0.26
<b>Density</b>	1.33 g/cm3 at 20 °C	<b>Henry's Law Constant</b>	0.343
<b>KOC</b>	356 (Estimated )	<b>Log KOW</b>	2.16
<b>Physical Form</b>	liquefied gas	<b>Volatility</b>	100 %
<b>Molecular Formula</b>	Cl2-C-F2	<b>Molecular Weight</b>	120.91

**Solvent Solubility****Soluble**

alcohol, ether, acetic acid, ketones, esters, Hydrocarbons, oils, chlorinated solvents, organic acids

**Insoluble**

glycols, glycerol, phenols

**Section 10 - STABILITY AND REACTIVITY****Reactivity**

No reactivity hazard is expected.

**Chemical Stability**

Stable at normal temperatures and pressure.

**Possibility of Hazardous Reactions**

Will not polymerize.

**Conditions to Avoid**

Protect from physical damage and heat. Containers may rupture or explode if exposed to heat.

**Incompatible Materials**

metals, combustible materials, aluminum, Acids

**Hazardous decomposition products**

Phosgene, halogenated anilines, hydrochloric acid, CARBONYL FLUORIDE, Chlorine, Hydrogen fluoride, fluorocarbons, hydrogen chloride

**Section 11 - TOXICOLOGICAL INFORMATION****Information on Likely Routes of Exposure**



## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880****Inhalation**

nausea, vomiting, difficulty breathing, irregular heartbeat, headache, drowsiness, fatigue, dizziness, Disorientation, mood swings, tingling sensation, loss of coordination, suffocation, convulsions, Unconsciousness, coma

**Skin Contact**

blisters, frostbite

**Eye Contact**

frostbite, eye damage, blurred vision

**Ingestion**

ingestion of a gas is unlikely

**Acute and Chronic Toxicity****Component Analysis - LD50/LC50**

The components of this material have been reviewed in various sources and the following selected endpoints are published:

**DICHLORODIFLUOROMETHANE (75-71-8)**

Oral LD50 Rat >1 g/kg

Inhalation LC50 Rat >800000 ppm 30 min

**Product Toxicity Data****Acute Toxicity Estimate**

Inhalation - Gas	> 20000 ppm
Oral	1000.1 mg/kg

**Immediate Effects**

frostbite, central nervous system depression

**Delayed Effects**

nervous system damage

**Irritation/Corrosivity Data**

No data available.

**Respiratory Sensitization**

No data available.

**Dermal Sensitization**

No data available.

**Component Carcinogenicity**

<b>DICHLORODIFLUOROMETHANE</b>	<b>75-71-8</b>
ACGIH:	A4 - Not Classifiable as a Human Carcinogen

**Germ Cell Mutagenicity**

No data available.

**Tumorigenic Data**

No data available

**Reproductive Toxicity**

No data available.

**Specific Target Organ Toxicity - Single Exposure**

central nervous system

**Specific Target Organ Toxicity - Repeated Exposure**

nervous system

**Aspiration hazard**

Not applicable.



## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880****Medical Conditions Aggravated by Exposure**

heart or cardiovascular disorders

**Additional Data**

Stimulants such as epinephrine may induce ventricular fibrillation.

**Section 12 - ECOLOGICAL INFORMATION****Component Analysis - Aquatic Toxicity**

No LOLI ecotoxicity data are available for this product's components.

**Persistence and Degradability**

No data available.

**Bioaccumulative Potential**

Bioconcentration potential in aquatic organisms is low based on a BCF value of 25.

**Mobility**

Expected to have moderate mobility in soil.

**Section 13 - DISPOSAL CONSIDERATIONS****Disposal Methods**

Dispose in accordance with all applicable regulations.

**Component Waste Numbers****DICHLORODIFLUOROMETHANE**

waste number U075

**Section 14 - TRANSPORT INFORMATION****US DOT Information:****Shipping Name:** DICHLORODIFLUOROMETHANE**Hazard Class:** 2.2**UN/NA #:** UN1028**Required Label(s):** 2.2**IMDG Information:****Shipping Name:** DICHLORODIFLUOROMETHANE**Hazard Class:** 2.2**UN#:** UN1028**Required Label(s):** 2.2**International Bulk Chemical Code**

This material does not contain any chemicals required by the IBC Code to be identified as dangerous chemicals in bulk.

**Section 15 - REGULATORY INFORMATION****U.S. Federal Regulations**

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), and/or require an OSHA process safety plan.

<b>DICHLORODIFLUOROMETHANE</b>	<b>75-71-8</b>
SARA 313:	1 % de minimis concentration
CERCLA:	5000 lb final RQ ; 2270 kg final RQ

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## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880****SARA Section 311/312 (40 CFR 370 Subparts B and C) reporting categories**

Gas Under Pressure; Acute toxicity; Specific Target Organ Toxicity

**U.S. State Regulations**

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA
<b>DICHLORODIFLUOROMETHANE</b>	<b>75-71-8</b>	Yes	Yes	Yes	Yes	Yes

**Not listed under California Proposition 65****Canada Regulations****Canadian WHMIS Ingredient Disclosure List (IDL)**

Components of this material have been checked against the Canadian WHMIS Ingredients Disclosure List. The List is composed of chemicals which must be identified on MSDSs if they are included in products which meet WHMIS criteria specified in the Controlled Products Regulations and are present above the threshold limits listed on the IDL

<b>DICHLORODIFLUOROMETHANE</b>	<b>75-71-8</b>
	1 %

**WHMIS Classification**

A

**Component Analysis - Inventory****DICHLORODIFLUOROMETHANE (75-71-8)**

US	CA	EU	AU	PH	JP - ENCS	JP - ISHL	KR KECI - Annex 1	KR KECI - Annex 2	KR - REACH CCA	CN	NZ	MX	TW	VN - NCI (Draft)
Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No

**Section 16 - OTHER INFORMATION****NFPA Ratings**

Health: 2 Fire: 0 Reactivity: 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

**Summary of Changes**

Updated: 05/01/2015

**Key / Legend**

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CA/MA/MN/NJ/PA - California/Massachusetts/Minnesota/New Jersey/Pennsylvania\*; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CFR - Code of Federal Regulations (US); CLP - Classification, Labelling, and Packaging; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSD - Dangerous Substance Directive; DSL - Domestic Substances List; EC - European Commission; EEC - European Economic Community; EIN - European Inventory of (Existing Commercial Chemical Substances); EINECS - European Inventory of Existing Commercial Chemical Substances; ENCS - Japan Existing and New Chemical Substance Inventory; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime

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## Safety Data Sheet

**Material Name: DICHLORODIFLUOROMETHANE****SDS ID: MAT06880**

Dangerous Goods; ISHL - Japan Industrial Safety and Health Law; IUCLID - International Uniform Chemical Information Database; JP - Japan; Kow - Octanol/water partition coefficient; KR KECI Annex 1 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR KECI Annex 2 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL) , KR - Korea; LD50/LC50 - Lethal Dose/ Lethal Concentration; LEL - Lower Explosive Limit; LLV - Level Limit Value; LOLI - List Of Lists™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; MX – Mexico; NDSL – Non-Domestic Substance List (Canada); NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PEL- Permissible Exposure Limit; PH - Philippines; RCRA - Resource Conservation and Recovery Act; REACH- Registration, Evaluation, Authorisation, and restriction of Chemicals; RID - European Rail Transport; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TCCA – Korea Toxic Chemicals Control Act; TDG - Transportation of Dangerous Goods; TLV - Threshold Limit Value; TSCA - Toxic Substances Control Act; TW – Taiwan; TWA - Time Weighted Average; UEL - Upper Explosive Limit; UN/NA - United Nations /North American; US - United States; VLE - Exposure Limit Value (Mexico); VN NCI (Draft) - Vietnam National Chemicals Inventory (NCI) (Draft); WHMIS - Workplace Hazardous Materials Information System (Canada) .

**Other Information****Disclaimer:**

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## SAFETY DATA SHEET

Version 5.3  
Revision Date 06/02/2016  
Print Date 06/23/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Dichloromethane

Product Number : 02575  
Brand : Sigma-Aldrich  
Index-No. : 602-004-00-3

CAS-No. : 75-09-2

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Skin irritation (Category 2), H315

Eye irritation (Category 2A), H319

Carcinogenicity (Category 2), H351

Specific target organ toxicity - single exposure (Category 3), Respiratory system, Central nervous system, H335, H336

Specific target organ toxicity - repeated exposure, Oral (Category 2), Liver, Blood, H373

Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Central nervous system, H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)

H315

Causes skin irritation.

H319

Causes serious eye irritation.

H335

May cause respiratory irritation.

H336

May cause drowsiness or dizziness.

H351

Suspected of causing cancer.

H373

May cause damage to organs (Liver, Blood) through prolonged or repeated exposure if swallowed.

H373

May cause damage to organs (Central nervous system) through

prolonged or repeated exposure if inhaled.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS**

**3.1 Substances**

Synonyms	: Methylene chloride
Formula	: CH <sub>2</sub> Cl <sub>2</sub>
Molecular weight	: 84.93 g/mol
CAS-No.	: 75-09-2
EC-No.	: 200-838-9
Index-No.	: 602-004-00-3
Registration number	: 01-2119480404-41-XXXX

**Hazardous components**

Component	Classification	Concentration
<b>Methylene chloride</b>		
	Skin Irrit. 2; Eye Irrit. 2A; Carc. 2; STOT SE 3; STOT RE 2; H315, H319, H335, H336, H351, H373, H373	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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**4. FIRST AID MEASURES**

**4.1 Description of first aid measures**

**General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

No data available

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

**6.3 Methods and materials for containment and cleaning up**

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Heat sensitive.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters****Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	Potential Occupational Carcinogen		



		See Appendix A		
Methylene chloride	75-09-2	TWA	50.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		TWA	50 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		Substance listed; for more information see OSHA document 1910.1052		
		Substance listed; for more information see OSHA document 1910.1052		
		See Table Z-2		
		PEL	25.000000 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH <sub>2</sub> Cl <sub>2</sub> . Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		
		STEL	125.000000 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH <sub>2</sub> Cl <sub>2</sub> . Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		
		PEL	25 ppm 87 mg/m <sup>3</sup>	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		see section 5202		
		STEL	125 ppm 435 mg/m <sup>3</sup>	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		see section 5202		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Methylene chloride	75-09-2	Dichloromethane	0.3000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

**Derived No Effect Level (DNEL)**

Application Area	Exposure routes	Health effect	Value
Workers	Inhalation	Acute systemic effects	706 mg/m3
Workers	Inhalation	Long-term systemic effects	353 mg/m3
Workers	Skin contact	Long-term systemic effects	4750mg/kg BW/d
Consumers	Ingestion	Long-term systemic effects	0.06mg/kg BW/d
Consumers	Inhalation	Long-term systemic effects	88.3 mg/m3
Consumers	Skin contact	Long-term systemic effects	2395mg/kg BW/d
Consumers	Inhalation	Acute systemic effects	353 mg/m3

**Predicted No Effect Concentration (PNEC)**

Compartment	Value
Soil	0.583 mg/kg
Marine water	0.194 mg/l
Fresh water	0.54 mg/l
Marine sediment	1.61 mg/kg
Fresh water sediment	4.47 mg/kg
Onsite sewage treatment plant	26 mg/l
Aquatic intermittent release	0.27 mg/l

**8.2 Exposure controls****Appropriate engineering controls**

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

**Personal protective equipment****Eye/face protection**

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Splash contact**

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 148 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: liquid Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -97 °C (-143 °F)
f) Initial boiling point and boiling range	39.8 - 40 °C (103.6 - 104 °F)
g) Flash point	No data available
h) Evaporation rate	0.71
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 19 %(V) Lower explosion limit: 12 %(V)
k) Vapour pressure	470.9 hPa (353.2 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density	2.93 - (Air = 1.0)
m) Relative density	1.325 g/mL at 25 °C (77 °F)
n) Water solubility	slightly soluble
o) Partition coefficient: n-octanol/water	log Pow: 1.25
p) Auto-ignition temperature	556.1 °C (1,033.0 °F) 662.0 °C (1,223.6 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

Relative vapour density	2.93 - (Air = 1.0)
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## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.  
Contains the following stabiliser(s):  
2-Methyl-2-butene (0.002 %)

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks. Exposure to sunlight.

## 10.5 Incompatible materials

Alkali metals, Aluminum, Strong oxidizing agents, Bases, Amines, Magnesium, Strong acids and strong bases, Vinyl compounds

## 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas  
Other decomposition products - No data available  
In the event of fire: see section 5

---

# 11. TOXICOLOGICAL INFORMATION

## 11.1 Information on toxicological effects

### Acute toxicity

LD50 Oral - Rat - > 2,000 mg/kg

LC50 Inhalation - Rat - 52,000 mg/m3

LD50 Dermal - Rat - > 2,000 mg/kg  
(OECD Test Guideline 402)

No data available

### Skin corrosion/irritation

Skin - Rabbit

Result: Irritating to skin. - 24 h  
(Draize Test)

### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Irritating to eyes. - 24 h  
(Draize Test)

### Respiratory or skin sensitisation

No data available

### Germ cell mutagenicity

Rat

DNA damage

### Carcinogenicity

Carcinogenicity - Rat - Inhalation

Tumorigenic: Carcinogenic by RTECS criteria. Endocrine: Tumors.

Limited evidence of carcinogenicity in animal studies

Suspected human carcinogens

OSHA: OSHA specifically regulated carcinogen (Methylene chloride)

### Reproductive toxicity

No data available

### Specific target organ toxicity - single exposure

May cause respiratory irritation.

May cause drowsiness or dizziness.

### Specific target organ toxicity - repeated exposure

Inhalation - May cause damage to organs through prolonged or repeated exposure. - Central nervous system

Oral - May cause damage to organs through prolonged or repeated exposure. - Liver, Blood

### Aspiration hazard

No data available

### Additional Information

RTECS: PA8050000

Dichloromethane is metabolized in the body producing carbon monoxide which increases and sustains carboxyhemoglobin levels in the blood, reducing the oxygen-carrying capacity of the blood., Acts as a simple asphyxiant by displacing air., anesthetic effects, Difficulty in breathing, Headache, Dizziness, Prolonged or repeated contact with skin may cause:, defatting, Dermatitis, Contact with eyes can cause:, Redness, Blurred vision, Provokes tears., Effects due to ingestion may include:, Gastrointestinal discomfort, Central nervous system depression, Paresthesia., Drowsiness, Convulsions, Conjunctivitis., Pulmonary edema. Effects may be delayed., Irregular breathing., Stomach/intestinal disorders, Nausea, Vomiting, Increased liver enzymes., Weakness, Heavy or prolonged skin exposure may result in the absorption of harmful amounts of material., Abdominal pain  
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 193.00 mg/l - 96 h NOEC - Cyprinodon variegatus (sheepshead minnow) - 130 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 1,682.00 mg/l - 48 h

### 12.2 Persistence and degradability

Biodegradability	Result: < 26 % - Not readily biodegradable. (OECD Test Guideline 301C)
------------------	---

### 12.3 Bioaccumulative potential

Does not bioaccumulate.

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1593	Class: 6.1	Packing group: III
Proper shipping name: Dichloromethane		
Reportable Quantity (RQ): 1000 lbs		

Poison Inhalation Hazard: No

### IMDG

UN number: 1593	Class: 6.1	Packing group: III	EMS-No: F-A, S-A
Proper shipping name: DICHLOROMETHANE			

### IATA

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure if swallowed.
Skin Irrit.	Skin irritation
STOT RE	Specific target organ toxicity - repeated exposure
STOT SE	Specific target organ toxicity - single exposure

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.3

Revision Date: 06/02/2016

Print Date: 06/23/2016

## SAFETY DATA SHEET

Version 5.5  
Revision Date 05/27/2016  
Print Date 07/04/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Dieldrin

Product Number : 33491  
Brand : Sigma-Aldrich  
Index-No. : 602-049-00-9

CAS-No. : 60-57-1

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 2), H300  
Acute toxicity, Dermal (Category 1), H310  
Carcinogenicity (Category 2), H351  
Specific target organ toxicity - repeated exposure, Oral (Category 1), H372  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H300 + H310

Fatal if swallowed or in contact with skin

H351

Suspected of causing cancer.

H372

Causes damage to organs through prolonged or repeated exposure if swallowed.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.



P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P262	Do not get in eyes, on skin, or on clothing.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER/doctor. Rinse mouth.
P302 + P350 + P310	IF ON SKIN: Gently wash with plenty of soap and water. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : 1,2,3,4,10,10-Hexachloro-1,4,4a,5,6,7,8,8a-octahydro-6,7-epoxy-1,4:5,8-dimethanonaphthalene

Formula : C<sub>12</sub>H<sub>8</sub>Cl<sub>6</sub>O  
Molecular weight : 380.91 g/mol  
CAS-No. : 60-57-1  
EC-No. : 200-484-5  
Index-No. : 602-049-00-9

#### Hazardous components

Component	Classification	Concentration
<b>Dieldrin</b>		
	Acute Tox. 2; Acute Tox. 1; Carc. 2; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H300 + H310, H351, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

No data available

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Diethrin	60-57-1	TWA	0.100000 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Liver damage Reproductive effects Confirmed animal carcinogen with unknown relevance to humans		

		Danger of cutaneous absorption		
		TWA	0.250000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A Potential for dermal absorption		
		TWA	0.250000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation		
		TWA	0.1 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Liver damage Reproductive effects Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		
		TWA	0.25 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A Potential for dermal absorption		
		TWA	0.25 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation		
		TWA	0.25 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		Skin notation		
		PEL	0.25 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### **Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: solid   |
| b) Odour  | No data available                                       |
| c) Odour Threshold                              | No data available                                       |
| d) pH   | No data available                                       |
| e) Melting point/freezing point                 | Melting point/range: 143 - 144 °C (289 - 291 °F) - lit. |
| f) Initial boiling point and boiling range      | No data available                                       |
| g) Flash point                                  | No data available                                       |
| h) Evaporation rate                             | No data available                                       |
| i) Flammability (solid, gas)                    | No data available                                       |
| j) Upper/lower flammability or explosive limits | No data available                                       |
| k) Vapour pressure                              | No data available                                       |
| l) Vapour density                               | No data available                                       |
| m) Relative density                             | No data available                                       |
| n) Water solubility                             | No data available                                       |
| o) Partition coefficient: n-octanol/water       | No data available                                       |
| p) Auto-ignition temperature                    | No data available                                       |
| q) Decomposition temperature                    | No data available                                       |
| r) Viscosity                                    | No data available                                       |
| s) Explosive properties                         | No data available                                       |
| t) Oxidizing properties                         | No data available                                       |

### **9.2 Other safety information**

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 38.3 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

Ingestion - Causes damage to organs through prolonged or repeated exposure.

**Aspiration hazard**

No data available

**Additional Information**

RTECS: IO1750000

Discomfort, Headache, Nausea, Vomiting, Dizziness, Tremors, tonic convulsions, clonic spasms, Coma., respiratory failure, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Blood - Irregularities - Based on Human Evidence

Blood - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish                      mortality LC50 - Carassius auratus (goldfish) - 1.6 µg/l - 96.0 h

Toxicity to daphnia and      Immobilization EC50 - Daphnia magna (Water flea) - 79.5 µg/l - 48 h  
other aquatic  
invertebrates

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 2811              Class: 6.1                      Packing group: I

Proper shipping name: Toxic solids, organic, n.o.s. (Dieldrin)

Reportable Quantity (RQ): 1 lbs

Marine pollutant: yes

Poison Inhalation Hazard: No

**IMDG**

UN number: 2811              Class: 6.1                      Packing group: I

Proper shipping name: TOXIC SOLID, ORGANIC, N.O.S. (Dieldrin)

EMS-No: F-A, S-A

Marine pollutant:yes

**IATA**

UN number: 2811      Class: 6.1      Packing group: I

Proper shipping name: Toxic solid, organic, n.o.s. (Dieldrin)

IATA Passenger: Not permitted for transport

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Dieldrin	60-57-1	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Dieldrin	60-57-1	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Dieldrin	60-57-1	1993-04-24

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Dieldrin	60-57-1	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H300	Fatal if swallowed.
H300 + H310	Fatal if swallowed or in contact with skin
H310	Fatal in contact with skin.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if swallowed.

### HMIS Rating

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	4
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.5

Revision Date: 05/27/2016

Print Date: 07/04/2016



## Material Safety Data Sheet

Version 5.0

Revision Date 10/16/2013

Print Date 06/21/2016

### 1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Diesel  
 Product Number : CRMMPGO  
 Brand : Sigma-Aldrich  
 Supplier : Sigma-Aldrich  
 3050 Spruce Street  
 SAINT LOUIS MO 63103  
 USA  
 Telephone : +1 800-325-5832  
 Fax : +1 800-325-5052  
 Emergency Phone # (For both supplier and manufacturer) : (314) 776-6555  
 Preparation Information : Sigma-Aldrich Corporation  
 Product Safety - Americas Region  
 1-800-521-8956

### 2. HAZARDS IDENTIFICATION

#### Emergency Overview

##### OSHA Hazards

Combustible Liquid, Target Organ Effect, Irritant

##### Target Organs

Blood, Thymus., Liver

##### GHS Classification

Flammable liquids (Category 3)  
 Acute toxicity, Inhalation (Category 4)  
 Acute toxicity, Dermal (Category 5)  
 Skin irritation (Category 2)  
 Carcinogenicity (Category 2)  
 Specific target organ toxicity - repeated exposure (Category 2)  
 Aspiration hazard (Category 1)  
 Acute aquatic toxicity (Category 2)  
 Chronic aquatic toxicity (Category 2)

##### GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H226 Flammable liquid and vapour.  
 H304 May be fatal if swallowed and enters airways.  
 H313 May be harmful in contact with skin.  
 H315 Causes skin irritation.  
 H332 Harmful if inhaled.  
 H351 Suspected of causing cancer.  
 H373 May cause damage to organs through prolonged or repeated exposure.  
 H411 Toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273 Avoid release to the environment.  
P281 Use personal protective equipment as required.  
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.  
P331 Do NOT induce vomiting.

**HMIS Classification**

**Health hazard:** 2  
**Chronic Health Hazard:** \*  
**Flammability:** 2  
**Physical hazards:** 0

**NFPA Rating**

**Health hazard:** 2  
**Fire:** 2  
**Reactivity Hazard:** 0

**Potential Health Effects**

**Inhalation** May be harmful if inhaled. Causes respiratory tract irritation.  
**Skin** May be harmful if absorbed through skin. Causes skin irritation.  
**Eyes** Causes eye irritation.  
**Ingestion** May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage.

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS**

Component		Concentration
<b>Diesel fuel</b>		
CAS-No.	68334-30-5	90 - 100 %
EC-No.	269-822-7	
Index-No.	649-224-00-6	

---

**4. FIRST AID MEASURES**

**General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

---

**5. FIREFIGHTING MEASURES**

**Conditions of flammability**

Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

**Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**Special protective equipment for firefighters**

Wear self contained breathing apparatus for fire fighting if necessary.

**Hazardous combustion products**

Hazardous decomposition products formed under fire conditions. - Carbon oxides

**Further information**

Use water spray to cool unopened containers.

---

**6. ACCIDENTAL RELEASE MEASURES****Personal precautions**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

**Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**Methods and materials for containment and cleaning up**

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

---

**7. HANDLING AND STORAGE****Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

**Conditions for safe storage**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****Components with workplace control parameters**

Components	CAS-No.	Value	Control parameters	Basis
Diesel fuel	68334-30-5	TWA	100 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
Remarks	Dermatitis Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption varies			

**Personal protective equipment****Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Hand protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Eye protection**

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin and body protection**

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Hygiene measures**

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### Appearance

Form	liquid
Colour	no data available

### Safety data

pH	no data available
Melting point/freezing point	no data available
Boiling point	141 - 462 °C (286 - 864 °F) at 1,013 hPa (760 mmHg)
Flash point	>= 56 °C (>= 133 °F) - closed cup
Ignition temperature	>= 225 °C (>= 437 °F) - Auto-flammability
Auto-ignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	400 hPa (300 mmHg) at 40 °C (104 °F)
Density	0.8 - 0.91 g/cm <sup>3</sup> at 15 °C (59 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	no data available
Viscosity, kinematic	>= 1.5 mm <sup>2</sup> /s at 40 °C (104 °F)
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evaporation rate	no data available

---

## 10. STABILITY AND REACTIVITY

### Chemical stability

Stable under recommended storage conditions.

### Possibility of hazardous reactions

no data available

### Conditions to avoid

Heat, flames and sparks.

### Materials to avoid

Strong oxidizing agents

### Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides  
Other decomposition products - no data available

---

## 11. TOXICOLOGICAL INFORMATION

### Acute toxicity

#### Oral LD50

LD50 Oral - rat - 17,900 mg/kg

**Inhalation LC50**

LC50 Inhalation - rat - 4 h - 5.6 mg/l

**Dermal LD50**

LD50 Dermal - rabbit - > 4,300 mg/kg

**Other information on acute toxicity**

no data available

**Skin corrosion/irritation**

Skin - rabbit - Irritating to skin. - 24 h - OECD Test Guideline 404

**Serious eye damage/eye irritation**

Eyes - rabbit - No eye irritation - 24 h - OECD Test Guideline 405

**Respiratory or skin sensitisation**

Maximisation Test - guinea pig - Did not cause sensitisation on laboratory animals. - OECD Test Guideline 406

**Germ cell mutagenicity****Carcinogenicity**

Limited evidence of carcinogenicity in animal studies

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity****Teratogenicity**

no data available

**Specific target organ toxicity - single exposure (Globally Harmonized System)**

no data available

**Specific target organ toxicity - repeated exposure (Globally Harmonized System)**

The substance or mixture is classified as specific target organ toxicant, repeated exposure, category 2.

**Aspiration hazard**

May be fatal if swallowed and enters airways.

**Potential health effects**

<b>Inhalation</b>	May be harmful if inhaled. Causes respiratory tract irritation.
<b>Ingestion</b>	May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage.
<b>Skin</b>	May be harmful if absorbed through skin. Causes skin irritation.
<b>Eyes</b>	Causes eye irritation.

**Signs and Symptoms of Exposure**

Cough, Difficulty in breathing, chest congestion, Shortness of breath, Fever, defatting, Dermatitis, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

**Synergistic effects**

no data available

**Additional Information**

RTECS: Not available

---

**12. ECOLOGICAL INFORMATION****Toxicity**

Toxicity to fish	static test LC50 - Oncorhynchus mykiss (rainbow trout) - 21 mg/l - 96 h Method: OECD Test Guideline 203
------------------	--

Toxicity to algae      Growth inhibition EC50 - Pseudokirchneriella subcapitata (green algae) - 10 mg/l - 72 h  
Method: OECD Test Guideline 201

**Persistence and degradability**

Biodegradability      aerobic  
Result: 57.5 % - According to the results of tests of biodegradability this product is not readily biodegradable.  
Method: OECD Test Guideline 301

**Bioaccumulative potential**

no data available

**Mobility in soil**

no data available

**PBT and vPvB assessment**

no data available

**Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life with long lasting effects.

---

**13. DISPOSAL CONSIDERATIONS**

**Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION**

**DOT (US)**

UN number: 1202    Class: 3      Packing group: III  
Proper shipping name: Diesel fuel  
Reportable Quantity (RQ):  
Marine pollutant: No  
Poison Inhalation Hazard: No

**IMDG**

UN number: 1202    Class: 3      Packing group: III      EMS-No: F-E, S-E  
Proper shipping name: DIESEL FUEL  
Marine pollutant: No

**IATA**

UN number: 1202    Class: 3      Packing group: III  
Proper shipping name: Diesel fuel

---

**15. REGULATORY INFORMATION**

**OSHA Hazards**

Combustible Liquid, Target Organ Effect, Irritant

**SARA 302 Components**

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

**Pennsylvania Right To Know Components**

Diesel fuel

CAS-No.  
68334-30-5

Revision Date  
1989-08-11

**New Jersey Right To Know Components**

Diesel fuel

CAS-No.  
68334-30-5

Revision Date  
1989-08-11

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Further information**

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---

## SAFETY DATA SHEET

Version 3.5  
Revision Date 06/26/2014  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Di-n-octyl phthalate

Product Number : 80153  
Brand : Aldrich

CAS-No. : 117-84-0

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Chronic aquatic toxicity (Category 4), H413

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram : none

Signal word : none

Hazard statement(s)

H413 : May cause long lasting harmful effects to aquatic life.

Precautionary statement(s)

P273 : Avoid release to the environment.

P501 : Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Synonyms : Phthalic acid di-n-octyl ester

Formula : C<sub>24</sub>H<sub>38</sub>O<sub>4</sub>

Molecular Weight : 390.56 g/mol

CAS-No. : 117-84-0

EC-No. : 204-214-7



No ingredients are hazardous according to OSHA criteria.  
No components need to be disclosed according to the applicable regulations.  
For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### **General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance.

#### **If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### **In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

#### **In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### **If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

no data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

### 5.4 Further information

no data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.  
For personal protection see section 8.

### 6.2 Environmental precautions

Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.  
Normal measures for preventive fire protection.  
For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

# 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

## 8.1 Control parameters

### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 480 min

Material tested:Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 230 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Do not let product enter drains.

---

# 9. PHYSICAL AND CHEMICAL PROPERTIES

## 9.1 Information on basic physical and chemical properties

a) Appearance                      Form: liquid, clear, viscous

	Colour: colourless
b) Odour	no data available
c) Odour Threshold	no data available
d) pH	no data available
e) Melting point/freezing point	no data available
f) Initial boiling point and boiling range	no data available
g) Flash point	109.0 °C (228.2 °F) - closed cup
h) Evaporation rate	no data available
i) Flammability (solid, gas)	no data available
j) Upper/lower flammability or explosive limits	no data available
k) Vapour pressure	no data available
l) Vapour density	no data available
m) Relative density	0.98 g/mL at 20 °C (68 °F)
n) Water solubility	no data available
o) Partition coefficient: n-octanol/water	no data available
p) Auto-ignition temperature	no data available
q) Decomposition temperature	no data available
r) Viscosity	no data available
s) Explosive properties	no data available
t) Oxidizing properties	no data available

## 9.2 Other safety information

no data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

no data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

no data available

### 10.4 Conditions to avoid

no data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - no data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - rat - 47,000 mg/kg

Inhalation: no data available

LD50 Dermal - guinea pig - > 5,000 mg/kg

no data available

#### Skin corrosion/irritation

Skin - rabbit

Result: Mild skin irritation - 24 h

#### Serious eye damage/eye irritation

Eyes - rabbit

Result: Mild eye irritation - 24 h

#### Respiratory or skin sensitisation

no data available

#### Germ cell mutagenicity

no data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

no data available

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

#### Specific target organ toxicity - single exposure

no data available

#### Specific target organ toxicity - repeated exposure

no data available

#### Aspiration hazard

no data available

#### Additional Information

Repeated dose toxicity - Effects on Embryo or Fetus: Other effects to embryo.

RTECS: T11925000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated., embryonic development, fetal development

Liver -

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish

NOEC - Cyprinodon variegatus (sheepshead minnow) - 168 mg/l - 96 h

## 12.2 Persistence and degradability

## 12.3 Bioaccumulative potential

Bioaccumulation      Gambusia affinis (Mosquito fish) - 33 d  
- 0.00006 mg/l

Bioconcentration factor (BCF): 9,400

## 12.4 Mobility in soil

no data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

no data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3082      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, liquid, n.o.s. (Diethyl phthalate)  
Reportable Quantity (RQ): 5000 lbs  
Marine pollutant: No  
Poison Inhalation Hazard: No

### IMDG

Not dangerous goods

### IATA

Not dangerous goods

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

No SARA Hazards

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Diethyl phthalate	117-84-0	1994-04-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Diethyl phthalate	117-84-0	1994-04-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Diethyl phthalate	117-84-0	1994-04-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

H413 May cause long lasting harmful effects to aquatic life.

#### HMIS Rating

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

#### NFPA Rating

Health hazard:	1
Fire Hazard:	0
Reactivity Hazard:	0
Health hazard:	0
Fire Hazard:	1
Reactivity Hazard:	0

#### Further information

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#### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.5

Revision Date: 06/26/2014

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.7  
Revision Date 07/09/2015  
Print Date 06/20/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Ethanol

Product Number : 34923  
Brand : Sigma-Aldrich  
Index-No. : 603-002-00-5

CAS-No. : 64-17-5

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Eye irritation (Category 2A), H319

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H225

Highly flammable liquid and vapour.

H319

Causes serious eye irritation.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.

P241

Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242

Use only non-sparking tools.

P243

Take precautionary measures against static discharge.

P264

Wash skin thoroughly after handling.

P280

Wear protective gloves/ eye protection/ face protection.

P303 + P361 + P353

IF ON SKIN (or hair): Take off immediately all contaminated clothing.

P305 + P351 + P338	Rinse skin with water/shower. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P235	Store in a well-ventilated place. Keep cool.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms	: Ethyl alcohol
Formula	: C <sub>2</sub> H <sub>6</sub> O
Molecular weight	: 46.07 g/mol
CAS-No.	: 64-17-5
EC-No.	: 200-578-6
Index-No.	: 603-002-00-5
Registration number	: 01-2119457610-43-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>Ethanol</b>		
	Flam. Liq. 2; Eye Irrit. 2A; H225, H319	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides



### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

hygroscopic

Storage class (TRGS 510): Flammable liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Ethanol	64-17-5	TWA	1,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Confirmed animal carcinogen with unknown relevance to humans		
		TWA	1,000 ppm 1,900 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	1,000 ppm 1,900 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	1,000.000000 ppm 1,900.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

		TWA	1,000.000000 ppm 1,900.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		STEL	1,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Confirmed animal carcinogen with unknown relevance to humans		

#### Derived No Effect Level (DNEL)

Application Area	Exposure routes	Health effect	Value
Workers	Inhalation	Long-term systemic effects	950 mg/m3
Workers	Skin contact	Long-term systemic effects	343mg/kg BW/d
Workers	Ingestion	Long-term systemic effects	343mg/kg BW/d
Workers	Inhalation	Acute local effects	1900 mg/m3

#### Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	0.63 mg/kg
Marine water	0.79 mg/l
Fresh water	0.96 mg/l
Fresh water sediment	3.6 mg/l
Sewage treatment plant	580 mg/l

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 38 min

Material tested:Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: liquid, clear<br>Colour: colourless                         |
| b) Odour  | No data available   |
| c) Odour Threshold                              | No data available   |
| d) pH   | No data available   |
| e) Melting point/freezing point                 | Melting point/range: -114 °C (-173 °F)                            |
| f) Initial boiling point and boiling range      | 78 °C (172 °F)  |
| g) Flash point                                  | 14.0 °C (57.2 °F) - closed cup                                    |
| h) Evaporation rate                             | No data available   |
| i) Flammability (solid, gas)                    | No data available   |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 19 %(V)<br>Lower explosion limit: 3.3 %(V) |
| k) Vapour pressure                              | 59.5 hPa (44.6 mmHg) at 20.0 °C (68.0 °F)                         |
| l) Vapour density                               | No data available   |
| m) Relative density                             | 0.789 g/mL at 25 °C (77 °F)                                       |
| n) Water solubility                             | completely soluble  |
| o) Partition coefficient: n-octanol/water       | log Pow: -0.349 at 24 °C (75 °F)                                  |
| p) Auto-ignition temperature                    | 363.0 °C (685.4 °F)   |
| q) Decomposition temperature                    | No data available   |
| r) Viscosity                                    | No data available   |
| s) Explosive properties                         | No data available   |
| t) Oxidizing properties                         | No data available   |

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

## 10.2 Chemical stability

Stable under recommended storage conditions.

## 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

## 10.4 Conditions to avoid

Heat, flames and sparks.

## 10.5 Incompatible materials

Alkali metals, Oxidizing agents, Peroxides

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

# 11. TOXICOLOGICAL INFORMATION

## 11.1 Information on toxicological effects

### Acute toxicity

LD50 Oral - Rat - 10,470 mg/kg

LC50 Inhalation - Rat - 4 h - 30,000 mg/l

LD50 Dermal - Rabbit - 15,800 mg/kg

No data available

### Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation - 24 h

(OECD Test Guideline 404)

### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Moderate eye irritation

(OECD Test Guideline 405)

### Respiratory or skin sensitisation

No data available

### Germ cell mutagenicity

No data available

### Carcinogenicity

Carcinogenicity - Mouse - Oral

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Liver: Tumors. Blood: Lymphomas including Hodgkin's disease.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

### Reproductive toxicity

No data available

Reproductive toxicity - Human - female - Oral

Effects on Newborn: Apgar score (human only). Effects on Newborn: Other neonatal measures or effects. Effects on Newborn: Drug dependence.

### Specific target organ toxicity - single exposure

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: KQ6300000

Central nervous system depression, narcosis, Damage to the heart., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 14,200 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates LC50 - Ceriodaphnia dubia (water flea) - 5,012 mg/l - 48 h

NOEC - Daphnia magna (Water flea) - 9.6 mg/l - 9 d

Toxicity to algae EC50 - Chlorella vulgaris (Fresh water algae) - 275 mg/l - 72 h  
(OECD Test Guideline 201)

**12.2 Persistence and degradability**

Biodegradability Result: 95 % - Readily biodegradable

**12.3 Bioaccumulative potential**

Due to the distribution coefficient n-octanol/water, accumulation in organisms is not expected.

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1170 Class: 3

Packing group: II

Proper shipping name: Ethanol

Reportable Quantity (RQ):

Poison Inhalation Hazard: No

**IMDG**

UN number: 1170 Class: 3

Packing group: II

EMS-No: F-E, S-D

Proper shipping name: ETHANOL

**IATA**

UN number: 1170      Class: 3  
Proper shipping name: Ethanol

Packing group: II

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H319	Causes serious eye irritation.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	1
Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 07/09/2015

Print Date: 06/20/2016



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## Safety Data Sheet

**Material Name: ETHYL BENZENE**

**SDS ID: MAT08780**

### Section 1 - PRODUCT AND COMPANY IDENTIFICATION

**Material Name**

ETHYL BENZENE

**Synonyms**

MTG MSDS 185; EB; PHENYLETHANE; ETHYLBENZENE; ETHYLBENZOL; ALPHA-METHYLTOLUENE; UN 1175; C8H10

**Chemical Family**

Hydrocarbons, aromatic

**Product Use**

industrial.

**Restrictions on Use**

None known.

**Details of the supplier of the safety data sheet**

MATHESON TRI-GAS, INC.

150 Allen Road, Suite 302

Basking Ridge, NJ 07920

General Information: 1-800-416-2505

Emergency #: 1-800-424-9300 (CHEMTREC)

Outside the US: 703-527-3887 (Call collect)

### Section 2 - HAZARDS IDENTIFICATION

**Classification in accordance with paragraph (d) of 29 CFR 1910.1200.**

Flammable Liquids - Category 2

Aspiration Hazard - Category 1

Acute Toxicity - Inhalation - Dust/Mist - Category 4

Acute Toxicity - Inhalation - Vapor - Category 4

Skin Corrosion/Irritation - Category 2

Serious Eye Damage/Eye Irritation - Category 2A

Carcinogenicity - Category 2

Reproductive Toxicity - Category 1B

Specific target organ toxicity - Single exposure - Category 2

Specific target organ toxicity - Single exposure - Category 3

Specific Target Organ Toxicity - Repeated Exposure - Category 2 ( ears , Ears )

Hazardous to the Aquatic Environment - Acute - Category 2

Hazardous to the Aquatic Environment - Chronic - Category 2

**GHS Label Elements**

**Symbol(s)**



**Signal Word**

Danger

**Hazard Statement(s)**





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## Safety Data Sheet

**Material Name: ETHYL BENZENE**

**SDS ID: MAT08780**

Highly flammable liquid and vapor.  
Harmful if inhaled.  
Causes skin irritation.  
Causes serious eye irritation.  
Suspected of causing cancer.  
May damage fertility or the unborn child.  
May cause damage to organs. (central nervous system )  
May cause respiratory irritation.  
May be fatal if swallowed and enters airways.  
Toxic to aquatic life.

### **Precautionary Statement(s)**

#### **Prevention**

Keep away from heat, sparks, open flame, and hot surfaces - No smoking.  
Keep container tightly closed.  
Ground/Bond container and receiving equipment.  
Use explosion-proof electrical/ventilating/lighting equipment.  
Use only non-sparking tools.  
Take precautionary measures against static discharge.  
Obtain special instructions before use.  
Do not handle until all safety precautions have been read and understood.  
Use Personal Protective equipment as required.  
Do not breathe vapor or mist.  
Use only outdoors or in a well-ventilated area.  
Wear protective gloves and eye/face protection.  
Wash thoroughly after handling.  
Do not eat, drink or smoke when using this product.  
Avoid release to the environment.

#### **Response**

In case of fire, use media appropriate for extinction.  
IF exposed or concerned: Get medical advice/attention.  
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.  
Call a POISON CENTER or doctor/physician if you feel unwell.  
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.  
If skin irritation occurs: Get medical advice/attention.  
Wash contaminated clothing before reuse.  
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.  
Continue rinsing.  
If eye irritation persists: Get medical advice/attention.  
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.  
Do NOT induce vomiting.

#### **Storage**

Store in a well-ventilated place.  
Keep cool.  
Keep container tightly closed.  
Store locked up.

#### **Disposal**

Dispose in accordance with all applicable regulations.

#### **Statement(s) of Unknown Acute Toxicity**

Inhalation 0% of the mixture consists of ingredient(s) of unknown acute toxicity.



## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780****Statement(s) of Unknown Aquatic Toxicity**

0% of the mixture consists of ingredient(s) of unknown acute aquatic toxicity.

0% of the mixture consists of ingredient(s) of unknown chronic aquatic toxicity.

**Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS**

CAS	Component Name	Percent
100-41-4	ETHYL BENZENE	100

**Section 4 - FIRST AID MEASURES****Inhalation**

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**Skin**

Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

**Eyes**

Flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Then get immediate medical attention.

**Ingestion**

aspiration hazard. Do NOT induce vomiting. When vomiting occurs, keep head lower than hips to help prevent aspiration. Get medical attention immediately. Give artificial respiration if not breathing.

**Most Important Symptoms/Effects****Acute**

respiratory tract irritation, skin irritation, eye irritation, central nervous system damage, lung damage (from aspiration)

**Delayed**

cancer, Reproductive Effects

**Note to Physicians**

For inhalation, consider oxygen.

**Section 5 - FIRE FIGHTING MEASURES****Extinguishing Media****Suitable Extinguishing Media**

regular dry chemical, carbon dioxide, water spray, regular foam, Large fires: Use water spray, fog or regular foam.

**Unsuitable Extinguishing Media**

Do not use high-pressure water streams.

**Special Hazards Arising from the Chemical**

Severe fire hazard. Vapor/air mixtures are explosive above flash point. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

**Hazardous Combustion Products**

Oxides of carbon

**Fire Fighting Measures**

Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank,



## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780**

rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Water may be ineffective.

**Special Protective Equipment and Precautions for Firefighters**

Wear full protective fire fighting gear including self contained breathing apparatus (SCBA) for protection against possible exposure.

### Section 6 - ACCIDENTAL RELEASE MEASURES

**Personal Precautions, Protective Equipment and Emergency Procedures**

Wear personal protective clothing and equipment, see Section 8.

**Methods and Materials for Containment and Cleaning Up**

Avoid heat, flames, sparks and other sources of ignition. Eliminate all ignition sources if safe to do so. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if possible without personal risk. Prevent entry into waterways, sewers, basements, or confined areas. Reduce vapors with water spray. Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Dike for later disposal. Remove sources of ignition. Use water spray to reduce vapors or divert vapor cloud drift. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

**Environmental Precautions**

Avoid release to the environment.

### Section 7 - HANDLING AND STORAGE

**Precautions for Safe Handling**

Keep away from heat, sparks, open flame, and hot surfaces - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharges. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use Personal Protective equipment as required. Do not breathe vapor or mist. Use only outdoors or in a well-ventilated area. Wear protective gloves/eye protection/face protection. Wash hands thoroughly after handling. Do not eat, drink, or smoke when using this product. Avoid release to the environment.

**Conditions for Safe Storage, Including any Incompatibilities**

Store in a well-ventilated place.

Keep cool.

Keep container tightly closed.

Store locked up.

Store and handle in accordance with all current regulations and standards. Store in a well-ventilated area. Keep cool. Keep container tightly closed. Keep locked up. Grounding and bonding required. Keep separated from incompatible substances. Protect from physical damage. Store outside or in a detached building. Store with flammable liquids. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106.

**Incompatible Materials**

Acids, bases, oxidizing materials, combustible materials

### Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

**Component Exposure Limits****ETHYL BENZENE****100-41-4**



## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780**

ACGIH:	20 ppm TWA
NIOSH:	100 ppm TWA ; 435 mg/m3 TWA
	125 ppm STEL ; 545 mg/m3 STEL
	800 ppm IDLH (10% LEL )
Europe:	100 ppm TWA ; 442 mg/m3 TWA
	Possibility of significant uptake through the skin
	200 ppm STEL ; 884 mg/m3 STEL
OSHA (US):	100 ppm TWA ; 435 mg/m3 TWA
Mexico:	100 ppm TWA VLE-PPT ; 435 mg/m3 TWA VLE-PPT
	125 ppm STEL [PPT-CT ] ; 545 mg/m3 STEL [PPT-CT ]

**ACGIH - Threshold Limit Values - Biological Exposure Indices (BEI)****ETHYL BENZENE (100-41-4)**

0.15 g/g creatinine Medium: urine Time: end of shift Parameter: Sum of mandelic acid and phenylglyoxylic acid (nonspecific )

**Engineering Controls**

Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

**Individual Protection Measures, such as Personal Protective Equipment****Eye/face protection**

Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**Skin Protection**

Wear appropriate chemical resistant clothing.

**Respiratory Protection**

The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA. 800 ppm. Any air-purifying half-mask respirator equipped with organic vapor cartridge(s). Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister. Any powered, air-purifying respirator with organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus with a full facepiece. Emergency or planned entry into unknown concentrations or IDLH conditions -. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. Escape -. Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister. Any appropriate escape-type, self-contained breathing apparatus. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

**Glove Recommendations**

Wear appropriate chemical resistant gloves.



## Safety Data Sheet

Material Name: ETHYL BENZENE

SDS ID: MAT08780

**Section 9 - PHYSICAL AND CHEMICAL PROPERTIES**

<b>Appearance</b>	Clear, colorless liquid	<b>Physical State</b>	liquid
<b>Odor</b>	aromatic odor	<b>Color</b>	colorless
<b>Odor Threshold</b>	140 ppm	<b>pH</b>	Not available
<b>Melting Point</b>	-95 °C (-139 °F )	<b>Boiling Point</b>	136 °C (277 °F )
<b>Boiling Point Range</b>	Not available	<b>Freezing point</b>	Not available
<b>Evaporation Rate</b>	<1 (Butyl acetate = 1 )	<b>Flammability (solid, gas)</b>	Not available
<b>Autoignition Temperature</b>	432 °C (810 °F )	<b>Flash Point</b>	15 °C Closed Cup (59 °F )
<b>Lower Explosive Limit</b>	0.8 %	<b>Decomposition temperature</b>	Not available
<b>Upper Explosive Limit</b>	6.7 %	<b>Vapor Pressure</b>	7.1 mmHg @ 20 °C
<b>Vapor Density (air=1)</b>	3.66	<b>Specific Gravity (water=1)</b>	0.867
<b>Water Solubility</b>	0.015 %	<b>Partition coefficient: n-octanol/water</b>	154170.05
<b>Viscosity</b>	0.64 cp	<b>Kinematic viscosity</b>	Not available
<b>Solubility (Other)</b>	Not available	<b>Bioconcentration Factor (BCF)</b>	36.39
<b>Density</b>	Not available	<b>Henry's Law Constant</b>	0.00788 atm-m <sup>3</sup> /mole
<b>KOC</b>	520 (Estimated )	<b>Physical Form</b>	liquid
<b>Volatility</b>	100 %	<b>Molecular Formula</b>	C-H <sub>3</sub> -C-H <sub>2</sub> -C <sub>6</sub> -H <sub>5</sub>
<b>Molecular Weight</b>	106.17	<b>OSHA Flammability Class</b>	IB

**Solvent Solubility****Soluble**

alcohol, ether, Benzene, sulfur dioxide, carbon tetrachloride

**Insoluble**

ammonia

**Section 10 - STABILITY AND REACTIVITY****Reactivity**

No reactivity hazard is expected.

**Chemical Stability**

Stable at normal temperatures and pressure.



## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780****Possibility of Hazardous Reactions**

Will not polymerize.

**Conditions to Avoid**

Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

**Incompatible Materials**

Acids, bases, oxidizing materials, combustible materials

**Hazardous decomposition products**

Oxides of carbon

**Section 11 - TOXICOLOGICAL INFORMATION****Information on Likely Routes of Exposure****Inhalation**

irritation (possibly severe), chest pain, difficulty breathing, emotional disturbances, headache, drowsiness, dizziness, loss of coordination, coma, cancer

**Skin Contact**

irritation

**Eye Contact**

irritation

**Ingestion**

nausea, vomiting, stomach pain, aspiration hazard

**Acute and Chronic Toxicity****Component Analysis - LD50/LC50**

The components of this material have been reviewed in various sources and the following selected endpoints are published:

**ETHYL BENZENE (100-41-4)**

Oral LD50 Rat 3500 mg/kg

Dermal LD50 Rabbit 15400 mg/kg

Inhalation LC50 Rat 17.4 mg/L 4 h

**Product Toxicity Data****Acute Toxicity Estimate**

Dermal	> 2000 mg/kg
Inhalation - Vapor	17.4 mg/L
Oral	> 2000 mg/kg

**Immediate Effects**

respiratory tract irritation, skin irritation, eye irritation, central nervous system damage, lung damage (from aspiration)

**Delayed Effects**

Reproductive Effects, cancer

**Irritation/Corrosivity Data**

respiratory tract irritation, skin irritation, eye irritation

**Respiratory Sensitization**

No data available.

**Dermal Sensitization**

No data available.

**Component Carcinogenicity**

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## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780**

<b>ETHYL BENZENE</b>	<b>100-41-4</b>
ACGIH:	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
IARC:	Monograph 77 [2000] (Group 2B (possibly carcinogenic to humans))
DFG:	Category 4 (no significant contribution to human cancer )
OSHA:	Present

**Germ Cell Mutagenicity**

No data available.

**Tumorigenic Data**

No data available

**Reproductive Toxicity**

Available data characterizes components of this product as reproductive hazards.

**Specific Target Organ Toxicity - Single Exposure**

central nervous system, Respiratory system

**Specific Target Organ Toxicity - Repeated Exposure**

No target organs identified.

**Aspiration hazard**

This material is an aspiration hazard.

**Medical Conditions Aggravated by Exposure**

kidney disorders, liver disorders, respiratory disorders, skin disorders and allergies

**Additional Data**

May cross the placenta.

**Section 12 - ECOLOGICAL INFORMATION****Ecotoxicity**

Toxic to aquatic life.

**Component Analysis - Aquatic Toxicity**

<b>ETHYL BENZENE</b>	<b>100-41-4</b>
Fish:	LC50 96 h Oncorhynchus mykiss 11 - 18 mg/L [static ]; LC50 96 h Oncorhynchus mykiss 4.2 mg/L [semi-static ]; LC50 96 h Pimephales promelas 7.55 - 11 mg/L [flow-through ]; LC50 96 h Lepomis macrochirus 32 mg/L [static ]; LC50 96 h Pimephales promelas 9.1 - 15.6 mg/L [static ]; LC50 96 h Poecilia reticulata 9.6 mg/L [static ]
Algae:	EC50 72 h Pseudokirchneriella subcapitata 4.6 mg/L IUCLID ; EC50 96 h Pseudokirchneriella subcapitata >438 mg/L IUCLID ; EC50 72 h Pseudokirchneriella subcapitata 2.6 - 11.3 mg/L [static ] EPA ; EC50 96 h Pseudokirchneriella subcapitata 1.7 - 7.6 mg/L [static ] EPA
Invertebrate:	EC50 48 h Daphnia magna 1.8 - 2.4 mg/L IUCLID

**Persistence and Degradability**

Not expected to undergo hydrolysis in the environment.

**Bioaccumulative Potential**

Bioconcentration potential in aquatic organisms is low based on a BCF value of 15.

**Mobility**

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## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780**

Expected to have moderate mobility in soil.

### Section 13 - DISPOSAL CONSIDERATIONS

**Disposal Methods**

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262.

Hazardous Waste Number(s): D001.

**Component Waste Numbers**

The U.S. EPA has not published waste numbers for this product's components.

### Section 14 - TRANSPORT INFORMATION

**US DOT Information:****Shipping Name:** ETHYLBENZENE**Hazard Class:** 3**UN/NA #:** UN1175**Packing Group:** II**Required Label(s):** 3

Marine pollutant

**IMDG Information:****Shipping Name:** ETHYLBENZENE**Hazard Class:** 3**UN#:** UN1175**Packing Group:** II**Required Label(s):** 3

Marine pollutant

**International Bulk Chemical Code**

This material contains one or more of the following chemicals required by the IBC Code to be identified as dangerous chemicals in bulk.

<b>ETHYL BENZENE</b>	<b>100-41-4</b>
IBC Code:	Category Y

### Section 15 - REGULATORY INFORMATION

**U.S. Federal Regulations**

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), and/or require an OSHA process safety plan.

<b>ETHYL BENZENE</b>	<b>100-41-4</b>
SARA 313:	0.1 % de minimis concentration
CERCLA:	1000 lb final RQ ; 454 kg final RQ

**SARA Section 311/312 (40 CFR 370 Subparts B and C) reporting categories**

Flammable; Carcinogenicity; Acute toxicity; Reproductive Toxicity; Skin Corrosion/Irritation; Serious Eye Damage/Eye Irritation; Specific Target Organ Toxicity; Aspiration Hazard

**U.S. State Regulations**

The following components appear on one or more of the following state hazardous substances lists:





## Safety Data Sheet

Material Name: ETHYL BENZENE

SDS ID: MAT08780

Component	CAS	CA	MA	MN	NJ	PA
ETHYL BENZENE	100-41-4	Yes	Yes	Yes	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer

ETHYL BENZENE	100-41-4
Carc:	carcinogen , 6/11/2004

### Canada Regulations

#### Canadian WHMIS Ingredient Disclosure List (IDL)

Components of this material have been checked against the Canadian WHMIS Ingredients Disclosure List. The List is composed of chemicals which must be identified on MSDSs if they are included in products which meet WHMIS criteria specified in the Controlled Products Regulations and are present above the threshold limits listed on the IDL

ETHYL BENZENE	100-41-4
	0.1 %

### WHMIS Classification

B2

### Component Analysis - Inventory

#### ETHYL BENZENE (100-41-4)

US	CA	EU	AU	PH	JP - ENCS	JP - ISHL	KR KECI - Annex 1	KR KECI - Annex 2	KR - REACH CCA	CN	NZ	MX	TW	VN - NCI (Draft)
Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes

## Section 16 - OTHER INFORMATION

### NFPA Ratings

Health: 2 Fire: 3 Reactivity: 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

### Summary of Changes

Updated: 05/01/2015

### Key / Legend

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CA/MA/MN/NJ/PA - California/Massachusetts/Minnesota/New Jersey/Pennsylvania\*; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CFR - Code of Federal Regulations (US); CLP - Classification, Labelling, and Packaging; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSD - Dangerous Substance Directive; DSL - Domestic Substances List; EC - European Commission; EEC - European Economic Community; EIN - European Inventory of (Existing Commercial Chemical Substances); EINECS - European Inventory of Existing Commercial Chemical Substances; ENCS - Japan Existing and New Chemical Substance Inventory; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; IARC - International Agency for Research

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## Safety Data Sheet

**Material Name: ETHYL BENZENE****SDS ID: MAT08780**

on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime Dangerous Goods; ISHL - Japan Industrial Safety and Health Law; IUCLID - International Uniform Chemical Information Database; JP - Japan; Kow - Octanol/water partition coefficient; KR KECI Annex 1 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR KECI Annex 2 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL) , KR - Korea; LD50/LC50 - Lethal Dose/ Lethal Concentration; LEL - Lower Explosive Limit; LLV - Level Limit Value; LOLI - List Of Lists™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; MX – Mexico; NDSL – Non-Domestic Substance List (Canada); NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PEL- Permissible Exposure Limit; PH - Philippines; RCRA - Resource Conservation and Recovery Act; REACH- Registration, Evaluation, Authorisation, and restriction of Chemicals; RID - European Rail Transport; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TCCA – Korea Toxic Chemicals Control Act; TDG - Transportation of Dangerous Goods; TLV - Threshold Limit Value; TSCA - Toxic Substances Control Act; TW – Taiwan; TWA - Time Weighted Average; UEL - Upper Explosive Limit; UN/NA - United Nations /North American; US - United States; VLE - Exposure Limit Value (Mexico); VN NCI (Draft) - Vietnam National Chemicals Inventory (NCI) (Draft); WHMIS - Workplace Hazardous Materials Information System (Canada) .

**Other Information****Disclaimer:**

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# SAFETY DATA SHEET

Creation Date 06-Aug-2010

Revision Date 30-Oct-2014

Revision Number 2

## 1. Identification

**Product Name** Ethylbenzene

**Cat No. :** AC433800000; AC433800010; AC433801000

**Synonyms** Ethylbenzol; Phenylethane

**Recommended Use** Laboratory chemicals.

**Uses advised against** No Information available

**Details of the supplier of the safety data sheet**

**Company**  
Fisher Scientific  
One Reagent Lane  
Fair Lawn, NJ 07410  
Tel: (201) 796-7100

**Entity / Business Name**  
Acros Organics  
One Reagent Lane  
Fair Lawn, NJ 07410

**Emergency Telephone Number**  
For information **US** call: 001-800-ACROS-01  
/ **Europe** call: +32 14 57 52 11  
Emergency Number **US**:001-201-796-7100 /  
**Europe**: +32 14 57 52 99  
**CHEMTREC** Tel. No.**US**:001-800-424-9300 /  
**Europe**:001-703-527-3887

## 2. Hazard(s) identification

### **Classification**

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Acute Inhalation Toxicity - Vapors	Category 4
Carcinogenicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Aspiration Toxicity	Category 1

### **Label Elements**

**Signal Word**  
Danger

### **Hazard Statements**

Highly flammable liquid and vapor  
May be fatal if swallowed and enters airways  
Harmful if inhaled  
May cause respiratory irritation  
May cause drowsiness or dizziness  
Suspected of causing cancer  
May cause damage to organs through prolonged or repeated exposure

**Precautionary Statements****Prevention**

Obtain special instructions before use  
Do not handle until all safety precautions have been read and understood  
Use personal protective equipment as required  
Use only outdoors or in a well-ventilated area  
Do not breathe dust/fume/gas/mist/vapors/spray  
Keep away from heat/sparks/open flames/hot surfaces. - No smoking  
Keep container tightly closed  
Ground/bond container and receiving equipment  
Use explosion-proof electrical/ventilating/lighting/equipment  
Use only non-sparking tools  
Take precautionary measures against static discharge  
Keep cool

**Response**

IF exposed or concerned: Get medical attention/advice

**Inhalation**

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

**Skin**

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

**Ingestion**

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician  
Do NOT induce vomiting

**Fire**

In case of fire: Use CO<sub>2</sub>, dry chemical, or foam for extinction

**Storage**

Store locked up  
Store in a well-ventilated place. Keep container tightly closed

**Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)**

Harmful to aquatic life with long lasting effects

### 3. Composition / information on ingredients

Component	CAS-No	Weight %
Ethylbenzene	100-41-4	>95

### 4. First-aid measures

**General Advice**

If symptoms persist, call a physician.

**Eye Contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.  
Obtain medical attention.

**Skin Contact**

Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

**Inhalation**

Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention. Aspiration into lungs can produce severe lung damage.

<b>Ingestion</b>	Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.
<b>Most important symptoms/effects</b>	Breathing difficulties. . Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: May cause central nervous system depression
<b>Notes to Physician</b>	Treat symptomatically

## 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
<b>Unsuitable Extinguishing Media</b>	Do not use a solid water stream as it may scatter and spread fire
<b>Flash Point</b>	15 °C / 59 °F
<b>Method -</b>	No information available
<b>Autoignition Temperature</b>	432 °C / 810 °F
<b>Explosion Limits</b>	
<b>Upper</b>	6.8%
<b>Lower</b>	1.2%
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	Yes

### Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

### Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO<sub>2</sub>)

### Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

### NFPA

**Health**  
3

**Flammability**  
3

**Instability**  
0

**Physical hazards**  
N/A

## 6. Accidental release measures

<b>Personal Precautions</b>	Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.
<b>Environmental Precautions</b>	Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
<b>Methods for Containment and Clean Up</b>	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

## 7. Handling and storage

<b>Handling</b>	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.
<b>Storage</b>	Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

## 8. Exposure controls / personal protection

### Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Ethylbenzene	TWA: 20 ppm	(Vacated) TWA: 100 ppm (Vacated) TWA: 435 mg/m <sup>3</sup> (Vacated) STEL: 125 ppm (Vacated) STEL: 545 mg/m <sup>3</sup> TWA: 100 ppm TWA: 435 mg/m <sup>3</sup>	IDLH: 800 ppm TWA: 100 ppm TWA: 435 mg/m <sup>3</sup> STEL: 125 ppm STEL: 545 mg/m <sup>3</sup>
Component	Quebec	Mexico OEL (TWA)	Ontario TWA EV
Ethylbenzene	TWA: 100 ppm TWA: 434 mg/m <sup>3</sup> STEL: 125 ppm STEL: 543 mg/m <sup>3</sup>	TWA: 100 ppm TWA: 435 mg/m <sup>3</sup> STEL: 125 ppm STEL: 545 mg/m <sup>3</sup>	TWA: 20 ppm

### Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

### Engineering Measures

Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

### Personal Protective Equipment

#### Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

#### Skin and body protection

Long sleeved clothing.

#### Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

#### Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

## 9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	136 °C / 276.8 °F
Flash Point	15 °C / 59 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	6.8%
Lower	1.2%
Vapor Pressure	No information available
Vapor Density	No information available
Relative Density	0.860
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	432 °C / 810 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C8 H10
Molecular Weight	106.17

## 10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO <sub>2</sub> )
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

## 11. Toxicological information

### Acute Toxicity

#### Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylbenzene	3500 mg/kg ( Rat )	15400 mg/kg ( Rabbit )	17.2 mg/L ( Rat ) 4 h

Toxicologically Synergistic No information available

#### Products

#### Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	May cause eye, skin, and respiratory tract irritation
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Ethylbenzene	100-41-4	Group 2B	Not listed	A3	X	Not listed

IARC: (International Agency for Research on Cancer)

Group 2B - Possibly Carcinogenic to Humans

IARC: (International Agency for Research on Cancer)

Group 1 - Carcinogenic to Humans

Group 2A - Probably Carcinogenic to Humans

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Respiratory system Central nervous system (CNS)
STOT - repeated exposure	None known

**Aspiration hazard** No information available

**Symptoms / effects, both acute and delayed** Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: May cause central nervous system depression

**Endocrine Disruptor Information** No information available

**Other Adverse Effects** See actual entry in RTECS for complete information.

## 12. Ecological information

### Ecotoxicity

Do not empty into drains. The product contains following substances which are hazardous for the environment. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Ethylbenzene	2.6 - 11.3 mg/L EC50 72 h 438 mg/L EC50 > 96 h 4.6 mg/L EC50 = 72 h 1.7 - 7.6 mg/L EC50 96 h	9.6 mg/L LC50 96 h 9.1 - 15.6 mg/L LC50 96 h 32 mg/L LC50 96 h 7.55 - 11 mg/L LC50 96 h 4.2 mg/L LC50 96 h 11.0 - 18.0 mg/L LC50 96 h	EC50 = 9.68 mg/L 30 min EC50 = 96 mg/L 24 h	1.8 - 2.4 mg/L EC50 48 h

**Persistence and Degradability** Insoluble in water Persistence is unlikely based on information available.

**Bioaccumulation/ Accumulation** No information available.

**Mobility** . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Ethylbenzene	3.118

## 13. Disposal considerations

**Waste Disposal Methods** Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

## 14. Transport information

### DOT

UN-No UN1175  
 Proper Shipping Name ETHYLBENZENE  
 Hazard Class 3  
 Packing Group II

### TDG

UN-No UN1175  
 Proper Shipping Name ETHYLBENZENE  
 Hazard Class 3  
 Packing Group II

### IATA

UN-No UN1175  
 Proper Shipping Name ETHYLBENZENE  
 Hazard Class 3  
 Packing Group II

### IMDG/IMO

UN-No UN1175  
 Proper Shipping Name ETHYLBENZENE  
 Hazard Class 3  
 Packing Group II

## 15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed The product is classified and labeled



according to EC directives or corresponding national laws The product is classified and labeled in accordance with Directive 1999/45/EC

#### International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Ethylbenzene	X	X	-	202-849-4	-		X	X	X	X	X

#### Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

#### U.S. Federal Regulations

TSCA 12(b) Not applicable

#### SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Ethylbenzene	100-41-4	>95	0.1

#### SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

#### Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Ethylbenzene	X	1000 lb	X	X

#### Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Ethylbenzene	X		-

#### OSHA Occupational Safety and Health Administration

Not applicable

#### CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Ethylbenzene	1000 lb	-

**California Proposition 65** This product contains the following Proposition 65 chemicals:

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Ethylbenzene	100-41-4	Carcinogen	54 µg/day 41 µg/day	Carcinogen

**State Right-to-Know**

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Ethylbenzene	X	X	X	X	X

**U.S. Department of Transportation**

Reportable Quantity (RQ): N  
DOT Marine Pollutant N  
DOT Severe Marine Pollutant N

**U.S. Department of Homeland Security**

This product does not contain any DHS chemicals.

**Other International Regulations**

**Mexico - Grade** Serious risk, Grade 3

**Canada**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

**WHMIS Hazard Class** B2 Flammable liquid  
D2A Very toxic materials

**16. Other information**

**Prepared By** Regulatory Affairs  
Thermo Fisher Scientific  
Email: EMSDS.RA@thermofisher.com

**Creation Date** 06-Aug-2010  
**Revision Date** 30-Oct-2014  
**Print Date** 30-Oct-2014  
**Revision Summary** This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

**Disclaimer**

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

**End of SDS**

## SAFETY DATA SHEET

Version 5.6  
Revision Date 02/28/2015  
Print Date 05/25/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Fluoranthene

Product Number : F807  
Brand : Aldrich

CAS-No. : 206-44-0

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Warning

Hazard statement(s)

H302

Harmful if swallowed.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P264

Wash skin thoroughly after handling.

P270

Do not eat, drink or smoke when using this product.

P273

Avoid release to the environment.

P301 + P312

IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.

P330

Rinse mouth.

P391

Collect spillage.

P501

Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Synonyms : Benzo[j,k]fluorene

Formula : C<sub>16</sub>H<sub>10</sub>

Molecular weight : 202.25 g/mol

CAS-No. : 206-44-0

EC-No. : 205-912-4

#### Hazardous components

Component	Classification	Concentration
<b>Fluoranthene</b>		
	Acute Tox. 4; Aquatic Acute 1; Aquatic Chronic 1; H302, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Avoid breathing dust.

For personal protection see section 8.

## **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## **6.3 Methods and materials for containment and cleaning up**

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

## **6.4 Reference to other sections**

For disposal see section 13.

---

# **7. HANDLING AND STORAGE**

## **7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

## **7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

## **7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

# **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

## **8.1 Control parameters**

### **Components with workplace control parameters**

Contains no substances with occupational exposure limit values.

## **8.2 Exposure controls**

### **Appropriate engineering controls**

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### **Personal protective equipment**

#### **Eye/face protection**

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### **Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### **Full contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

##### **Splash contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: solid   |
| b) Odour  | No data available                                       |
| c) Odour Threshold                              | No data available                                       |
| d) pH   | No data available                                       |
| e) Melting point/freezing point                 | Melting point/range: 105 - 110 °C (221 - 230 °F) - lit. |
| f) Initial boiling point and boiling range      | 384 °C (723 °F) - lit.                                  |
| g) Flash point                                  | 198.0 °C (388.4 °F) - closed cup                        |
| h) Evaporation rate                             | No data available                                       |
| i) Flammability (solid, gas)                    | No data available                                       |
| j) Upper/lower flammability or explosive limits | No data available                                       |
| k) Vapour pressure                              | No data available                                       |
| l) Vapour density                               | No data available                                       |
| m) Relative density                             | No data available                                       |
| n) Water solubility                             | No data available                                       |
| o) Partition coefficient: n-octanol/water       | No data available                                       |
| p) Auto-ignition temperature                    | No data available                                       |
| q) Decomposition temperature                    | No data available                                       |
| r) Viscosity                                    | No data available                                       |
| s) Explosive properties                         | No data available                                       |
| t) Oxidizing properties                         | No data available                                       |

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 2,000 mg/kg

Inhalation: No data available

LD50 Dermal - Rabbit - 3,180 mg/kg

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Laboratory experiments have shown mutagenic effects.

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Fluoranthene)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

## Additional Information

RTECS: LL4025000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 0.0077 mg/l - 96 h NOEC - Cyprinodon variegatus (sheepshead minnow) - 560 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	Immobilization EC50 - Daphnia magna (Water flea) - > 0.005 - < 0.01 mg/l - 3 d Immobilization EC50 - Daphnia magna (Water flea) - 0.78 mg/l - 20 h NOEC - Daphnia magna (Water flea) - 0.085 mg/l - 48 h

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Fluoranthene)  
Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Fluoranthene)  
Marine pollutant: yes

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Fluoranthene)



**Further information**

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Fluoranthene	206-44-0	1993-04-24

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Fluoranthene	206-44-0	1993-04-24

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Fluoranthene	206-44-0	1993-04-24

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H302	Harmful if swallowed.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	1
Physical Hazard	0

**NFPA Rating**

Health hazard:	1
Fire Hazard:	1
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.6

Revision Date: 02/28/2015

Print Date: 05/25/2016



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## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE**

**SDS ID: MAT09990**

### Section 1 - PRODUCT AND COMPANY IDENTIFICATION

**Material Name**

FLUOROTRICHLOROMETHANE

**Synonyms**

MTG MSDS 36; FREON 11; F 11; FC 11; R 11; CFC 11; TRICHLOROMONOFUOROMETHANE; FREON MF; REFRIGERANT 11; MONOFLUOROTRICHLOROMETHANE; HALON 11; TRICHLOROFLUOROCARBON; FLUOROCARBON-11; FLUOROCHLOROFORM; CCl3F

**Chemical Family**

halogenated hydrocarbons

**Product Use**

Industrial and Specialty Gas Applications.

**Restrictions on Use**

None known.

**Details of the supplier of the safety data sheet**

MATHESON TRI-GAS, INC.

150 Allen Road, Suite 302

Basking Ridge, NJ 07920

General Information: 1-800-416-2505

Emergency #: 1-800-424-9300 (CHEMTREC)

Outside the US: 703-527-3887 (Call collect)

### Section 2 - HAZARDS IDENTIFICATION

**Classification in accordance with paragraph (d) of 29 CFR 1910.1200.**

Gases Under Pressure - Compressed gas

Reproductive Toxicity - Category 2

Specific target organ toxicity - Single exposure - Category 1

Specific target organ toxicity - Single exposure - Category 3

**GHS Label Elements**

**Symbol(s)**



**Signal Word**

Danger

**Hazard Statement(s)**

Contains gas under pressure; may explode if heated.

Suspected of damaging fertility or the unborn child.

Causes damage to organs. (heart )

May cause respiratory irritation.

May cause drowsiness and dizziness.

**Precautionary Statement(s)**

**Prevention**

Obtain special instructions before use.

Do not handle until all safety precautions have been read and understood.



## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990**

Use Personal Protective equipment as required.

Do not breathe gas.

Wash thoroughly after handling.

Do not eat, drink or smoke when using this product.

Use only outdoors or in a well-ventilated area.

**Response**

IF exposed or concerned: Get medical advice/attention.

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

Call a POISON CENTER or doctor/physician if you feel unwell.

**Storage**

Protect from sunlight. Store in a well-ventilated place.

Keep container tightly closed.

Store locked up.

**Disposal**

Dispose in accordance with all applicable regulations.

**Other Hazards**

Rapid release of compressed gas may cause frostbite.

**Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS**

CAS	Component Name	Percent
75-69-4	FLUOROTRICHLOROMETHANE	100

**Section 4 - FIRST AID MEASURES****Inhalation**

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**Skin**

If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115°F; 41-46°C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get medical attention.

**Eyes**

Flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Then get immediate medical attention.

**Ingestion**

If swallowed, get medical attention.

**Most Important Symptoms/Effects****Acute**

frostbite, respiratory tract irritation, central nervous system depression, heart damage

**Delayed**

Reproductive Effects

**Note to Physicians**

For inhalation, consider oxygen.

**Section 5 - FIRE FIGHTING MEASURES****Extinguishing Media****Suitable Extinguishing Media**

carbon dioxide, regular dry chemical, Large fires: Use water spray, fog or regular foam.

**Unsuitable Extinguishing Media**

Do not direct water at source of leak or safety devices; icing may occur.



## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990****Special Hazards Arising from the Chemical**

Negligible fire hazard. Containers may rupture or explode if exposed to heat.

**Hazardous Combustion Products**

acid halides, Phosgene, halogenated compounds, fluorocarbons, hydrogen chloride, Hydrogen fluoride, Chlorine, CARBONYL FLUORIDE

**Fire Fighting Measures**

Move container from fire area if it can be done without risk. Damaged cylinders should be handled only by specialists. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile). Use extinguishing agents appropriate for surrounding fire. Apply water from a protected location or from a safe distance. Do not get water directly on material. Reduce vapors with water spray. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Consider downwind evacuation if material is leaking.

**Special Protective Equipment and Precautions for Firefighters**

Wear full protective fire fighting gear including self contained breathing apparatus (SCBA) for protection against possible exposure.

### Section 6 - ACCIDENTAL RELEASE MEASURES

**Personal Precautions, Protective Equipment and Emergency Procedures**

Wear personal protective clothing and equipment, see Section 8.

**Methods and Materials for Containment and Cleaning Up**

Stop leak if possible without personal risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

**Environmental Precautions**

Avoid release to the environment.

### Section 7 - HANDLING AND STORAGE

**Precautions for Safe Handling**

Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use Personal Protective equipment as required. Do not breathe gas. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area.

**Conditions for Safe Storage, Including any Incompatibilities**

Protect from sunlight. Store in a well-ventilated place.

Keep container tightly closed.

Store locked up.

Store and handle in accordance with all current regulations and standards. Protect from sunlight. Store in a well-ventilated area. Keep container tightly closed. Keep locked up. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances.

**Incompatible Materials**

metals, combustible materials, Acids

### Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

**Component Exposure Limits**

FLUOROTRICHLOROMETHANE	75-69-4
ACGIH:	1000 ppm Ceiling



## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990**

NIOSH:	1000 ppm Ceiling ; 5600 mg/m3 Ceiling
	2000 ppm IDLH
OSHA (US):	1000 ppm TWA ; 5600 mg/m3 TWA
Mexico:	1000 ppm Ceiling ; 5600 mg/m3 Ceiling

**ACGIH - Threshold Limit Values - Biological Exposure Indices (BEI)**

There are no biological limit values for any of this product's components.

**Engineering Controls**

Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

**Individual Protection Measures, such as Personal Protective Equipment****Eye/face protection**

Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area. Contact lenses should not be worn.

**Skin Protection**

For the gas: Wear appropriate chemical resistant clothing. For the liquid: Wear appropriate protective, cold insulating clothing.

**Respiratory Protection**

The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA. 2000 ppm. Any supplied-air respirator. Any self-contained breathing apparatus with a full facepiece. Emergency or planned entry into unknown concentrations or IDLH conditions -. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. Escape -. Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister. Any appropriate escape-type, self-contained breathing apparatus.

**Glove Recommendations**

For the gas: Wear appropriate chemical resistant gloves. For the liquid: Wear insulated gloves.

**Protective Materials**

Rubber, neoprene

**Section 9 - PHYSICAL AND CHEMICAL PROPERTIES**

<b>Appearance</b>	clear, colorless liquid (below 23.7°) or gas at ambient temperatures	<b>Physical State</b>	gas
<b>Odor</b>	faint odor ,sweet odor	<b>Color</b>	colorless
<b>Odor Threshold</b>	28 mg/m3	<b>pH</b>	Not available
<b>Melting Point</b>	-111 °C (-168 °F )	<b>Boiling Point</b>	23.7 °C (75 °F )
<b>Boiling Point Range</b>	Not available	<b>Freezing point</b>	Not available
<b>Evaporation Rate</b>	63 (Butyl acetate = 1 )	<b>Flammability (solid, gas)</b>	Not available
<b>Autoignition</b>	Not available	<b>Flash Point</b>	(Not



## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990**

<b>Temperature</b>			flammable )
<b>Lower Explosive Limit</b>	Not available	<b>Decomposition temperature</b>	Not available
<b>Upper Explosive Limit</b>	Not available	<b>Vapor Pressure</b>	890 hPa @ 20 °C
<b>Vapor Density (air=1)</b>	4.9 (Air = 1 )	<b>Specific Gravity (water=1)</b>	1.494 at 17.2 °C
<b>Water Solubility</b>	1.3 g/L ( @ 20 °C )	<b>Partition coefficient: n-octanol/water</b>	Not available
<b>Viscosity</b>	0.43 mPa-s	<b>Kinematic viscosity</b>	Not available
<b>Solubility (Other)</b>	Not available	<b>Bioconcentration Factor (BCF)</b>	0.29
<b>Density</b>	1.49 g/cm3 at 20 °C	<b>Henry's Law Constant</b>	59.07 hPa at 25 °C
<b>KOC</b>	97 (Estimated )	<b>Log KOW</b>	2.5 at 25 °C
<b>Physical Form</b>	gas	<b>Molecular Formula</b>	C-Cl3-F
<b>Molecular Weight</b>	137.37		

**Solvent Solubility****Soluble**

alcohol, ether, organic solvents

**Section 10 - STABILITY AND REACTIVITY****Reactivity**

No reactivity hazard is expected.

**Chemical Stability**

Stable at normal temperatures and pressure.

**Possibility of Hazardous Reactions**

Will not polymerize.

**Conditions to Avoid**

Protect from physical damage and heat. Containers may rupture or explode if exposed to heat.

**Incompatible Materials**

metals, combustible materials, Acids

**Hazardous decomposition products**

acid halides, Phosgene, halogenated compounds, fluorocarbons, hydrogen chloride, Hydrogen fluoride, Chlorine, CARBONYL FLUORIDE

**Section 11 - TOXICOLOGICAL INFORMATION****Information on Likely Routes of Exposure**



## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990****Inhalation**

irritation, ringing in the ears, nausea, vomiting, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, tremors, loss of coordination, Unconsciousness

**Skin Contact**

irritation, frostbite

**Eye Contact**

irritation, frostbite

**Ingestion**

ingestion of a gas is unlikely

**Acute and Chronic Toxicity****Component Analysis - LD50/LC50**

The components of this material have been reviewed in various sources and the following selected endpoints are published:

**FLUOROTRICHLOROMETHANE (75-69-4)**

Oral LD50 Rat >15000 mg/kg

Inhalation LC50 Rat 26200 ppm 4 h

**Product Toxicity Data****Acute Toxicity Estimate**

Inhalation - Gas	> 20000 ppm
Oral	> 2000 mg/kg

**Immediate Effects**

frostbite, respiratory tract irritation, central nervous system depression, heart damage

**Delayed Effects**

Reproductive Effects

**Irritation/Corrosivity Data**

respiratory tract irritation

**Respiratory Sensitization**

No data available.

**Dermal Sensitization**

No data available.

**Component Carcinogenicity**

<b>FLUOROTRICHLOROMETHANE</b>	<b>75-69-4</b>
ACGIH:	A4 - Not Classifiable as a Human Carcinogen

**Germ Cell Mutagenicity**

No data available.

**Tumorigenic Data**

No data available

**Reproductive Toxicity**

Available data characterizes components of this product as reproductive hazards.

**Specific Target Organ Toxicity - Single Exposure**

respiratory tract, central nervous system, heart

**Specific Target Organ Toxicity - Repeated Exposure**

No data available.

**Aspiration hazard**

Not applicable.



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## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990****Medical Conditions Aggravated by Exposure**

heart or cardiovascular disorders

**Additional Data**

Stimulants such as epinephrine may induce ventricular fibrillation. May cross react with similar compounds.

**Section 12 - ECOLOGICAL INFORMATION****Component Analysis - Aquatic Toxicity**

<b>FLUOROTRICHLOROMETHANE</b>	<b>75-69-4</b>
Invertebrate:	EC50 48 h Daphnia magna 130 mg/L IUCLID

**Persistence and Degradability**

Not readily biodegradable.

**Bioaccumulative Potential**

Bioconcentration potential in aquatic organisms is moderate based on a BCF value of 49.

**Mobility**

Expected to have high mobility in soil.

**Section 13 - DISPOSAL CONSIDERATIONS****Disposal Methods**

Dispose in accordance with all applicable regulations.

**Component Waste Numbers**

<b>FLUOROTRICHLOROMETHANE</b>	waste number U121
-------------------------------	-------------------

**Section 14 - TRANSPORT INFORMATION****US DOT Information:****Shipping Name:** COMPRESSED GAS, N.O.S. , ( Contains: FLUOROTRICHLOROMETHANE )**Hazard Class:** 2.2**UN/NA #:** UN1956**Required Label(s):** 2.2**IMDG Information:****Shipping Name:** COMPRESSED GAS, N.O.S. , ( Contains: FLUOROTRICHLOROMETHANE )**Hazard Class:** 2.2**UN#:** UN1956**Required Label(s):** 2.2**International Bulk Chemical Code**

This material does not contain any chemicals required by the IBC Code to be identified as dangerous chemicals in bulk.

**Section 15 - REGULATORY INFORMATION****U.S. Federal Regulations**

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), and/or require an OSHA process safety plan.

<b>FLUOROTRICHLOROMETHANE</b>	<b>75-69-4</b>
SARA 313:	1 % de minimis concentration



## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE**

**SDS ID: MAT09990**

CERCLA:	5000 lb final RQ ; 2270 kg final RQ
---------	-------------------------------------

**SARA Section 311/312 (40 CFR 370 Subparts B and C) reporting categories**

Gas Under Pressure; Reproductive Toxicity; Specific Target Organ Toxicity

**U.S. State Regulations**

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA
<b>FLUOROTRICHLOROMETHANE</b>	<b>75-69-4</b>	Yes	Yes	Yes	Yes	Yes

**Not listed under California Proposition 65**

**Canada Regulations**

**Canadian WHMIS Ingredient Disclosure List (IDL)**

Components of this material have been checked against the Canadian WHMIS Ingredients Disclosure List. The List is composed of chemicals which must be identified on MSDSs if they are included in products which meet WHMIS criteria specified in the Controlled Products Regulations and are present above the threshold limits listed on the IDL

<b>FLUOROTRICHLOROMETHANE</b>	<b>75-69-4</b>
	1 %

**WHMIS Classification**

A

**Component Analysis - Inventory**

**FLUOROTRICHLOROMETHANE (75-69-4)**

US	CA	EU	AU	PH	JP - ENCS	JP - ISHL	KR KECI - Annex 1	KR KECI - Annex 2	KR - REACH CCA	CN	NZ	MX	TW	VN - NCI (Draft)
Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No

### Section 16 - OTHER INFORMATION

**NFPA Ratings**

Health: 2 Fire: 0 Reactivity: 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

**Summary of Changes**

Updated: 05/01/2015

**Key / Legend**

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CA/MA/MN/NJ/PA - California/Massachusetts/Minnesota/New Jersey/Pennsylvania\*; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CFR - Code of Federal Regulations (US); CLP - Classification, Labelling, and Packaging; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSD - Dangerous Substance Directive; DSL - Domestic Substances List; EC - European Commission; EEC - European Economic Community; EIN - European Inventory of (Existing Commercial Chemical Substances); EINECS - European Inventory of Existing Commercial Chemical Substances; ENCS - Japan Existing and New Chemical Substance Inventory; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; IARC - International Agency for Research

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## Safety Data Sheet

**Material Name: FLUOROTRICHLOROMETHANE****SDS ID: MAT09990**

on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime Dangerous Goods; ISHL - Japan Industrial Safety and Health Law; IUCLID - International Uniform Chemical Information Database; JP - Japan; Kow - Octanol/water partition coefficient; KR KECI Annex 1 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR KECI Annex 2 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL) , KR - Korea; LD50/LC50 - Lethal Dose/ Lethal Concentration; LEL - Lower Explosive Limit; LLV - Level Limit Value; LOLI - List Of Lists™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; MX - Mexico; NDSL - Non-Domestic Substance List (Canada); NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PEL - Permissible Exposure Limit; PH - Philippines; RCRA - Resource Conservation and Recovery Act; REACH - Registration, Evaluation, Authorisation, and restriction of Chemicals; RID - European Rail Transport; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TCCA - Korea Toxic Chemicals Control Act; TDG - Transportation of Dangerous Goods; TLV - Threshold Limit Value; TSCA - Toxic Substances Control Act; TW - Taiwan; TWA - Time Weighted Average; UEL - Upper Explosive Limit; UN/NA - United Nations /North American; US - United States; VLE - Exposure Limit Value (Mexico); VN NCI (Draft) - Vietnam National Chemicals Inventory (NCI) (Draft); WHMIS - Workplace Hazardous Materials Information System (Canada) .

**Other Information****Disclaimer:**

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## SAFETY DATA SHEET

Version 4.7  
Revision Date 07/30/2014  
Print Date 07/04/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name :  $\gamma$ -Chlordane

Product Number : 442599  
Brand : Supelco

CAS-No. : 5103-74-2

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Carcinogenicity (Category 2), H351  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)

H302

Harmful if swallowed.

H351

Suspected of causing cancer.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P264

Wash skin thoroughly after handling.

P270

Do not eat, drink or smoke when using this product.

P273

Avoid release to the environment.

P281

Use personal protective equipment as required.

P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P330	Rinse mouth.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>10</sub> H <sub>6</sub> Cl <sub>8</sub>
Molecular Weight	: 409.76 g/mol
CAS-No.	: 5103-74-2
EC-No.	: 225-826-0

#### Hazardous components

Component	Classification	Concentration
<b>trans-Chlordane</b>		
	Acute Tox. 4; Carc. 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H410	90 - 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

no data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

no data available

### 5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

### 5.4 Further information

no data available

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## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

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## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

##### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

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## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: crystalline Colour: white
b) Odour	odourless
c) Odour Threshold	no data available
d) pH	no data available
e) Melting point/freezing point	no data available
f) Initial boiling point and boiling range	no data available
g) Flash point	no data available
h) Evaporation rate	no data available
i) Flammability (solid, gas)	no data available
j) Upper/lower flammability or explosive limits	no data available
k) Vapour pressure	no data available
l) Vapour density	no data available
m) Relative density	1.590 g/cm <sup>3</sup>
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	no data available
p) Auto-ignition temperature	no data available
q) Decomposition temperature	no data available
r) Viscosity	no data available
s) Explosive properties	no data available
t) Oxidizing properties	no data available

### 9.2 Other safety information

no data available

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## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

no data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

no data available

### 10.4 Conditions to avoid

no data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

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## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - mouse - 275 mg/kg

LD50 Oral - rat - 1,100 mg/kg

Inhalation: no data available

Dermal: no data available

no data available

#### Skin corrosion/irritation

no data available

#### Serious eye damage/eye irritation

no data available

#### Respiratory or skin sensitisation

no data available

#### Germ cell mutagenicity

no data available

#### Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (trans-Chlordane)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

no data available

no data available

#### Specific target organ toxicity - single exposure

no data available

#### Specific target organ toxicity - repeated exposure

no data available

#### Aspiration hazard

no data available

#### Additional Information

RTECS: Not available

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - *Lepomis macrochirus* - 0.05 mg/l - 96 h

### 12.2 Persistence and degradability

no data available



### 12.3 Bioaccumulative potential

no data available

### 12.4 Mobility in soil

no data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (trans-Chlordane)  
Reportable Quantity (RQ):  
Marine pollutant: No  
Poison Inhalation Hazard: No

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (trans-Chlordane)  
Marine pollutant: Marine pollutant

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (trans-Chlordane)

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## 15. REGULATORY INFORMATION

### SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
trans-Chlordane	5103-74-2	

### New Jersey Right To Know Components

	CAS-No.	Revision Date
trans-Chlordane	5103-74-2	

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 07/30/2014

Print Date: 07/04/2016



# SAFETY DATA SHEET

SDS ID NO.: 0127MAR019  
Revision Date: 06/01/2016

## 1. IDENTIFICATION

**Product Name:** Marathon Petroleum Gasoline - All Grades

**Synonym:** Gasoline; Regular Unleaded Gasoline; Conventional Regular Unleaded Gasoline; Mid Grade Unleaded Gasoline; Conventional Mid Grade Unleaded Gasoline; Premium Unleaded Gasoline; Conventional Premium Unleaded Gasoline; Sub-Octane Gasoline; Regular RBOB; Super RBOB; Premium RBOB; RBOB; Reformulated Blend Stock For Oxygenated Blending; 84 Octane Gasoline; CBOB; Premium CBOB; Conventional Blend Stock for Oxygenate Blending; Recreational Gasoline; Recreational Gasoline; Recreational Unleaded Gasoline; 89 Recreational Gasoline; Brand 89 Recreational Gasoline; 7.0 Max RVP 89 Recreational Gasoline; BR 7.0 Max RVP 89 Recreational Gasoline; 90 Recreational Gasoline; 90 Marina Gasoline; Brand 91 Recreational Gasoline; 91 Recreational Gasoline; 91 Marina Gasoline; 90 Octane Midgrade Gasoline with No Ethanol; 0125MAR019; 0126MAR019; 0134MAR019; 0313MAR019; 0314MAR019

**Chemical Family:** Complex Hydrocarbon Substance

**Recommended Use:** Fuel.

**Restrictions on Use:** All others.

**Manufacturer, Importer, or Responsible Party Name and Address:**  
**MARATHON PETROLEUM COMPANY LP**  
**539 South Main Street**  
**Findlay, OH 45840**

**SDS information:** 1-419-421-3070

**Emergency Telephone:** 1-877-627-5463

## 2. HAZARD IDENTIFICATION

### Classification

#### OSHA Regulatory Status

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 1
Skin corrosion/irritation	Category 2
Germ cell mutagenicity	Category 1B
Carcinogenicity	Category 1B
Reproductive toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Aspiration toxicity	Category 1
Acute aquatic toxicity	Category 2
Chronic aquatic toxicity	Category 2

#### Hazards Not Otherwise Classified (HNOC)

Static accumulating flammable liquid

**Label elements**

**EMERGENCY OVERVIEW**

**Danger**

**EXTREMELY FLAMMABLE LIQUID AND VAPOR**

May accumulate electrostatic charge and ignite or explode

May be fatal if swallowed and enters airways

Causes skin irritation

May cause respiratory irritation

May cause drowsiness or dizziness

May cause genetic defects

May cause cancer

Suspected of damaging fertility or the unborn child

Toxic to aquatic life with long lasting effects



**Appearance** Clear yellow liquid

**Physical State** Liquid

**Odor** Hydrocarbon

**Precautionary Statements - Prevention**

Obtain special instructions before use

Do not handle until all safety precautions have been read and understood

Keep away from heat/sparks/open flames/hot surfaces. - No smoking

Keep container tightly closed

Ground/bond container and receiving equipment

Use explosion-proof electrical/ventilating/lighting/equipment

Use only non-sparking tools.

Take precautionary measures against static discharge

Avoid breathing mist/vapors/spray

Use only outdoors or in a well-ventilated area

Wear protective gloves/protective clothing/eye protection/face protection

Wash hands and any possibly exposed skin thoroughly after handling

Avoid release to the environment

**Precautionary Statements - Response**

IF exposed or concerned: Get medical attention

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

If skin irritation occurs: Get medical attention

Wash contaminated clothing before reuse

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Call a POISON CENTER or doctor if you feel unwell

IF SWALLOWED: Immediately call a POISON CENTER or doctor

Do NOT induce vomiting

In case of fire: Use water spray, fog or regular foam for extinction

Collect spillage

**Precautionary Statements - Storage**

Store in a well-ventilated place. Keep container tightly closed

Keep cool

Store locked up

**Precautionary Statements - Disposal**

Dispose of contents/container at an approved waste disposal plant

**3. COMPOSITION/INFORMATION ON INGREDIENTS**

Gasoline is a complex combination of hydrocarbons consisting of paraffins, cycloparaffins, aromatic and olefinic hydrocarbons having molecular chains ranging in length from four to ten carbons. May contain small amounts of dye and other additives (>0.02%) which are not considered hazardous at the concentrations used.

**Composition Information:**

Name	CAS Number	% Concentration
Gasoline	86290-81-5	100
Heptane (mixed isomers)	142-82-5	2.5-26
Pentane (mixed isomers)	78-78-4	6.5-19
Butane (mixed isomers)	106-97-8	0.5-14
Hexane Isomers (other than n-Hexane)	107-83-5	2-12
Toluene	108-88-3	3-9.5
Xylene (mixed isomers)	1330-20-7	3.5-9.5
n-Hexane	110-54-3	0.1-4.5
Cumene	98-82-8	0-4
1,2,4 Trimethylbenzene	95-63-6	1-4
Ethylbenzene	100-41-4	0.5-2.5
Benzene	71-43-2	0.1-1.5
Cyclohexane	110-82-7	0-1.5
Octane	111-65-9	0-1.5
1,2,3-trimethylbenzene	526-73-8	0-1
Naphthalene	91-20-3	0.1-0.5

All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

**4. FIRST AID MEASURES****First Aid Measures****General Advice:**

In case of accident or if you feel unwell, seek medical advice immediately (show directions for use or safety data sheet if possible).

**Inhalation:**

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear, give oxygen and continue to monitor. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. If symptoms occur get medical attention.

**Skin Contact:**

Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. May be absorbed through the skin in harmful amounts. Get medical attention if irritation persists. Any injection injury from high pressure equipment should be evaluated immediately by a physician as potentially serious (See NOTES TO PHYSICIAN).

Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties. Destroy contaminated, non-chemical resistant footwear.

**Eye Contact:**

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Gently remove contacts while flushing. Get medical attention if irritation persists.

**Ingestion:** Do not induce vomiting because of danger of aspirating liquid into lungs, causing serious damage and chemical pneumonitis. If spontaneous vomiting occurs, keep head below hips, or if patient is lying down, turn body and head to side to prevent aspiration and monitor for breathing difficulty. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

**Most important signs and symptoms, both short-term and delayed with overexposure**

**Adverse Effects:** Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

**Indication of any immediate medical attention and special treatment needed**

**Notes To Physician:**

INHALATION: This material (or a component) sensitizes the myocardium to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administration of sympathomimetic drugs should be avoided.

SKIN: Leaks or accidents involving high-pressure equipment may inject a stream of material through the skin and initially produce an injury that may not appear serious. Only a small puncture wound may appear on the skin surface but, without proper treatment and depending on the nature, original pressure, volume, and location of the injected material, can compromise blood supply to an affected body part. Prompt surgical debridement of the wound may be necessary to prevent irreversible loss of function and/or the affected body part. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES.

INGESTION: This material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

## 5. FIRE-FIGHTING MEASURES

**Suitable extinguishing media**

For small fires, Class B fire extinguishing media such as CO<sub>2</sub>, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Firefighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

**Unsuitable extinguishing media**

Do not use straight water streams to avoid spreading fire.

**Specific hazards arising from the chemical**

This product has been determined to be an extremely flammable liquid per the OSHA Hazard Communication Standard and should be handled accordingly. May accumulate electrostatic charge and ignite or explode. Vapors may travel along the ground or be moved by ventilation and ignited by many sources such as pilot lights, sparks, electric motors, static discharge, or other ignition sources at locations distant from material handling. Flashback can occur along vapor trail. For additional fire related information, see NFPA 30 or the Emergency Response Guidebook 128.

**Hazardous combustion products**

Smoke, carbon monoxide, and other products of incomplete combustion.

**Explosion data**

**Sensitivity to Mechanical Impact** No.

**Sensitivity to Static Discharge** Yes.

**Special protective equipment and precautions for firefighters**

Firefighters should wear full protective clothing and positive-pressure self-contained breathing apparatus (SCBA) with a full face-piece, as appropriate. Avoid using straight water streams. Water may be ineffective in extinguishing low flash point fires, but can be used to cool exposed surfaces. Avoid excessive water spray application. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Keep run-off water out of sewers and water sources.

**Additional firefighting tactics**

**FIRES INVOLVING TANKS OR CAR/TRAILER LOADS:** Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after the fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

**EVACUATION:** Consider initial downwind evacuation for at least 1000 feet. If tank, rail car or tank truck is involved in a fire, ISOLATE for 5280 feet (1 mile) in all directions; also, consider initial evacuation of 5280 feet (1 mile) in all directions.

**NFPA** Health 1 Flammability 3 Instability 0 Special Hazard -

## 6. ACCIDENTAL RELEASE MEASURES

<b>Personal precautions:</b>	Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources.
<b>Protective equipment:</b>	Use personal protection measures as recommended in Section 8.
<b>Emergency procedures:</b>	Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate.
<b>Environmental precautions:</b>	Avoid release to the environment. Avoid subsoil penetration. Ethanol in gasoline phase separates in contact with water. Monitor downstream for dissolved ethanol or other appropriate indicators.
<b>Methods and materials for containment:</b>	Contain liquid with sand or soil. Prevent spilled material from entering storm drains, sewers, and open waterways.
<b>Methods and materials for cleaning up:</b>	Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids. Recover and return free product to proper containers. When recovering free liquids ensure all equipment is grounded and bonded. Use only non-sparking tools.

## 7. HANDLING AND STORAGE

**Safe Handling Precautions:**

NEVER SIPHON THIS PRODUCT BY MOUTH. Use appropriate grounding and bonding practices. Static accumulating flammable liquid. Bonding and grounding may be insufficient to eliminate the hazard from static electricity. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Vapors may travel along the ground or be moved by ventilation. Flashback may occur along vapor trails. No smoking. Use only non-sparking tools. Avoid contact with skin, eyes and clothing. Avoid breathing fumes, gas, or vapors. Use only with adequate ventilation. Avoid repeated and prolonged skin contact. Use personal protection measures as recommended in Section 8. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water. Do not cut, drill, grind or weld on empty containers since explosive residues may remain. Refer to applicable EPA, OSHA, NFPA and consistent state and local requirements.

Hydrocarbons are basically non-conductors of electricity and can become electrostatically charged during mixing, filtering, pumping at high flow rates or loading and transfer operations. If this charge reaches a sufficiently high level, sparks can form that may ignite the vapors of flammable liquids. Sudden release of hot organic chemical vapors or mists from process equipment operating under elevated temperature and pressure, or sudden ingress of air into vacuum equipment may result in ignition of vapors or mists without the presence of obvious ignition sources. Nozzle spouts must be kept in contact with the containers or tank during the entire filling operation.

Portable containers should never be filled while in or on a motor vehicle or marine craft. Containers should be placed on the ground. Static electric discharge can ignite fuel vapors when filling non-grounded containers or vehicles on trailers. The nozzle spout must be kept in contact with the container before and during the entire filling operation. Use only approved containers.

A buildup of static electricity can occur upon re-entry into a vehicle during fueling especially in cold or dry climate conditions. The charge is generated by the action of dissimilar fabrics (i.e., clothing and upholstery) rubbing across each other as a person enters/exits the vehicle. A flash fire can result from this discharge if sufficient flammable vapors are present. Therefore, do not get back in your vehicle while refueling.

Cellular phones and other electronic devices may have the potential to emit electrical charges (sparks). Sparks in potentially explosive atmospheres (including fueling areas such as gas stations) could cause an explosion if sufficient flammable vapors are present. Therefore, turn off cellular phones and other electronic devices when working in potentially explosive atmospheres or keep devices inside your vehicle during refueling.

High-pressure injection of any material through the skin is a serious medical emergency even though the small entrance wound at the injection site may not initially appear serious. These injection injuries can occur from high-pressure equipment such as paint spray or grease or guns, fuel injectors, or pinhole leaks in hoses or hydraulic lines and should all be considered serious. High pressure injection injuries may be SERIOUS SURGICAL EMERGENCIES (See First Aid Section 4).

**Storage Conditions:**

Store in properly closed containers that are appropriately labeled and in a cool, well-ventilated area. Do not store near an open flame, heat or other sources of ignition.

**Incompatible Materials**

Strong oxidizing agents.

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

Name	ACGIH TLV	OSHA PELs:	OSHA - Vacated PELs	NIOSH IDLH
Gasoline 86290-81-5	300 ppm TWA 500 ppm STEL	-	300 ppm TWA 900 mg/m <sup>3</sup> TWA 500 ppm STEL 1500 mg/m <sup>3</sup> STEL	-



Heptane (mixed isomers) 142-82-5	400 ppm TWA 500 ppm STEL	TWA: 500 ppm TWA: 2000 mg/m <sup>3</sup>	400 ppm TWA 1600 mg/m <sup>3</sup> TWA 500 ppm STEL 2000 mg/m <sup>3</sup> STEL	750 ppm
Pentane (mixed isomers) 78-78-4	1000 ppm TWA	-	-	-
Butane (mixed isomers) 106-97-8	1000 ppm STEL	-	800 ppm TWA 1900 mg/m <sup>3</sup> TWA	-
Hexane Isomers (other than n-Hexane) 107-83-5	500 ppm TWA 1000 ppm STEL	-	500 ppm TWA 1800 mg/m <sup>3</sup> TWA 1000 ppm STEL 3600 mg/m <sup>3</sup> STEL	-
Toluene 108-88-3	20 ppm TWA	TWA: 200 ppm Ceiling: 300 ppm	100 ppm TWA 375 mg/m <sup>3</sup> TWA 150 ppm STEL 560 mg/m <sup>3</sup> STEL	500 ppm
Xylene (mixed isomers) 1330-20-7	100 ppm TWA 150 ppm STEL	TWA: 100 ppm TWA: 435 mg/m <sup>3</sup>	100 ppm TWA 435 mg/m <sup>3</sup> TWA 150 ppm STEL 655 mg/m <sup>3</sup> STEL	900 ppm
n-Hexane 110-54-3	50 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 500 ppm TWA: 1800 mg/m <sup>3</sup>	50 ppm TWA 180 mg/m <sup>3</sup> TWA	1100 ppm
Cumene 98-82-8	50 ppm TWA	TWA: 50 ppm TWA: 245 mg/m <sup>3</sup> Skin	50 ppm TWA 245 mg/m <sup>3</sup> TWA Limit applies to skin	900 ppm
1,2,4 Trimethylbenzene 95-63-6	25 ppm TWA	-	25 ppm TWA 125 mg/m <sup>3</sup> TWA	-
Ethylbenzene 100-41-4	20 ppm TWA	TWA: 100 ppm TWA: 435 mg/m <sup>3</sup>	100 ppm TWA 435 mg/m <sup>3</sup> TWA 125 ppm STEL 545 mg/m <sup>3</sup> STEL	800 ppm
Benzene 71-43-2	0.5 ppm TWA 2.5 ppm STEL Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm (applies to industry segments exempt from the benzene standard) TWA: 1 ppm STEL: 5 ppm (see 29 CFR 1910.1028)	25 ppm Ceiling 1 ppm TWA 5 ppm STEL	500 ppm
Cyclohexane 110-82-7	100 ppm TWA	TWA: 300 ppm TWA: 1050 mg/m <sup>3</sup>	300 ppm TWA 1050 mg/m <sup>3</sup> TWA	1300 ppm
Octane 111-65-9	300 ppm TWA	TWA: 500 ppm TWA: 2350 mg/m <sup>3</sup>	300 ppm TWA 1450 mg/m <sup>3</sup> TWA 375 ppm STEL 1800 mg/m <sup>3</sup> STEL	1000 ppm
1,2,3-trimethylbenzene 526-73-8	25 ppm TWA	-	25 ppm TWA 125 mg/m <sup>3</sup> TWA	-
Naphthalene 91-20-3	10 ppm TWA Skin - potential significant contribution to overall exposure by the cutaneous route	TWA: 10 ppm TWA: 50 mg/m <sup>3</sup>	10 ppm TWA 50 mg/m <sup>3</sup> TWA 15 ppm STEL 75 mg/m <sup>3</sup> STEL	250 ppm

**Notes:**

The manufacturer has voluntarily elected to provide exposure limits contained in OSHA's 1989 air contaminants standard in its SDSs, even though certain of those exposure limits were vacated in 1992.

**Engineering measures:**

Local or general exhaust required in an enclosed area or when there is inadequate ventilation. Use mechanical ventilation equipment that is explosion-proof.

**Personal protective equipment**

<b>Eye protection:</b>	Use goggles or face-shield if the potential for splashing exists.
<b>Skin and body protection:</b>	Use nitrile rubber, Viton® or PVA gloves for repeated or prolonged skin exposure. Glove suitability is based on workplace conditions and usage. Contact the glove manufacturer for specific advice on glove selection and breakthrough times.
<b>Respiratory protection:</b>	Use a NIOSH approved organic vapor chemical cartridge or supplied air respirators when there is the potential for airborne exposures to exceed permissible exposure limits or if excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 29 CFR 1910.134. Self-contained breathing apparatus should be used for fire fighting.
<b>Hygiene measures:</b>	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes and clothing.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### Information on basic physical and chemical properties

<b>Physical State</b>	Liquid
<b>Appearance</b>	Clear yellow liquid
<b>Color</b>	Yellow
<b>Odor</b>	Hydrocarbon
<b>Odor Threshold</b>	No data available.

<u>Property</u>	<u>Values (Method)</u>
<b>Melting Point / Freezing Point</b>	No data available.
<b>Initial Boiling Point / Boiling Range</b>	24-210 °C / 75-410 °F (ASTM D86)
<b>Flash Point</b>	-43 °C / -45 °F
<b>Evaporation Rate</b>	No data available.
<b>Flammability (solid, gas)</b>	Not applicable.
<b>Flammability Limit in Air (%):</b>	
Upper Flammability Limit:	7.6
Lower Flammability Limit:	1.4
<b>Explosion limits:</b>	No data available.
<b>Vapor Pressure</b>	5.5-15 psi (ASTM D4814)
<b>Vapor Density</b>	3-4
<b>Specific Gravity / Relative Density</b>	0.70-0.76
<b>Water Solubility</b>	No data available.
<b>Solubility in other solvents</b>	No data available.
<b>Partition Coefficient</b>	2.13-4.5
<b>Decomposition temperature</b>	No data available.
<b>pH:</b>	Not applicable
<b>Autoignition Temperature</b>	280 °C / 536 °F
<b>Kinematic Viscosity</b>	No data available.
<b>Dynamic Viscosity</b>	No data available.
<b>Explosive Properties</b>	No data available.
<b>VOC Content (%)</b>	100%
<b>Density</b>	No data available.
<b>Bulk Density</b>	Not applicable.

## 10. STABILITY AND REACTIVITY

<b><u>Reactivity</u></b>	The product is non-reactive under normal conditions.
<b><u>Chemical stability</u></b>	The material is stable at 70°F, 760 mmHg pressure.
<b><u>Possibility of hazardous reactions</u></b>	None under normal processing.
<b><u>Hazardous polymerization</u></b>	Will not occur.

**Conditions to avoid**

Excessive heat, sources of ignition, open flame.

**Incompatible Materials**

Strong oxidizing agents.

**Hazardous decomposition products**

None known under normal conditions of use.

**11. TOXICOLOGICAL INFORMATION****Potential short-term adverse effects from overexposures****Inhalation**

May cause irritation of respiratory tract. May cause drowsiness or dizziness. Breathing high concentrations of this material in a confined space or by intentional abuse can cause irregular heartbeats which can cause death.

**Eye contact**

Exposure to vapor or contact with liquid may cause mild eye irritation, including tearing, stinging, and redness.

**Skin contact**

Causes skin irritation. Effects may become more serious with repeated or prolonged contact. May be absorbed through the skin in harmful amounts.

**Ingestion**

May be fatal if swallowed or vomited and enters airways. May cause irritation of the mouth, throat and gastrointestinal tract.

**Acute toxicological data**

Name	Oral LD50	Dermal LD50	Inhalation LC50
Gasoline 86290-81-5	14000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.2 mg/L (Rat) 4 h
Heptane (mixed isomers) 142-82-5	-	3000 mg/kg (Rabbit)	103 g/m <sup>3</sup> (Rat) 4 h
Pentane (mixed isomers) 78-78-4	-	-	450 mg/L (Mouse) 2 h
Butane (mixed isomers) 106-97-8	-	-	658 mg/L (Rat) 4 h
Hexane Isomers (other than n-Hexane) 107-83-5	> 5000 mg/kg (Rat)	-	-
Toluene 108-88-3	> 2000 mg/kg (Rat)	8390 mg/kg (Rabbit)	12.5 mg/L (Rat) 4 h
Xylene (mixed isomers) 1330-20-7	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 5.04 mg/L (Rat) 4 h
n-Hexane 110-54-3	15000 mg/kg (Rat)	3000 mg/kg (Rabbit)	48000 ppm (Rat) 4 h
Cumene 98-82-8	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 20 mg/L (Rat) 6 h
1,2,4 Trimethylbenzene 95-63-6	3280 mg/kg (Rat)	> 3160 mg/kg (Rabbit)	18,000 mg/m <sup>3</sup> (Rat) 4 h
Ethylbenzene 100-41-4	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h
Benzene 71-43-2	> 2000 mg/kg (Rat)	> 5000 mg/kg (Rabbit)	> 20 mg/l (Rat) 4 h
Cyclohexane 110-82-7	> 5000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	13.9 mg/L (Rat) 4 h
Octane 111-65-9	-	-	118 g/m <sup>3</sup> (Rat) 4 h
1,2,3-trimethylbenzene 526-73-8	-	-	-
Naphthalene 91-20-3	490 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 340 mg/m <sup>3</sup> (Rat) 1 h

**Delayed and immediate effects as well as chronic effects from short and long-term exposure**

NAPHTHAS: In a large epidemiological study on over 15,000 employees at several petroleum refineries and amongst residents located near these refineries, no increased risk of kidney cancer was observed in association with gasoline exposures (a similar material). In a similar study, no increased risk of kidney cancer was observed among petroleum refinery workers, but there was a slight trend in the incidence of kidney cancers among service station employees, especially after a 30-year latency period. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffer's Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

C9 AROMATIC HYDROCARBONS: A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm.

PENTANES: Studies of pentane isomers in laboratory animals indicate exposure to extremely high levels (roughly 10 vol.%) may induce cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

BUTANES: Studies in laboratory animals indicate exposure to extremely high levels of butanes (1-10 or higher vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

TOLUENE: Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Abuse of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system, and can cause CNS depression, cardiac arrhythmias, and death. Studies of workers indicate longterm exposure may be related to impaired color vision and hearing. Some studies of workers suggest longterm exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest longterm exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals have been largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long-term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Adverse effects on the liver, kidney, thymus and nervous system were observed in animal studies following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

XYLENES, ALL ISOMERS: Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, nervous system damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross overexposure. Effects from Prolonged or Repeated Exposure: Impaired neurological function was reported

in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure with evidence of maternal toxicity. The relevance of these observations to humans is not clear at this time. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

**1,2,4-TRIMETHYLBENZENE:** The following information pertains to a mixture of C9 aromatic hydrocarbons, over 40% of which was composed of 1,2,4-trimethylbenzene. A developmental inhalation study was conducted in laboratory mice. Increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate were observed at the highest exposure level (1,500 ppm). This exposure level was extremely toxic to pregnant female mice (44% mortality). Reduced fetal body weights were also observed at 500 ppm. A multi-generation reproduction inhalation study was conducted in laboratory rats. Reductions in pup weights, pup weight gain, litter size, and pup survival were observed at 1,500 ppm, an exposure level at which significant maternal toxicity was observed. Reduced pup weight gain was also observed at 500 ppm. Embryotoxicity has been reported in studies of laboratory animals. Adverse effects included increased implantation losses, reduced fetal weights, delayed ossification and an increased incidence of cleft palate.<n><n>

**N-HEXANE:** Long-term or repeated exposure to n-hexane can cause peripheral nerve damage. Initial symptoms are numbness of the fingers and toes. Also, motor weakness can occur in the digits, but may also involve muscles of the arms, thighs and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. Testicular atrophy and partial to full loss of the germ cell line were observed in sub-chronic high-dose inhalation studies of laboratory rodents. These effects appeared irreversible. Rodent reproduction studies have shown evidence of reduced fetal weight but no frank malformations.

**CUMENE:** Overexposure to cumene may cause upper respiratory tract irritation and CNS depression. Studies in laboratory animals indicate evidence of respiratory tract hyperplasia, and adverse effects on the liver, kidney and adrenal glands following high level exposure. The relevance of these findings to humans is not clear at this time. Findings from lifetime laboratory rodent inhalation studies were as follows: In F344/N rats: an increased incidence of renal carcinomas and adenomas, respiratory epithelial adenomas, and interstitial cell adenomas of the testes. In B6C3F1 mice: an increased incidence of carcinomas and adenomas of the bronchi and lung, liver neoplasms, hemangiosarcomas of the spleen, and adenomas of the thyroid.

**ETHYLBENZENE:** Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). The incidence of tumors was also elevated in male mice (alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as "possibly carcinogenic to humans" (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure with evidence of maternal toxicity. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals have demonstrated evidence of ototoxicity (hearing loss) following exposure levels as low as 300 ppm for 5 days. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

**BENZENE:** Studies of workers exposed to benzene show clear evidence that overexposure can cause cancer and other diseases of the blood forming organs including Acute

Myelogenous Leukemia (AML), and Aplastic Anemia (AA), an often fatal disease. Some studies suggest overexposure to benzene may also be associated with Myelodysplastic Syndrome (MDS). Findings from a case control study of workers exposed to benzene was reported during the 2009 Benzene Symposium in Munich included an increase in Acute Myeloid Leukemias and Non-Hodgkins Lymphoid Neoplasms (NHLN) of the subtype follicular lymphoma (FL) in some occupational categories. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of AA have been reported in the offspring of persons severely overexposed to benzene. Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and minor skeletal variations. Benzene has been classified as a proven human carcinogen by OSHA and a Group 1 (Carcinogenic to Humans) material by IARC. The current proposed IARC classification for benzene is summarized as follows: Sufficient evidence for Acute Myeloid Leukemia; limited evidence for Acute Lymphatic Leukemia, Chronic Lymphatic Leukemia, Non-Hodgkin Lymphoma, and Multiple Myeloma.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

CARBON MONOXIDE: is a chemical asphyxiant with no warning properties (such as odor). At 400-500 ppm for 1 hour headache and dyspnea may occur. If activity is increased, symptoms of overexposure may include nausea, irritability, increased respiration, tinnitus, sweating, chest pain, confusion, impaired judgement, dizziness, weakness, drowsiness, ataxia, irregular heart beat, cyanosis and pallor. Levels in excess of 1000 ppm can result in collapse, loss of consciousness, respiratory failure and death. Extremely high concentrations (12,800 ppm) can cause immediate unconsciousness and death in 1-3 minutes. Repeated anoxia can lead to central nervous system damage and peripheral neuropathy, with loss of sensation in the fingers, amnesia, and mental deterioration and possible congestive heart failure. Damage may also occur to the fetus, lung, liver, kidney, spleen, cardiovascular system and other organs.

WHOLLY-VAPORIZED UNLEADED GASOLINE: Lifetime exposure to wholly vaporized unleaded gasoline produced an increased incidence of liver tumors in female mice exposed to the highest exposure concentration (2056 ppm) and  $\alpha$ -2 urinary globulin-mediated kidney tumors in male rats. No exposure-related tumors were observed in male mice or female rats. The male-specific rat kidney tumors are not considered relevant to human health. Mice receiving lifetime repeated skin application of various petroleum naphthas exhibited an irritation-dependent increased incidence of skin tumors. Additional studies suggest that these tumors occur through a mechanism that may not be relevant to human health. Epidemiological data from over 18,000 petroleum marketing and distribution workers

showed no increased risk of leukemia, multiple myeloma, or kidney cancer resulting from gasoline exposure. Unleaded gasoline has been identified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

COMBUSTION ENGINE EXHAUST: Chronic inhalation studies of gasoline engine exhaust in mice, rats and hamsters did not produce any carcinogenic effects. Condensates/extracts of gasoline engine exhaust produced an increase in tumors compared to controls when testing by skin painting, subcutaneous injection, intratracheal instillation or implantation into the lungs. Gasoline exhaust has been classified as possibly carcinogenic to humans (2B) by the International Agency for Research on Cancer (IARC).

#### **Adverse effects related to the physical, chemical and toxicological characteristics**

##### **Signs and Symptoms**

Irritating to the skin and mucous membranes. Symptoms may include redness, itching, and inflammation. May cause nausea, vomiting, diarrhea, and signs of nervous system depression: headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue. Aspiration hazard. May cause coughing, chest pains, shortness of breath, pulmonary edema and/or chemical pneumonitis. Repeated or prolonged skin contact may cause drying, reddening, itching and cracking.

##### **Sensitization**

Not expected to be a skin or respiratory sensitizer.

##### **Mutagenic effects**

May cause genetic defects.

##### **Carcinogenicity**

May cause cancer.

Cancer designations are listed in the table below

<b>Name</b>	<b>ACGIH (Class)</b>	<b>IARC (Class)</b>	<b>NTP</b>	<b>OSHA</b>
Gasoline 86290-81-5	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Heptane (mixed isomers) 142-82-5	Not Listed	Not Listed	Not Listed	Not Listed
Pentane (mixed isomers) 78-78-4	Not Listed	Not Listed	Not Listed	Not Listed
Butane (mixed isomers) 106-97-8	Not Listed	Not Listed	Not Listed	Not Listed
Hexane Isomers (other than n-Hexane) 107-83-5	Not Listed	Not Listed	Not Listed	Not Listed
Toluene 108-88-3	Not Classifiable (A4)	Not Classifiable (3)	Not Listed	Not Listed
Xylene (mixed isomers) 1330-20-7	Not classifiable (A4)	Not classifiable (3)	Not Listed	Not Listed
n-Hexane 110-54-3	Not Listed	Not Listed	Not Listed	Not Listed
Cumene 98-82-8	Not listed	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not listed
1,2,4 Trimethylbenzene 95-63-6	Not Listed	Not Listed	Not Listed	Not Listed
Ethylbenzene 100-41-4	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Not Listed	Not Listed
Benzene 71-43-2	Confirmed human carcinogen (A1)	Carcinogenic to humans (1)	Known to be human carcinogen	Known carcinogen
Cyclohexane 110-82-7	Not Listed	Not Listed	Not Listed	Not Listed
Octane 111-65-9	Not Listed	Not Listed	Not Listed	Not Listed
1,2,3-trimethylbenzene 526-73-8	Not Listed	Not Listed	Not Listed	Not Listed
Naphthalene 91-20-3	Confirmed animal carcinogen (A3)	Possible human carcinogen (2B)	Reasonably anticipated to be a human carcinogen	Not Listed

##### **Reproductive toxicity**

Suspected of damaging fertility or the unborn child.

**Specific Target Organ Toxicity (STOT) - single exposure** Respiratory system. Central nervous system.

**Specific Target Organ Toxicity (STOT) - repeated exposure** Not classified.

**Aspiration hazard** May be fatal if swallowed or vomited and enters airways.

## 12. ECOLOGICAL INFORMATION

**Ecotoxicity** This product should be considered toxic to aquatic organisms, with the potential to cause long lasting adverse effects in the aquatic environment.

Name	Algae/aquatic plants	Fish	Toxicity to Microorganisms	Crustacea
Gasoline 86290-81-5	72-hr EC50 = 56 mg/l Algae	96-hr LC50 = 11 mg/l Rainbow trout (static)	-	48-hr LC50 = 7.6 mg/l Daphnia magna
Heptane (mixed isomers) 142-82-5	-	96-hr LC50 = 375 mg/L Tilapia	-	-
Pentane (mixed isomers) 78-78-4	-	96-hr LC50 = 3.1 mg/L Rainbow trout	-	48-hr EC50 = >1 - <10 mg/L Daphnia magna
Butane (mixed isomers) 106-97-8	-	-	-	-
Hexane Isomers (other than n-Hexane) 107-83-5	-	-	-	-
Toluene 108-88-3	72-hr EC50 = 12.5 mg/l Algae	96-hr LC50 ≤ 10 mg/l Rainbow trout	-	48-hr EC50 = 5.46-9.83 mg/l Daphnia magna 48-hr EC50 = 11.5 mg/l Daphnia magna (Static)
Xylene (mixed isomers) 1330-20-7	72-hr EC50 = 11 mg/l Algae	96-hr LC50 = 8 mg/l Rainbow trout	-	48-hr LC50 = 3.82 mg/l Daphnia magna
n-Hexane 110-54-3	-	96-hr LC50 = 2.5 mg/l Fathead minnow	-	-
Cumene 98-82-8	72-hr EC50 = 2.6 mg/l Algae	96-hr LC50 = 6.04-6.61 mg/l Fathead minnow (Flow-through) 96-hr LC50 = 2.7 mg/l Rainbow trout (semi-static)	-	48-hr EC50 = 7.9-14.1 mg/l Daphnia magna (static)
1,2,4 Trimethylbenzene 95-63-6	-	96-hr LC50 = 7.19-8.28 mg/l Fathead minnow (flow-through)	-	48-hr EC50 = 6.14 mg/L Daphnia magna
Ethylbenzene 100-41-4	72-hr EC50 = 1.7-7.6 mg/l Algae	96-hr LC50 = 4 mg/L Rainbow trout	-	48-hr EC50 = 1-4 mg/L Daphnia magna
Benzene 71-43-2	72-hr EC50 = 29 mg/l Algae	96-hr LC50 = 5.3 mg/l Rainbow trout (flow-through)	-	48-hr EC50 = 8.76-15.6 mg/l Daphnia magna (Static)
Cyclohexane 110-82-7	72-hr EC50 = 500 mg/l Algae	96-hr LC50 = 3.96-5.18 mg/l Fathead minnow	-	48-hr EC50 = 1.7-3.5 mg/L Bay shrimp
Octane 111-65-9	-	-	-	48-hr LC50 = 0.38 mg/l Daphnia magna
1,2,3-trimethylbenzene 526-73-8	-	96-hr LC50 = 7.72 mg/l Fathead Minnow (flow-through)	-	-
Naphthalene 91-20-3	-	96-hr LC50 = 0.91-2.82 mg/l Rainbow trout (static) 96-hr LC50 = 1.99 mg/l Fathead minnow (static)	-	48-hr LC50 = 1.6 mg/l Daphnia magna

**Persistence and degradability** Expected to be inherently biodegradable. The presence of ethanol in this product may impede the biodegradation of benzene, toluene, ethylbenzene and xylene in groundwater, resulting in elongated plumes of these constituents.



**Bioaccumulation** Has the potential to bioaccumulate.

**Mobility in soil** May partition into air, soil and water.

**Other adverse effects** No information available.

## 13. DISPOSAL CONSIDERATIONS

### Description of Waste Residues

This material may be a flammable liquid waste.

### Safe Handling of Wastes

Handle in accordance with applicable local, state, and federal regulations. Use personal protection measures as required. Use appropriate grounding and bonding practices. Use only non-sparking tools. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. No smoking.

### Disposal of Wastes / Methods of Disposal

The user is responsible for determining if any discarded material is a hazardous waste (40 CFR 262.11). Dispose of in accordance with federal, state and local regulations.

### Methods of Contaminated Packaging Disposal

Empty containers should be completely drained and then discarded or recycled, if possible. Do not cut, drill, grind or weld on empty containers since explosive residues may be present. Dispose of in accordance with federal, state and local regulations.

## 14. TRANSPORT INFORMATION

### DOT (49 CFR 172.101):

<b>UN Proper Shipping Name:</b>	Gasoline
<b>UN/Identification No:</b>	UN 1203
<b>Transport Hazard Class(es):</b>	3
<b>Packing Group:</b>	II

### TDG (Canada):

<b>UN Proper Shipping Name:</b>	Gasoline
<b>UN/Identification No:</b>	UN 1203
<b>Transport Hazard Class(es):</b>	3
<b>Packing Group:</b>	II

## 15. REGULATORY INFORMATION

### US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b):

This product and/or its components are listed on the TSCA Chemical Inventory.

### EPA Superfund Amendment & Reauthorization Act (SARA):

**SARA Section 302:** This product does not contain any component(s) included on EPA's Extremely Hazardous Substance (EHS) List.

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Gasoline	NA
Heptane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Butane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Toluene	NA
Xylene (mixed isomers)	NA

n-Hexane	NA
Cumene	NA
1,2,4 Trimethylbenzene	NA
Ethylbenzene	NA
Benzene	NA
Cyclohexane	NA
Octane	NA
1,2,3-trimethylbenzene	NA
Naphthalene	NA

**SARA Section 304:**

This product may contain component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	Hazardous Substances RQs
Gasoline	NA
Heptane (mixed isomers)	NA
Pentane (mixed isomers)	NA
Butane (mixed isomers)	NA
Hexane Isomers (other than n-Hexane)	NA
Toluene	1000 lb final RQ 454 kg final RQ
Xylene (mixed isomers)	100 lb final RQ 45.4 kg final RQ
n-Hexane	5000 lb final RQ 2270 kg final RQ
Cumene	5000 lb final RQ 2270 kg final RQ
1,2,4 Trimethylbenzene	NA
Ethylbenzene	1000 lb final RQ 454 kg final RQ
Benzene	10 lb final RQ 4.54 kg final RQ
Cyclohexane	1000 lb final RQ 454 kg final RQ
Octane	NA
1,2,3-trimethylbenzene	NA
Naphthalene	100 lb final RQ 45.4 kg final RQ

**SARA:**

The following EPA hazard categories apply to this product:

Acute Health Hazard  
Chronic Health Hazard  
Fire Hazard

**SARA Section 313:**

This product may contain component(s), which if in exceedance of the de minimus threshold, may be subject to the reporting requirements of SARA Title III Section 313 Toxic Release Reporting (Form R).

Name	CERCLA/SARA 313 Emission reporting:
Gasoline	None
Heptane (mixed isomers)	None
Pentane (mixed isomers)	None
Butane (mixed isomers)	None
Hexane Isomers (other than n-Hexane)	None
Toluene	1.0 % de minimis concentration
Xylene (mixed isomers)	1.0 % de minimis concentration
n-Hexane	1.0 % de minimis concentration
Cumene	1.0 % de minimis concentration

1,2,4 Trimethylbenzene	1.0 % de minimis concentration
Ethylbenzene	0.1 % de minimis concentration
Benzene	0.1 % de minimis concentration
Cyclohexane	1.0 % de minimis concentration
Octane	None
1,2,3-trimethylbenzene	None
Naphthalene	0.1 % de minimis concentration

**State and Community Right-To-Know Regulations:**

The following component(s) of this material are identified on the regulatory lists below:

**Gasoline**

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0957
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0957 TPQ: 10000 lb (Under N.J.A.C. 7:1G, environmental hazardous substances in mixtures such as gasoline or new and used petroleum oil may be reported under these categories)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

**Heptane (mixed isomers)**

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1339
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

**Pentane (mixed isomers)**

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1064
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed

California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 1064 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Butane (mixed isomers)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0273
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - fourth degree
New Jersey - Environmental Hazardous Substances List:	SN 0273 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Hexane Isomers (other than n-Hexane)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1285
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Not Listed
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Toluene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Developmental toxicity, initial date 1/1/91 Female reproductive toxicity, initial date 8/7/09
New Jersey Right-To-Know:	SN 1866
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed

New Jersey - Special Hazardous Substances:	Flammable - third degree; Teratogen
New Jersey - Environmental Hazardous Substances List:	SN 1866 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)
Xylene (mixed isomers)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 2014
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold all isomers
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 2014 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)
n-Hexane	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1340
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 1340 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1 lb RQ (air); 1 lb RQ (land/water)
Cumene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/6/10
New Jersey Right-To-Know:	SN 0542
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin)
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0542 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present

New York - Reporting of Releases Part 597 - List of Hazardous Substances:	5000 lb RQ (air); 1 lb RQ (land/water)
1,2,4 Trimethylbenzene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To-Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Ethylbenzene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 6/11/04
New Jersey Right-To-Know:	SN 0851
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To-Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen; flammable - Third degree
New Jersey - Environmental Hazardous Substances List:	SN 0851 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)
Benzene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 2/27/87
	Developmental toxicity, initial date 12/26/97
	Male reproductive toxicity, initial date 12/26/97
New Jersey Right-To-Know:	SN 0197
Pennsylvania Right-To-Know:	Environmental hazard; Special hazardous substance
Massachusetts Right-To-Know:	Carcinogen; Extraordinarily hazardous
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic (skin); Flammable (skin); Carcinogen (skin)
Michigan Critical Materials Register List:	100 lb Annual usage threshold
Massachusetts Extraordinarily Hazardous Substances:	Carcinogen; Extraordinarily hazardous
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Present
New Jersey - Special Hazardous Substances:	Carcinogen; Flammable - third degree; Mutagen
New Jersey - Environmental Hazardous Substances List:	SN 0197 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	10 lb RQ (air); 1 lb RQ (land/water)

## Cyclohexane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 0565
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To-Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	SN 0565 TPQ: 500 lb
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	1000 lb RQ (air); 1 lb RQ (land/water)

## Octane

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1434
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To-Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Flammable - third degree
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

## 1,2,3-trimethylbenzene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	SN 1929
Pennsylvania Right-To-Know:	Present
Massachusetts Right-To-Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

## Naphthalene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	SN 1322 SN 3758

Pennsylvania Right-To-Know:	Environmental hazard Present (particulate)
Massachusetts Right-To Know:	Present
Florida Substance List:	Not Listed
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan Critical Materials Register List:	Not Listed
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ: 500 lb (Reportable at the de minimis quantity of >0.1%)
Illinois - Toxic Air Contaminants:	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	100 lb RQ (air); 1 lb RQ (land/water)

**Canada DSL/NDL Inventory:** This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

**Canadian Regulatory Information:** This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the (M)SDS contains all the information required by the Controlled Products Regulations.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Gasoline	B2,D2A,D2B	0.1%
Heptane (mixed isomers)	B2,D2B	1%
Pentane (mixed isomers)	B2	1%
Butane (mixed isomers)	A,B1	1%
Hexane Isomers (other than n-Hexane)	B2	1%
Toluene	B2,D2A,D2B	0.1%
Xylene (mixed isomers)	B2,D2A,D2B	m-, o-isomers 1.0%; p-isomer 0.1%
n-Hexane	B2,D2A,D2B	1%
Cumene	B2,D2A	0.1%
1,2,4 Trimethylbenzene	B3,D2B	1%
Ethylbenzene	B2,D2A,D2B	0.1%
Benzene	B2,D2A,D2B	0.1%
Cyclohexane	B2,D2B	1%
Octane	B2,D2B	1%
1,2,3-trimethylbenzene	B3	1%
Naphthalene	B4,D2A	0.1%



**Note:** Not applicable.

## 16. OTHER INFORMATION

**Prepared By** Toxicology and Product Safety

**Revision Date:** 06/01/2016

**Revision Note:**



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**Revised Sections**

The following sections (§) have been updated:

1. IDENTIFICATION
2. HAZARD IDENTIFICATION
3. COMPOSITION/INFORMATION ON INGREDIENTS
4. FIRST AID MEASURES
6. ACCIDENTAL RELEASE MEASURES
7. HANDLING AND STORAGE
8. EXPOSURE CONTROLS/PERSONAL PROTECTION
9. PHYSICAL AND CHEMICAL PROPERTIES
11. TOXICOLOGICAL INFORMATION
12. ECOLOGICAL INFORMATION
15. REGULATORY INFORMATION

**Disclaimer**

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information is intended as guidance for safe handling, use, processing, storage, transportation, accidental release, clean-up and disposal and is not considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

## SAFETY DATA SHEET

Version 3.7  
Revision Date 06/14/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Helium

Product Number : 295345

Brand : Aldrich

CAS-No. : 7440-59-7

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Gases under pressure (Compressed gas), H280

Simple Asphyxiant,

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Warning

Hazard statement(s)

H280

Contains gas under pressure; may explode if heated.  
May displace oxygen and cause rapid suffocation.

Precautionary statement(s)

P410 + P403

Protect from sunlight. Store in a well-ventilated place.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

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3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Formula : He

Molecular weight : 4.00 g/mol

CAS-No. : 7440-59-7

EC-No. : 231-168-5

**Hazardous components**

Component	Classification	Concentration
<b>Helium</b>		
	Press. Gas Compr. Gas; SA ; H280,	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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**4. FIRST AID MEASURES****4.1 Description of first aid measures****General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

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**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

No data available

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

Use water spray to cool unopened containers.

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. For personal protection see section 8.

**6.2 Environmental precautions**

Do not let product enter drains.

**6.3 Methods and materials for containment and cleaning up**

Clean up promptly by sweeping or vacuum.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

Storage class (TRGS 510): Gases

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

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## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Body Protection

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

##### Control of environmental exposure

Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: Compressed gas                              |
| b) Odour                                   | No data available                                 |
| c) Odour Threshold                         | No data available                                 |
| d) pH                                      | No data available                                 |
| e) Melting point/freezing point            | Melting point/range: -272.2 °C (-458.0 °F) - lit. |
| f) Initial boiling point and boiling range | -268.9 °C (-452.0 °F) - lit.                      |
| g) Flash point                             | Not applicable                                    |
| h) Evaporation rate                        | No data available                                 |
| i) Flammability (solid, gas)               | No data available                                 |
| j) Upper/lower                             | No data available                                 |

flammability or  
explosive limits

- |    |  |                    |
|----|--|--------------------|
| k) | Vapour pressure                        | No data available  |
| l) | Vapour density                         | 0.14 - (Air = 1.0) |
| m) | Relative density                       | No data available  |
| n) | Water solubility                       | 0.0015 g/l         |
| o) | Partition coefficient: n-octanol/water | No data available  |
| p) | Auto-ignition temperature              | No data available  |
| q) | Decomposition temperature              | No data available  |
| r) | Viscosity                              | No data available  |
| s) | Explosive properties                   | No data available  |
| t) | Oxidizing properties                   | No data available  |

## 9.2 Other safety information

Relative vapour density 0.14 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

## **Carcinogenicity**

- IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
- ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
- NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
- OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

## **Reproductive toxicity**

No data available

No data available

## **Specific target organ toxicity - single exposure**

No data available

## **Specific target organ toxicity - repeated exposure**

No data available

## **Aspiration hazard**

No data available

## **Additional Information**

RTECS: MH6520000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

No data available

### **12.2 Persistence and degradability**

No data available

### **12.3 Bioaccumulative potential**

No data available

### **12.4 Mobility in soil**

No data available

### **12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### **12.6 Other adverse effects**

No data available

---

## **13. DISPOSAL CONSIDERATIONS**

### **13.1 Waste treatment methods**

#### **Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### **Contaminated packaging**

Dispose of as unused product.

---

## **14. TRANSPORT INFORMATION**

### **DOT (US)**

UN number: 1046      Class: 2.2

Proper shipping name: Helium, compressed  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

#### IMDG

UN number: 1046      Class: 2.2  
Proper shipping name: HELIUM, COMPRESSED

EMS-No: F-C, S-V

#### IATA

UN number: 1046      Class: 2.2  
Proper shipping name: Helium, compressed

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Sudden Release of Pressure Hazard, Acute Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Helium	7440-59-7	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Helium	7440-59-7	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Helium	7440-59-7	1993-04-24

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

H280	May displace oxygen and cause rapid suffocation.
Press. Gas	Contains gas under pressure; may explode if heated.
SA	Gases under pressure
	Simple Asphyxiant

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	1
Physical Hazard	1

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0
Special hazard.I:	SA

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.7

Revision Date: 06/14/2015

Print Date: 05/01/2016



## SAFETY DATA SHEET

Version 5.7  
Revision Date 05/24/2016  
Print Date 05/25/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Heptane

Product Number : 650536  
Brand : SIGALD  
Index-No. : 601-008-00-2

CAS-No. : 142-82-5

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Skin irritation (Category 2), H315  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Aspiration hazard (Category 1), H304  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H225 : Highly flammable liquid and vapour.  
H304 : May be fatal if swallowed and enters airways.  
H315 : Causes skin irritation.  
H336 : May cause drowsiness or dizziness.  
H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P210 : Keep away from heat/sparks/open flames/hot surfaces. No smoking.

P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P312	Call a POISON CENTER/doctor if you feel unwell.
P321	Specific treatment (see supplemental first aid instructions on this label).
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>7</sub> H <sub>16</sub>
Molecular weight	: 100.20 g/mol
CAS-No.	: 142-82-5
EC-No.	: 205-563-8
Index-No.	: 601-008-00-2

#### Hazardous components

Component	Classification	Concentration
<b>Heptane</b>		
	Flam. Liq. 2; Skin Irrit. 2; STOT SE 3; Asp. Tox. 1; Aquatic Acute 1; Aquatic Chronic 1; H225, H304, H315, H336, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

For small (incipient) fires, use media such as "alcohol" foam, dry chemical, or carbon dioxide. For large fires, apply water from as far as possible. Use very large quantities (flooding) of water applied as a mist or spray; solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water.

**5.2 Special hazards arising from the substance or mixture**

Flash back possible over considerable distance.

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. Use water spray to cool unopened containers.

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Store under inert gas. Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Heptane	142-82-5	TWA	85.000000 ppm 350.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	440.000000 ppm 1,800.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	15 minute ceiling value		
		TWA	500.000000 ppm 2,000.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	400.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		STEL	500.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		TWA	400.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		STEL	500.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		TWA	400 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		STEL	500 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		PEL	400 ppm 1,600 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	500 ppm 2,000 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min

Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |                                   |
|--|-----------------------------------|
| a) Appearance                              | Form: liquid                      |
| b) Odour                                   | No data available                 |
| c) Odour Threshold                         | No data available                 |
| d) pH                                      | No data available                 |
| e) Melting point/freezing point            | -91.0 °C (-131.8 °F)              |
| f) Initial boiling point and boiling range | 98.0 - 99.0 °C (208.4 - 210.2 °F) |
| g) Flash point                             | -4.0 °C (24.8 °F) - closed cup    |
| h) Evaporation rate                        | No data available                 |
| i) Flammability (solid, gas)               | No data available                 |
| j) Upper/lower                             | Upper explosion limit: 7 %(V)     |

	flammability or explosive limits	Lower explosion limit: 1.1 %(V)
k)	Vapour pressure	110.7 hPa (83.0 mmHg) at 37.7 °C (99.9 °F) 53.3 hPa (40.0 mmHg) at 20.0 °C (68.0 °F)
l)	Vapour density	No data available
m)	Relative density	0.68 g/cm <sup>3</sup>
n)	Water solubility	insoluble
o)	Partition coefficient: n-octanol/water	log Pow: > 3.000log Pow: 5
p)	Auto-ignition temperature	223.0 °C (433.4 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LC50 Inhalation - Rat - 4 h - 103,000 mg/m<sup>3</sup>

Inhalation: Irritating to respiratory system.

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation

(OECD Test Guideline 405)

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

May cause drowsiness or dizziness.

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

May be fatal if swallowed and enters airways.

**Additional Information**

RTECS: MI7700000

Prolonged or repeated exposure to skin causes defatting and dermatitis., Central nervous system depression, narcosis, Damage to the lungs.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - Carassius auratus (goldfish) - 4 mg/l - 24.0 h

LC50 - Tilapia mossambica - 375 mg/l - 96.0 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 1.50 mg/l - 48 h

### 12.2 Persistence and degradability

Ratio BOD/ThBOD 3.5 %

### 12.3 Bioaccumulative potential

Indication of bioaccumulation.

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Very toxic to aquatic life.

Do not empty into drains. Avoid release to the environment.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1206      Class: 3      Packing group: II  
Proper shipping name: Heptanes  
Marine pollutant: yes  
Poison Inhalation Hazard: No

### IMDG

UN number: 1206      Class: 3      Packing group: II      EMS-No: F-E, S-D  
Proper shipping name: HEPTANES  
Marine pollutant: yes      Marine pollutant: yes

### IATA

UN number: 1206      Class: 3      Packing group: II  
Proper shipping name: Heptanes

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

Heptane	CAS-No. 142-82-5	Revision Date 1993-04-24
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### Pennsylvania Right To Know Components

Heptane	CAS-No. 142-82-5	Revision Date 1993-04-24
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### New Jersey Right To Know Components

Heptane	CAS-No. 142-82-5	Revision Date 1993-04-24
---------	---------------------	-----------------------------

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.



---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Asp. Tox.	Aspiration hazard
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H336	May cause drowsiness or dizziness.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Skin Irrit.	Skin irritation

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.7

Revision Date: 05/24/2016

Print Date: 05/25/2016

## SAFETY DATA SHEET

Version 5.6  
Revision Date 05/23/2016  
Print Date 06/21/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Hexane

Product Number : 52750  
Brand : Sigma-Aldrich  
Index-No. : 601-037-00-0

CAS-No. : 110-54-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Skin irritation (Category 2), H315  
Reproductive toxicity (Category 2), H361  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Specific target organ toxicity - repeated exposure, Oral (Category 2), Nervous system, H373  
Aspiration hazard (Category 1), H304  
Acute aquatic toxicity (Category 2), H401  
Chronic aquatic toxicity (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

H225 : Highly flammable liquid and vapour.  
H304 : May be fatal if swallowed and enters airways.  
H315 : Causes skin irritation.  
H336 : May cause drowsiness or dizziness.  
H361 : Suspected of damaging fertility or the unborn child.  
H373 : May cause damage to organs (Nervous system) through prolonged or

H411	repeated exposure if swallowed. Toxic to aquatic life with long lasting effects.
Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms	: <i>n</i> -Hexane
Formula	: C <sub>6</sub> H <sub>14</sub>
Molecular weight	: 86.18 g/mol
CAS-No.	: 110-54-3
EC-No.	: 203-777-6
Index-No.	: 601-037-00-0
Registration number	: 01-2119480412-44-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>n-Hexane</b>		
	Flam. Liq. 2; Skin Irrit. 2; Repr. 2; STOT SE 3; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; Aquatic Chronic 2; H225, H304, H315, H336, H361, H373, H411	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

# 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

## 8.1 Control parameters

### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
n-Hexane	110-54-3	TWA	50.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Eye irritation Peripheral neuropathy Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Danger of cutaneous absorption		
		TWA	50.000000 ppm 180.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	500.000000 ppm 1,800.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	50 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Eye irritation Peripheral neuropathy Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Danger of cutaneous absorption		
		TWA	50 ppm 180 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	500 ppm 1,800 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	50 ppm 180 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		PEL	50 ppm 180 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
n-Hexane	110-54-3	2,5-Hexanedione	0.4 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 59 min

Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| a) Appearance                   | Form: liquid<br>Colour: colourless    |
| b) Odour                        | No data available                     |
| c) Odour Threshold              | No data available                     |
| d) pH                           | 7.0                                   |
| e) Melting point/freezing point | Melting point/range: -95 °C (-139 °F) |
| f) Initial boiling point and    | 69 °C (156 °F)                        |

boiling range

- g) Flash point -26.0 °C (-14.8 °F) - closed cup
- h) Evaporation rate 15.8
- i) Flammability (solid, gas) No data available
- j) Upper/lower flammability or explosive limits Upper explosion limit: 7.7 %(V)  
Lower explosion limit: 1.2 %(V)
- k) Vapour pressure 341.3 hPa (256.0 mmHg) at 37.7 °C (99.9 °F)  
176.0 hPa (132.0 mmHg) at 20.0 °C (68.0 °F)
- l) Vapour density No data available
- m) Relative density 0.659 g/mL at 25 °C (77 °F)
- n) Water solubility insoluble
- o) Partition coefficient: n-octanol/water log Pow: 3.90 - 4.11
- p) Auto-ignition temperature 234.0 °C (453.2 °F)
- q) Decomposition temperature No data available
- r) Viscosity No data available
- s) Explosive properties No data available
- t) Oxidizing properties No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

### 10.5 Incompatible materials

Oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 25,000 mg/kg

LC50 Inhalation - Rat - 4 h - 48000 ppm

Dermal: No data available

No data available

**Skin corrosion/irritation**

Irritating to skin.

**Serious eye damage/eye irritation**

Eyes - Rabbit

Result: Mild eye irritation

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals. Suspected human reproductive toxicant Suspected of damaging fertility.

**Specific target organ toxicity - single exposure**

May cause drowsiness or dizziness.

**Specific target organ toxicity - repeated exposure**

Ingestion - May cause damage to organs through prolonged or repeated exposure. - Nervous system

**Aspiration hazard**

May be fatal if swallowed and enters airways.

**Additional Information**

RTECS: MN9275000

Prolonged or repeated contact with skin may cause:; defatting, Dermatitis, Contact with eyes can cause:; Redness, Blurred vision, Provokes tears.; Effects due to ingestion may include:; Gastrointestinal discomfort, Central nervous system depression, Lung irritation, chest pain, pulmonary edema, giddiness, slowed reaction time, slurred speech, Headache, Dizziness, Drowsiness, Unconsciousness

Testes. - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 2.5 mg/l - 96.0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 3,878.00 mg/l - 48 h
Toxicity to algae	EC50 - Chlorella vulgaris (Fresh water algae) - 12,840.00 mg/l - 3 h
	EC50 - SKELETOMA - 0.30 mg/l - 8 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available



## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1208      Class: 3      Packing group: II  
Proper shipping name: Hexanes  
Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1208      Class: 3      Packing group: II      EMS-No: F-E, S-D  
Proper shipping name: HEXANES  
Marine pollutant:yes

### IATA

UN number: 1208      Class: 3      Packing group: II  
Proper shipping name: Hexanes

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
n-Hexane	110-54-3	2007-07-01

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
n-Hexane	110-54-3	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
n-Hexane	110-54-3	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
n-Hexane	110-54-3	2007-07-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Asp. Tox.	Aspiration hazard
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H336	May cause drowsiness or dizziness.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure if swallowed.
H401	Toxic to aquatic life.
H411	Toxic to aquatic life with long lasting effects.
Repr.	Reproductive toxicity

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.6

Revision Date: 05/23/2016

Print Date: 06/21/2016

## SAFETY DATA SHEET

Version 3.8  
Revision Date 02/24/2016  
Print Date 04/30/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Hydrogen sulfide

Product Number : 295442  
Brand : Aldrich  
Index-No. : 016-001-00-4

CAS-No. : 7783-06-4

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable gases (Category 1), H220  
Gases under pressure (Liquefied gas), H280  
Acute toxicity, Inhalation (Category 2), H330  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H220 : Extremely flammable gas.  
H280 : Contains gas under pressure; may explode if heated.  
H330 : Fatal if inhaled.  
H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P210 : Keep away from heat/sparks/open flames/hot surfaces. No smoking.  
P260 : Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.  
P271 : Use only outdoors or in a well-ventilated area.

P273	Avoid release to the environment.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381	Eliminate all ignition sources if safe to do so.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P410 + P403	Protect from sunlight. Store in a well-ventilated place.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: H <sub>2</sub> S
Molecular weight	: 34.08 g/mol
CAS-No.	: 7783-06-4
EC-No.	: 231-977-3
Index-No.	: 016-001-00-4

#### Hazardous components

Component	Classification	Concentration
<b>Hydrogen sulphide</b>		
	Flam. Gas 1; Press. Gas Liquefied gas; Acute Tox. 2; Aquatic Acute 1; Aquatic Chronic 1; H220, H280, H330, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations.

Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Clean up promptly by sweeping or vacuum.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Moisture sensitive.

Storage class (TRGS 510): Gases

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Hydrogen sulphide	7783-06-4	CEIL	20.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
	Remarks	Z37.2-1966		
		Peak	50.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.2-1966		

		TWA	1.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		TWA	1 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		STEL	5 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		STEL	5.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation		
		C	10.000000 ppm 15.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		10 minute ceiling value		
		See Table Z-2		
		CEIL	20 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.2-1966		
		Peak	50 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.2-1966		

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

#### Splash contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |   |
|---|---|
| a) Appearance                                   | Form: Liquefied gas<br>Colour: colourless                       |
| b) Odour  | Stench.   |
| c) Odour Threshold                              | No data available   |
| d) pH   | No data available   |
| e) Melting point/freezing point                 | Melting point/range: -85 °C (-121 °F) - lit.                    |
| f) Initial boiling point and boiling range      | -60 °C (-76 °F) - lit.  |
| g) Flash point                                  | Not applicable  |
| h) Evaporation rate                             | No data available   |
| i) Flammability (solid, gas)                    | No data available   |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 46 %(V)<br>Lower explosion limit: 4 %(V) |
| k) Vapour pressure                              | 17,369.8 hPa (13,028.4 mmHg) at 21 °C (70 °F)                   |
| l) Vapour density                               | 1.17 - (Air = 1.0)  |
| m) Relative density                             | No data available   |
| n) Water solubility                             | No data available   |
| o) Partition coefficient: n-octanol/water       | No data available   |
| p) Auto-ignition temperature                    | No data available   |
| q) Decomposition temperature                    | No data available   |
| r) Viscosity                                    | No data available   |
| s) Explosive properties                         | No data available   |
| t) Oxidizing properties                         | No data available   |

**9.2 Other safety information**

Relative vapour density 1.17 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Strong oxidizing agents, Strong bases

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Sulphur oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LC50 Inhalation - Mouse - 1 h - 634 ppm

LC50 Inhalation - Rat - 444 ppm

Remarks: Lungs, Thorax, or Respiration:Other changes. Diarrhoea Kidney, Ureter, Bladder:Urine volume increased.

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

Reproductive toxicity - Rat - Inhalation

Effects on Newborn: Physical.

No data available

#### Specific target organ toxicity - single exposure

No data available



**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: MX1225000

Hydrogen sulfide is strongly bound to methemoglobin in a manner similar to cyanide. Toxicologically, its reaction with enzymes in the blood stream inhibits cell respiration resulting in pulmonary paralysis, sudden collapse, and death. It is recognized by its characteristic odor of "rotten eggs". The detectable, minimum perceptible odor occurs at 0.13ppm, rapid olfactory fatigue can occur at high concentrations (>100 ppm). At concentrations of 20ppm hydrogen sulfide begins acting as an irritant on the mucous membranes of the eyes and respiratory tract and increases with concentration and exposure time. Eye irritation is characterized by irritation of the conjunctiva with photophobia to keratoconjunctivitis and vesiculation of the cornea epithelium. Prolonged exposure to moderate concentrations (250ppm) may cause pulmonary edema. At concentrations over 500ppm, drowsiness, dizziness, excitement, headache, unstable gait, and other systemic symptoms occur within a few minutes. Sudden loss of consciousness without premonition, anxiety, or sense of struggle are characteristic of acute exposure at concentrations above 700ppm. At concentrations of 1000-2000ppm hydrogen sulfide is rapidly absorbed through the lung into the blood. In this range a single inhalation may cause coma and may be rapidly fatal. Initially hyperpnea occurs, followed by rapid collapse and respiratory inhibition. At higher concentrations, hydrogen sulfide exerts an immediate paralyzing effect on the respiratory centers. When concentration reaches 5000ppm, imminent death almost always results., Exposure to and/or consumption of alcohol may increase toxic effects.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish                      LC50 - Pimephales promelas (fathead minnow) - 0.016 mg/l - 96.0 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1053              Class: 2.3 (2.1)

Proper shipping name: Hydrogen sulfide

Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: Hazard zone D

#### IMDG

UN number: 1053      Class: 2.3 (2.1)  
Proper shipping name: HYDROGEN SULPHIDE  
Marine pollutant: yes

EMS-No: F-D, S-U

#### IATA

UN number: 1053      Class: 2.3 (2.1)  
Proper shipping name: Hydrogen sulphide  
IATA Passenger: Not permitted for transport  
IATA Cargo: Not permitted for transport

---

### 15. REGULATORY INFORMATION

#### SARA 302 Components

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Hydrogen sulphide	7783-06-4	1993-04-24

#### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Hydrogen sulphide	7783-06-4	1993-04-24

#### SARA 311/312 Hazards

Fire Hazard, Sudden Release of Pressure Hazard, Acute Health Hazard

#### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Hydrogen sulphide	7783-06-4	1993-04-24

#### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Hydrogen sulphide	7783-06-4	1993-04-24

#### New Jersey Right To Know Components

	CAS-No.	Revision Date
Hydrogen sulphide	7783-06-4	1993-04-24

#### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

### 16. OTHER INFORMATION

#### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Flam. Gas	Flammable gases
H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.
H330	Fatal if inhaled.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Press. Gas	Gases under pressure

#### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	
Flammability:	4

Physical Hazard 3

**NFPA Rating**

Health hazard: 4

Fire Hazard: 4

Reactivity Hazard: 0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation

Product Safety – Americas Region

1-800-521-8956

Version: 3.8

Revision Date: 02/24/2016

Print Date: 04/30/2016

## SAFETY DATA SHEET

Version 5.8  
Revision Date 05/27/2016  
Print Date 07/04/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Indeno[1,2,3-*cd*]pyrene

Product Number : 94377  
Brand : Sigma-Aldrich

CAS-No. : 193-39-5

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Carcinogenicity (Category 2), H351

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Warning

Hazard statement(s)  
H351 : Suspected of causing cancer.

Precautionary statement(s)  
P201 : Obtain special instructions before use.  
P202 : Do not handle until all safety precautions have been read and understood.  
P281 : Use personal protective equipment as required.  
P308 + P313 : IF exposed or concerned: Get medical advice/ attention.  
P405 : Store locked up.  
P501 : Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Formula : C<sub>22</sub>H<sub>12</sub>  
Molecular weight : 276.33 g/mol  
CAS-No. : 193-39-5  
EC-No. : 205-893-2

##### Hazardous components

Component	Classification	Concentration
Indeno[1,2,3-cd]pyrene	Carc. 2; H351	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

No data available

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Moisture sensitive.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Body Protection

Impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

##### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                    |                   |
|--------------------|-------------------|
| a) Appearance      | Form: solid       |
| b) Odour           | No data available |
| c) Odour Threshold | No data available |
| d) pH              | No data available |

e)	Melting point/freezing point	163.6 °C (326.5 °F)
f)	Initial boiling point and boiling range	536.0 °C (996.8 °F)
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

This product is or contains a component that has been reported to be possibly carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Indeno[1,2,3-cd]pyrene)

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Indeno[1,2,3-cd]pyrene)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: Reasonably anticipated to be a human carcinogen (Indeno[1,2,3-cd]pyrene)

NTP: Reasonably anticipated to be a human carcinogen (Indeno[1,2,3-cd]pyrene)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

No data available



**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

Not dangerous goods

**IMDG**

Not dangerous goods

**IATA**

Not dangerous goods

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Indeno[1,2,3-cd]pyrene	193-39-5	1993-04-24

**SARA 311/312 Hazards**

Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Indeno[1,2,3-cd]pyrene	193-39-5	1993-04-24

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Indeno[1,2,3-cd]pyrene	193-39-5	1993-04-24

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Indeno[1,2,3-cd]pyrene	193-39-5	1993-04-24

**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Indeno[1,2,3-cd]pyrene	193-39-5	2007-09-28

WARNING! This product contains a chemical known to the

CAS-No.	Revision Date
---------	---------------

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Carc.	Carcinogenicity
H351	Suspected of causing cancer.

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	1
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.8

Revision Date: 05/27/2016

Print Date: 07/04/2016

## SAFETY DATA SHEET

Version 4.3  
Revision Date 06/25/2014  
Print Date 05/01/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Iron

Product Number : 356824  
Brand : Aldrich

CAS-No. : 7439-89-6

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture**

Not a hazardous substance or mixture.

**2.2 GHS Label elements, including precautionary statements**

Not a hazardous substance or mixture.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Formula : Fe  
Molecular Weight : 55.85 g/mol  
CAS-No. : 7439-89-6  
EC-No. : 231-096-4

No ingredients are hazardous according to OSHA criteria.  
No components need to be disclosed according to the applicable regulations.

---

**4. FIRST AID MEASURES****4.1 Description of first aid measures****If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration.

**In case of skin contact**

Wash off with soap and plenty of water.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

no data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

**5.2 Special hazards arising from the substance or mixture**

Iron oxides

**5.3 Advice for firefighters**

Wear self contained breathing apparatus for fire fighting if necessary.

**5.4 Further information**

The product itself does not burn.

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Avoid dust formation. Avoid breathing vapours, mist or gas.

For personal protection see section 8.

**6.2 Environmental precautions**

No special environmental precautions required.

**6.3 Methods and materials for containment and cleaning up**

Sweep up and shovel. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters****Components with workplace control parameters**

Contains no substances with occupational exposure limit values.

**8.2 Exposure controls****Appropriate engineering controls**

General industrial hygiene practice.

## Personal protective equipment

### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

No special environmental precautions required.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |   |
|---|---|
| a) Appearance                                   | Form: Wire                                      |
| b) Odour  | no data available                               |
| c) Odour Threshold                              | no data available                               |
| d) pH   | no data available                               |
| e) Melting point/freezing point                 | Melting point/range: 1,535 °C (2,795 °F) - lit. |
| f) Initial boiling point and boiling range      | 2,750 °C (4,982 °F) - lit.                      |
| g) Flash point                                  | not applicable                                  |
| h) Evaporation rate                             | no data available                               |
| i) Flammability (solid, gas)                    | no data available                               |
| j) Upper/lower flammability or explosive limits | no data available                               |

- |    |  |   |
|----|--|---|
| k) | Vapour pressure                        | no data available                       |
| l) | Vapour density                         | no data available                       |
| m) | Relative density                       | 7.86 g/cm <sup>3</sup> at 25 °C (77 °F) |
| n) | Water solubility                       | insoluble                               |
| o) | Partition coefficient: n-octanol/water | no data available                       |
| p) | Auto-ignition temperature              | no data available                       |
| q) | Decomposition temperature              | no data available                       |
| r) | Viscosity                              | no data available                       |
| s) | Explosive properties                   | no data available                       |
| t) | Oxidizing properties                   | no data available                       |

## 9.2 Other safety information

no data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

no data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

no data available

### 10.4 Conditions to avoid

no data available

### 10.5 Incompatible materials

acids, Oxygen, Strong oxidizing agents, Halogens, Phosphorus

### 10.6 Hazardous decomposition products

Other decomposition products - no data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - rat - 30,000 mg/kg

Remarks: Nutritional and Gross Metabolic: Weight loss or decreased weight gain.

Inhalation: no data available

Dermal: no data available

no data available

#### Skin corrosion/irritation

no data available

#### Serious eye damage/eye irritation

no data available

#### Respiratory or skin sensitisation

no data available

#### Germ cell mutagenicity

no data available

## **Carcinogenicity**

Carcinogenicity - rat - Intratracheal

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Lungs, Thorax, or Respiration: Tumors.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

## **Reproductive toxicity**

no data available

no data available

## **Specific target organ toxicity - single exposure**

no data available

## **Specific target organ toxicity - repeated exposure**

no data available

## **Aspiration hazard**

no data available

## **Additional Information**

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

no data available

### **12.2 Persistence and degradability**

no data available

### **12.3 Bioaccumulative potential**

no data available

### **12.4 Mobility in soil**

no data available

### **12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### **12.6 Other adverse effects**

no data available

---

## **13. DISPOSAL CONSIDERATIONS**

### **13.1 Waste treatment methods**

#### **Product**

Offer surplus and non-recyclable solutions to a licensed disposal company.

#### **Contaminated packaging**

Dispose of as unused product.

---

## **14. TRANSPORT INFORMATION**

### **DOT (US)**

Not dangerous goods

**IMDG**

Not dangerous goods

**IATA**

Not dangerous goods

---

**15. REGULATORY INFORMATION**

**SARA 302 Components**

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

No SARA Hazards

**Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Iron	7439-89-6	

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Iron	7439-89-6	

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION**

**HMIS Rating**

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.3

Revision Date: 06/25/2014

Print Date: 05/01/2016







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## Safety Data Sheet

**Material Name:** Isobutylene

**SDS ID:** 00244392

### Section 1 - PRODUCT AND COMPANY IDENTIFICATION

**Material Name**

Isobutylene

**Synonyms**

2-Methylpropene; Isobutylene; Liquified petroleum gas; 2-Methyl-1-propene; L.P.G.; gamma-Butylene; Asym-dimethyl ethylene; UN 1055

**Chemical Family**

Hydrocarbons, aliphatic

**Product Description**

Classification determined in accordance with Compressed Gas Association standards.

**Product Use**

Industrial and Specialty Gas Applications.

**Restrictions on Use**

None known.

**Details of the supplier of the safety data sheet**

MATHESON TRI-GAS, INC.

150 Allen Road, Suite 302

Basking Ridge, NJ 07920

General Information: 1-800-416-2505

Emergency #: 1-800-424-9300 (CHEMTREC)

Outside the US: 703-527-3887 (Call collect)

### Section 2 - HAZARDS IDENTIFICATION

**Classification in accordance with paragraph (d) of 29 CFR 1910.1200.**

Flammable Gases - Category 1

Gases Under Pressure - Liquefied gas

**GHS Label Elements**

**Symbol(s)**



**Signal Word**

Danger

**Hazard Statement(s)**

Extremely flammable gas.

Contains gas under pressure; may explode if heated.

**Precautionary Statement(s)**

**Prevention**

Keep away from heat/sparks/open flame/hot surfaces - No smoking.

**Response**

Leaking gas fire: Do not extinguish, unless leak can be stopped safely.

Eliminate all ignition sources if safe to do so.

**Storage**

Protect from sunlight. Store in a well-ventilated place.



## Safety Data Sheet

**Material Name: Isobutylene****SDS ID: 00244392****Disposal**

Dispose in accordance with all applicable regulations.

**Other Hazards**

May cause frostbite upon sudden release of liquefied gas.

**Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS**

CAS	Component Name	Percent
115-11-7	Isobutylene	100

**Section 4 - FIRST AID MEASURES****Inhalation**

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**Skin**

If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115°F; 41-46°C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

**Eyes**

Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Then get immediate medical attention.

**Ingestion**

If swallowed, get medical attention.

**Most Important Symptoms/Effects****Acute**

frostbite

**Delayed**

No information on significant adverse effects.

**Note to Physicians**

For inhalation, consider oxygen.

**Section 5 - FIRE FIGHTING MEASURES****Extinguishing Media****Suitable Extinguishing Media**

carbon dioxide, regular dry chemical, Large fires: water spray or fog

**Unsuitable Extinguishing Media**

None known.

**Special Hazards Arising from the Chemical**

Extremely flammable gas. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point.

**Hazardous Combustion Products**

Oxides of carbon

**Fire Fighting Measures**

Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Do not direct water at source of leak or safety devices; icing may occur. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire.



## Safety Data Sheet

**Material Name: Isobutylene****SDS ID: 00244392**

For tank, rail car or tank truck: Evacuation radius: 1600 meters (1 mile). Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Consider downwind evacuation if material is leaking

**Special Protective Equipment and Precautions for Firefighters**

Wear full protective fire fighting gear including self contained breathing apparatus (SCBA) for protection against possible exposure.

### Section 6 - ACCIDENTAL RELEASE MEASURES

**Personal Precautions, Protective Equipment and Emergency Procedures**

Wear personal protective clothing and equipment, see Section 8.

**Methods and Materials for Containment and Cleaning Up**

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering.

**Environmental Precautions**

Avoid release to the environment.

### Section 7 - HANDLING AND STORAGE

**Precautions for Safe Handling**

Wash thoroughly after handling. Keep away from heat, sparks, open flame, and hot surfaces - No smoking. Avoid breathing gas. Use only outdoors or in a well-ventilated area.

**Conditions for Safe Storage, Including any Incompatibilities**

Protect from sunlight. Store in a well-ventilated place.

Store and handle in accordance with all current regulations and standards. Keep separated from incompatible substances.

**Incompatible Materials**

oxidizing materials

### Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

**Component Exposure Limits**

Isobutylene	115-11-7
ACGIH:	250 ppm TWA

**ACGIH - Threshold Limit Values - Biological Exposure Indices (BEI)**

There are no biological limit values for any of this product's components.

**Engineering Controls**

Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

**Individual Protection Measures, such as Personal Protective Equipment****Eye/face protection**

For the gas: Eye protection not required, but recommended. For the liquid: Wear splash resistant safety goggles. Contact lenses should not be worn. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**Skin Protection**

For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.



## Safety Data Sheet

**Material Name: Isobutylene****SDS ID: 00244392****Respiratory Protection**

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

**Glove Recommendations**

For the gas: Wear insulated gloves. For the liquid: Wear appropriate protective, cold insulating clothing.

**Section 9 - PHYSICAL AND CHEMICAL PROPERTIES**

<b>Appearance</b>	colorless gas	<b>Physical State</b>	gas
<b>Odor</b>	petroleum odor	<b>Color</b>	colorless
<b>Odor Threshold</b>	Not available	<b>pH</b>	Not available
<b>Melting Point</b>	-140 °C (-220 °F )	<b>Boiling Point</b>	-7 °C (19 °F )
<b>Boiling Point Range</b>	Not available	<b>Freezing point</b>	Not available
<b>Evaporation Rate</b>	Not available	<b>Flammability (solid, gas)</b>	Flammable gas
<b>Autoignition Temperature</b>	465 °C (869 °F )	<b>Flash Point</b>	-76 °C (-105 °F )
<b>Lower Explosive Limit</b>	Not available	<b>Decomposition temperature</b>	Not available
<b>Upper Explosive Limit</b>	Not available	<b>Vapor Pressure</b>	3278 mmHg @ 37.7 °C
<b>Vapor Density (air=1)</b>	1.9	<b>Specific Gravity (water=1)</b>	0.5879 at 25 °C
<b>Water Solubility</b>	(Insoluble, Almost )	<b>Partition coefficient: n-octanol/water</b>	Not available
<b>Viscosity</b>	Not available	<b>Kinematic viscosity</b>	Not available
<b>Solubility (Other)</b>	Not available	<b>Density</b>	Not available
<b>KOC</b>	450 (Estimated )	<b>Log KOW</b>	2.34
<b>Physical Form</b>	Liquefied gas	<b>Molecular Formula</b>	C4-H8
<b>Molecular Weight</b>	56.12		

**Solvent Solubility****Soluble**

organic solvents, alcohol, ether, sulfuric acid

**Section 10 - STABILITY AND REACTIVITY****Reactivity**

No reactivity hazard is expected.

**Chemical Stability**

Stable at normal temperatures and pressure.



## Safety Data Sheet

**Material Name: Isobutylene****SDS ID: 00244392****Possibility of Hazardous Reactions**

Will not polymerize.

**Conditions to Avoid**

Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Containers may rupture or explode if exposed to heat.

**Incompatible Materials**

oxidizing materials

**Hazardous decomposition products**

Oxides of carbon

**Section 11 - TOXICOLOGICAL INFORMATION****Information on Likely Routes of Exposure****Inhalation**

irritation, nausea, vomiting, headache, drowsiness, dizziness, loss of coordination, disorientation, tingling sensation, suffocation, convulsions, coma

**Skin Contact**

frostbite

**Eye Contact**

irritation, frostbite, blurred vision

**Ingestion**

frostbite

**Acute and Chronic Toxicity****Component Analysis - LD50/LC50**

The components of this material have been reviewed in various sources and the following selected endpoints are published:

**Isobutylene (115-11-7)**

Inhalation LC50 Rat 620 mg/L 4 h

**Product Toxicity Data****Acute Toxicity Estimate**

Inhalation - Gas	> 20000 ppm
------------------	-------------

**Immediate Effects**

frostbite

**Delayed Effects**

No information on significant adverse effects.

**Irritation/Corrosivity Data**

No human or animal test data available.

**Respiratory Sensitization**

No data available.

**Dermal Sensitization**

No data available.

**Component Carcinogenicity**

Isobutylene	115-11-7
ACGIH:	A4 - Not Classifiable as a Human Carcinogen

**Germ Cell Mutagenicity**

No data available.

**Tumorigenic Data**

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## Safety Data Sheet

**Material Name: Isobutylene****SDS ID: 00244392**

No data available

**Reproductive Toxicity**

No data available.

**Specific Target Organ Toxicity - Single Exposure**

No target organs identified.

**Specific Target Organ Toxicity - Repeated Exposure**

No target organs identified.

**Aspiration hazard**

Not applicable.

**Medical Conditions Aggravated by Exposure**

None known.

**Section 12 - ECOLOGICAL INFORMATION****Component Analysis - Aquatic Toxicity**

No LOLI ecotoxicity data are available for this product's components.

**Persistence and Degradability**

No information available for the product.

**Bioaccumulative Potential**

Bioconcentration potential in aquatic organisms is moderate based on a BCF value of 35.

**Mobility**

Expected to have moderate mobility in soil.

**Section 13 - DISPOSAL CONSIDERATIONS****Disposal Methods**

Dispose in accordance with all applicable regulations.

**Component Waste Numbers**

The U.S. EPA has not published waste numbers for this product's components.

**Section 14 - TRANSPORT INFORMATION****US DOT Information:****Shipping Name:** ISOBUTYLENE**Hazard Class:** 2.1**UN/NA #:** UN1055**Required Label(s):** 2.1**IMDG Information:****Shipping Name:** ISOBUTYLENE**Hazard Class:** 2.1**UN#:** UN1055**Required Label(s):** 2.1**International Bulk Chemical Code**

This material does not contain any chemicals required by the IBC Code to be identified as dangerous chemicals in bulk.

**Section 15 - REGULATORY INFORMATION****U.S. Federal Regulations**

None of this products components are listed under SARA Sections 302/304 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), or require an OSHA process safety plan.

**SARA Section 311/312 (40 CFR 370 Subparts B and C) reporting categories**

Flammable; Gas Under Pressure



## Safety Data Sheet

**Material Name: Isobutylene**

**SDS ID: 00244392**

### U.S. State Regulations

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA
Isobutylene	115-11-7	No	Yes	No	Yes	Yes

**Not listed under California Proposition 65**

### Canada Regulations

#### Canadian WHMIS Ingredient Disclosure List (IDL)

The components of this product are either not listed on the IDL or are present below the threshold limit listed on the IDL.

### Component Analysis - Inventory

#### Isobutylene (115-11-7)

US	CA	EU	AU	PH	JP - ENCS	JP - ISHL	KR KECI - Annex 1	KR KECI - Annex 2	KR - REACH CCA	CN	NZ	MX	TW	VN - NCI (Draft)
Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes

## Section 16 - OTHER INFORMATION

### NFPA Ratings

Health: 1 Fire: 4 Reactivity: 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

### Summary of Changes

Updated: 02/15/2017

### Key / Legend

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CA/MA/MN/NJ/PA - California/Massachusetts/Minnesota/New Jersey/Pennsylvania\*; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CFR - Code of Federal Regulations (US); CLP - Classification, Labelling, and Packaging; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSD - Dangerous Substance Directive; DSL - Domestic Substances List; EC - European Commission; EEC - European Economic Community; EIN - European Inventory of (Existing Commercial Chemical Substances); EINECS - European Inventory of Existing Commercial Chemical Substances; ENCS - Japan Existing and New Chemical Substance Inventory; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime Dangerous Goods; ISHL - Japan Industrial Safety and Health Law; IUCLID - International Uniform Chemical Information Database; JP - Japan; Kow - Octanol/water partition coefficient; KR KECI Annex 1 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR KECI Annex 2 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL) , KR - Korea; LD50/LC50 - Lethal Dose/ Lethal Concentration; LEL - Lower Explosive Limit; LLV - Level Limit Value; LOLI - List Of Lists™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; MX - Mexico; NDSL - Non-Domestic Substance List (Canada); NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health



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## Safety Data Sheet

**Material Name: Isobutylene****SDS ID: 00244392**

Administration; PEL- Permissible Exposure Limit; PH - Philippines; RCRA - Resource Conservation and Recovery Act; REACH- Registration, Evaluation, Authorisation, and restriction of Chemicals; RID - European Rail Transport; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TCCA – Korea Toxic Chemicals Control Act; TDG - Transportation of Dangerous Goods; TLV - Threshold Limit Value; TSCA - Toxic Substances Control Act; TW – Taiwan; TWA - Time Weighted Average; UEL - Upper Explosive Limit; UN/NA - United Nations /North American; US - United States; VLE - Exposure Limit Value (Mexico); VN NCI (Draft) - Vietnam National Chemicals Inventory (NCI) (Draft); WHMIS - Workplace Hazardous Materials Information System (Canada) .

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## SAFETY DATA SHEET

Version 4.5  
Revision Date 12/22/2015  
Print Date 04/30/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Isopropanol

Product Number : 563935

Brand : Sigma-Aldrich

CAS-No. : 67-63-0

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225

Eye irritation (Category 2A), H319

Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H225

Highly flammable liquid and vapour.

H319

Causes serious eye irritation.

H336

May cause drowsiness or dizziness.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.

P241

Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242

Use only non-sparking tools.

P243

Take precautionary measures against static discharge.

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

May form explosive peroxides.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.2 Mixtures

Synonyms : 2-Propanol solution  
IPA  
Isopropyl alcohol

Molecular weight : 60.1 g/mol

#### Hazardous components

Component		Classification	Concentration
<b>2-Propanol</b>			
CAS-No.	67-63-0	Flam. Liq. 2; Eye Irrit. 2A; STOT SE 3; H225, H319, H336	>= 70 - < 90 %
EC-No.	200-661-7		
Index-No.	603-117-00-0		

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Flammable liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
2-Propanol	67-63-0	TWA	200.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		

		TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	400 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	400.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	500.000000 ppm 1,225.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
2-Propanol	67-63-0	Acetone	40.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Splash contact  
Material: Nitrile rubber  
Minimum layer thickness: 0.11 mm  
Break through time: 33 min  
Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### **Body Protection**

Impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |                                    |
|---|------------------------------------|
| a) Appearance                                   | Form: liquid<br>Colour: colourless |
| b) Odour  | No data available                  |
| c) Odour Threshold                              | No data available                  |
| d) pH   | No data available                  |
| e) Melting point/freezing point                 | No data available                  |
| f) Initial boiling point and boiling range      | 80.9 - 83.2 °C (177.6 - 181.8 °F)  |
| g) Flash point                                  | 22.2 °C (72.0 °F) - closed cup     |
| h) Evaporation rate                             | No data available                  |
| i) Flammability (solid, gas)                    | No data available                  |
| j) Upper/lower flammability or explosive limits | No data available                  |
| k) Vapour pressure                              | No data available                  |
| l) Vapour density                               | No data available                  |
| m) Relative density                             | 0.858 g/cm <sup>3</sup>            |
| n) Water solubility                             | No data available                  |
| o) Partition coefficient: n-octanol/water       | No data available                  |
| p) Auto-ignition temperature                    | No data available                  |
| q) Decomposition temperature                    | No data available                  |

- r) Viscosity No data available
- s) Explosive properties No data available
- t) Oxidizing properties No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Aluminium, Acids, Oxidizing agents, Halogenated compounds, Acid anhydrides

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (2-Propanol)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

Central nervous system depression, prolonged or repeated exposure can cause: Nausea, Dizziness, narcosis, Drowsiness, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Kidney - Irregularities - Based on Human Evidence

Kidney - Irregularities - Based on Human Evidence (2-Propanol)

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1219 Class: 3

Packing group: II

Proper shipping name: Isopropanol

Reportable Quantity (RQ):

Poison Inhalation Hazard: No

**IMDG**

UN number: 1219 Class: 3

Packing group: II

EMS-No: F-E, S-D

Proper shipping name: ISOPROPANOL

**IATA**

UN number: 1219 Class: 3

Packing group: II

Proper shipping name: Isopropanol

---

**15. REGULATORY INFORMATION****SARA 302 Components**



No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

#### **SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

#### **SARA 311/312 Hazards**

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

#### **Massachusetts Right To Know Components**

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

#### **Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01
Water	7732-18-5	

#### **New Jersey Right To Know Components**

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01
Water	7732-18-5	

#### **California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## **16. OTHER INFORMATION**

#### **Full text of H-Statements referred to under sections 2 and 3.**

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
STOT SE	Specific target organ toxicity - single exposure

#### **HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

#### **NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

#### **Further information**

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#### **Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956



## SAFETY DATA SHEET

Version 5.9  
Revision Date 05/27/2016  
Print Date 06/20/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Isopropyl alcohol

Product Number : W292907  
Brand : Aldrich  
Index-No. : 603-117-00-0

CAS-No. : 67-63-0

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225

Eye irritation (Category 2A), H319

Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H225

Highly flammable liquid and vapour.

H319

Causes serious eye irritation.

H336

May cause drowsiness or dizziness.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.

P241

Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242

Use only non-sparking tools.

P243

Take precautionary measures against static discharge.

P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312	Call a POISON CENTER/doctor if you feel unwell.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

May form explosive peroxides.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : 2-Propanol  
sec-Propyl alcohol  
Isopropyl alcohol  
Isopropanol

Formula : C<sub>3</sub>H<sub>8</sub>O  
Molecular weight : 60.10 g/mol  
CAS-No. : 67-63-0  
EC-No. : 200-661-7  
Index-No. : 603-117-00-0

#### Hazardous components

Component	Classification	Concentration
<b>2-Propanol</b>		
	Flam. Liq. 2; Eye Irrit. 2A; STOT SE 3; H225, H319, H336	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Move out of dangerous area. Consult a physician. Show this safety data sheet to the doctor in attendance.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### **4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### **4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

### **5. FIREFIGHTING MEASURES**

#### **5.1 Extinguishing media**

##### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### **5.2 Special hazards arising from the substance or mixture**

No data available

#### **5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

#### **5.4 Further information**

Use water spray to cool unopened containers.

---

### **6. ACCIDENTAL RELEASE MEASURES**

#### **6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

#### **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

#### **6.3 Methods and materials for containment and cleaning up**

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

#### **6.4 Reference to other sections**

For disposal see section 13.

---

### **7. HANDLING AND STORAGE**

#### **7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

#### **7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Handle and store under inert gas. hygroscopic

#### **7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **8.1 Control parameters**

**Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
2-Propanol	67-63-0	TWA	200.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	400 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	400.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	500.000000 ppm 1,225.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		PEL	400 ppm 980 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	500 ppm 1,225 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
2-Propanol	67-63-0	Acetone	40.0000	Urine	ACGIH - Biological

			mg/l		Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 60 min

Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                                 |  |
|---------------------------------|--|
| a) Appearance                   | Form: liquid<br>Colour: colourless               |
| b) Odour                        | alcohol-like                                     |
| c) Odour Threshold              | No data available                                |
| d) pH                           | No data available                                |
| e) Melting point/freezing point | Melting point/range: -89.5 °C (-129.1 °F) - lit. |
| f) Initial boiling point and    | 82 °C (180 °F) - lit.                            |

boiling range

- |   |  |
|---|--|
| g) Flash point                                  | 12.0 °C (53.6 °F) - closed cup   |
| h) Evaporation rate                             | 3.0  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 12.7 %(V)<br>Lower explosion limit: 2 %(V)                      |
| k) Vapour pressure                              | 43.2 hPa (32.4 mmHg) at 20.0 °C (68.0 °F)<br>58.7 hPa (44.0 mmHg) at 25.0 °C (77.0 °F) |
| l) Vapour density                               | No data available  |
| m) Relative density                             | 0.785 g/cm <sup>3</sup> at 25 °C (77 °F)   |
| n) Water solubility                             | completely soluble   |
| o) Partition coefficient: n-octanol/water       | log Pow: 0.05  |
| p) Auto-ignition temperature                    | 425.0 °C (797.0 °F)  |
| q) Decomposition temperature                    | No data available  |
| r) Viscosity                                    | No data available  |
| s) Explosive properties                         | No data available  |
| t) Oxidizing properties                         | No data available  |

## 9.2 Other safety information

Surface tension 20.8 mN/m at 25.0 °C (77.0 °F)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Test for peroxide formation before distillation or evaporation. Test for peroxide formation or discard after 1 year.  
Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

### 10.5 Incompatible materials

Oxidizing agents, Acid anhydrides, Aluminium, Halogenated compounds, Acids

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides  
Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 5,045 mg/kg

Remarks: Behavioral: Altered sleep time (including change in righting reflex). Behavioral: Somnolence (general depressed activity).



LC50 Inhalation - Rat - 8 h - 16000 ppm

LD50 Dermal - Rabbit - 12,800 mg/kg

No data available

**Skin corrosion/irritation**

Skin - Rabbit

Result: Mild skin irritation

**Serious eye damage/eye irritation**

Eyes - Rabbit

Result: Eye irritation - 24 h

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

Inhalation, Oral - May cause drowsiness or dizziness.

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: NT8050000

Central nervous system depression, prolonged or repeated exposure can cause:, Nausea, Headache, Vomiting, narcosis, Drowsiness, Overexposure may cause mild, reversible liver effects., Aspiration may lead to:, Lung oedema, Pneumonia

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Kidney - Irregularities - Based on Human Evidence

Kidney - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 9,640.00 mg/l - 96 h

Toxicity to daphnia and other aquatic EC50 - Daphnia magna (Water flea) - 5,102.00 mg/l - 24 h

invertebrates

Immobilization EC50 - Daphnia magna (Water flea) - 6,851 mg/l - 24 h

Toxicity to algae EC50 - Desmodesmus subspicatus (green algae) - > 2,000.00 mg/l - 72 h

EC50 - Algae - > 1,000.00 mg/l - 24 h

## 12.2 Persistence and degradability

No data available

## 12.3 Bioaccumulative potential

No bioaccumulation is to be expected (log Pow <= 4).

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

No data available

---

# 13. DISPOSAL CONSIDERATIONS

## 13.1 Waste treatment methods

### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

### Contaminated packaging

Dispose of as unused product.

---

# 14. TRANSPORT INFORMATION

## DOT (US)

UN number: 1219      Class: 3      Packing group: II  
Proper shipping name: Isopropanol  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

## IMDG

UN number: 1219      Class: 3      Packing group: II      EMS-No: F-E, S-D  
Proper shipping name: ISOPROPANOL

## IATA

UN number: 1219      Class: 3      Packing group: II  
Proper shipping name: Isopropanol

---

# 15. REGULATORY INFORMATION

## SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

## SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

## SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

## Massachusetts Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

## Pennsylvania Right To Know Components

2-Propanol

CAS-No.  
67-63-0

Revision Date  
1987-01-01

## New Jersey Right To Know Components

2-Propanol

CAS-No.  
67-63-0

Revision Date  
1987-01-01

## California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
STOT SE	Specific target organ toxicity - single exposure

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.9

Revision Date: 05/27/2016

Print Date: 06/20/2016

## SAFETY DATA SHEET

Version 4.7  
Revision Date 12/28/2015  
Print Date 05/01/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead

Product Number : 695912

Brand : Aldrich

CAS-No. : 7439-92-1

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302

Carcinogenicity (Category 2), H351

Reproductive toxicity (Category 2), H361

Specific target organ toxicity - repeated exposure (Category 2), H373

Acute aquatic toxicity (Category 1), H400

Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H302 Harmful if swallowed.

H351 Suspected of causing cancer.

H361 Suspected of damaging fertility or the unborn child.

H373 May cause damage to organs through prolonged or repeated exposure.

H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 Obtain special instructions before use.

P202 Do not handle until all safety precautions have been read and

	understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: Pb
Molecular weight	: 207.20 g/mol
CAS-No.	: 7439-92-1
EC-No.	: 231-100-4

#### Hazardous components

Component	Classification	Concentration
<b>Lead</b>		
	Acute Tox. 4; Carc. 2; Repr. 2; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H361, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

## 5.2 Special hazards arising from the substance or mixture

Lead oxides

## 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	See 1910.1025		
Lead	7439-92-1	TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		

		TWA	0.05 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lead	7439-92-1	Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: Shot
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 327.4 °C (621.3 °F) - lit.
f) Initial boiling point and boiling range	1,740 °C (3,164 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong acids

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5



---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Rat

Cytogenetic analysis

#### Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Lead)

NTP: Reasonably anticipated to be a human carcinogen (Lead)

Reasonably anticipated to be a human carcinogen The reference note has been added by TD based on the background information of the NTP. (Lead)

OSHA: 1910.1025 (Lead)

OSHA specifically regulated carcinogen (Lead)

#### Reproductive toxicity

Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation

Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - Rat - Oral

Effects on Newborn: Behavioral.

Reproductive toxicity - Mouse - Oral

Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated ). Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea).

Developmental Toxicity - Rat - Inhalation

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow).

Developmental Toxicity - Rat - Oral

Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow). Effects on Newborn: Growth statistics (e.g., reduced weight gain).

Developmental Toxicity - Rat - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Developmental Toxicity - Mouse - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

#### Specific target organ toxicity - single exposure

No data available

**Specific target organ toxicity - repeated exposure**

May cause damage to organs through prolonged or repeated exposure.

**Aspiration hazard**

No data available

**Additional Information**

RTECS: OF7525000

anemia

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish	mortality LOEC - Oncorhynchus mykiss (rainbow trout) - 1.19 mg/l - 96.0 h
	LC50 - Micropterus dolomieu - 2.2 mg/l - 96.0 h
	mortality NOEC - Salvelinus fontinalis - 1.7 mg/l - 10.0 d
Toxicity to daphnia and other aquatic invertebrates	mortality LOEC - Daphnia (water flea) - 0.17 mg/l - 24 h
	mortality NOEC - Daphnia (water flea) - 0.099 mg/l - 24 h
Toxicity to algae	mortality EC50 - Skeletonema costatum - 7.94 mg/l - 10 d

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

Bioaccumulation	Oncorhynchus kisutch - 2 Weeks - 150 µg/l
	Bioconcentration factor (BCF): 12

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 3077	Class: 9	Packing group: III
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Lead)		
Reportable Quantity (RQ): 10 lbs		

Poison Inhalation Hazard: No

#### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead)  
Marine pollutant: yes

#### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead)

#### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

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### 15. REGULATORY INFORMATION

#### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

#### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

#### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

#### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

#### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

#### New Jersey Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

#### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Lead	7439-92-1	1989-07-10

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

	CAS-No.	Revision Date
Lead	7439-92-1	1989-07-10

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### 16. OTHER INFORMATION

#### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.

H400 Very toxic to aquatic life.  
H410 Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard: 1  
Chronic Health Hazard: \*  
Flammability: 0  
Physical Hazard 0

**NFPA Rating**

Health hazard: 1  
Fire Hazard: 0  
Reactivity Hazard: 0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 12/28/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.6  
Revision Date 08/13/2014  
Print Date 05/01/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Magnesium

Product Number : 465666  
Brand : Sigma-Aldrich  
Index-No. : 012-001-00-3

CAS-No. : 7439-95-4

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Pyrophoric solids (Category 1), H250

Substances and mixtures, which in contact with water, emit flammable gases (Category 1), H260

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H250

Catches fire spontaneously if exposed to air.

H260

In contact with water releases flammable gases which may ignite spontaneously.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P222

Do not allow contact with air.

P223

Keep away from any possible contact with water, because of violent reaction and possible flash fire.

P231 + P232

Handle under inert gas. Protect from moisture.

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.

P335 + P334

Brush off loose particles from skin. Immerse in cool water/ wrap in wet

P370 + P378	bandages. In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P402 + P404	Store in a dry place. Store in a closed container.
P422	Store contents under inert gas.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Combustible dust

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: Mg
Molecular weight	: 24.31 g/mol
CAS-No.	: 7439-95-4
EC-No.	: 231-104-6
Index-No.	: 012-001-00-3

#### Hazardous components

Component	Classification	Concentration
<b>Magnesium</b>		
	Pyr. Sol. 1; Water-react. 1; H250, H260	90 - 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Dry powder

### 5.2 Special hazards arising from the substance or mixture

Magnesium oxide

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Do not flush with water. Keep in suitable, closed containers for disposal. Contain spillage, pick up with an electrically protected vacuum cleaner or by wet-brushing and transfer to a container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed. Keep away from sources of ignition - No smoking.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Never allow product to get in contact with water during storage.

Keep in a dry place.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Protective gloves against thermal risks

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

Splash contact  
Material: Nitrile rubber  
Minimum layer thickness: 0.11 mm  
Break through time: 480 min  
Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |   |
|---|---|
| a) Appearance                                   | Form: powder  |
| b) Odour  | No data available   |
| c) Odour Threshold                              | No data available   |
| d) pH   | No data available   |
| e) Melting point/freezing point                 | Melting point/range: 648 °C (1,198 °F) - lit.               |
| f) Initial boiling point and boiling range      | 1,090 °C (1,994 °F) - lit.                                  |
| g) Flash point                                  | No data available   |
| h) Evaporation rate                             | No data available   |
| i) Flammability (solid, gas)                    | May form combustible dust concentrations in air             |
| j) Upper/lower flammability or explosive limits | No data available   |
| k) Vapour pressure                              | 1 hPa (1 mmHg) at 621 °C (1,150 °F)                         |
| l) Vapour density                               | No data available   |
| m) Relative density                             | 1.74 g/mL at 25 °C (77 °F)                                  |
| n) Water solubility                             | No data available   |
| o) Partition coefficient: n-octanol/water       | No data available   |
| p) Auto-ignition temperature                    | The substance or mixture is pyrophoric with the category 1. |
| q) Decomposition temperature                    | No data available   |
| r) Viscosity                                    | No data available   |



- s) Explosive properties      No data available
- t) Oxidizing properties      No data available

## **9.2 Other safety information**

No data available

---

## **10. STABILITY AND REACTIVITY**

### **10.1 Reactivity**

No data available

### **10.2 Chemical stability**

Stable under recommended storage conditions.

### **10.3 Possibility of hazardous reactions**

Reacts violently with water.

### **10.4 Conditions to avoid**

Exposure to moisture.

### **10.5 Incompatible materials**

Strong oxidizing agents, acids, Acid chlorides, Halogens

### **10.6 Hazardous decomposition products**

Other decomposition products - No data available

In the event of fire: see section 5

---

## **11. TOXICOLOGICAL INFORMATION**

### **11.1 Information on toxicological effects**

#### **Acute toxicity**

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### **Skin corrosion/irritation**

No data available

#### **Serious eye damage/eye irritation**

No data available

#### **Respiratory or skin sensitisation**

No data available

#### **Germ cell mutagenicity**

No data available

#### **Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### **Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: OM2100000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Liver - Irregularities - Based on Human Evidence

Liver - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1418      Class: 4.3 (4.2)      Packing group: II

Proper shipping name: Magnesium, powder

Reportable Quantity (RQ):

Marine pollutant: No

Poison Inhalation Hazard: No

**IMDG**

UN number: 1418      Class: 4.3 (4.2)      Packing group: II      EMS-No: F-G, S-O

Proper shipping name: MAGNESIUM POWDER

Marine pollutant: No

**IATA**

UN number: 1418      Class: 4.3 (4.2)      Packing group: II

Proper shipping name: Magnesium powder

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Reactivity Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Magnesium	7439-95-4	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Magnesium	7439-95-4	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Magnesium	7439-95-4	1993-04-24

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

H250	Catches fire spontaneously if exposed to air.
H260	In contact with water releases flammable gases which may ignite spontaneously.
Pyr. Sol.	Pyrophoric solids
Water-react.	Substances and mixtures, which in contact with water, emit flammable gases

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	1

### NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	1
Special hazard.I:	W

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956



## SAFETY DATA SHEET

Version 4.6  
Revision Date 10/09/2015  
Print Date 05/01/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Manganese

Product Number : 266167  
Brand : Aldrich

CAS-No. : 7439-96-5

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute aquatic toxicity (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram none

Signal word none

Hazard statement(s)  
H401 Toxic to aquatic life.

Precautionary statement(s)  
P273 Avoid release to the environment.  
P501 Dispose of contents/ container to an approved waste disposal plant.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Formula : Mn  
Molecular weight : 54.94 g/mol  
CAS-No. : 7439-96-5  
EC-No. : 231-105-1

**Hazardous components**

Component	Classification	Concentration
<b>Manganese</b>		
	Aquatic Acute 2; H401	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Manganese/manganese oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Moisture sensitive. Handle and store under inert gas.

Storage class (TRGS 510): Non Combustible Solids

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

# 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

## 8.1 Control parameters

### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Manganese	7439-96-5	TWA	0.200000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC)		
		C	5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Ceiling limit is to be determined from breathing-zone air samples.		
		C	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Ceiling limit is to be determined from breathing-zone air samples.		
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	3.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	3.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Ceiling limit is to be determined from breathing-zone air samples.		
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	3.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.200000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) varies		
		TWA	0.100000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment 2015 Adoption varies		

		TWA	0.020000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment 2015 Adoption varies		
		TWA	0.1 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment varies		
		TWA	0.02 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment varies		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: chips<br>Colour: grey, brown, silver      |
| b) Odour                                   | odourless                                       |
| c) Odour Threshold                         | No data available                               |
| d) pH                                      | No data available                               |
| e) Melting point/freezing point            | Melting point/range: 1,244 °C (2,271 °F) - lit. |
| f) Initial boiling point and boiling range | 1,962 °C (3,564 °F) - lit.                      |
| g) Flash point                             | Not applicable                                  |
| h) Evaporation rate                        | No data available                               |
| i) Flammability (solid, gas)               | No data available                               |



j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	7.3 g/mL at 25 °C (77 °F)
n)	Water solubility	0.0007 g/l at 20 °C (68 °F) - slightly soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Avoid moisture.

### 10.5 Incompatible materials

acids, Halogens, Bases, Phosphorus, Sulphur oxides, Hydrogen peroxide, Oxidizing agents, Nitric acid, Sodium Hydroxide, Carbon dioxide (CO<sub>2</sub>), Nitryl Flouride, Steam

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - female - > 2,000 mg/kg  
(OECD Test Guideline 420)

LC50 Inhalation - Rat - male and female - 4 h - > 5.14 mg/l  
(OECD Test Guideline 403)

Dermal: No data available

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation  
(OECD Test Guideline 404)

**Serious eye damage/eye irritation**

Eyes - Rabbit

Result: No eye irritation - 72 h

(OECD Test Guideline 405)

**Respiratory or skin sensitisation**

- Mouse

Result: Does not cause skin sensitisation.

(OECD Test Guideline 429)

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

Men exposed to manganese dusts showed a decrease in fertility. Chronic manganese poisoning primarily involves the central nervous system. Early symptoms include languor, sleepiness and weakness in the legs. A stolid mask-like appearance of the face, emotional disturbances such as uncontrollable laughter and a spastic gait with tendency to fall in walking are findings in more advanced cases. High incidence of pneumonia has been found in workers exposed to the dust or fume of some manganese compounds., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish	semi-static test NOEC - Oncorhynchus mykiss (rainbow trout) - 3.6 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	Immobilization NOEC - Daphnia magna (Water flea) - 1.6 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	Growth inhibition EC50 - Desmodesmus subspicatus (Scenedesmus subspicatus) - 4.5 mg/l - 72 h (OECD Test Guideline 201)
Toxicity to bacteria	Respiration inhibition EC50 - Sludge Treatment - 1,000 mg/l - 3 h (OECD Test Guideline 209)

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

Not dangerous goods

**IMDG**

Not dangerous goods

**IATA**

Not dangerous goods

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Manganese	7439-96-5	2007-07-01

**SARA 311/312 Hazards**

Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Manganese	7439-96-5	2007-07-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Manganese	7439-96-5	2007-07-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Manganese	7439-96-5	2007-07-01

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute H401	Acute aquatic toxicity Toxic to aquatic life.
-----------------------	--

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.6

Revision Date: 10/09/2015

Print Date: 05/01/2016



# Material Safety Data Sheet

Catalog Number: 214121  
Revision date: 25-Apr-2006

## 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY INFORMATION

Catalog Number: 214121

Product name: m-DICHLOROBENZENE

**Supplier:**

MP Biomedicals, LLC  
29525 Fountain Parkway  
Solon, OH 44139  
tel: 440-337-1200

Emergency telephone number: CHEMTREC: 1-800-424-9300 (1-703-527-3887)

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA Exposure Limits:
m-DICHLOROBENZENE	541-73-1	90 - 100%	None	None

## 3. HAZARDS IDENTIFICATION

**EMERGENCY OVERVIEW:** Harmful by inhalation, in contact with skin and if swallowed., Combustible material, Harmful to flora, fauna, soil organisms and aquatic organisms.

**Category of Danger:**

Harmful , Dangerous for the environment

**Principle routes of exposure:** Skin

**Inhalation:** Harmful by inhalation.

**Ingestion:** Harmful if swallowed.

**Skin contact:** Harmful in contact with skin.

**Eye contact:** Risk of serious damage to eyes

**Statements of hazard** HARMFUL IF SWALLOWED. MAY BE HARMFUL IF ABSORBED THROUGH SKIN OR INHALED.

COMBUSTIBLE MATERIAL AND VAPOR.

**Statement of Spill or Leak - ANSI Label** Eliminate all ignition sources. Absorb and/or contain spill with inert materials (e.g., sand, vermiculite). Then place in appropriate container. For large spills, use water spray to disperse vapors, flush spill area. Prevent runoff from entering waterways or sewers.

**Precautions - ANSI Label** Keep away from heat, sparks and flame. Keep containers closed. Use only with adequate ventilation.

## 4. FIRST AID MEASURES

**General advice:** In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

**Inhalation:** Move to fresh air. Call a physician immediately.

**Skin contact:** Rinse immediately with plenty of water and seek medical advice

**Ingestion:** Do not induce vomiting without medical advice.

**Eye contact:** In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

**Protection of first-aiders:** No information available

**Medical conditions aggravated by exposure:** None known

## 5. FIRE FIGHTING MEASURES

**Suitable extinguishing media:**

**Extinguishing media which must not be used for safety reasons:**

**Specific hazards:**

**Unusual hazards:**

**Special protective equipment for firefighters:**

Use water spray (fog), foam, dry chemical or CO<sub>2</sub>.

Do not use a solid water stream as it may scatter and spread fire.

Flammable

None known

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

Water mist may be used to cool closed containers.

**Specific methods:**

**Flash point:**

65 °C (method not stated)

**Autoignition temperature:**

> 500 °C

**NFPA rating:**

NFPA Health: 1

NFPA Flammability: 1

NFPA Reactivity: 0

## 6. ACCIDENTAL RELEASE MEASURES

**Personal precautions:**

Remove all sources of ignition. Use personal protective equipment.

**Environmental precautions:**

Do not flush into surface water or sanitary sewer system.

**Methods for cleaning up:**

Soak up with inert absorbent material.

## 7. HANDLING AND STORAGE

**Storage:**

ROOM TEMPERATURE

**Handling:**

Use only in area provided with appropriate exhaust ventilation.

**Safe handling advice:**

Wear personal protective equipment.

**Technical measures/storage conditions:**

Keep away from heat and sources of ignition

**Incompatible products:**

Oxidising and spontaneously flammable products

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**Engineering measures:** Ensure adequate ventilation.

**PERSONAL PROTECTIVE EQUIPMENT**

**Respiratory protection:** Breathing apparatus only if aerosol or dust is formed.

**Hand protection:** Pvc or other plastic material gloves

**Skin and body protection:** Usual safety precautions while handling the product will provide adequate protection against this potential effect.

**Eye protection:** Safety glasses with side-shields

**Hygiene measures:** Handle in accordance with good industrial hygiene and safety practice.



## 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Physical state:</b>	Liquid
<b>Formula:</b>	C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub>
<b>Molecular weight:</b>	147
<b>Melting point/range:</b>	-25.5 °C
<b>Boiling point/range:</b>	173 °C at 1013 hPa
<b>Density:</b>	1.29 g/cm <sup>3</sup> at 20 °C
<b>Vapor pressure:</b>	1.8 hPa at 20 °C
<b>Evaporation rate:</b>	No data available
<b>Vapor density:</b>	No data available
<b>Solubility (in water):</b>	Slightly soluble
<b>Flash point:</b>	65 °C (method not stated)
<b>Autoignition temperature:</b>	> 500 °C

## 10. STABILITY AND REACTIVITY

<b>Stability:</b>	Stable under recommended storage conditions.
<b>Polymerization:</b>	None under normal processing.
<b>Hazardous decomposition products:</b>	Chloride/Hydrochloric acid
<b>Materials to avoid:</b>	-
Forms explosive mixture with air. Incompatible with strong oxidizers, alkali metals (lithium, sodium, potassium, rubidium, cesium, francium...).	
<b>Conditions to avoid:</b>	Exposure to air or moisture over prolonged periods.

## 11. TOXICOLOGICAL INFORMATION

### Product Information

#### Acute toxicity

##### Components

m-DICHLOROBENZENE

##### RTECS Number:

CZ4499000

##### Selected LD50s and LC50s

Not Determined

<b>Chronic toxicity:</b>	Chronic exposure may cause nausea and vomiting, higher exposure causes unconsciousness.
<b>Local effects:</b>	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.
<b>Specific effects:</b>	May include moderate to severe erythema (redness) and moderate edema (raised skin), nausea, vomiting, headache.
<b>Primary irritation:</b>	No data is available on the product itself.
<b>Carcinogenic effects:</b>	No data is available on the product itself.
<b>Mutagenic effects:</b>	No data is available on the product itself.
<b>Reproductive toxicity:</b>	No data is available on the product itself.

## 12. ECOLOGICAL INFORMATION

<b>Mobility:</b>	No data available
<b>Bioaccumulation:</b>	No data available
<b>Ecotoxicity effects:</b>	No data available
<b>Aquatic toxicity:</b>	May cause long-term adverse effects in the aquatic environment.

##### Components

m-DICHLOROBENZENE

##### U.S. DOT - Appendix B - Marine Pollutan

DOT regulated marine pollutant

##### U.S. DOT - Appendix B - Severe Marine Pollutants

Not Listed

##### United Kingdom - The Red List:

Not Listed

<b>Components</b>	<b>Germany VCI (WGK)</b>	<b>World Health Organization (WHO) - Drinking Water</b>	<b>Ecotoxicity - Fish Species Data</b>
m-DICHLOROBENZENE	2	Inadequate data	Not Listed
<b>Components</b>	<b>Ecotoxicity - Freshwater Algae Data</b>	<b>Ecotoxicity - Microtox Data</b>	<b>Ecotoxicity - Water Flea Data</b>
m-DICHLOROBENZENE	Not Listed	EC50 (5,15,30 min) Photobacterium phosphoreum:3.29 - 5.10 mg/L Microtox test:15 °C	Not Listed
<b>Components</b>	<b>EPA - ATSDR Priority List</b>	<b>EPA - HPV Challenge Program Chemical List</b>	<b>California - Priority Toxic Pollutants</b>
m-DICHLOROBENZENE	Rank (of 275): 201	indicator 0; Fully sponsored	Not Listed
<b>Components</b>	<b>California - Priority Toxic Pollutants</b>	<b>California - Priority Toxic Pollutants</b>	
m-DICHLOROBENZENE	Water and organisms = 400 ug/L; organisms only = 2,600 ug/L	Water and organisms = 400 ug/L; organisms only = 2,600 ug/L	

### 13. DISPOSAL CONSIDERATIONS

#### Waste from residues / unused products:

Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority. Residue from fires extinguished with this material may be hazardous.

#### Contaminated packaging: Methods for cleaning up:

Do not re-use empty containers  
Soak up with inert absorbent material.

### 14. TRANSPORT INFORMATION

#### UN/Id No:

2810

#### DOT:

#### Proper shipping name: IATA Hazard Label(s): Hazard Class

Toxic liquid, organic, n.o.s.

Toxic

6.1 -

Toxic substances - oral

#### Packing group:

III

#### Emergency Response Guide Number (ERG):

153

#### Components

m-DICHLOROBENZENE

#### U.S. DOT - Appendix A Table 1 - Reportable Quantities

RQ = 100 pounds (45.4 kg); also listed as Benzene, 1,3-dichloro-; also listed as m-Dichlorobenzene

#### TDG (Canada):

#### WHMIS hazard class:

D1b toxic materials



:

#### IMDG/IMO



Proper shipping name:

Toxic liquid, organic, n.o.s.

IMDG - Hazard Classifications

Not Applicable

## Components

## U.S. DOT - Appendix B - Marine Pollutan

## U.S. DOT - Appendix B - Severe Marine Pollutants

m-DICHLOROBENZENE

DOT regulated marine pollutant

Not Listed

IMO-labels:

## 15. REGULATORY INFORMATION

## International Inventories

## Components

m-DICHLOROBENZENE

Inventory - United States TSCA - Sect. 8(b)

Present

Canada DSL Inventory List -

Present

Australia (AICS):

Present

Inventory - China:

Present

EU EINECS List -

208-792-1; C6H4Cl2

Inventory - Japan:

3-41

Korean KECL:

KE-10067

Philippines PICCS:

Present

U.S. regulations:

## Components

m-DICHLOROBENZENE

California Proposition 65

- Not Listed

Massachusetts Right to Know List: [present]

New Jersey Right to Know List: sn 2301

Pennsylvania Right to Know List: environmental hazard

## Components

m-DICHLOROBENZENE

Florida substance List:

Not Listed

Rhode Island Right to Know List: Not Listed

Illinois - Toxic Air Contaminants Not Listed

Connecticut - Hazardous Air Pollutants Not Listed

## Components

m-DICHLOROBENZENE

SARA 313 Emission reporting/Toxic Release of Chemicals

form R reporting required for 1.0% de minimis concentration

CERCLA/SARA - Section 302 Extremely Haz

Not Listed

NTP:

None

IARC:

None

## SARA 313 Notification:

The above is your notification as to the SARA 313 listing for this product(s) pursuant to Section 313 of Title III of the Superfund Ammendments and Reauthorization Act of 1986 and 40 CFR Part 372.

If you are unsure if you are subject to the reporting requirements of Section 313, or need more information, please call the EPA Emergency Planning and Community Right-To-Know Information Hotline: (800) 535-0202 or (202) 479-2499 (in Washington, DC or Alaska).

## State Notification:

The above information is your notice as to the Right-to-Know listings of the stated product(s). Individual states will list chemicals for a variety of reasons including, but not limited to, the compounds toxicity; carcinogenic, tumorigenic and/or reproductive hazards; and the compounds environmental impact if accidentally released.

**16. OTHER INFORMATION**

**Prepared by:** Health & Safety

**Disclaimer:** The information and recommendations contained herein are based upon tests believed to be reliable. However, MP Biomedicals does not guarantee the accuracy or completeness NOR SHALL ANY OF THIS INFORMATION CONSTITUTE A WARRANTY, WHETHER EXPRESSED OR IMPLIED, AS TO THE SAFETY OF THE GOODS, THE MERCHANTABILITY OF THE GOODS, OR THE FITNESS OF THE GOODS FOR A PARTICULAR PURPOSE. Adjustment to conform to actual conditions of usage maybe required. MP Biomedicals assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied.

**End of Safety Data Sheet**

## SAFETY DATA SHEET

Version 3.12  
Revision Date 12/02/2015  
Print Date 05/01/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Mercury

Product Number : 215457  
Brand : Sigma-Aldrich  
Index-No. : 080-001-00-0

CAS-No. : 7439-97-6

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Inhalation (Category 2), H330  
Reproductive toxicity (Category 1B), H360  
Specific target organ toxicity - repeated exposure (Category 1), H372  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H330 Fatal if inhaled.  
H360 May damage fertility or the unborn child.  
H372 Causes damage to organs through prolonged or repeated exposure.  
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and understood.

P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: Hg
Molecular weight	: 200.59 g/mol
CAS-No.	: 7439-97-6
EC-No.	: 231-106-7
Index-No.	: 080-001-00-0

#### Hazardous components

Component	Classification	Concentration
<b>Mercury</b>		
	Acute Tox. 2; Repr. 1B; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H330, H360, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Mercury/mercury oxides.

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal. In some instances, a mercury spill kit may be used. Please consult with your site EHS representative to determine the most appropriate clean up method. Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Store under inert gas.

Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Mercury	7439-97-6	C	0.1 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits
	Remarks	Potential for dermal absorption		

		CEIL	1.0mg/10m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	0.05 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		Skin notation		
		TWA	0.025 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen Danger of cutaneous absorption		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Mercury	7439-97-6	Mercury	0.0400 mg/g	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to shift (16 hours after exposure ceases)			
		Mercury	15.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |  |
|---|--|
| a) Appearance                                   | Form: liquid<br>Colour: silver, white  |
| b) Odour  | odourless  |
| c) Odour Threshold                              | No data available  |
| d) pH   | No data available  |
| e) Melting point/freezing point                 | Melting point/range: -38.87 °C (-37.97 °F) - lit.                              |
| f) Initial boiling point and boiling range      | 356.6 °C (673.9 °F) - lit.   |
| g) Flash point                                  | Not applicable   |
| h) Evaporation rate                             | No data available  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | No data available  |
| k) Vapour pressure                              | < 0.01 hPa (< 0.01 mmHg) at 20 °C (68 °F)<br>1 hPa (1 mmHg) at 126 °C (259 °F) |
| l) Vapour density                               | 6.93 - (Air = 1.0)   |
| m) Relative density                             | 13.55 g/cm <sup>3</sup> at 25 °C (77 °F)                                       |
| n) Water solubility                             | 0.00006 g/l at 25 °C (77 °F)   |
| o) Partition coefficient: n-octanol/water       | No data available  |
| p) Auto-ignition temperature                    | No data available  |
| q) Decomposition temperature                    | No data available  |
| r) Viscosity                                    | No data available  |
| s) Explosive properties                         | No data available  |
| t) Oxidizing properties                         | No data available  |

**9.2 Other safety information**

Relative vapour density 6.93 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents, Ammonia, Azides, Nitrates, Chlorates, Copper

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LC50 Inhalation - Rat - male - 2 h - < 27 mg/m<sup>3</sup>

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Mercury)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

Presumed human reproductive toxicant

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

Causes damage to organs through prolonged or repeated exposure.

#### Aspiration hazard

No data available



**Additional Information**

RTECS: OV4550000

Mercury accumulates in almost all tissues, especially in the: Kidney, Effects due to ingestion may include: Nausea, Vomiting, Diarrhoea, intestinal bleeding

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish mortality LC50 - Cyprinus carpio (Carp) - 0.160 mg/l - 96 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**Bioaccumulation Carassius auratus (goldfish) - 1,789 d  
- 0.25 µg/l

Bioconcentration factor (BCF): 155,986

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 2809 Class: 8 (6.1) Packing group: III  
Proper shipping name: A,W Mercury  
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 2809 Class: 8 (6.1) Packing group: III EMS-No: F-A, S-B  
Proper shipping name: MERCURY  
Marine pollutant: yes

**IATA**

UN number: 2809 Class: 8 (6.1) Packing group: III  
Proper shipping name: Mercury

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

**California Prop. 65 Components**

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

CAS-No.	Revision Date
7439-97-6	2013-12-20

Mercury

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H330	Fatal if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Repr.	Reproductive toxicity

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.12

Revision Date: 12/02/2015

Print Date: 05/01/2016

**SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION**

Manufacturer: AccuStandard, Inc.  
125 Market Street  
New Haven, CT 06513

Date MSDS Printed: 9/29/2005  
Preparation Date: 9/29/2005  
Information Phone Number: 203-786-5290  
Emergency Phone Number: 203-786-5290  
Hours: Mon. to Fri. 8am-5pm EDT

MSDS Number: PS-252C-07

Product Name: Mesitylene

Synonyms: 1,3,5-Trimethylbenzene; Mesitylene; sym-Trimethylbenzene; 3,5-Dimethyltoluene; Trimethylbenzol

Formula: C<sub>9</sub>H<sub>12</sub>

Molecular Weight: 120.20

**SECTION 2 - COMPOSITION / INFORMATION ON INGREDIENTS**

Component(s) ( 1 )	CAS #	Appr. %	ACGIH-TLV (mg/m3)		OSHA-PEL (mg/m3)	
			TWA	STEL	skin	skin
1,3,5-Trimethylbenzene	108-67-8	100	123			

**SECTION 3 - HAZARDS IDENTIFICATION****Symptoms of Exposure:**

Irritating to skin, mucous membranes and upper respiratory system.

May be irritating to eyes.

To the best of our knowledge the chemical, physical and toxicological properties of the component ingredients have not been thoroughly investigated.

**Potential Health Effects:**

May be harmful if inhaled, absorbed through the skin, or swallowed.

May cause central nervous system damage.

May cause blood disorders.

**Routes of Entry:**

Inhalation, ingestion or skin contact.

**Carcinogenicity:**

This product is or contains a component that is not listed (ACGIH, IARC, NTP, OSHA) as a cancer causing agent.

**SECTION 4 - FIRST AID MEASURES****Emergency First Aid:**

Get medical assistance for all cases of overexposure.

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

Eye contact: Immediately flush with plenty of water. After initial flushing, remove and contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

Ingestion: Drink water and induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

---

## **SECTION 5 - FIRE FIGHTING MEASURES**

### **Flammable Properties:**

Flash Point: 127.4 °F (53 °C) (cc)

Flammable Limits LEL (%): 0.88

Flammable Limits UEL (%): N/A

Autoignition Temperature: 550 °C

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

### **Extinguishing Media:**

Use alcohol foam, carbon dioxide, or dry chemical when fighting fires involving this material.

### **Fire Fighting Procedures:**

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

---

## **SECTION 6 - ACCIDENTAL RELEASE MEASURES**

### **Spill Response:**

Wear self-contained breathing apparatus and full protective clothing. Stop leak if you can do so without risk. Ventilate area.

Neutralize spill with soda ash or lime. Take up and containerize for proper disposal. Flush spill area with water. Keep combustibles away from spilled material. Comply with Federal, State, and local regulations.

---

## **SECTION 7 - HANDLING AND STORAGE**

Store in a tightly closed container.

Store in a cool place away from ignition sources.

Do not breathe vapor.

Do not get in eyes, on skin, or on clothing.

Avoid prolonged or repeated exposure.

This product should only be used by persons trained in the safe handling of hazardous chemicals.

---

## **SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION**

### **Engineering Controls and Personal Protection Equipment (PPE):**

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), a NIOSH/MSHA approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions (see your safety equipment supplier). Engineering and/or administrative controls should be implemented to reduce exposure.

Material must be handled or transferred in an approved fume hood or with equivalent ventilation.

Compatible chemical-resistant protective gloves must be worn to prevent skin contact.

Safety glasses with side shields must be worn at all times.

#### **General Hygiene Considerations:**

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

### **SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES**

---

Appearance: Clear, colorless liquid  
Odor: N/A  
pH: N/A  
Vapor Pressure: 2.49 mmHg (25 °C)  
Vapor Density (Air = 1): 4.1 g/l  
Boiling Point: 165 °C  
Melting Point: -45 °C  
Solubility in Water (%): Slight  
Specific Gravity (H<sub>2</sub>O = 1): 0.865 g/cm<sup>3</sup>  
Flash Point: 127.4 °F (53 °C) (cc)  
Explosion Limits (%): 0.88 to N/A  
Autoignition Temperature: 550 °C  
Percent Volatile: N/A  
Evaporation Rate (BuAc = 1): N/A  
Molecular Weight: 120.20  
Molecular Formula: C<sub>9</sub>H<sub>12</sub>

### **SECTION 10 - STABILITY AND REACTIVITY**

---

Stability: Stable  
Conditions To Avoid: None indicated  
Materials To Avoid: Oxidizers  
  
Hazardous Decomposition: Carbon oxides  
Hazardous Polymerization: Does not occur

### **SECTION 11 - TOXICOLOGICAL INFORMATION**

---

See section 3 for specific toxicological information for the ingredients of this product.

### **SECTION 12 - ECOLOGICAL INFORMATION**

---

By complying with sections 6 and 7 there will be no release to the environment.

### **SECTION 13 - DISPOSAL CONSIDERATIONS**

---

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

### **SECTION 14 - TRANSPORT INFORMATION**

---

**DOT** UN Number: UN2325 Shipping Class: 3 Packing Group: III **FLAMMABLE**

### **SECTION 15 - REGULATORY INFORMATION**

---

In addition to Federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

The following regulations apply:

None.

#### **SECTION 16 - OTHER INFORMATION**

---

This document has been designed to meet the requirements of OSHA, ANSI and CHIPs regulations.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. It is intended for use only by persons having the necessary technical skill and at their own discretion and risk. Since conditions and manner of use are outside our control, we make

NO WARRANTY, EXPRESSED OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE.

Legend : N/A = Not Available    ND = Not Determined    NR = Not regulated

\* \* \* End of Document \* \* \*

## SAFETY DATA SHEET

Version 3.7  
Revision Date 12/01/2015  
Print Date 04/30/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Methane

Product Number : 295477  
Brand : Aldrich  
Index-No. : 601-001-00-4

CAS-No. : 74-82-8

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable gases (Category 1), H220  
Gases under pressure (Compressed gas), H280  
Simple Asphyxiant,

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H220

Extremely flammable gas.

H280

Contains gas under pressure; may explode if heated.  
May displace oxygen and cause rapid suffocation.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. No smoking.

P377

Leaking gas fire: Do not extinguish, unless leak can be stopped safely.

P381

Eliminate all ignition sources if safe to do so.

P410 + P403

Protect from sunlight. Store in a well-ventilated place.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**



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### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Formula : CH<sub>4</sub>  
Molecular weight : 16.04 g/mol  
CAS-No. : 74-82-8  
EC-No. : 200-812-7  
Index-No. : 601-001-00-4

#### Hazardous components

Component	Classification	Concentration
<b>Methane</b>		
	Flam. Gas 1; Press. Gas Compr. Gas; SA ; H220, H280,	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

Use water spray to cool unopened containers.

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

## 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

## 6.3 Methods and materials for containment and cleaning up

Clean up promptly by sweeping or vacuum.

## 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

Storage class (TRGS 510): Gases

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Methane	74-82-8	TWA	1,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Cardiac sensitization		
		See Appendix F: Minimal Oxygen Content Asphyxia 2015 Adoption		
		TWA	0.100000 mg/m3	USA. NIOSH Recommended Exposure Limits
		'Ca' in the presence of formaldehyde, acetaldehyde, or malonaldehyde. See Appendices A & C (Aldehydes).		
		TWA	0.100000 mg/m3	USA. NIOSH Recommended Exposure Limits
		'Ca' in the presence of formaldehyde, acetaldehyde, or malonaldehyde. See Appendices A & C (Aldehydes).		
		See Appendix F: Minimal Oxygen Content Asphyxia		
		TWA	0.1 mg/m3	USA. NIOSH Recommended Exposure Limits
		'Ca' in the presence of formaldehyde, acetaldehyde, or malonaldehyde. See Appendices A & C (Aldehydes).		

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 60 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: gaseous<br>Colour: colourless           |
| b) Odour                                   | No data available                             |
| c) Odour Threshold                         | No data available                             |
| d) pH                                      | No data available                             |
| e) Melting point/freezing point            | Melting point/range: -183 °C (-297 °F) - lit. |
| f) Initial boiling point and boiling range | -161 °C (-258 °F) - lit.                      |
| g) Flash point                             | -187.99 °C (-306.38 °F) - closed cup          |
| h) Evaporation rate                        | No data available                             |
| i) Flammability (solid, gas)               | No data available                             |
| j) Upper/lower                             | Upper explosion limit: 15 %(V)                |

flammability or  
explosive limits      Lower explosion limit: 5 %(V)

- |    |  |  |
|----|--|--|
| k) | Vapour pressure                        | No data available                        |
| l) | Vapour density                         | 0.55 - (Air = 1.0)                       |
| m) | Relative density                       | 0.716 g/cm <sup>3</sup> at 25 °C (77 °F) |
| n) | Water solubility                       | 3.5 g/l at 17 °C (63 °F)                 |
| o) | Partition coefficient: n-octanol/water | No data available                        |
| p) | Auto-ignition temperature              | No data available                        |
| q) | Decomposition temperature              | No data available                        |
| r) | Viscosity                              | No data available                        |
| s) | Explosive properties                   | No data available                        |
| t) | Oxidizing properties                   | No data available                        |

## 9.2 Other safety information

Relative vapour density      0.55 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: PA1490000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

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**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1971

Class: 2.1

Proper shipping name: Methane, compressed  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

#### IMDG

UN number: 1971      Class: 2.1  
Proper shipping name: METHANE, COMPRESSED

EMS-No: F-D, S-U

#### IATA

UN number: 1971      Class: 2.1  
Proper shipping name: Methane, compressed  
IATA Passenger: Not permitted for transport

---

### 15. REGULATORY INFORMATION

#### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

#### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

#### SARA 311/312 Hazards

Fire Hazard

#### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Methane	74-82-8	1993-04-24

#### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Methane	74-82-8	1993-04-24

#### New Jersey Right To Know Components

	CAS-No.	Revision Date
Methane	74-82-8	1993-04-24

#### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

### 16. OTHER INFORMATION

#### Full text of H-Statements referred to under sections 2 and 3.

Flam. Gas	May displace oxygen and cause rapid suffocation.
H220	Flammable gases
H280	Extremely flammable gas.
Press. Gas	Contains gas under pressure; may explode if heated.
SA	Gases under pressure
	Simple Asphyxiant

#### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	4
Physical Hazard	3

#### NFPA Rating

Health hazard:	0
Fire Hazard:	4
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation

Product Safety – Americas Region

1-800-521-8956

Version: 3.7

Revision Date: 12/01/2015

Print Date: 04/30/2016

# Methyl chloride (Refrigerant gas R 40)

## Safety Data Sheet P-4622

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1980

Revision date: 03/06/2015

Supersedes: 05/01/2009

### SECTION: 1. Product and company identification

#### 1.1. Product identifier

Product form : Substance  
Name : Methyl chloride (Refrigerant gas R 40)  
CAS No : 74-87-3  
Formula : CH<sub>3</sub>Cl  
Other means of identification : methylchloride, halocarbon 40, monochloromethane

#### 1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Industrial use. Use as directed.

#### 1.3. Details of the supplier of the safety data sheet

Praxair, Inc.  
39 Old Ridgebury Road  
Danbury, CT 06810-5113 - USA  
T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146  
[www.praxair.com](http://www.praxair.com)

#### 1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week — Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887 (collect calls accepted, Contract 17729)

### SECTION 2: Hazards identification

#### 2.1. Classification of the substance or mixture

##### Classification (GHS-US)

Flam. Gas 1 H220  
Liquefied gas H280  
Acute Tox. 4 (Inhalation:gas) H332  
Carc. 2 H351  
STOT RE 2 H373

#### 2.2. Label elements

##### GHS-US labeling

Hazard pictograms (GHS-US) :



GHS02

GHS04

GHS07

GHS08

Signal word (GHS-US) :

DANGER

Hazard statements (GHS-US) :

H220 - EXTREMELY FLAMMABLE GAS  
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED  
H332 - HARMFUL IF INHALED  
H351 - SUSPECTED OF CAUSING CANCER  
H373 - MAY CAUSE DAMAGE TO ORGANS(LUNG, KIDNEYS, LIVER, CENTRAL NERVOUS SYSTEM) THROUGH PROLONGED OR REPEATED EXPOSURE  
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR  
CGA-HG01 - MAY CAUSE FROSTBITE.

Precautionary statements (GHS-US) :

P201 - Obtain special instructions before use  
P202 - Do not handle until all safety precautions have been read and understood  
P210 - Keep away from Heat, Open flames, Sparks, Hot surfaces. - No smoking  
P260 - Do not breathe gas  
P262 - Do not get in eyes, on skin, or on clothing.  
P271+P403 - Use and store only outdoors or in a well-ventilated place.



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P280+P284 - Wear protective gloves, protective clothing, eye protection, respiratory protection, and/or face protection.  
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely  
P381 - Eliminate all ignition sources if safe to do so  
P405 - Store locked up  
P501 - Dispose of contents/container in accordance with container supplier/owner instructions  
CGA-PG05 - Use a back flow preventive device in the piping.  
CGA-PG12 - Do not open valve until connected to equipment prepared for use.  
CGA-PG06 - Close valve after each use and when empty.  
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

### 2.3. Other hazards

Other hazards not contributing to the classification : Contact with liquid may cause cold burns/frostbite.

### 2.4. Unknown acute toxicity (GHS-US)

No data available

## SECTION 3: Composition/information on ingredients

### 3.1. Substance

Name	Product identifier	%
Methyl chloride (Refrigerant gas R 40) (Main constituent)	(CAS No) 74-87-3	100

### 3.2. Mixture

Not applicable

## SECTION 4: First aid measures

### 4.1. Description of first aid measures

First-aid measures after inhalation : Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

First-aid measures after skin contact : For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

### 4.2. Most important symptoms and effects, both acute and delayed

No additional information available

### 4.3. Indication of any immediate medical attention and special treatment needed

Obtain medical assistance.

## SECTION 5: Firefighting measures

### 5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog. Use extinguishing media appropriate for surrounding fire.

### 5.2. Special hazards arising from the substance or mixture

Fire hazard : EXTREMELY FLAMMABLE GAS. If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.

Explosion hazard : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents.

Reactivity : No reactivity hazard other than the effects described in sub-sections below.

# Methyl chloride (Refrigerant gas R 40)

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### 5.3. Advice for firefighters

Firefighting instructions

: **DANGER! Toxic, flammable liquid and gas under pressure**

Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Special protective equipment for fire fighters

: Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Other information

: Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.).

## SECTION 6: Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

General measures

: **DANGER: Flammable liquid and gas under pressure.** Forms explosive mixtures with air. Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if safe to do so. Reduce vapors with fog or fine water spray, taking care not to spread liquid with water. Shut off flow if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an appropriate device.

#### 6.1.1. For non-emergency personnel

No additional information available

#### 6.1.2. For emergency responders

No additional information available

### 6.2. Environmental precautions

Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

### 6.3. Methods and material for containment and cleaning up

No additional information available

### 6.4. Reference to other sections

See also sections 8 and 13.

## SECTION 7: Handling and storage

### 7.1. Precautions for safe handling

Precautions for safe handling

: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

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### 7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Store only where temperature will not exceed 125°F (52°C). Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g., NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

### 7.3. Specific end use(s)

None.

## SECTION 8: Exposure controls/personal protection

### 8.1. Control parameters

Methyl chloride (Refrigerant gas R 40) (74-87-3)		
ACGIH	ACGIH TLV-TWA (ppm)	50 ppm
ACGIH	ACGIH TLV-STEL (ppm)	100 ppm
USA OSHA	OSHA PEL (TWA) (ppm)	100 ppm
USA OSHA	OSHA PEL (Ceiling) (ppm)	200 ppm

### 8.2. Exposure controls

Appropriate engineering controls : Use an explosion-proof local exhaust system. Local exhaust and general ventilation must be adequate to meet exposure standards. MECHANICAL (GENERAL): Inadequate - Use only in a closed system. Use explosion proof equipment and lighting. A canopy-type, forced-draft fume hood is preferred.

Eye protection : Wear safety glasses when handling cylinders; vapor-proof goggles and a face shield during cylinder changeout or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.

Skin and body protection : Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear neoprene gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

Respiratory protection : When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

Thermal hazard protection : Wear cold insulating gloves when transfilling or breaking transfer connections.

## SECTION 9: Physical and chemical properties

### 9.1. Information on basic physical and chemical properties

Physical state : Gas

Appearance : Colorless gas.

Molecular mass : 50.5 g/mol

Color : Colorless.

Odor : Ethereal.

# Methyl chloride (Refrigerant gas R 40)

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Odor threshold	: < 0.01 ppm
pH	: Not applicable.
Relative evaporation rate (butyl acetate=1)	: No data available
Relative evaporation rate (ether=1)	: Not applicable.
Melting point	: -98 °C
Freezing point	: No data available
Boiling point	: -24.2 °C
Flash point	: Not applicable.
Critical temperature	: 143.1 °C
Auto-ignition temperature	: 632 °C
Decomposition temperature	: No data available
Flammability (solid, gas)	: 10.7 - 17.4 vol %
Vapor pressure	: 490 kPa
Critical pressure	: 6679 kPa
Relative vapor density at 20 °C	: No data available
Relative density	: 1
Specific gravity / density	: 0.921 g/cm <sup>3</sup> (at 20 °C)
Relative gas density	: 1.8
Solubility	: Water: 6310 mg/l
Log Pow	: 0.91
Log Kow	: Not applicable.
Viscosity, kinematic	: Not applicable.
Viscosity, dynamic	: Not applicable.
Explosive properties	: Not applicable.
Oxidizing properties	: None.
Explosive limits	: No data available

### 9.2. Other information

Gas group	: Liquefied gas
Additional information	: Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level.

## SECTION 10: Stability and reactivity

### 10.1. Reactivity

No reactivity hazard other than the effects described in sub-sections below.

### 10.2. Chemical stability

Stable under normal conditions.

### 10.3. Possibility of hazardous reactions

May occur.

### 10.4. Conditions to avoid

Avoid temperature above 752°F (400°C).

### 10.5. Incompatible materials

May react with aluminium. Reaction with aluminum may form pyrophoric trimethyl aluminum or aluminum alkyls. Oxidizing agents. Magnesium. Zinc. Potassium. Sodium. Aluminum chloride. Ethylene. Moisture. Rubber.

### 10.6. Hazardous decomposition products

Carbon dioxide. Carbon monoxide. Chlorine. On heating/burning: release of toxic and corrosive gases/vapors hydrogen chloride : formation of small quantities of phosgene.

# Methyl chloride (Refrigerant gas R 40)

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Revision date: 03/06/2015

Supersedes: 05/01/2009

### SECTION 11: Toxicological information

#### 11.1. Information on toxicological effects

Acute toxicity : Inhalation:gas: HARMFUL IF INHALED.

Methyl chloride (Refrigerant gas R 40) ( 74-87-3)	
LD50 oral rat	1800 mg/kg
LC50 inhalation rat (mg/l)	5300 mg/m <sup>3</sup> (Exposure time: 4 h)
LC50 inhalation rat (ppm)	8300 ppm/4h
ATE US (oral)	1800.000 mg/kg body weight
ATE US (gases)	2566.500 ppmV/4h

Skin corrosion/irritation : Not classified  
pH: Not applicable.

Serious eye damage/irritation : Not classified  
pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : SUSPECTED OF CAUSING CANCER.

Methyl chloride (Refrigerant gas R 40) (74-87-3)	
IARC group	3 - Not classifiable
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: Not classified
Specific target organ toxicity (repeated exposure)	: MAY CAUSE DAMAGE TO ORGANS(LUNG, KIDNEYS, LIVER, CENTRAL NERVOUS SYSTEM) THROUGH PROLONGED OR REPEATED EXPOSURE.
Aspiration hazard	: Not classified

### SECTION 12: Ecological information

#### 12.1. Toxicity

Ecology - general : No known ecological damage caused by this product.

Methyl chloride (Refrigerant gas R 40) (74-87-3)	
LC50 fish 1	550 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [static])

#### 12.2. Persistence and degradability

Methyl chloride (Refrigerant gas R 40) (74-87-3)	
Persistence and degradability	The substance is biodegradable. Unlikely to persist.

#### 12.3. Bioaccumulative potential

Methyl chloride (Refrigerant gas R 40) (74-87-3)	
Log Pow	0.91
Log Kow	Not applicable.
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.

#### 12.4. Mobility in soil

Methyl chloride (Refrigerant gas R 40) (74-87-3)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.

#### 12.5. Other adverse effects

Other adverse effects : May cause pH changes in aqueous ecological systems.

Effect on ozone layer : None.

Global warming potential [CO2=1] : 13

# Methyl chloride (Refrigerant gas R 40)

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Effect on the global warming : Contains Fluorinated greenhouse gases covered by the Kyoto protocol.

### SECTION 13: Disposal considerations

#### 13.1. Waste treatment methods

Regional legislation (waste) : U.S. - RCRA (Resource Conservation & Recovery Act) - Basis for Listing - Appendix VII. U.S. - RCRA (Resource Conservation & Recovery Act) - Constituents for Detection Monitoring. U.S. - RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261. U.S. - RCRA (Resource Conservation & Recovery Act) - List for Hazardous Constituents. U.S. - RCRA (Resource Conservation & Recovery Act) - Part 268 Appendix III - Halogenated Organic Compounds (HOCs). U.S. - RCRA (Resource Conservation & Recovery Act) - Phase 4 LDR Rule - Universal Treatment Standards. U.S. - RCRA (Resource Conservation & Recovery Act) - TSD Facilities Ground Water Monitoring. U.S. - RCRA (Resource Conservation & Recovery Act) - U Series Wastes - Acutely Toxic Wastes & Other Hazardous Characteristics.

Waste disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

### SECTION 14: Transport information

In accordance with DOT

Transport document description : UN1063 Methyl chloride, 2.1

UN-No.(DOT) : UN1063

Proper Shipping Name (DOT) : Methyl chloride

Department of Transportation (DOT) Hazard Classes : 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115

Hazard labels (DOT) : 2.1 - Flammable gas



DOT Special Provisions (49 CFR 172.102) : N86 - UN pressure receptacles made of aluminum alloy are not authorized.  
T50 - When portable tank instruction T50 is referenced in Column (7) of the 172.101 Table, the applicable liquefied compressed gases are authorized to be transported in portable tanks in accordance with the requirements of 173.313 of this subchapter.

#### Additional information

Emergency Response Guide (ERG) Number : 115

Other information : No supplementary information available.

Special transport precautions : Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers:  
- Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

#### Transport by sea

UN-No. (IMDG) : 1063

Proper Shipping Name (IMDG) : METHYL CHLORIDE (REFRIGERANT GAS R 40)

Class (IMDG) : 2 - Gases

MFAG-No : 115

#### Air transport

UN-No.(IATA) : 1063

Proper Shipping Name (IATA) : Methyl chloride

Class (IATA) : 2

Civil Aeronautics Law : Gases under pressure/Gases flammable under pressure

# Methyl chloride (Refrigerant gas R 40)

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### SECTION 15: Regulatory information

#### 15.1. US Federal regulations

##### Methyl chloride (Refrigerant gas R 40) (74-87-3)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

Listed on United States SARA Section 313

EPA TSCA Regulatory Flag

T - T - indicates a substance that is the subject of a Section 4 test rule under TSCA.

SARA Section 311/312 Hazard Classes

Immediate (acute) health hazard  
Delayed (chronic) health hazard  
Sudden release of pressure hazard  
Fire hazard

SARA Section 313 - Emission Reporting

1.0 %

#### 15.2. International regulations

##### CANADA

##### Methyl chloride (Refrigerant gas R 40) (74-87-3)

Listed on the Canadian DSL (Domestic Substances List)

#### EU-Regulations

##### Methyl chloride (Refrigerant gas R 40) (74-87-3)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

#### 15.2.2. National regulations

##### Methyl chloride (Refrigerant gas R 40) (74-87-3)

Listed on the AICS (Australian Inventory of Chemical Substances)  
Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)  
Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory  
Listed on the Korean ECL (Existing Chemicals List)  
Listed on NZIoC (New Zealand Inventory of Chemicals)  
Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)  
Japanese Poisonous and Deleterious Substances Control Law  
Japanese Pollutant Release and Transfer Register Law (PRTR Law)  
Listed on the Canadian IDL (Ingredient Disclosure List)

#### 15.3. US State regulations

##### Methyl chloride (Refrigerant gas R 40)(74-87-3)

U.S. - California - Proposition 65 - Carcinogens List

No

U.S. - California - Proposition 65 - Developmental Toxicity

Yes

U.S. - California - Proposition 65 - Reproductive Toxicity - Female

No

U.S. - California - Proposition 65 - Reproductive Toxicity - Male

Yes

State or local regulations

U.S. - Massachusetts - Right To Know List  
U.S. - New Jersey - Right to Know Hazardous Substance List  
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List  
U.S. - Pennsylvania - RTK (Right to Know) List

### SECTION 16: Other information

Revision date

: 3/6/2015 12:00:00 AM



# Methyl chloride (Refrigerant gas R 40)

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### Other information

: When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair SDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Praxair sales representative, local distributor, or supplier, or download from [www.praxair.com](http://www.praxair.com). If you have questions regarding Praxair SDSs, would like the document number and date of the latest SDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (Phone: 1-800-PRAXAIR/1-800-772-9247; Address: Praxair Call Center, Praxair, Inc., P.O. Box 44, Tonawanda, NY 14151-0044).

PRAXAIR and the Flowing Airstream design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.

### NFPA health hazard

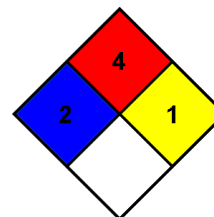
: 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.

### NFPA fire hazard

: 4 - Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.

### NFPA reactivity

: 1 - Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.



### HMIS III Rating

#### Health

: 2 Moderate Hazard - Temporary or minor injury may occur

#### Flammability

: 4 Severe Hazard

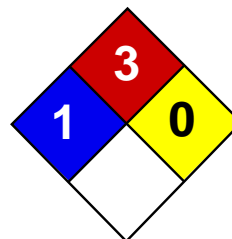
#### Physical

: 2 Moderate Hazard

SDS US (GHS HazCom 2012) - Praxair

*This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.*





Health	2
Fire	3
Reactivity	0
Personal Protection	H

## Material Safety Data Sheet

### Methyl ethyl ketone MSDS

#### Section 1: Chemical Product and Company Identification

**Product Name:** Methyl ethyl ketone

**Catalog Codes:** SLM2626, SLM3232

**CAS#:** 78-93-3

**RTECS:** EL6475000

**TSCA:** TSCA 8(b) inventory: Methyl ethyl ketone

**CI#:** Not applicable.

**Synonym:** 2-Butanone

**Chemical Name:** Methyl Ethyl Ketone

**Chemical Formula:** C<sub>4</sub>H<sub>8</sub>O

**Contact Information:**

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**

1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

#### Section 2: Composition and Information on Ingredients

**Composition:**

Name	CAS #	% by Weight
Methyl ethyl ketone	78-93-3	100

**Toxicological Data on Ingredients:** Methyl ethyl ketone: ORAL (LD<sub>50</sub>): Acute: 2737 mg/kg [Rat]. 4050 mg/kg [Mouse]. DERMAL (LD<sub>50</sub>): Acute: 6480 mg/kg [Rabbit]. VAPOR (LC<sub>50</sub>): Acute: 23500 mg/m 8 hours [Rat].

#### Section 3: Hazards Identification

**Potential Acute Health Effects:**

Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation (lung irritant).

**Potential Chronic Health Effects:**

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to gastrointestinal tract, upper respiratory tract, skin, eyes, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

#### Section 4: First Aid Measures

**Eye Contact:**

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

**Skin Contact:**

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

**Serious Skin Contact:**

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

**Inhalation:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Serious Inhalation:**

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

**Ingestion:**

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** Flammable.

**Auto-Ignition Temperature:** 404°C (759.2°F)

**Flash Points:** CLOSED CUP: -9°C (15.8°F). OPEN CUP: -5.5556°C (22°F) (Tag).

**Flammable Limits:** LOWER: 1.8% UPPER: 10%

**Products of Combustion:** These products are carbon oxides (CO, CO<sub>2</sub>).

**Fire Hazards in Presence of Various Substances:** Highly flammable in presence of open flames and sparks, of heat.

**Explosion Hazards in Presence of Various Substances:**

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

**Fire Fighting Media and Instructions:**

Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

**Special Remarks on Fire Hazards:**

Ignition on contact with potassium t-butoxide. Vapor may cause a flash fire

**Special Remarks on Explosion Hazards:**

Reaction with Hydrogen Peroxide + nitric acid forms heat and shock-sensitive explosive product. Mixture with 2-propanol will produce explosive peroxides during storage.

## Section 6: Accidental Release Measures

**Small Spill:**

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

**Large Spill:**

Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

## Section 7: Handling and Storage

### Precautions:

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

### Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

## Section 8: Exposure Controls/Personal Protection

### Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

### Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

### Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

### Exposure Limits:

TWA: 200 STEL: 300 (ppm) from ACGIH (TLV) [United States] [1999] TWA: 150 STEL: 300 (ppm) [Australia] TWA: 590 STEL: 885 (mg/m3) from NIOSH TWA: 200 STEL: 300 (ppm) from NIOSH TWA: 590 STEL: 885 (mg/m3) [Canada] TWA: 200 STEL: 300 (ppm) from OSHA (PEL) [United States] TWA: 590 STEL: 885 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

## Section 9: Physical and Chemical Properties

**Physical state and appearance:** Liquid.

### Odor:

Acetone-like Pleasant. Pungent. Sweetish. (Strong.)

**Taste:** Not available.

**Molecular Weight:** 72.12g/mole

**Color:** Clear Colorless.

**pH (1% soln/water):** Not available.

**Boiling Point:** 79.6 (175.3°F)

**Melting Point:** -86°C (-122.8°F)

**Critical Temperature:** 262.5°C (504.5°F)

**Specific Gravity:** 0.805(Water = 1)

**Vapor Pressure:** 10.3 kPa (@ 20°C)

**Vapor Density:** 2.41 (Air = 1)

**Volatility:** Not available.

**Odor Threshold:** 0.25 ppm

**Water/Oil Dist. Coeff.:** The product is more soluble in oil;  $\log(\text{oil/water}) = 0.3$

**Ionicity (in Water):** Not available.

**Dispersion Properties:** See solubility in water, diethyl ether, acetone.

**Solubility:** Soluble in cold water, diethyl ether, acetone.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Heat, ignition sources, mechanical shock, incompatible materials.

**Incompatibility with various substances:** Reactive with oxidizing agents, metals, acids, alkalis.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:**

Incompatible with chloroform, copper, hydrogen peroxide, nitric acid, potassium t-butoxide, 2-propanol, chlorosulfonic acid, strong oxidizers, amines, ammonia, inorganic acids, isocyanates, caustics, pyridines. Vigorous reaction with chloroform +alkali.

**Special Remarks on Corrosivity:** Not available.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Absorbed through skin. Dermal contact. Eye contact. Inhalation.

**Toxicity to Animals:**

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2737 mg/kg [Rat]. Acute dermal toxicity (LD50): 6480 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 32000 mg/m<sup>3</sup> 4 hours [Mouse].

**Chronic Effects on Humans:**

MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. May cause damage to the following organs: gastrointestinal tract, upper respiratory tract, skin, eyes, central nervous system (CNS).

**Other Toxic Effects on Humans:** Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation (lung irritant).

**Special Remarks on Toxicity to Animals:** Not available.

**Special Remarks on Chronic Effects on Humans:** May cause birth defects based on animal data. Embryotoxic and/or foetotoxic in animal.

**Special Remarks on other Toxic Effects on Humans:**

Acute Potential Health Effects: Skin: Causes skin irritation. May be absorbed through the skin. Eyes: Causes eye irritation. Inhalation: Inhalation of high concentrations may cause central nervous effects characterized by headache, dizziness, unconsciousness, and coma. Causes respiratory tract irritation and affects the sense organs. May affect the liver and urinary system. Ingestion: Causes gastrointestinal tract irritation with nausea, vomiting and diarrhea. May affect the liver. Chronic Potential Health Effects: Chronic inhalation may cause effects similar to those of acute inhalation. Prolonged or repeated skin contact may cause defatting and dermatitis.

## Section 12: Ecological Information

**Ecotoxicity:** Ecotoxicity in water (LC50): 3220 mg/l 96 hours [Fathead Minnow]. 1690 mg/l 96 hours [Bluegill].

**BOD5 and COD:** Not available.

**Products of Biodegradation:**

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The product itself and its products of degradation are not toxic.

**Special Remarks on the Products of Biodegradation:** Not available.

## Section 13: Disposal Considerations

**Waste Disposal:**

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

## Section 14: Transport Information

**DOT Classification:** CLASS 3: Flammable liquid.

**Identification:** : Ethyl methyl ketone UNNA: 1193 PG: II

**Special Provisions for Transport:** Not available.

## Section 15: Other Regulatory Information

**Federal and State Regulations:**

New York release reporting list: Methyl ethyl ketone Rhode Island RTK hazardous substances: Methyl ethyl ketone Pennsylvania RTK: Methyl ethyl ketone Minnesota: Methyl ethyl ketone Massachusetts RTK: Methyl ethyl ketone New Jersey: Methyl ethyl ketone California Director's list of Hazardous Substances: Methyl ethyl ketone TSCA 8(b) inventory: Methyl ethyl ketone TSCA 8(d) H and S data reporting: Methyl ethyl ketone: Effective: 10/4/82; Sunset: 10/4/92 SARA 313 toxic chemical notification and release reporting: Methyl ethyl ketone CERCLA: Hazardous substances.: Methyl ethyl ketone: 5000 lbs. (2268 kg)

**Other Regulations:**

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

**Other Classifications:**

**WHMIS (Canada):**

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

**DSCL (EEC):**

R11- Highly flammable. R36/37- Irritating to eyes and respiratory system. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S33- Take precautionary measures against static discharges.

**HMIS (U.S.A.):**

**Health Hazard:** 2

**Fire Hazard:** 3

**Reactivity:** 0

**Personal Protection:** h

**National Fire Protection Association (U.S.A.):**

**Health:** 1

**Flammability:** 3

**Reactivity:** 0

**Specific hazard:**

**Protective Equipment:**

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

**Section 16: Other Information**

**References:** Not available.

**Other Special Considerations:** Not available.

**Created:** 10/10/2005 08:39 PM

**Last Updated:** 05/21/2013 12:00 PM

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## SAFETY DATA SHEET

Version 5.10  
Revision Date 12/02/2015  
Print Date 04/30/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Methyl methacrylate

Product Number : M55909  
Brand : Aldrich  
Index-No. : 607-035-00-6

CAS-No. : 80-62-6

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Skin irritation (Category 2), H315  
Skin sensitisation (Category 1), H317  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Acute aquatic toxicity (Category 3), H402

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H225 Highly flammable liquid and vapour.  
H315 Causes skin irritation.  
H317 May cause an allergic skin reaction.  
H335 May cause respiratory irritation.  
H402 Harmful to aquatic life.

Precautionary statement(s)

P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.  
P233 Keep container tightly closed.

P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Lachrymator.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>5</sub> H <sub>8</sub> O <sub>2</sub>
Molecular weight	: 100.12 g/mol
CAS-No.	: 80-62-6
EC-No.	: 201-297-1
Index-No.	: 607-035-00-6

#### Hazardous components

Component	Classification	Concentration
<b>Methyl methacrylate</b>		
	Flam. Liq. 2; Skin Irrit. 2; Skin Sens. 1; STOT SE 3; Aquatic Acute 3; H225, H315, H317, H335, H402	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.



#### **4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### **4.3 Indication of any immediate medical attention and special treatment needed**

No data available

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### **5. FIREFIGHTING MEASURES**

#### **5.1 Extinguishing media**

##### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### **5.2 Special hazards arising from the substance or mixture**

Carbon oxides

Flash back possible over considerable distance., Container explosion may occur under fire conditions.

#### **5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

#### **5.4 Further information**

Use water spray to cool unopened containers.

---

### **6. ACCIDENTAL RELEASE MEASURES**

#### **6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

#### **6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### **6.3 Methods and materials for containment and cleaning up**

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

#### **6.4 Reference to other sections**

For disposal see section 13.

---

### **7. HANDLING AND STORAGE**

#### **7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

#### **7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Recommended storage temperature 2 - 8 °C

Storage class (TRGS 510): Flammable liquids

#### **7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **8.1 Control parameters**

**Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
Methyl methacrylate	80-62-6	TWA	50 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Dermal Sensitization Upper Respiratory Tract irritation Eye irritation Pulmonary edema body weight effects 2015 Adoption Not classifiable as a human carcinogen		
		TWA	50.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation Pulmonary edema body weight effects Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Not classifiable as a human carcinogen Sensitizer		
		STEL	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation Pulmonary edema body weight effects Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Not classifiable as a human carcinogen Sensitizer		
		STEL	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Dermal Sensitization Upper Respiratory Tract irritation Eye irritation Pulmonary edema body weight effects 2015 Adoption Not classifiable as a human carcinogen		
		TWA	100.000000 ppm 410.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	100.000000 ppm 410.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100 ppm 410 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100 ppm 410 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	100 ppm 410 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Splash contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 66 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: liquid<br>Colour: colourless          |
| b) Odour                                   | pungent                                     |
| c) Odour Threshold                         | No data available                           |
| d) pH                                      | No data available                           |
| e) Melting point/freezing point            | Melting point/range: -48 °C (-54 °F) - lit. |
| f) Initial boiling point and boiling range | 100 °C (212 °F) - lit.                      |
| g) Flash point                             | 9 °C (48 °F) - closed cup                   |
| h) Evaporation rate                        | No data available                           |
| i) Flammability (solid, gas)               | No data available                           |
| j) Upper/lower                             | Upper explosion limit: 12.5 %(V)            |

flammability or  
explosive limits                      Lower explosion limit: 2.12 %(V)

- k) Vapour pressure                      37 hPa (28 mmHg) at 20 °C (68 °F)
- l) Vapour density                        3.46 - (Air = 1.0)
- m) Relative density                    0.936 g/cm<sup>3</sup> at 25 °C (77 °F)
- n) Water solubility                    15.3 g/l at 20 °C (68 °F)
- o) Partition coefficient: n-  
octanol/water                      log Pow: 1.38
- p) Auto-ignition  
temperature                        400 °C (752 °F) at 1,013.25 hPa (760.00 mmHg)
- q) Decomposition  
temperature                        No data available
- r) Viscosity                              No data available
- s) Explosive properties                No data available
- t) Oxidizing properties                No data available

## 9.2 Other safety information

Surface tension                      28 mN/m at 20 °C (68 °F)  
Relative vapour density            3.46 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Polymerizes with evolution of heat. Avoid contact with incompatible materials. Unless inhibited, product can polymerize, raising temperature and pressure, possibly rupturing container. Check inhibitor content often adding to bulk liquid if needed. Do not blanket or mix with oxygen-free gas as it renders inhibitor ineffective.

Stable under recommended storage conditions.

Contains the following stabiliser(s):

Mequinol (<=0.003 %)

### 10.3 Possibility of hazardous reactions

Polymerises readily unless inhibited. Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

May polymerize on exposure to light.

Heat, flames and sparks. Heat Extremes of temperature and direct sunlight.

Heat, flames and sparks.

### 10.5 Incompatible materials

Oxidizing agents, Peroxides, Amines, Bases, acids, Reducing agents, Halogens

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 7,900 mg/kg

LC50 Inhalation - Rat - 4 h - 78,000 mg/m<sup>3</sup>

LD50 Dermal - Rabbit - male - > 5,000 mg/kg  
(OECD Test Guideline 402)

No data available

**Skin corrosion/irritation**

Skin - Rabbit

Result: Irritating to skin. - 4 h

**Serious eye damage/eye irritation**

Eyes - Rabbit

Result: No eye irritation

**Respiratory or skin sensitisation**

in vivo assay - Mouse

May cause allergic skin reaction.

(OECD Test Guideline 429)

**Germ cell mutagenicity**

No data available

Ames test

S. typhimurium

Result: negative

OECD Test Guideline 478

Mouse - male

Result: negative

**Carcinogenicity**

Carcinogenicity - Rat - male and female - Inhalation

No significant adverse effects were reported

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Methyl methacrylate)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

Developmental Toxicity - Rat - Inhalation

No significant adverse effects were reported

**Specific target organ toxicity - single exposure**

May cause respiratory irritation.

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

Repeated dose toxicity Rat - male - Oral - NOAEL :  $\geq 124.1$  mg/kg

RTECS: OZ5075000

Central nervous system depression, Drowsiness, Irritability, Dizziness, Ataxia., narcosis, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Liver - Irregularities - Based on Human Evidence  
Liver - Irregularities - Based on Human Evidence  
Stomach - Irregularities - Based on Human Evidence (Mequinol)

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish                      static test LC50 - *Lepomis macrochirus* (Bluegill) - 283 mg/l - 96 h  
Toxicity to daphnia and      flow-through test EC50 - *Daphnia magna* (Water flea) - 69 mg/l - 48 h  
other aquatic  
invertebrates  
Toxicity to algae                      static test EC50 - *Pseudokirchneriella subcapitata* - > 110 mg/l - 72 h  
(OECD Test Guideline 201)

### 12.2 Persistence and degradability

Biodegradability                      aerobic - Exposure time 14 d  
Result: 94 % - Readily biodegradable  
(OECD Test Guideline 301C)

### 12.3 Bioaccumulative potential

### 12.4 Mobility in soil

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1247                      Class: 3                      Packing group: II  
Proper shipping name: Methyl methacrylate monomer, stabilized  
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1247                      Class: 3                      Packing group: II                      EMS-No: F-E, S-D  
Proper shipping name: METHYL METHACRYLATE MONOMER, STABILIZED

### IATA

UN number: 1247                      Class: 3                      Packing group: II  
Proper shipping name: Methyl methacrylate monomer, stabilized

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Methyl methacrylate	80-62-6	2007-07-01

#### **SARA 311/312 Hazards**

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

#### **Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Methyl methacrylate	80-62-6	2007-07-01

#### **Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Methyl methacrylate	80-62-6	2007-07-01

#### **New Jersey Right To Know Components**

	CAS-No.	Revision Date
Methyl methacrylate	80-62-6	2007-07-01

#### **California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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## **16. OTHER INFORMATION**

### **Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H335	May cause respiratory irritation.
H402	Harmful to aquatic life.
Skin Irrit.	Skin irritation
Skin Sens.	Skin sensitisation
STOT SE	Specific target organ toxicity - single exposure

### **HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

### **NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

### **Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### **Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956





## SAFETY DATA SHEET

Version 5.1  
Revision Date 01/09/2015  
Print Date 06/20/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Methylene Chloride

Product Number : PHR1557  
Brand : Sigma-Aldrich  
Index-No. : 602-004-00-3

CAS-No. : 75-09-2

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Skin irritation (Category 2), H315

Eye irritation (Category 2A), H319

Carcinogenicity (Category 2), H351

Specific target organ toxicity - single exposure (Category 3), Respiratory system, Central nervous system, H335, H336

Specific target organ toxicity - repeated exposure, Oral (Category 2), Liver, Blood, H373

Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Central nervous system, H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H315

Causes skin irritation.

H319

Causes serious eye irritation.

H335

May cause respiratory irritation.

H336

May cause drowsiness or dizziness.

H351

Suspected of causing cancer.

H373

May cause damage to organs (Liver, Blood) through prolonged or repeated exposure if swallowed.

H373

May cause damage to organs (Central nervous system) through prolonged or repeated exposure if inhaled.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P321	Specific treatment (see supplemental first aid instructions on this label).
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Molecular weight	: 84.93 g/mol
CAS-No.	: 75-09-2
EC-No.	: 200-838-9
Index-No.	: 602-004-00-3

#### Hazardous components

Component	Classification	Concentration
<b>Methylene chloride</b>		
	Skin Irrit. 2; Eye Irrit. 2A; Carc. 2; STOT SE 3; STOT RE 2; H315, H319, H335, H336, H351, H373, H373	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

No data available

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

#### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Store at Room Temperature.

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### **Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	Potential Occupational Carcinogen See Appendix A		
Methylene chloride	75-09-2	TWA	50.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		

		TWA	50 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		Substance listed; for more information see OSHA document 1910.1052		
		Substance listed; for more information see OSHA document 1910.1052		
		See Table Z-2		
		PEL	25.000000 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH <sub>2</sub> Cl <sub>2</sub> . Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		
		STEL	125.000000 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH <sub>2</sub> Cl <sub>2</sub> . Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Methylene chloride	75-09-2	Dichloromethane	0.3000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: liquid Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	-97.0 °C (-142.6 °F)
f) Initial boiling point and boiling range	40.0 °C (104.0 °F) at 1,013.2 hPa (760.0 mmHg)
g) Flash point	No data available
h) Evaporation rate	0.71
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 19 %(V) Lower explosion limit: 12 %(V)
k) Vapour pressure	470.9 hPa (353.2 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density	2.93 - (Air = 1.0)
m) Relative density	1.32 g/cm <sup>3</sup>
n) Water solubility	slightly soluble
o) Partition coefficient: n-octanol/water	log Pow: 1.25
p) Auto-ignition temperature	556.1 °C (1,033.0 °F) 662.0 °C (1,223.6 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

Relative vapour density	2.93 - (Air = 1.0)
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**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.  
Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks. Exposure to sunlight.

### 10.5 Incompatible materials

Alkali metals, Aluminum, Strong oxidizing agents, Bases, Amines, Magnesium, Strong acids and strong bases, Vinyl compounds

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LD50 Oral - Rat - > 2,000 mg/kg

Inhalation: No data available

LC50 Inhalation - Rat - 52,000 mg/m<sup>3</sup>

Dermal: No data available

LD50 Dermal - Rat - > 2,000 mg/kg  
(OECD Test Guideline 402)

No data available

No data available

#### Skin corrosion/irritation

No data available

Skin - Rabbit

Result: Irritating to skin. - 24 h  
(Draize Test)

#### Serious eye damage/eye irritation

No data available

Eyes - Rabbit

Result: Irritating to eyes. - 24 h  
(Draize Test)

#### Respiratory or skin sensitisation

No data available

No data available

#### Germ cell mutagenicity

No data available

Rat

DNA damage

#### Carcinogenicity

Carcinogenicity - Rat - Inhalation

Tumorigenic: Carcinogenic by RTECS criteria. Endocrine: Tumors.

Limited evidence of carcinogenicity in animal studies

Suspected human carcinogens

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Methylene chloride)

OSHA: OSHA specifically regulated carcinogen (Methylene chloride)

No data available

No data available

No data available

## No data available

## RTECS: Not available

Dichloromethane is metabolized in the body producing carbon monoxide which increases and sustains carboxyhemoglobin levels in the blood, reducing the oxygen-carrying capacity of the blood., Acts as a simple asphyxiant by displacing air., anesthetic effects, Difficulty in breathing, Headache, Dizziness, Prolonged or repeated contact with skin may cause:, defatting, Dermatitis, Contact with eyes can cause:, Redness, Blurred vision, Provokes tears., Effects due to ingestion may include:, Gastrointestinal discomfort, Central nervous system depression, Paresthesia., Drowsiness, Convulsions, Conjunctivitis., Pulmonary edema. Effects may be delayed., Irregular breathing., Stomach/intestinal disorders, Nausea, Vomiting, Increased liver enzymes., Weakness, Heavy or prolonged skin exposure may result in the absorption of harmful amounts of material., Abdominal pain

## Stomach - Irregularities - Based on Human Evidence

## 12.1 Toxicity

No data available

Toxicity to fish LC50 - *Pimephales promelas* (fathead minnow) - 193.00 mg/l - 96 h  
NOEC - *Cyprinodon variegatus* (sheepshead minnow) - 130 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates

## No data available

No data available

No data available

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1593      Class: 6.1      Packing group: III  
Proper shipping name: Dichloromethane  
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1593      Class: 6.1      Packing group: III      EMS-No: F-A, S-A  
Proper shipping name: DICHLOROMETHANE

### IATA

UN number: 1593      Class: 6.1      Packing group: III  
Proper shipping name: Dichloromethane

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-09-28

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## 16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.



Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure if swallowed.
Skin Irrit.	Skin irritation
STOT RE	Specific target organ toxicity - repeated exposure
STOT SE	Specific target organ toxicity - single exposure

#### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

#### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

#### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

#### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.1

Revision Date: 01/09/2015

Print Date: 06/20/2016

## SAFETY DATA SHEET

Version 5.5  
Revision Date 06/02/2016  
Print Date 06/21/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : *m*-Xylene

Product Number : 95670  
Brand : Sigma-Aldrich  
Index-No. : 601-022-00-9

CAS-No. : 108-38-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 3), H226  
Acute toxicity, Dermal (Category 4), H312  
Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Aspiration hazard (Category 1), H304  
Acute aquatic toxicity (Category 3), H402  
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

H226 : Flammable liquid and vapour.  
H304 : May be fatal if swallowed and enters airways.  
H312 : Harmful in contact with skin.  
H315 : Causes skin irritation.  
H319 : Causes serious eye irritation.  
H335 : May cause respiratory irritation.

H412	Harmful to aquatic life with long lasting effects.
Precautionary statement(s)	
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 + P312	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Synonyms	: 1,3-Dimethylbenzene
Formula	: C <sub>8</sub> H <sub>10</sub>
Molecular weight	: 106.17 g/mol
CAS-No.	: 108-38-3
EC-No.	: 203-576-3
Index-No.	: 601-022-00-9

#### Hazardous components

Component	Classification	Concentration
<b>m-Xylene</b>		
	Flam. Liq. 3; Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; Asp. Tox. 1; Aquatic Acute 3; Aquatic Chronic 3; H226, H304, H312, H315, H319, H335, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Flammable liquids

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

# 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

## 8.1 Control parameters

### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
m-Xylene	108-38-3	TWA	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100.000000 ppm 435.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	150.000000 ppm 655.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100.000000 ppm 435.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section)		

		Not classifiable as a human carcinogen		
		TWA	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
m-Xylene	108-38-3	Methylhippuric acids	1.5g/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			
		Methylhippuric acids	1,500.000 0 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 30 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### **Body Protection**

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

a) Appearance	Form: liquid Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -48 °C (-54 °F) - lit.
f) Initial boiling point and boiling range	138 - 139 °C (280 - 282 °F) - lit.
g) Flash point	25.0 °C (77.0 °F) - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 7 %(V) Lower explosion limit: 1.1 %(V)
k) Vapour pressure	8.0 hPa (6.0 mmHg) at 20.0 °C (68.0 °F) 21.3 hPa (16.0 mmHg) at 37.7 °C (99.9 °F)
l) Vapour density	No data available
m) Relative density	0.868 g/mL at 25 °C (77 °F)
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	log Pow: 3.2 at 20 °C (68 °F)
p) Auto-ignition temperature	465.0 °C (869.0 °F) 528.0 °C (982.4 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available

t) Oxidizing properties      No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - male - 6,602 mg/kg  
(OECD Test Guideline 401)

LC50 Inhalation - Rat - male - 4 h - 6700 ppm  
(Directive 67/548/EEC, Annex V, B.2.)

LD50 Dermal - Rabbit - male - 12,126 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Skin irritation - 24 h

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Severe eye irritation - 24 h

#### Respiratory or skin sensitisation

- Mouse

Result: Does not cause skin sensitisation.  
(OECD Test Guideline 429)

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC:      3 - Group 3: Not classifiable as to its carcinogenicity to humans (m-Xylene)

IARC:      No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP:      No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.



No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

### **Reproductive toxicity**

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

### **Specific target organ toxicity - single exposure**

Inhalation - May cause respiratory irritation.

### **Specific target organ toxicity - repeated exposure**

No data available

### **Aspiration hazard**

May be fatal if swallowed and enters airways.

### **Additional Information**

RTECS: ZE2275000

Liver injury may occur., Kidney injury may occur., Blood disorders, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, narcosis, Lung irritation, chest pain, pulmonary edema, Central nervous system depression, Dermatitis, Gastrointestinal disturbance

Kidney -

---

## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

Toxicity to fish                      mortality LC50 - Fish - 11.23 mg/l - 96 h  
(OECD Test Guideline 203)

Toxicity to daphnia and      Remarks: No data available  
other aquatic  
invertebrates

Toxicity to algae                  Remarks: No data available

### **12.2 Persistence and degradability**

No data available

### **12.3 Bioaccumulative potential**

Due to the distribution coefficient n-octanol/water, accumulation in organisms is not expected.

### **12.4 Mobility in soil**

No data available

### **12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### **12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life with long lasting effects.

No data available

---

## **13. DISPOSAL CONSIDERATIONS**

### **13.1 Waste treatment methods**

#### **Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

**Contaminated packaging**  
Dispose of as unused product.

---

#### 14. TRANSPORT INFORMATION

##### DOT (US)

UN number: 1307      Class: 3      Packing group: III  
Proper shipping name: Xylenes  
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

##### IMDG

UN number: 1307      Class: 3      Packing group: III      EMS-No: F-E, S-D  
Proper shipping name: XYLENES

##### IATA

UN number: 1307      Class: 3      Packing group: III  
Proper shipping name: Xylenes

---

#### 15. REGULATORY INFORMATION

##### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

##### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
m-Xylene	108-38-3	2007-07-01

##### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard

##### Massachusetts Right To Know Components

	CAS-No.	Revision Date
m-Xylene	108-38-3	2007-07-01

##### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
m-Xylene	108-38-3	2007-07-01

##### New Jersey Right To Know Components

	CAS-No.	Revision Date
m-Xylene	108-38-3	2007-07-01

##### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

#### 16. OTHER INFORMATION

##### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Asp. Tox.	Aspiration hazard
Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H226	Flammable liquid and vapour.

H304	May be fatal if swallowed and enters airways.
H312	Harmful in contact with skin.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.5

Revision Date: 06/02/2016

Print Date: 06/21/2016

## SAFETY DATA SHEET

Version 5.7  
Revision Date 03/02/2016  
Print Date 05/01/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Naphthalene

Product Number : 184500  
Brand : Aldrich  
Index-No. : 601-052-00-2

CAS-No. : 91-20-3

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable solids (Category 2), H228  
Acute toxicity, Oral (Category 4), H302  
Carcinogenicity (Category 2), H351  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H228 Flammable solid.  
H302 Harmful if swallowed.  
H351 Suspected of causing cancer.  
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and understood.

P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>10</sub> H <sub>8</sub> C <sub>10</sub> H <sub>8</sub>
Molecular weight	: 128.17 g/mol
CAS-No.	: 91-20-3
EC-No.	: 202-049-5
Index-No.	: 601-052-00-2

#### Hazardous components

Component	Classification	Concentration
<b>Naphthalene</b>		
	Flam. Sol. 2; Acute Tox. 4; Carc. 2; Aquatic Acute 1; Aquatic Chronic 1; H228, H302, H351, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Keep in suitable, closed containers for disposal. Contain spillage, pick up with an electrically protected vacuum cleaner or by wet-brushing and transfer to a container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Flammable solid hazardous materials

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Naphthalene	91-20-3	TWA	10 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Hemolytic anemia Upper Respiratory Tract irritation Cataract Confirmed animal carcinogen with unknown relevance to humans		

		Danger of cutaneous absorption		
		TWA	10.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Hematologic effects Upper Respiratory Tract irritation Eye irritation Eye damage Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Not classifiable as a human carcinogen Danger of cutaneous absorption		
		STEL	15.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Hematologic effects Upper Respiratory Tract irritation Eye irritation Eye damage Adopted values or notations enclosed are those for which changes are proposed in the NIC See Notice of Intended Changes (NIC) Not classifiable as a human carcinogen Danger of cutaneous absorption		
		TWA	10.000000 ppm 50.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	10.000000 ppm 50.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	15.000000 ppm 75.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	10 ppm 50 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	15 ppm 75 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	10 ppm 50 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	10 ppm 50 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		STEL	15 ppm 75 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Naphthalene	91-20-3	1-Naphthol + 2-Naphthol			ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: flakes, granules<br>Colour: white               |
| b) Odour                                   | aromatic  |
| c) Odour Threshold                         | No data available                                     |
| d) pH                                      | No data available                                     |
| e) Melting point/freezing point            | Melting point/range: 80 - 82 °C (176 - 180 °F) - lit. |
| f) Initial boiling point and boiling range | 218 °C (424 °F) - lit.                                |
| g) Flash point                             | 80.0 °C (176.0 °F) - closed cup                       |
| h) Evaporation rate                        | No data available                                     |
| i) Flammability (solid, gas)               | No data available                                     |



j) Upper/lower flammability or explosive limits	Upper explosion limit: 5.9 %(V) Lower explosion limit: 0.9 %(V)
k) Vapour pressure	1.3 hPa (1.0 mmHg) at 53.0 °C (127.4 °F) 0.04 hPa (0.03 mmHg) at 25.0 °C (77.0 °F)
l) Vapour density	No data available
m) Relative density	1.085 g/cm <sup>3</sup> at 24.7 °C (76.5 °F)
n) Water solubility	0.0308 g/l at 25 °C (77 °F) - OECD Test Guideline 105 - slightly soluble
o) Partition coefficient: n-octanol/water	log Pow: 3.4 at 25 °C (77 °F)
p) Auto-ignition temperature	526.0 °C (978.8 °F)
q) Decomposition temperature	No data available
r) Viscosity	1.05 mm <sup>2</sup> /s at 81.5 °C (178.7 °F) -
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

Surface tension	31.8 mN/m at 100.0 °C (212.0 °F)
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## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 490.0 mg/kg

LC50 Inhalation - Rat - male and female - 4 h - > 0.4 mg/l  
(OECD Test Guideline 403)

LD50 Dermal - Rabbit - 20,000 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation - 24 h

**Serious eye damage/eye irritation**

Eyes - Rabbit

Result: Mild eye irritation

**Respiratory or skin sensitisation**

Maximisation Test - Guinea pig

Result: Does not cause skin sensitisation.

(OECD Test Guideline 406)

**Germ cell mutagenicity**

Ames test

S. typhimurium

Result: negative

Rat - male

Result: negative

**Carcinogenicity**

Carcinogenicity - Rat - male and female - inhalation (vapour)

Tumorigenic: Tumors at site of application.

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Naphthalene)

NTP: Reasonably anticipated to be a human carcinogen (Naphthalene)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

Repeated dose toxicity Rat - male and female - Oral - NOAEL : 100 mg/kg - LOAEL : 400 mg/kg - OECD Test Guideline 408

RTECS: QJ0525000

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer., Naphthalene is retinotoxic and systemic absorption of its vapors above 15ppm, may result in: cataracts, optic neuritis, corneal injury, Eye irritation, Ingestion may provoke the following symptoms: hemolytic anemia, hemoglobinuria, Nausea, Headache, Vomiting, Gastrointestinal disturbance, Convulsions, anemia, Kidney injury may occur., Seizures., Coma.

Heart -

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish flow-through test LC50 - Pimephales promelas (fathead minnow) - 7.9 mg/l - 96 h (OECD Test Guideline 203)

Toxicity to daphnia and other aquatic invertebrates static test EC50 - Daphnia magna (Water flea) - 2.16 mg/l - 48 h

**12.2 Persistence and degradability**

Biodegradability aerobic - Exposure time 28 d

Result: 2 % - Not readily biodegradable.

### 12.3 Bioaccumulative potential

Bioaccumulation Fish

Bioconcentration factor (BCF): 427 - 1,158

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

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## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1334 Class: 4.1 Packing group: III  
Proper shipping name: Naphthalene, crude  
Reportable Quantity (RQ): 100 lbs  
Marine pollutant:yes  
Poison Inhalation Hazard: No

### IMDG

UN number: 1334 Class: 4.1 Packing group: III EMS-No: F-A, S-G  
Proper shipping name: NAPHTHALENE, CRUDE  
Marine pollutant:yes

### IATA

UN number: 1334 Class: 4.1 Packing group: III  
Proper shipping name: Naphthalene, crude

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## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Naphthalene	91-20-3	2007-07-01

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Naphthalene	91-20-3	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Naphthalene	91-20-3	2007-07-01

## New Jersey Right To Know Components

Naphthalene

CAS-No.  
91-20-3

Revision Date  
2007-07-01

## California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.  
Naphthalene

CAS-No.  
91-20-3

Revision Date  
1990-01-01

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## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
Flam. Sol.	Flammable solids
H228	Flammable solid.
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	2
Physical Hazard	2

### NFPA Rating

Health hazard:	2
Fire Hazard:	2
Reactivity Hazard:	2

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.7

Revision Date: 03/02/2016

Print Date: 05/01/2016

# SAFETY DATA SHEET

N-Butane

**Airgas**  
an Air Liquide company

## Section 1. Identification

<b>GHS product identifier</b>	: N-Butane
<b>Chemical name</b>	: butane
<b>Other means of identification</b>	: n-BUTANE; Methylethylmethane; Diethyl; Butyl hydride; normal-Butane; butane, pure
<b>Product type</b>	: Gas.
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>Synonym</b>	: n-BUTANE; Methylethylmethane; Diethyl; Butyl hydride; normal-Butane; butane, pure
<b>SDS #</b>	: 001007
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>24-hour telephone</b>	: 1-866-734-3438

## Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Liquefied gas

### GHS label elements

#### **Hazard pictograms**



#### **Signal word**

: Danger

#### **Hazard statements**

: Extremely flammable gas.  
May form explosive mixtures with air.  
Contains gas under pressure; may explode if heated.  
May displace oxygen and cause rapid suffocation.

### Precautionary statements

#### **General**

: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

#### **Prevention**

: Never Put cylinders into unventilated areas of passenger vehicles. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use and store only outdoors or in a well ventilated place.

#### **Response**

: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

#### **Storage**

: Protect from sunlight. Store in a well-ventilated place.

#### **Disposal**

: Not applicable.

#### **Hazards not otherwise classified**

: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

## Section 3. Composition/information on ingredients

<b>Substance/mixture</b>	: Substance
<b>Chemical name</b>	: butane
<b>Other means of identification</b>	: n-BUTANE; Methylethylmethane; Diethyl; Butyl hydride; normal-Butane; butane, pure
<b>Product code</b>	: 001007

### CAS number/other identifiers

**CAS number** : 106-97-8

<b>Ingredient name</b>	<b>%</b>	<b>CAS number</b>
N-Butane	100	106-97-8

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

**There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.**

**Occupational exposure limits, if available, are listed in Section 8.**

## Section 4. First aid measures

### Description of necessary first aid measures

<b>Eye contact</b>	: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.
<b>Inhalation</b>	: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
<b>Skin contact</b>	: Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.
<b>Ingestion</b>	: As this product is a gas, refer to the inhalation section.

### Most important symptoms/effects, acute and delayed

#### Potential acute health effects

<b>Eye contact</b>	: No known significant effects or critical hazards.
<b>Inhalation</b>	: No known significant effects or critical hazards.
<b>Skin contact</b>	: No known significant effects or critical hazards.
<b>Frostbite</b>	: Try to warm up the frozen tissues and seek medical attention.
<b>Ingestion</b>	: As this product is a gas, refer to the inhalation section.

#### Over-exposure signs/symptoms

<b>Eye contact</b>	: No specific data.
<b>Inhalation</b>	: No specific data.
<b>Skin contact</b>	: No specific data.
<b>Ingestion</b>	: No specific data.

### Indication of immediate medical attention and special treatment needed, if necessary

<b>Notes to physician</b>	: Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
<b>Specific treatments</b>	: No specific treatment.

## Section 4. First aid measures

- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

## Section 5. Fire-fighting measures

### Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

- Hazardous thermal decomposition products** : Decomposition products may include the following materials:  
carbon dioxide  
carbon monoxide

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

## Section 6. Accidental release measures

### Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

### Methods and materials for containment and cleaning up

- Small spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.
- Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

## Section 7. Handling and storage

### Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
- Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment.
- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.
- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

## Section 8. Exposure controls/personal protection

### Control parameters

#### Occupational exposure limits

Ingredient name	Exposure limits
N-Butane	<b>NIOSH REL (United States, 10/2016).</b> TWA: 1900 mg/m <sup>3</sup> 10 hours. TWA: 800 ppm 10 hours. <b>OSHA PEL 1989 (United States, 3/1989).</b> TWA: 1900 mg/m <sup>3</sup> 8 hours. TWA: 800 ppm 8 hours. <b>ACGIH TLV (United States, 3/2017).</b> STEL: 1000 ppm 15 minutes.

- Appropriate engineering controls** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
- Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.
- Individual protection measures**
- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.



## Section 8. Exposure controls/personal protection

- Eye/face protection** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.
- Skin protection**
- Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

## Section 9. Physical and chemical properties

### Appearance

- Physical state** : Gas. [Compressed gas.]
- Color** : Colorless.
- Odor** : Odorless.
- Odor threshold** : Not available.
- pH** : Not available.
- Melting point** : -138°C (-216.4°F)
- Boiling point** : -0.5°C (31.1°F)
- Critical temperature** : 151.85°C (305.3°F)
- Flash point** : Closed cup: -60°C (-76°F)
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.
- Lower and upper explosive (flammable) limits** : Lower: 1.8%  
Upper: 8.4%
- Vapor pressure** : 16.3 (psig)
- Vapor density** : 2.1 (Air = 1)
- Specific Volume (ft<sup>3</sup>/lb)** : 6.435
- Gas Density (lb/ft<sup>3</sup>)** : 0.1554
- Relative density** : Not applicable.
- Solubility** : Not available.
- Solubility in water** : 0.06 g/l
- Partition coefficient: n-octanol/water** : 2.89
- Auto-ignition temperature** : 365°C (689°F)
- Decomposition temperature** : Not available.

## Section 9. Physical and chemical properties

**Viscosity** : Not applicable.

**Flow time (ISO 2431)** : Not available.

**Molecular weight** : 58.14 g/mole

### Aerosol product

**Heat of combustion** : -45384912 J/kg

## Section 10. Stability and reactivity

**Reactivity** : No specific test data related to reactivity available for this product or its ingredients.

**Chemical stability** : The product is stable.

**Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.

**Conditions to avoid** : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

**Incompatible materials** : Oxidizers

**Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

**Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

## Section 11. Toxicological information

### Information on toxicological effects

#### Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
N-Butane	LC50 Inhalation Vapor	Rat	658000 mg/m <sup>3</sup>	4 hours

#### Irritation/Corrosion

Not available.

#### Sensitization

Not available.

#### Mutagenicity

Not available.

#### Carcinogenicity

Not available.

#### Reproductive toxicity

Not available.

#### Teratogenicity

Not available.

#### Specific target organ toxicity (single exposure)

Not available.

#### Specific target organ toxicity (repeated exposure)

Not available.

## Section 11. Toxicological information

### Aspiration hazard

Not available.

**Information on the likely routes of exposure** : Not available.

### Potential acute health effects

**Eye contact** : No known significant effects or critical hazards.  
**Inhalation** : No known significant effects or critical hazards.  
**Skin contact** : No known significant effects or critical hazards.  
**Ingestion** : As this product is a gas, refer to the inhalation section.

### Symptoms related to the physical, chemical and toxicological characteristics

**Eye contact** : No specific data.  
**Inhalation** : No specific data.  
**Skin contact** : No specific data.  
**Ingestion** : No specific data.

### Delayed and immediate effects and also chronic effects from short and long term exposure

#### Short term exposure

**Potential immediate effects** : Not available.  
**Potential delayed effects** : Not available.

#### Long term exposure

**Potential immediate effects** : Not available.  
**Potential delayed effects** : Not available.

### Potential chronic health effects

Not available.

**General** : No known significant effects or critical hazards.  
**Carcinogenicity** : No known significant effects or critical hazards.  
**Mutagenicity** : No known significant effects or critical hazards.  
**Teratogenicity** : No known significant effects or critical hazards.  
**Developmental effects** : No known significant effects or critical hazards.  
**Fertility effects** : No known significant effects or critical hazards.

### Numerical measures of toxicity

#### Acute toxicity estimates

Not available.

## Section 12. Ecological information

### Toxicity

Not available.

### Persistence and degradability

Not available.

## Section 12. Ecological information

### Bioaccumulative potential

Product/ingredient name	LogP <sub>ow</sub>	BCF	Potential
N-Butane	2.89	-	low

### Mobility in soil






Soil/water partition coefficient (K<sub>oc</sub>) : Not available.

Other adverse effects : No known significant effects or critical hazards.

## Section 13. Disposal considerations

**Disposal methods** : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

## Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1011	UN1011	UN1011	UN1011	UN1011
UN proper shipping name	BUTANE	BUTANE	BUTANE	BUTANE	BUTANE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

### Additional information

#### DOT Classification

: **Limited quantity** Yes.  
**Quantity limitation** Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.  
**Special provisions** 19, T50

#### TDG Classification

: Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).  
**Explosive Limit and Limited Quantity Index** 0.125  
**ERAP Index** 3000  
**Passenger Carrying Ship Index** Forbidden  
**Passenger Carrying Road or Rail Index** Forbidden  
**Special provisions** 29

#### IATA

: **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

## Section 14. Transport information

**Special precautions for user** : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

**Transport in bulk according to Annex II of MARPOL and the IBC Code** : Not available.

## Section 15. Regulatory information

**U.S. Federal regulations** : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined  
**Clean Air Act (CAA) 112 regulated flammable substances:** butane

**Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs)** : Not listed

**Clean Air Act Section 602 Class I Substances** : Not listed

**Clean Air Act Section 602 Class II Substances** : Not listed

**DEA List I Chemicals (Precursor Chemicals)** : Not listed

**DEA List II Chemicals (Essential Chemicals)** : Not listed

### SARA 302/304

#### Composition/information on ingredients

No products were found.

**SARA 304 RQ** : Not applicable.

### SARA 311/312

**Classification** : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

### State regulations

**Massachusetts** : This material is listed.

**New York** : This material is not listed.

**New Jersey** : This material is listed.

**Pennsylvania** : This material is listed.

### International regulations

#### Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

#### Montreal Protocol (Annexes A, B, C, E)

Not listed.

#### Stockholm Convention on Persistent Organic Pollutants

Not listed.

#### Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

#### UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

### Inventory list

**Australia** : This material is listed or exempted.

**Canada** : This material is listed or exempted.

## Section 15. Regulatory information

<b>China</b>	: This material is listed or exempted.
<b>Europe</b>	: This material is listed or exempted.
<b>Japan</b>	: <b>Japan inventory (ENCS)</b> : This material is listed or exempted. <b>Japan inventory (ISHL)</b> : This material is listed or exempted.
<b>Malaysia</b>	: This material is listed or exempted.
<b>New Zealand</b>	: This material is listed or exempted.
<b>Philippines</b>	: This material is listed or exempted.
<b>Republic of Korea</b>	: This material is listed or exempted.
<b>Taiwan</b>	: This material is listed or exempted.
<b>Thailand</b>	: Not determined.
<b>Turkey</b>	: This material is listed or exempted.
<b>United States</b>	: This material is listed or exempted.
<b>Viet Nam</b>	: Not determined.

## Section 16. Other information

### Hazardous Material Information System (U.S.A.)

Health	/	1
Flammability		4
Physical hazards		3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

### National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

### Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment

### History

<b>Date of printing</b>	: 10/5/2018
<b>Date of issue/Date of revision</b>	: 10/5/2018
<b>Date of previous issue</b>	: 4/9/2018

## Section 16. Other information

**Version** : 2

**Key to abbreviations** : ATE = Acute Toxicity Estimate  
BCF = Bioconcentration Factor  
GHS = Globally Harmonized System of Classification and Labelling of Chemicals  
IATA = International Air Transport Association  
IBC = Intermediate Bulk Container  
IMDG = International Maritime Dangerous Goods  
LogPow = logarithm of the octanol/water partition coefficient  
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973  
as modified by the Protocol of 1978. ("Marpol" = marine pollution)  
UN = United Nations

**References** : Not available.

### Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

# SAFETY DATA SHEET

**Airgas**

n-Heptane

## Section 1. Identification

<b>GHS product identifier</b>	: n-Heptane
<b>Chemical name</b>	: heptane
<b>Other means of identification</b>	: n-heptane; Heptane (n-Heptane)
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>Synonym</b>	: n-heptane; Heptane (n-Heptane)
<b>SDS #</b>	: 001108
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>Emergency telephone number (with hours of operation)</b>	: 1-866-734-3438

## Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: FLAMMABLE LIQUIDS - Category 1 SKIN CORROSION/IRRITATION - Category 2 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 AQUATIC HAZARD (ACUTE) - Category 1 AQUATIC HAZARD (LONG-TERM) - Category 1

### GHS label elements

**Hazard pictograms**



**Signal word**

: Danger

**Hazard statements**

: Extremely flammable liquid and vapor.  
May form explosive mixtures with air.  
Causes skin irritation.  
May cause drowsiness and dizziness.  
Very toxic to aquatic life.  
Very toxic to aquatic life with long lasting effects.

### Precautionary statements

**General**

: Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

**Prevention**

: Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Avoid breathing vapor. Wash hands thoroughly after handling.

**Date of issue/Date of revision**

: 4/29/2015.

**Date of previous issue**

: 10/28/2014.

**Version** : 0.02

1/13



## Section 2. Hazards identification

- Response** : Collect spillage. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. If skin irritation occurs: Get medical attention.
- Storage** : Store locked up. Store in a well-ventilated place. Keep cool.
- Disposal** : Dispose of contents and container in accordance with all local, regional, national and international regulations.
- Hazards not otherwise classified** : None known.

## Section 3. Composition/information on ingredients

- Substance/mixture** : Substance
- Chemical name** : heptane
- Other means of identification** : n-heptane; Heptane (n-Heptane)

### CAS number/other identifiers

- CAS number** : 142-82-5
- Product code** : 001108

Ingredient name	%	CAS number
heptane	100	142-82-5

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

## Section 4. First aid measures

### Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If necessary, call a poison center or physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention.

## Section 4. First aid measures

immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

### Most important symptoms/effects, acute and delayed

#### Potential acute health effects

- Eye contact** : Causes serious eye irritation.
- Inhalation** : Can cause central nervous system (CNS) depression. May cause drowsiness and dizziness.
- Skin contact** : Causes skin irritation.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : Can cause central nervous system (CNS) depression. Irritating to mouth, throat and stomach.

#### Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:  
pain or irritation  
watering  
redness
- Inhalation** : Adverse symptoms may include the following:  
nausea or vomiting  
headache  
drowsiness/fatigue  
dizziness/vertigo  
unconsciousness
- Skin contact** : Adverse symptoms may include the following:  
irritation  
redness
- Ingestion** : No specific data.

### Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

## Section 5. Fire-fighting measures

### Extinguishing media

- Suitable extinguishing media** : Use dry chemical, CO<sub>2</sub>, water spray (fog) or foam.
- Unsuitable extinguishing media** : Do not use water jet.

## Section 5. Fire-fighting measures

<b>Specific hazards arising from the chemical</b>	: Extremely flammable liquid and vapor. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. This material is very toxic to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.
<b>Hazardous thermal decomposition products</b>	: Decomposition products may include the following materials: carbon dioxide carbon monoxide
<b>Special protective actions for fire-fighters</b>	: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
<b>Special protective equipment for fire-fighters</b>	: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

## Section 6. Accidental release measures

### Personal precautions, protective equipment and emergency procedures

<b>For non-emergency personnel</b>	: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
<b>For emergency responders</b>	: If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".
<b>Environmental precautions</b>	: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

### Methods and materials for containment and cleaning up

<b>Small spill</b>	: Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
<b>Large spill</b>	: Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

## Section 7. Handling and storage

### Precautions for safe handling

**Protective measures** : Put on appropriate personal protective equipment (see Section 8). Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapor or mist. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

**Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

**Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

## Section 8. Exposure controls/personal protection

### Control parameters

#### Occupational exposure limits

Ingredient name	Exposure limits
heptane	<p><b>ACGIH TLV (United States, 3/2012).</b>            STEL: 2050 mg/m<sup>3</sup> 15 minutes.            STEL: 500 ppm 15 minutes.            TWA: 1640 mg/m<sup>3</sup> 8 hours.            TWA: 400 ppm 8 hours.</p> <p><b>NIOSH REL (United States, 1/2013).</b>            CEIL: 1800 mg/m<sup>3</sup> 15 minutes.            CEIL: 440 ppm 15 minutes.            TWA: 350 mg/m<sup>3</sup> 10 hours.            TWA: 85 ppm 10 hours.</p> <p><b>OSHA PEL (United States, 6/2010).</b>            TWA: 2000 mg/m<sup>3</sup> 8 hours.            TWA: 500 ppm 8 hours.</p> <p><b>OSHA PEL 1989 (United States, 3/1989).</b>            STEL: 2000 mg/m<sup>3</sup> 15 minutes.            STEL: 500 ppm 15 minutes.            TWA: 1600 mg/m<sup>3</sup> 8 hours.            TWA: 400 ppm 8 hours.</p>

**Appropriate engineering controls** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

## Section 8. Exposure controls/personal protection

**Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

### Individual protection measures

**Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

**Eye/face protection** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

### Skin protection

**Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

**Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

**Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

**Respiratory protection** : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

## Section 9. Physical and chemical properties

### Appearance

**Physical state** : Liquid. [Watery liquid.]

**Color** : Colorless.

**Molecular weight** : 100.23 g/mole

**Molecular formula** : C7-H16

**Boiling/condensation point** : 98.5°C (209.3°F)

**Melting/freezing point** : -90.6°C (-131.1°F)

**Critical temperature** : 266.85°C (512.3°F)

**Odor** : Characteristic.

**Odor threshold** : Not available.

**pH** : Not available.

**Flash point** : Closed cup: -3.89°C (25°F)

**Burning time** : Not applicable.

**Burning rate** : Not applicable.

## Section 9. Physical and chemical properties

<b>Evaporation rate</b>	: 3.18 (butyl acetate = 1)
<b>Flammability (solid, gas)</b>	: Not available.
<b>Lower and upper explosive (flammable) limits</b>	: Lower: 1.05% Upper: 6.7%
<b>Vapor pressure</b>	: 4.6 kPa (34.502803352 mm Hg) [room temperature]
<b>Vapor density</b>	: 3.46 (Air = 1)
<b>Specific Volume (ft<sup>3</sup>/lb)</b>	: 1.462
<b>Gas Density (lb/ft<sup>3</sup>)</b>	: 0.684
<b>Relative density</b>	: 0.68
<b>Solubility</b>	: Not available.
<b>Solubility in water</b>	: Not available.
<b>Partition coefficient: n-octanol/water</b>	: 4.66
<b>Auto-ignition temperature</b>	: 285°C (545°F)
<b>Decomposition temperature</b>	: Not available.
<b>SADT</b>	: Not available.
<b>Viscosity</b>	: Kinematic (room temperature): 0.00641 cm <sup>2</sup> /s (0.641 cSt)

## Section 10. Stability and reactivity

<b>Reactivity</b>	: No specific test data related to reactivity available for this product or its ingredients.
<b>Chemical stability</b>	: The product is stable.
<b>Possibility of hazardous reactions</b>	: Under normal conditions of storage and use, hazardous reactions will not occur.
<b>Conditions to avoid</b>	: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.
<b>Incompatibility with various substances</b>	: Extremely reactive or incompatible with the following materials: oxidizing materials.
<b>Hazardous decomposition products</b>	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

**Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

## Section 11. Toxicological information

### Information on toxicological effects

#### Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
heptane	LC50 Inhalation Gas.	Rat	48000 ppm	4 hours
	LC50 Inhalation Vapor	Rat	50242 ppm	1 hours
	LC50 Inhalation Vapor	Rat	103 g/m <sup>3</sup>	4 hours

#### Irritation/Corrosion

**Date of issue/Date of revision** : 4/29/2015. **Date of previous issue** : 10/28/2014. **Version** : 0.02 7/13

## Section 11. Toxicological information

Not available.

### Sensitization

Not available.

### Mutagenicity

Not available.

### Carcinogenicity

Not available.

### Reproductive toxicity

Not available.

### Teratogenicity

Not available.

### Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
heptane	Category 3	Not applicable.	Narcotic effects

### Specific target organ toxicity (repeated exposure)

Not available.

### Aspiration hazard

Not available.

**Information on the likely routes of exposure** : Not available.

### Potential acute health effects

- Eye contact** : Causes serious eye irritation.
- Inhalation** : Can cause central nervous system (CNS) depression. May cause drowsiness and dizziness.
- Skin contact** : Causes skin irritation.
- Ingestion** : Can cause central nervous system (CNS) depression. Irritating to mouth, throat and stomach.

### Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : Adverse symptoms may include the following:  
pain or irritation  
watering  
redness
- Inhalation** : Adverse symptoms may include the following:  
nausea or vomiting  
headache  
drowsiness/fatigue  
dizziness/vertigo  
unconsciousness
- Skin contact** : Adverse symptoms may include the following:  
irritation  
redness
- Ingestion** : No specific data.



## Section 11. Toxicological information

### Delayed and immediate effects and also chronic effects from short and long term exposure

#### Short term exposure

**Potential immediate effects** : Not available.

**Potential delayed effects** : Not available.

#### Long term exposure

**Potential immediate effects** : Not available.

**Potential delayed effects** : Not available.

#### Potential chronic health effects

Not available.

**General** : No known significant effects or critical hazards.

**Carcinogenicity** : No known significant effects or critical hazards.

**Mutagenicity** : No known significant effects or critical hazards.

**Teratogenicity** : No known significant effects or critical hazards.

**Developmental effects** : No known significant effects or critical hazards.

**Fertility effects** : No known significant effects or critical hazards.

### Numerical measures of toxicity

#### Acute toxicity estimates

Not available.

## Section 12. Ecological information

### Toxicity

Product/ingredient name	Result	Species	Exposure
heptane	Acute LC50 375000 µg/l Fresh water	Fish - Oreochromis mossambicus	96 hours

### Persistence and degradability

Not available.

### Bioaccumulative potential

Product/ingredient name	LogP <sub>ow</sub>	BCF	Potential
heptane	4.66	552	high

### Mobility in soil

**Soil/water partition coefficient (K<sub>oc</sub>)** : Not available.







**Other adverse effects** : No known significant effects or critical hazards.



## Section 13. Disposal considerations

**Disposal methods** : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

## Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
<b>UN number</b>	UN1206	UN1206	UN1206	UN1206	UN1206
<b>UN proper shipping name</b>	Heptanes	Heptanes	Heptanes	Heptanes	Heptanes
<b>Transport hazard class(es)</b>	3 	3 	3 	3  	3 
<b>Packing group</b>	II	II	II	II	II
<b>Environment</b>	No.	No.	No.	Yes.	No.
<b>Additional information</b>	-	<u>Explosive Limit and Limited Quantity Index</u> 1  <u>Passenger Carrying Road or Rail Index</u> 5	-	The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.	The environmentally hazardous substance mark may appear if required by other transportation regulations.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

**Special precautions for user** : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

**Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code** : Not available.

## Section 15. Regulatory information

**U.S. Federal regulations** : TSCA 8(a) PAIR: heptane  
 TSCA 8(a) CDR Exempt/Partial exemption: Not determined  
 TSCA 12(b) one-time export: heptane  
 United States inventory (TSCA 8b): This material is listed or exempted.

**Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs)** : Not listed

**Clean Air Act Section 602 Class I Substances** : Not listed

**Clean Air Act Section 602 Class II Substances** : Not listed

**DEA List I Chemicals (Precursor Chemicals)** : Not listed

**DEA List II Chemicals (Essential Chemicals)** : Not listed

### SARA 302/304

#### Composition/information on ingredients

No products were found.

**SARA 304 RQ** : Not applicable.

### SARA 311/312

**Classification** : Fire hazard  
 Immediate (acute) health hazard

#### Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
heptane	100	Yes.	No.	No.	Yes.	No.

### State regulations

**Massachusetts** : This material is listed.  
**New York** : This material is not listed.  
**New Jersey** : This material is listed.  
**Pennsylvania** : This material is listed.  
**Canada inventory** : This material is listed or exempted.

### International regulations

**International lists** : **Australia inventory (AICS)**: This material is listed or exempted.  
**China inventory (IECSC)**: This material is listed or exempted.  
**Japan inventory**: This material is listed or exempted.  
**Korea inventory**: This material is listed or exempted.  
**Malaysia Inventory (EHS Register)**: Not determined.  
**New Zealand Inventory of Chemicals (NZIoC)**: This material is listed or exempted.  
**Philippines inventory (PICCS)**: This material is listed or exempted.  
**Taiwan inventory (CSNN)**: Not determined.

**Chemical Weapons Convention List Schedule I Chemicals** : Not listed

## Section 15. Regulatory information

**Chemical Weapons Convention List Schedule II Chemicals** : Not listed

**Chemical Weapons Convention List Schedule III Chemicals** : Not listed

### Canada

**WHMIS (Canada)** : Class B-2: Flammable liquid  
Class D-2B: Material causing other toxic effects (Toxic).  
**CEPA Toxic substances**: This material is not listed.  
**Canadian ARET**: This material is not listed.  
**Canadian NPRI**: This material is listed.  
**Alberta Designated Substances**: This material is not listed.  
**Ontario Designated Substances**: This material is not listed.  
**Quebec Designated Substances**: This material is not listed.

## Section 16. Other information

**Canada Label requirements** : Class B-2: Flammable liquid  
Class D-2B: Material causing other toxic effects (Toxic).

### Hazardous Material Information System (U.S.A.)

Health	2
Flammability	3
Physical hazards	0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

### National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

### History

**Date of printing** : 4/29/2015.

**Date of issue/Date of revision** : 4/29/2015.

**Date of issue/Date of revision** : 4/29/2015. **Date of previous issue** : 10/28/2014. **Version** : 0.02 12/13

## Section 16. Other information

**Date of previous issue** : 10/28/2014.

**Version** : 0.02

**Key to abbreviations** :

- ATE = Acute Toxicity Estimate
- BCF = Bioconcentration Factor
- GHS = Globally Harmonized System of Classification and Labelling of Chemicals
- IATA = International Air Transport Association
- IBC = Intermediate Bulk Container
- IMDG = International Maritime Dangerous Goods
- LogPow = logarithm of the octanol/water partition coefficient
- MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
- UN = United Nations
- ACGIH – American Conference of Governmental Industrial Hygienists
- AIHA – American Industrial Hygiene Association
- CAS – Chemical Abstract Services
- CEPA – Canadian Environmental Protection Act
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
- CFR – United States Code of Federal Regulations
- CPR – Controlled Products Regulations
- DSL – Domestic Substances List
- GWP – Global Warming Potential
- IARC – International Agency for Research on Cancer
- ICAO – International Civil Aviation Organisation
- Inh – Inhalation
- LC – Lethal concentration
- LD – Lethal dosage
- NDSL – Non-Domestic Substances List
- NIOSH – National Institute for Occupational Safety and Health
- TDG – Canadian Transportation of Dangerous Goods Act and Regulations
- TLV – Threshold Limit Value
- TSCA – Toxic Substances Control Act
- WEEL – Workplace Environmental Exposure Level
- WHMIS – Canadian Workplace Hazardous Material Information System

**References** : Not available.

Indicates information that has changed from previously issued version.

### Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

# SAFETY DATA SHEET

n-Hexane

**Airgas**  
an Air Liquide company

## Section 1. Identification

<b>GHS product identifier</b>	: n-Hexane
<b>Chemical name</b>	: n-hexane
<b>Other means of identification</b>	: hexane; normal-Hexane; Hexyl hydride; n-Hexylhydride; n-Caproylhdyride; Hexane, normale; NSC 68472; n-HEXANE, conc. (3) 5%; hexane, n-; Hexane (n-Hexane)
<b>Product type</b>	: Liquid.
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>Synonym</b>	: hexane; normal-Hexane; Hexyl hydride; n-Hexylhydride; n-Caproylhdyride; Hexane, normale; NSC 68472; n-HEXANE, conc. (3) 5%; hexane, n-; Hexane (n-Hexane)
<b>SDS #</b>	: 001060
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>24-hour telephone</b>	: 1-866-734-3438

## Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: FLAMMABLE LIQUIDS - Category 2 TOXIC TO REPRODUCTION (Fertility) - Category 2 TOXIC TO REPRODUCTION (Unborn child) - Category 2 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2 AQUATIC HAZARD (ACUTE) - Category 2 AQUATIC HAZARD (LONG-TERM) - Category 2

### GHS label elements

<b>Hazard pictograms</b>	: 
--------------------------	--

<b>Signal word</b>	: Danger
<b>Hazard statements</b>	: May form explosive mixtures with air. Highly flammable liquid and vapor. Suspected of damaging fertility or the unborn child. May cause drowsiness or dizziness. May cause damage to organs through prolonged or repeated exposure. Toxic to aquatic life with long lasting effects.

### Precautionary statements

<b>General</b>	: Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.
<b>Prevention</b>	: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Do not breathe vapor.

## Section 2. Hazards identification

<b>Response</b>	: Collect spillage. Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower.
<b>Storage</b>	: Store locked up. Store in a well-ventilated place. Keep cool.
<b>Disposal</b>	: Dispose of contents and container in accordance with all local, regional, national and international regulations.
<b>Hazards not otherwise classified</b>	: None known.

## Section 3. Composition/information on ingredients

<b>Substance/mixture</b>	: Substance
<b>Chemical name</b>	: n-hexane
<b>Other means of identification</b>	: hexane; normal-Hexane; Hexyl hydride; n-Hexylhydride; n-Caproylhydride; Hexane, normale; NSC 68472; n-HEXANE, conc. (3) 5%; hexane, n-; Hexane (n-Hexane)
<b>Product code</b>	: 001060

### CAS number/other identifiers

**CAS number** : 110-54-3

<b>Ingredient name</b>	<b>%</b>	<b>CAS number</b>
n-hexane	100	110-54-3

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

**There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.**

Occupational exposure limits, if available, are listed in Section 8.

## Section 4. First aid measures

### Description of necessary first aid measures

<b>Eye contact</b>	: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention following exposure or if feeling unwell.
<b>Inhalation</b>	: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
<b>Skin contact</b>	: Wash contaminated skin with soap and water. Remove contaminated clothing and shoes. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.
<b>Ingestion</b>	: Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If necessary, call a poison center or physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

### Most important symptoms/effects, acute and delayed

## Section 4. First aid measures

### Potential acute health effects

- Eye contact** : No known significant effects or critical hazards.
- Inhalation** : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness.
- Skin contact** : No known significant effects or critical hazards.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : Can cause central nervous system (CNS) depression.

### Over-exposure signs/symptoms

- Eye contact** : No specific data.
- Inhalation** : Adverse symptoms may include the following: nausea or vomiting, headache, drowsiness/fatigue, dizziness/vertigo, unconsciousness, reduced fetal weight, increase in fetal deaths, skeletal malformations
- Skin contact** : Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations
- Ingestion** : Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations

### Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

## Section 5. Fire-fighting measures

### Extinguishing media

- Suitable extinguishing media** : Use dry chemical, CO<sub>2</sub>, water spray (fog) or foam.
- Unsuitable extinguishing media** : Do not use water jet.

- Specific hazards arising from the chemical** : Highly flammable liquid and vapor. Runoff to sewer may create fire or explosion hazard. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. This material is toxic to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

- Hazardous thermal decomposition products** : Decomposition products may include the following materials:  
carbon dioxide  
carbon monoxide

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.



## Section 6. Accidental release measures

### Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

### Methods and materials for containment and cleaning up

- Small spill** : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
- Large spill** : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

## Section 7. Handling and storage

### Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Avoid release to the environment. Do not ingest. Empty containers retain product residue and can be hazardous. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Do not reuse container. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe vapor or mist. Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Avoid exposure during pregnancy.
- Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Store locked up. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.



## Section 8. Exposure controls/personal protection

### Control parameters

#### Occupational exposure limits

Ingredient name	Exposure limits
n-hexane	<p><b>ACGIH TLV (United States, 3/2017).</b>  <b>Absorbed through skin.</b>  TWA: 50 ppm 8 hours.</p> <p><b>NIOSH REL (United States, 10/2016).</b>  TWA: 180 mg/m<sup>3</sup> 10 hours.  TWA: 50 ppm 10 hours.</p> <p><b>OSHA PEL (United States, 6/2016).</b>  TWA: 1800 mg/m<sup>3</sup> 8 hours.  TWA: 500 ppm 8 hours.</p> <p><b>OSHA PEL 1989 (United States, 3/1989).</b>  TWA: 180 mg/m<sup>3</sup> 8 hours.  TWA: 50 ppm 8 hours.</p>

#### Appropriate engineering controls

- : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

#### Environmental exposure controls

- : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

### Individual protection measures

#### Hygiene measures

- : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

#### Eye/face protection

- : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

### Skin protection

#### Hand protection

- : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

#### Body protection

- : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

#### Other skin protection

- : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

#### Respiratory protection

- : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

## Section 9. Physical and chemical properties

### Appearance

Physical state	: Liquid. [COLORLESS LIQUID WITH A MILD GASOLINE-LIKE ODOR]
Color	: Colorless.
Odor	: Characteristic.
Odor threshold	: Not available.
pH	: Not available.
Melting point	: -95.35°C (-139.6°F)
Boiling point	: 68.73°C (155.7°F)
Critical temperature	: 234.25°C (453.6°F)
Flash point	: Closed cup: -22°C (-7.6°F)
Evaporation rate	: 6.82 (butyl acetate = 1)
Flammability (solid, gas)	: Extremely flammable in the presence of the following materials or conditions: oxidizing materials.
Lower and upper explosive (flammable) limits	: Lower: 1.1% Upper: 7.5%
Vapor pressure	: 17 kPa (127.51 mm Hg) [room temperature]
Vapor density	: 3 (Air = 1)
Specific Volume (ft <sup>3</sup> /lb)	: 1.5138
Gas Density (lb/ft <sup>3</sup> )	: 0.6606 (25°C / 77 to °F)
Relative density	: 0.7
Solubility	: Not available.
Solubility in water	: 0.01 g/l
Partition coefficient: n-octanol/water	: 4
Auto-ignition temperature	: 225°C (437°F)
Decomposition temperature	: Not available.
Viscosity	: Dynamic (room temperature): 0.3 mPa·s (0.3 cP)
Flow time (ISO 2431)	: Not available.
Molecular weight	: 86.18 g/mole
<b>Aerosol product</b>	
Heat of combustion	: -44766196 J/kg

## Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.
Incompatible materials	: Reactive or incompatible with the following materials: oxidizing materials
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

## Section 10. Stability and reactivity

**Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

## Section 11. Toxicological information

### Information on toxicological effects

#### Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
n-hexane	LC50 Inhalation Gas. LC50 Inhalation Vapor LD50 Oral	Rat Rat Rat	48000 ppm 96000 ppm 15840 mg/kg	4 hours 1 hours -

#### Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
n-hexane	Eyes - Mild irritant	Rabbit	-	10 milligrams	-

#### Sensitization

Not available.

#### Mutagenicity

Not available.

#### Carcinogenicity

Not available.

#### Reproductive toxicity

Not available.

#### Teratogenicity

Not available.

#### Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
n-hexane	Category 3	Not applicable.	Narcotic effects

#### Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
n-hexane	Category 2	Not determined	Not determined

#### Aspiration hazard

Not available.

**Information on the likely routes of exposure** : Not available.

#### Potential acute health effects

**Eye contact** : No known significant effects or critical hazards.

**Inhalation** : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness.

**Skin contact** : No known significant effects or critical hazards.

**Ingestion** : Can cause central nervous system (CNS) depression.

#### Symptoms related to the physical, chemical and toxicological characteristics

**Eye contact** : No specific data.

## Section 11. Toxicological information

- Inhalation** : Adverse symptoms may include the following: nausea or vomiting, headache, drowsiness/fatigue, dizziness/vertigo, unconsciousness, reduced fetal weight, increase in fetal deaths, skeletal malformations
- Skin contact** : Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations
- Ingestion** : Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations

### Delayed and immediate effects and also chronic effects from short and long term exposure

#### Short term exposure

**Potential immediate effects** : Not available.

**Potential delayed effects** : Not available.

#### Long term exposure

**Potential immediate effects** : Not available.

**Potential delayed effects** : Not available.

#### Potential chronic health effects

Not available.

**General** : May cause damage to organs through prolonged or repeated exposure.

**Carcinogenicity** : No known significant effects or critical hazards.

**Mutagenicity** : No known significant effects or critical hazards.

**Teratogenicity** : Suspected of damaging the unborn child.

**Developmental effects** : No known significant effects or critical hazards.

**Fertility effects** : Suspected of damaging fertility.

### Numerical measures of toxicity

#### Acute toxicity estimates

Not available.

## Section 12. Ecological information

### Toxicity

Product/ingredient name	Result	Species	Exposure
n-hexane	Acute LC50 2500 µg/l Fresh water	Fish - Pimephales promelas	96 hours

### Persistence and degradability

Not available.

### Bioaccumulative potential

Product/ingredient name	LogP <sub>ow</sub>	BCF	Potential
n-hexane	4	501.187	high

### Mobility in soil

**Soil/water partition coefficient (K<sub>oc</sub>)** : Not available.









**Other adverse effects** : No known significant effects or critical hazards.

## Section 13. Disposal considerations

### Disposal methods

- The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

## Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1208	UN1208	UN1208	UN1208	UN1208
UN proper shipping name	Hexanes	Hexanes	Hexanes	Hexanes	Hexanes
Transport hazard class(es)	3  	3  	3 	3  	3 
Packing group	II	II	II	II	II
Environmental hazards	Yes.	Yes.	Yes. The environmentally hazardous substance mark is not required.	Yes.	Yes. The environmentally hazardous substance mark is not required.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

### Additional information

#### DOT Classification

- This product is not regulated as a marine pollutant when transported on inland waterways in sizes of ≤5 L or ≤5 kg or by road, rail, or inland air in non-bulk sizes, provided the packagings meet the general provisions of §§ 173.24 and 173.24a. **Reportable quantity** 5000 lbs / 2270 kg [907.77 gal / 3436.3 L]. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.

#### TDG Classification

- Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.18-2.19 (Class 3), 2.7 (Marine pollutant mark). The marine pollutant mark is not required when transported by road or rail. **Explosive Limit and Limited Quantity Index** 1  
**Passenger Carrying Ship Index** Forbidden  
**Passenger Carrying Road or Rail Index** 5

#### IMDG

- The marine pollutant mark is not required when transported in sizes of ≤5 L or ≤5 kg.

#### IATA

- The environmentally hazardous substance mark may appear if required by other transportation regulations.

- Special precautions for user** : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

## Section 14. Transport information

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

## Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

### SARA 302/304

#### Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

### SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

### SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	n-hexane	110-54-3	100
Supplier notification	n-hexane	110-54-3	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

### State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

### International regulations

#### Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

#### Montreal Protocol (Annexes A, B, C, E)

Not listed.

#### Stockholm Convention on Persistent Organic Pollutants

Not listed.

#### Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

#### UNECE Aarhus Protocol on POPs and Heavy Metals

## Section 15. Regulatory information

Not listed.

### Inventory list

<b>Australia</b>	: This material is listed or exempted.
<b>Canada</b>	: This material is listed or exempted.
<b>China</b>	: This material is listed or exempted.
<b>Europe</b>	: This material is listed or exempted.
<b>Japan</b>	: <b>Japan inventory (ENCS)</b> : This material is listed or exempted. <b>Japan inventory (ISHL)</b> : This material is listed or exempted.
<b>Malaysia</b>	: This material is listed or exempted.
<b>New Zealand</b>	: This material is listed or exempted.
<b>Philippines</b>	: This material is listed or exempted.
<b>Republic of Korea</b>	: This material is listed or exempted.
<b>Taiwan</b>	: This material is listed or exempted.
<b>Thailand</b>	: Not determined.
<b>Turkey</b>	: This material is listed or exempted.
<b>United States</b>	: This material is listed or exempted.
<b>Viet Nam</b>	: Not determined.

## Section 16. Other information

### Hazardous Material Information System (U.S.A.)

Health	/	2
Flammability		4
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

### National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

### Procedure used to derive the classification

## Section 16. Other information

Classification	Justification
FLAMMABLE LIQUIDS - Category 2	On basis of test data
TOXIC TO REPRODUCTION (Fertility) - Category 2	Expert judgment
TOXIC TO REPRODUCTION (Unborn child) - Category 2	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2	Expert judgment
AQUATIC HAZARD (ACUTE) - Category 2	On basis of test data
AQUATIC HAZARD (LONG-TERM) - Category 2	Expert judgment

### History

**Date of printing** : 12/22/2017

**Date of issue/Date of revision** : 12/22/2017

**Date of previous issue** : No previous validation

**Version** : 1

**Key to abbreviations** : ATE = Acute Toxicity Estimate  
 BCF = Bioconcentration Factor  
 GHS = Globally Harmonized System of Classification and Labelling of Chemicals  
 IATA = International Air Transport Association  
 IBC = Intermediate Bulk Container  
 IMDG = International Maritime Dangerous Goods  
 LogPow = logarithm of the octanol/water partition coefficient  
 MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)  
 UN = United Nations

**References** : Not available.

▣ Indicates information that has changed from previously issued version.

### Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.



## SAFETY DATA SHEET

Version 4.7  
Revision Date 12/28/2015  
Print Date 05/01/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Nickel

Product Number : 268259  
Brand : Aldrich  
Index-No. : 028-002-00-7

CAS-No. : 7440-02-0

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Skin sensitisation (Category 1), H317  
Carcinogenicity (Category 2), H351  
Specific target organ toxicity - repeated exposure, Inhalation (Category 1), H372  
Acute aquatic toxicity (Category 3), H402  
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H317

May cause an allergic skin reaction.

H351

Suspected of causing cancer.

H372

Causes damage to organs through prolonged or repeated exposure if inhaled.

H412

Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and

	understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: Ni
Molecular weight	: 58.69 g/mol
CAS-No.	: 7440-02-0
EC-No.	: 231-111-4
Index-No.	: 028-002-00-7

#### Hazardous components

Component	Classification	Concentration
<b>Nickel</b>		
	Skin Sens. 1; Carc. 2; STOT RE 1; Aquatic Acute 3; Aquatic Chronic 3; H317, H351, H372, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

## 5.2 Special hazards arising from the substance or mixture

Nickel/nickel oxides

## 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs. Avoid contact with skin and eyes. Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Nickel	7440-02-0	TWA	1.500000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Dermatitis Pneumoconiosis Not suspected as a human carcinogen		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		TWA	1.5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Dermatitis Pneumoconiosis Not suspected as a human carcinogen		
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: Foil Colour: white, silver, metallic
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 1,453 °C (2,647 °F) - lit.
f) Initial boiling point and boiling range	2,732 °C (4,950 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	1 hPa (1 mmHg) at 1,810 °C (3,290 °F)
l) Vapour density	No data available
m) Relative density	8.9 g/mL at 25 °C (77 °F)
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available

**10.4 Conditions to avoid**

No data available

## 10.5 Incompatible materials

acids, Oxidizing agents, Sulphur compounds, Hydrogen gas, Oxygen, Methanol, organic solvents, Aluminium, Fluorine, Ammonia

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

May cause sensitisation by skin contact.

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Nickel)

1 - Group 1: Carcinogenic to humans (Nickel)

2B - Group 2B: Possibly carcinogenic to humans (Nickel)

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Nickel)

1 - Group 1: Carcinogenic to humans (Nickel)

2B - Group 2B: Possibly carcinogenic to humans (Nickel)

NTP: Reasonably anticipated to be a human carcinogen (Nickel)

Reasonably anticipated to be a human carcinogen (Nickel)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

Inhalation - Causes damage to organs through prolonged or repeated exposure.

#### Aspiration hazard

No data available

**Additional Information**

RTECS: QR5950000

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Cyprinus carpio (Carp) - 1.3 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 1 mg/l - 48 h

**12.2 Persistence and degradability**

Not applicable

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life with long lasting effects.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

Not dangerous goods

**IMDG**

Not dangerous goods

**IATA**

Not dangerous goods

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

Nickel	CAS-No. 7440-02-0	Revision Date 2007-07-01
<b>Pennsylvania Right To Know Components</b>		
Nickel	CAS-No. 7440-02-0	Revision Date 2007-07-01
<b>New Jersey Right To Know Components</b>		
Nickel	CAS-No. 7440-02-0	Revision Date 2007-07-01
<b>California Prop. 65 Components</b>		
WARNING! This product contains a chemical known to the State of California to cause cancer.		
Nickel	CAS-No. 7440-02-0	Revision Date 2007-09-28

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if inhaled.
H402	Harmful to aquatic life.
H412	Harmful to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 12/28/2015

Print Date: 05/01/2016



## SAFETY DATA SHEET

Version 3.7  
Revision Date 12/11/2015  
Print Date 04/30/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Nitrogen

Product Number : 295574  
Brand : Aldrich

CAS-No. : 7727-37-9

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Gases under pressure (Compressed gas), H280  
Simple Asphyxiant,

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Warning

Hazard statement(s)  
H280

Contains gas under pressure; may explode if heated.  
May displace oxygen and cause rapid suffocation.

Precautionary statement(s)  
P410 + P403

Protect from sunlight. Store in a well-ventilated place.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Formula : N<sub>2</sub>  
Molecular weight : 28.01 g/mol

CAS-No. : 7727-37-9  
EC-No. : 231-783-9

#### **Hazardous components**

Component	Classification	Concentration
<b>Nitrogen</b>		
	Press. Gas Compr. Gas; SA ; H280,	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## **4. FIRST AID MEASURES**

### **4.1 Description of first aid measures**

#### **General advice**

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### **If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### **In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

#### **In case of eye contact**

Flush eyes with water as a precaution.

#### **If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### **4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### **4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

## **5. FIREFIGHTING MEASURES**

### **5.1 Extinguishing media**

#### **Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### **5.2 Special hazards arising from the substance or mixture**

Nitrogen oxides (NOx)

### **5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

### **5.4 Further information**

Use water spray to cool unopened containers.

---

## **6. ACCIDENTAL RELEASE MEASURES**

### **6.1 Personal precautions, protective equipment and emergency procedures**

Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.  
For personal protection see section 8.

### **6.2 Environmental precautions**

Do not let product enter drains.

### **6.3 Methods and materials for containment and cleaning up**

Clean up promptly by sweeping or vacuum.

### **6.4 Reference to other sections**

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

Storage class (TRGS 510): Gases

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact

Material: Chloroprene

Minimum layer thickness: 0.6 mm

Break through time: 30 min

Material tested: Camapren® (KCL 722 / Aldrich Z677493, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

##### Body Protection

Impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**  
Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: Compressed gas Colour: colourless
b) Odour	odourless
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -210 °C (-346 °F) - lit.
f) Initial boiling point and boiling range	-196 °C (-321 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	0.97 g/cm <sup>3</sup>
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: QW9700000

May be harmful., Nausea, Headache, Vomiting, Acts as a simple asphyxiant by displacing air.

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1066      Class: 2.2  
Proper shipping name: Nitrogen, compressed  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 1066      Class: 2.2  
Proper shipping name: NITROGEN, COMPRESSED

EMS-No: F-C, S-V

### IATA

UN number: 1066      Class: 2.2  
Proper shipping name: Nitrogen, compressed

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Sudden Release of Pressure Hazard, Acute Health Hazard

### Massachusetts Right To Know Components

Nitrogen	CAS-No. 7727-37-9	Revision Date 1993-04-24
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### Pennsylvania Right To Know Components

Nitrogen	CAS-No. 7727-37-9	Revision Date 1993-04-24
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### New Jersey Right To Know Components

Nitrogen	CAS-No. 7727-37-9	Revision Date 1993-04-24
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### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

H280	May displace oxygen and cause rapid suffocation.
Press. Gas	Contains gas under pressure; may explode if heated.
SA	Gases under pressure
	Simple Asphyxiant

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	1
Physical Hazard	1

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0
Special hazard.I:	SA

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.7

Revision Date: 12/11/2015

Print Date: 04/30/2016

# SAFETY DATA SHEET

Nonflammable Gas Mixture: Argon / Helium / Nitrogen / Oxygen

## Section 1. Identification

<b>GHS product identifier</b>	: Nonflammable Gas Mixture: Argon / Helium / Nitrogen / Oxygen
<b>Other means of identification</b>	: Not available.
<b>Product type</b>	: Gas.
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>SDS #</b>	: 014397
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>24-hour telephone</b>	: 1-866-734-3438

## Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: GASES UNDER PRESSURE - Compressed gas

### GHS label elements

**Hazard pictograms**



<b>Signal word</b>	: Warning
<b>Hazard statements</b>	: Contains gas under pressure; may explode if heated. May displace oxygen and cause rapid suffocation.

### Precautionary statements

<b>General</b>	: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.
<b>Prevention</b>	: Not applicable.
<b>Response</b>	: Not applicable.
<b>Storage</b>	: Protect from sunlight. Store in a well-ventilated place.
<b>Disposal</b>	: Not applicable.
<b>Hazards not otherwise classified</b>	: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

## Section 3. Composition/information on ingredients

<b>Substance/mixture</b>	: Mixture
<b>Other means of identification</b>	: Not available.
<b>Product code</b>	: 014397



## Section 3. Composition/information on ingredients

Ingredient name	%	CAS number
Nitrogen	0.0000001 - 99.9997	7727-37-9
Argon	0.0000001 - 99.9997	7440-37-1
Helium	0.0000001 - 99.9997	7440-59-7
oxygen	0.000001 - 14.4	7782-44-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

**There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.**

Occupational exposure limits, if available, are listed in Section 8.

## Section 4. First aid measures

### Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : As this product is a gas, refer to the inhalation section.

### Most important symptoms/effects, acute and delayed

#### Potential acute health effects

- Eye contact** : Contact with rapidly expanding gas may cause burns or frostbite.
- Inhalation** : No known significant effects or critical hazards.
- Skin contact** : Contact with rapidly expanding gas may cause burns or frostbite.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : As this product is a gas, refer to the inhalation section.

#### Over-exposure signs/symptoms

- Eye contact** : No specific data.
- Inhalation** : No specific data.
- Skin contact** : No specific data.
- Ingestion** : No specific data.

### Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

## Section 4. First aid measures

See toxicological information (Section 11)

## Section 5. Fire-fighting measures

### Extinguishing media

**Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.

**Unsuitable extinguishing media** : None known.

**Specific hazards arising from the chemical** : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

**Hazardous thermal decomposition products** : Decomposition products may include the following materials: nitrogen oxides

**Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

**Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

## Section 6. Accidental release measures

### Personal precautions, protective equipment and emergency procedures

**For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

**For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

**Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

### Methods and materials for containment and cleaning up

**Small spill** : Immediately contact emergency personnel. Stop leak if without risk.

**Large spill** : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

## Section 7. Handling and storage

### Precautions for safe handling

**Protective measures** : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous.

**Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

## Section 7. Handling and storage

- Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

## Section 8. Exposure controls/personal protection

### Control parameters

#### Occupational exposure limits

Ingredient name	Exposure limits
Nitrogen	ACGIH TLV (United States, 3/2017). Oxygen Depletion [Asphyxiant].
Argon	ACGIH TLV (United States, 3/2017). Oxygen Depletion [Asphyxiant].
Helium	ACGIH TLV (United States, 3/2017). Oxygen Depletion [Asphyxiant].
oxygen	None.

- Appropriate engineering controls** : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.
- Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

### Individual protection measures

- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
- Eye/face protection** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.
- Skin protection**
- Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

## Section 8. Exposure controls/personal protection

- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

## Section 9. Physical and chemical properties

### Appearance

- Physical state** : Gas.
- Color** : Not available.
- Odor** : Not available.
- Odor threshold** : Not available.
- pH** : Not available.
- Melting point** : -189.2°C (-308.6°F) This is based on data for the following ingredient: argon. Weighted average: -223.56°C (-370.4°F)
- Boiling point** : Not available.
- Critical temperature** : Lowest known value: -267.9°C (-450.2°F) (helium).
- Flash point** : Not available.
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Not available.
- Vapor pressure** : Not available.
- Vapor density** : Highest known value: 1.66 (Air = 1) (argon). Weighted average: 0.93 (Air = 1)
- Gas Density (lb/ft<sup>3</sup>)** : Weighted average: 0.03
- Relative density** : Not applicable.
- Solubility** : Not available.
- Solubility in water** : Not available.
- Partition coefficient: n-octanol/water** : Not available.
- Auto-ignition temperature** : Not available.
- Decomposition temperature** : Not available.
- Viscosity** : Not applicable.
- Flow time (ISO 2431)** : Not available.

## Section 10. Stability and reactivity

- Reactivity** : No specific test data related to reactivity available for this product or its ingredients.
- Chemical stability** : The product is stable.
- Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.
- Conditions to avoid** : No specific data.
- Incompatible materials** : No specific data.
- Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

## Section 10. Stability and reactivity

**Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

## Section 11. Toxicological information

### Information on toxicological effects

#### Acute toxicity

Not available.

#### Irritation/Corrosion

Not available.

#### Sensitization

Not available.

#### Mutagenicity

Not available.

#### Carcinogenicity

Not available.

#### Reproductive toxicity

Not available.

#### Teratogenicity

Not available.

#### Specific target organ toxicity (single exposure)

Not available.

#### Specific target organ toxicity (repeated exposure)

Not available.

#### Aspiration hazard

Not available.

**Information on the likely routes of exposure** : Not available.

### Potential acute health effects

**Eye contact** : Contact with rapidly expanding gas may cause burns or frostbite.  
**Inhalation** : No known significant effects or critical hazards.  
**Skin contact** : Contact with rapidly expanding gas may cause burns or frostbite.  
**Ingestion** : As this product is a gas, refer to the inhalation section.

### Symptoms related to the physical, chemical and toxicological characteristics

**Eye contact** : No specific data.  
**Inhalation** : No specific data.  
**Skin contact** : No specific data.  
**Ingestion** : No specific data.

### Delayed and immediate effects and also chronic effects from short and long term exposure

#### Short term exposure

**Potential immediate effects** : Not available.  
**Potential delayed effects** : Not available.

#### Long term exposure

## Section 11. Toxicological information

**Potential immediate effects** : Not available.

**Potential delayed effects** : Not available.

### Potential chronic health effects

Not available.

**General** : No known significant effects or critical hazards.

**Carcinogenicity** : No known significant effects or critical hazards.

**Mutagenicity** : No known significant effects or critical hazards.

**Teratogenicity** : No known significant effects or critical hazards.

**Developmental effects** : No known significant effects or critical hazards.

**Fertility effects** : No known significant effects or critical hazards.

### Numerical measures of toxicity

#### Acute toxicity estimates

Not available.

## Section 12. Ecological information

### Toxicity

Not available.

### Persistence and degradability

Not available.

### Bioaccumulative potential

Product/ingredient name	LogP <sub>ow</sub>	BCF	Potential
Nitrogen	0.67	-	low
Argon	0.74	-	low
Helium	0.28	-	low
oxygen	0.65	-	low

### Mobility in soil






**Soil/water partition coefficient (K<sub>oc</sub>)** : Not available.

**Other adverse effects** : No known significant effects or critical hazards.

## Section 13. Disposal considerations

**Disposal methods** : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

## Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S. (argon, oxygen)	COMPRESSED GAS, N.O.S. (argon, oxygen)	COMPRESSED GAS, N.O.S. (argon, oxygen)	COMPRESSED GAS, N.O.S. (argon, oxygen)	COMPRESSED GAS, N.O.S. (argon, oxygen)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

### Additional information

#### TDG Classification

: Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).

**Explosive Limit and Limited Quantity Index** 0.125

**Passenger Carrying Road or Rail Index** 75

**Special precautions for user** : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

**Transport in bulk according to Annex II of MARPOL and the IBC Code** : Not available.

## Section 15. Regulatory information

**U.S. Federal regulations** : TSCA 8(a) CDR Exempt/Partial exemption: Not determined

**Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs)** : Not listed

**Clean Air Act Section 602 Class I Substances** : Not listed

**Clean Air Act Section 602 Class II Substances** : Not listed

**DEA List I Chemicals (Precursor Chemicals)** : Not listed

**DEA List II Chemicals (Essential Chemicals)** : Not listed

### SARA 302/304

#### Composition/information on ingredients

No products were found.

**SARA 304 RQ** : Not applicable.

### SARA 311/312

**Classification** : Refer to Section 2: Hazards Identification of this SDS for classification of substance.



## Section 15. Regulatory information

### State regulations

- Massachusetts** : The following components are listed: NITROGEN; NITROGEN (LIQUIFIED); ARGON; HELIUM; OXYGEN (LIQUID)
- New York** : None of the components are listed.
- New Jersey** : The following components are listed: NITROGEN; ARGON; HELIUM; OXYGEN
- Pennsylvania** : The following components are listed: NITROGEN; ARGON; HELIUM; OXYGEN

### International regulations

#### Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

#### Montreal Protocol (Annexes A, B, C, E)

Not listed.

#### Stockholm Convention on Persistent Organic Pollutants

Not listed.

#### Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

#### UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

### Inventory list

- Australia** : All components are listed or exempted.
- Canada** : All components are listed or exempted.
- China** : All components are listed or exempted.
- Europe** : All components are listed or exempted.
- Japan** : **Japan inventory (ENCS)**: Not determined.  
**Japan inventory (ISHL)**: Not determined.
- Malaysia** : Not determined.
- New Zealand** : All components are listed or exempted.
- Philippines** : All components are listed or exempted.
- Republic of Korea** : All components are listed or exempted.
- Taiwan** : All components are listed or exempted.
- Thailand** : Not determined.
- Turkey** : Not determined.
- United States** : All components are listed or exempted.
- Viet Nam** : Not determined.

## Section 16. Other information

### Hazardous Material Information System (U.S.A.)

Health	/	1
Flammability		0
Physical hazards		3

**Caution:** HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.



## Section 16. Other information

### National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

### Procedure used to derive the classification

Classification	Justification
GASES UNDER PRESSURE - Compressed gas	On basis of test data

### History

Date of printing : 3/30/2018

Date of issue/Date of revision : 3/30/2018

Date of previous issue : 3/30/2018

Version : 1.02

Key to abbreviations : ATE = Acute Toxicity Estimate  
BCF = Bioconcentration Factor  
GHS = Globally Harmonized System of Classification and Labelling of Chemicals  
IATA = International Air Transport Association  
IBC = Intermediate Bulk Container  
IMDG = International Maritime Dangerous Goods  
LogPow = logarithm of the octanol/water partition coefficient  
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)  
UN = United Nations

References : Not available.

### Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

## SAFETY DATA SHEET

Version 3.4  
Revision Date 07/03/2014  
Print Date 04/30/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Oxygen

Product Number : 295604  
Brand : Aldrich  
Index-No. : 008-001-00-8

CAS-No. : 7782-44-7

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Oxidising gases (Category 1), H270  
Gases under pressure (Compressed gas), H280

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H270 : May cause or intensify fire; oxidiser.  
H280 : Contains gas under pressure; may explode if heated.

Precautionary statement(s)

P220 : Keep/Store away from clothing/ combustible materials.  
P244 : Keep reduction valves free from grease and oil.  
P370 + P376 : In case of fire: Stop leak if safe to do so.  
P410 + P403 : Protect from sunlight. Store in a well-ventilated place.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Aldrich - 295604

Formula : O<sub>2</sub>  
Molecular Weight : 32.00 g/mol  
CAS-No. : 7782-44-7  
EC-No. : 231-956-9  
Index-No. : 008-001-00-8

#### Hazardous components

Component	Classification	Concentration
<b>Oxygen</b>		
	Ox. Gas 1; Press. Gas ; H270, H280	-

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

no data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

no data available

### 5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

## 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Keep away from sources of ignition - No smoking.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: butyl-rubber

Minimum layer thickness: 0.3 mm

Break through time: 480 min

Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)

##### Splash contact

Material: Chloroprene

Minimum layer thickness: 0.6 mm

Break through time: 30 min

Material tested: Camapren® (KCL 722 / Aldrich Z677493, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

##### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators

and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |  |
|---|--|
| a) Appearance                                   | Form: Compressed gas<br>Colour: colourless                               |
| b) Odour  | odourless  |
| c) Odour Threshold                              | no data available  |
| d) pH   | no data available  |
| e) Melting point/freezing point                 | Melting point/range: -218 °C (-360 °F) - lit.                            |
| f) Initial boiling point and boiling range      | -183 °C (-297 °F) - lit.   |
| g) Flash point                                  | no data available  |
| h) Evaporation rate                             | no data available  |
| i) Flammability (solid, gas)                    | no data available  |
| j) Upper/lower flammability or explosive limits | no data available  |
| k) Vapour pressure                              | no data available  |
| l) Vapour density                               | 1.1 - (Air = 1.0)1.1 - (Air = 1.0)                                       |
| m) Relative density                             | no data available  |
| n) Water solubility                             | no data available  |
| o) Partition coefficient: n-octanol/water       | no data available  |
| p) Auto-ignition temperature                    | no data available  |
| q) Decomposition temperature                    | no data available  |
| r) Viscosity                                    | no data available  |
| s) Explosive properties                         | no data available  |
| t) Oxidizing properties                         | The substance or mixture is classified as oxidizing with the category 1. |

### 9.2 Other safety information

- |                         |  |
|-------------------------|--|
| Relative vapour density | 1.1 - (Air = 1.0)<br>1.1 - (Air = 1.0) |
|-------------------------|--|

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

no data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

no data available

#### 10.4 Conditions to avoid

no data available

#### 10.5 Incompatible materials

Phosphorus, Organic materials, Powdered metals

#### 10.6 Hazardous decomposition products

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

no data available

Inhalation: no data available

Dermal: no data available

no data available

##### Skin corrosion/irritation

no data available

##### Serious eye damage/eye irritation

no data available

##### Respiratory or skin sensitisation

no data available

##### Germ cell mutagenicity

no data available

##### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

no data available

no data available

##### Specific target organ toxicity - single exposure

no data available

##### Specific target organ toxicity - repeated exposure

no data available

##### Aspiration hazard

no data available

##### Additional Information

RTECS: RS2060000

Nausea, Dizziness, Unconsciousness, May be harmful.

---

### 12. ECOLOGICAL INFORMATION

#### 12.1 Toxicity

no data available

## 12.2 Persistence and degradability

no data available

## 12.3 Bioaccumulative potential

no data available

## 12.4 Mobility in soil

no data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

no data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1072      Class: 2.2 (5.1)  
Proper shipping name: Oxygen, compressed  
Marine pollutant: No  
Poison Inhalation Hazard: No

### IMDG

UN number: 1072      Class: 2.2 (5.1)  
Proper shipping name: OXYGEN, COMPRESSED  
Marine pollutant: No

EMS-No: F-C, S-W

### IATA

UN number: 1072      Class: 2.2 (5.1)  
Proper shipping name: Oxygen, compressed

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Sudden Release of Pressure Hazard

### Massachusetts Right To Know Components

Oxygen

CAS-No.  
7782-44-7

Revision Date  
2007-03-01

### Pennsylvania Right To Know Components

Oxygen

CAS-No.  
7782-44-7

Revision Date  
2007-03-01

### New Jersey Right To Know Components

Oxygen

CAS-No.  
7782-44-7

Revision Date  
2007-03-01

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

H270	May cause or intensify fire; oxidiser.
H280	Contains gas under pressure; may explode if heated.
Ox. Gas	Oxidising gases
Press. Gas	Gases under pressure

**HMIS Rating**

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0
Special hazard.I:	OX

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.4

Revision Date: 07/03/2014

Print Date: 04/30/2016



## SAFETY DATA SHEET

Version 5.5  
Revision Date 06/02/2016  
Print Date 06/21/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : o-Xylene

Product Number : 95660  
Brand : Sigma-Aldrich  
Index-No. : 601-022-00-9

CAS-No. : 95-47-6

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 3), H226  
Acute toxicity, Inhalation (Category 4), H332  
Acute toxicity, Dermal (Category 4), H312  
Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Aspiration hazard (Category 1), H304  
Acute aquatic toxicity (Category 3), H402  
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H226 : Flammable liquid and vapour.  
H304 : May be fatal if swallowed and enters airways.  
H312 + H332 : Harmful in contact with skin or if inhaled  
H315 : Causes skin irritation.  
H319 : Causes serious eye irritation.

H335	May cause respiratory irritation.
H412	Harmful to aquatic life with long lasting effects.
Precautionary statement(s)	
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Synonyms	: 1,2-Dimethylbenzene
Formula	: C <sub>8</sub> H <sub>10</sub>
Molecular weight	: 106.17 g/mol
CAS-No.	: 95-47-6
EC-No.	: 202-422-2
Index-No.	: 601-022-00-9

#### Hazardous components

Component	Classification	Concentration
<b>o-Xylene</b>		
	Flam. Liq. 3; Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; Asp. Tox. 1; Aquatic Acute 3; Aquatic Chronic 3; H226, H304, H312 + H332, H315, H319, H335, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Flammable liquids

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

# 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

## 8.1 Control parameters

### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
o-Xylene	95-47-6	TWA	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100.000000 ppm 435.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	100.000000 ppm 435.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	150.000000 ppm 655.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100.000000 ppm 435.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment		

		Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
o-Xylene	95-47-6	Methylhippuric acids	1,500.000 0 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			
		Methylhippuric acids	1.5g/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm  
Break through time: 30 min  
Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |  |
|---|--|
| a) Appearance                                   | Form: liquid<br>Colour: colourless                                 |
| b) Odour  | No data available  |
| c) Odour Threshold                              | No data available  |
| d) pH   | No data available  |
| e) Melting point/freezing point                 | Melting point/range: -26 - -23 °C (-15 - -9 °F) - lit.             |
| f) Initial boiling point and boiling range      | 143 - 145 °C (289 - 293 °F) - lit.                                 |
| g) Flash point                                  | 31.0 °C (87.8 °F) - closed cup                                     |
| h) Evaporation rate                             | No data available  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 6.7 %(V)<br>Lower explosion limit: 0.9 %(V) |
| k) Vapour pressure                              | 21.3 hPa (16.0 mmHg) at 37.7 °C (99.9 °F)                          |
| l) Vapour density                               | No data available  |
| m) Relative density                             | 0.879 g/mL at 20 °C (68 °F)  |
| n) Water solubility                             | 0.1705 g/l at 25 °C (77 °F) - partly soluble                       |
| o) Partition coefficient: n-octanol/water       | log Pow: 3.12 at 20 °C (68 °F)                                     |
| p) Auto-ignition temperature                    | 464.0 °C (867.2 °F)  |
| q) Decomposition temperature                    | No data available  |
| r) Viscosity                                    | No data available  |

- s) Explosive properties      No data available  
t) Oxidizing properties      No data available

## 9.2 Other safety information

Surface tension      29.8 mN/m at 25.0 °C (77.0 °F)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LC50 Inhalation - Rat - male - 6 h - 18,800 mg/m<sup>3</sup>

Dermal: No data available

LD50 Intraperitoneal - Mouse - 1,364 mg/kg

#### Skin corrosion/irritation

Skin - Rabbit

Result: Irritating to skin. - 24 h

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

- Mouse

Result: Does not cause skin sensitisation.

(OECD Test Guideline 429)

#### Germ cell mutagenicity

Ames test

Salmonella typhimurium

Result: negative

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC:      3 - Group 3: Not classifiable as to its carcinogenicity to humans (o-Xylene)

IARC:      No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.  
No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.  
No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

May be fatal if swallowed and enters airways.

**Additional Information**

RTECS: ZE2450000

narcosis, Lung irritation, chest pain, pulmonary edema, Central nervous system depression, Dermatitis, Gastrointestinal disturbance, Liver injury may occur., Kidney injury may occur., Blood disorders

Nerves. -

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - *Lepomis macrochirus* (Bluegill) - 16.10 mg/l - 96 h

### 12.2 Persistence and degradability

Biodegradability aerobic - Exposure time 28 d  
Result: 69.67 % - Not readily biodegradable.  
(OECD Test Guideline 301F)  
Remarks: The 10 day time window criterion is not fulfilled.

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life with long lasting effects.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Contact a licensed professional waste disposal service to dispose of this material. Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.



---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1307      Class: 3      Packing group: III  
Proper shipping name: Xylenes  
Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1307      Class: 3      Packing group: III      EMS-No: F-E, S-D  
Proper shipping name: XYLENES

### IATA

UN number: 1307      Class: 3      Packing group: III  
Proper shipping name: Xylenes

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
o-Xylene	95-47-6	2007-07-01

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
o-Xylene	95-47-6	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
o-Xylene	95-47-6	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
o-Xylene	95-47-6	2007-07-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Asp. Tox.	Aspiration hazard
Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H226	Flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H312	Harmful in contact with skin.

H312 + H332	Harmful in contact with skin or if inhaled
H315	Causes skin irritation.
H319	Causes serious eye irritation.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	
Flammability:	3
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.5

Revision Date: 06/02/2016

Print Date: 06/21/2016

## Section 1 - Chemical Product and Company Identification

**MSDS Name:** Sym.-Dibenzoylhydrazine  
**Catalog Numbers:** AC112590000, AC112590050  
**Synonyms:** Benzoic Acid, 2-Benzoylhydrazide.  
**Company Identification:** Acros Organics BVBA  
 Janssen Pharmaceuticaaan 3a  
 2440 Geel, Belgium  
**Company Identification: (USA)** Acros Organics  
 One Reagent Lane  
 Fair Lawn, NJ 07410  
**For information in the US, call:** 800-ACROS-01  
**For information in Europe, call:** +32 14 57 52 11  
**Emergency Number, Europe:** +32 14 57 52 99  
**Emergency Number US:** 201-796-7100  
**CHEMTREC Phone Number, US:** 800-424-9300  
**CHEMTREC Phone Number, Europe:** 703-527-3887

## Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name:	%	EINECS#
787-84-8	Benzoic Acid, 2-Benzoylhydrazide	ca 100	212-329-9

**Hazard Symbols:** XN



**Risk Phrases:** 20/21

## Section 3 - Hazards Identification

### EMERGENCY OVERVIEW

Caution! The toxicological properties of this material have not been fully investigated. May cause eye and skin irritation. May cause respiratory and digestive tract irritation. Target Organs: None known.

#### Potential Health Effects

**Eye:** May cause eye irritation.

**Skin:** May cause skin irritation.

**Ingestion:** May cause irritation of the digestive tract. The toxicological properties of this substance have not been fully investigated.

**Inhalation:** May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated.

**Chronic:** No information found.

## Section 4 - First Aid Measures

**Eyes:** Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

**Skin:** Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

**Ingestion:** Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

**Inhalation:** Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

**Notes to Physician:**

#### Section 5 - Fire Fighting Measures

**General Information:** As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

**Extinguishing Media:** Use agent most appropriate to extinguish fire. Use water spray, dry chemical, carbon dioxide, or appropriate foam.

**Autoignition Temperature:** Not applicable.

**Flash Point:** Not applicable.

**Explosion Limits:** Not available

**Lower:**

**Explosion Limits:** Not available

**Upper:**

**NFPA Rating:** health: 1; flammability: 0; instability: 0;

#### Section 6 - Accidental Release Measures

**General Information:** Use proper personal protective equipment as indicated in Section 8.

**Spills/Leaks:** Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation.

#### Section 7 - Handling and Storage

**Handling:** Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.

**Storage:** Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

#### Section 8 - Exposure Controls, Personal Protection

##### Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

##### Exposure Limits

CAS# 787-84-8:

##### Personal Protective Equipment

**Eyes:** Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

**Skin:** Wear appropriate protective gloves to prevent skin exposure.

**Clothing:** Wear appropriate protective clothing to prevent skin exposure.

**Respirators:** A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

#### Section 9 - Physical and Chemical Properties

**Physical State:** Powder

**Color:** off-white to tan

**Odor:** Not available

**pH:** Not available

**Vapor Pressure:** Not available

**Vapor Density:** Not available

**Evaporation Rate:** Not available

**Viscosity:** Not available

**Boiling Point:** Not available

**Freezing/Melting Point:** 238.50 - 240.50 deg C

**Decomposition Temperature:**

**Solubility in water:**

**Specific Gravity/Density:**

**Molecular Formula:** C<sub>14</sub>H<sub>12</sub>N<sub>2</sub>O<sub>2</sub>

**Molecular Weight:** 240.26

#### Section 10 - Stability and Reactivity

<b>Chemical Stability:</b>	Stable at room temperature in closed containers under normal storage and handling conditions.
<b>Conditions to Avoid:</b>	Incompatible materials, dust generation, excess heat.
<b>Incompatibilities with Other Materials</b>	Not available
<b>Hazardous Decomposition Products</b>	Carbon monoxide, oxides of nitrogen, irritating and toxic fumes and gases, carbon dioxide.
<b>Hazardous Polymerization</b>	Has not been reported.

#### Section 11 - Toxicological Information

**RTECS#:** CAS# 787-84-8: MV2085000

**LD50/LC50:** Not available

**Carcinogenicity:** Benzoic Acid, 2-Benzoylhydrazide - Not listed as a carcinogen by ACGIH, IARC, NTP, or CA Prop 65.

**Other:** See actual entry in RTECS for complete information.

#### Section 12 - Ecological Information

Not available

#### Section 13 - Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

#### Section 14 - Transport Information

	US DOT	Canada TDG
<b>Shipping Name:</b>	Please contact Fisher Scientific for shipping information	Not available
<b>Hazard Class:</b>		
<b>UN Number:</b>		
<b>Packing Group:</b>		

#### Section 15 - Regulatory Information

##### European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: XN

Risk Phrases:

R 20/21 Harmful by inhalation and in contact with skin.

Safety Phrases:

S 23 Do not inhale gas/fumes/vapour/spray.

S 28A After contact with skin, wash immediately with plenty of water.

S 37 Wear suitable gloves.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

CAS# 787-84-8: Not available

Canada

CAS# 787-84-8 is listed on Canada's NDSL List

Canadian WHMIS Classifications: Not available

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

CAS# 787-84-8 is not listed on Canada's Ingredient Disclosure List.

**US Federal**

TSCA

CAS# 787-84-8 is listed on the TSCA Inventory.

<b>Section 16 - Other Information</b>
---------------------------------------

**MSDS Creation Date:** 5/24/1999

**Revision #3 Date** 10/03/2005

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential, or exemplary damages howsoever arising, even if the company has been advised of the possibility of such damages.



## **MATERIAL SAFETY DATA SHEET**

### **(POLYCHLORINATED BIPHENYLS)**

#### **COMPOSITION/INFORMATION ON INGREDIENTS**

Ingredients Name: polychlorinated biphenyls (PCBs)

#### **HAZARD IDENTIFICATION**

Reports of Carcinogenicity: YES

#### **HEALTH HAZARDS ACUTE AND CHRONIC**

- **Eyes**: Moderately irritating to eye tissues.
- **Skin**: Can be absorbed through intact skin, may cause de-fatting, potential for chloracne.
- **Inhalation**: Possible liver injury.
- **Ingestion**: Slightly toxic; reasonably anticipated to be carcinogenic.

#### **EFFECTS OF OVER-EXPOSURE**

Can cause dermatological symptoms; however, these are reversible upon removal of exposure source.

#### **FIRST AID MEASURES**

- **Eyes**: Irrigate immediately with copious quantities of running water for at least 15 minutes if liquid or solid PCBs get into them.
- **Skin**: Contaminated clothing should be removed and the skin washed thoroughly with soap and water. Hot PCBs may cause thermal burns.
- **Inhalation**: Remove to fresh air; if skin rash or respiratory irritation persists, consult a physician (if electrical equipment arcs over, PCBs may decompose to produce hydrochloric acid).
- **Ingestion**: Consult a physician. Do not induce vomiting or give any oily laxatives. (If large amounts are ingested, gastric lavage is suggested).

**FIRE FIGHTING MEASURES**: Flash Point: >141 °C (285.8 °F)

**EXTINGUISHING MEDIA**: PCBs are fire-resistant compounds.

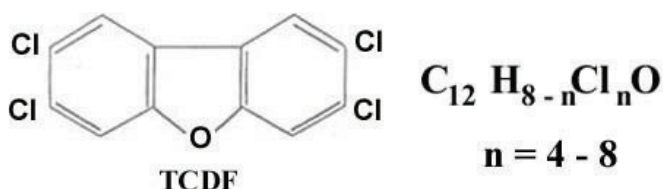
## **FIRE-FIGHTING PROCEDURES**

Standard fire-fighting wearing apparel and self-contained breathing apparatus should be worn when fighting fires that involve possible exposure to chemical combustion products. Fire fighting equipment should be thoroughly cleaned and decontaminated after use.

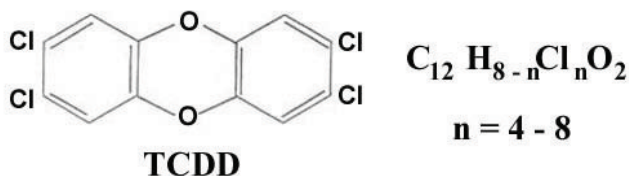
## **UNUSUAL FIRE/EXPLOSION HAZARD**

If a PCB transformer is involved in a fire-related incident, the owner of the transformer is required to report the incident. Consult and follow appropriate federal, provincial and local regulations.

***Note:*** When askarel liquid becomes involved in a fire, toxic by-products of combustion are typically produced including polychlorinated dibenzofurans and polychlorinated dibenzodioxins, both known carcinogens. The structures of these chemical species are as follows:



**2,3,7,8-tetrachlorodibenzofuran**



**2,3,7,8-tetrachloro-dibenzo-p-dioxin**

***Note:*** 2,3,7,8-tetrachloro-dibenzo-p-dioxin is one of the most potent teratogenic, mutagenic and carcinogenic agents known to man.

## **SPILL RELEASE PROCEDURES**

Cleanup & disposal of liquid PCBs are strictly regulated by the federal government. Ventilate area. Contain spill/leak. Remove spill by means of absorptive material. Spill clean-up personnel should use proper protective clothing. All wastes and residues containing PCBs should be collected, containerized, marked and disposed of in the manner prescribed by applicable federal, provincial and local laws.

## **HANDLING AND STORAGE PRECAUTIONS**

Care should be taken to prevent entry into the environment through spills, leakage, use, vaporization, or disposal of liquid. Avoid prolonged breathing of vapours or mists. Avoid contact with eyes or prolonged contact with skin. Comply with all federal, provincial and local regulations.



## **OTHER PRECAUTIONS**

Federal regulations require PCBs, PCB items, storage areas, transformer vaults, and transport vehicles to be appropriately labelled.

## **RESPIRATORY PROTECTION**

Use OSHA approved equipment when airborne exposure limits are exceeded. Full facepiece equipment is recommended and, if used, replaces need for face shield and/or chemical splash goggles. The respirator use limitations specified by the manufacturer must be observed.

## **VENTILATION**

Provide natural or mechanical ventilation to control exposure levels below airborne exposure levels.

**PROTECTIVE GLOVES:** Wear appropriate chemical resistant gloves to prevent skin contact.

**EYE PROTECTION:** Wear chemical splash goggles and have eye baths available.

## **OTHER PROTECTIVE EQUIPMENT**

Wear appropriate protective clothing. Provide a safety shower at any location where skin contact can occur.

## **WORK HYGIENIC PRACTICES**

Wash thoroughly after handling. Supplemental safety and health : none

## **PHYSICAL/CHEMICAL PROPERTIES**

- **Vapour pressure:** (mm Hg @100 °F) 0.005 - 0.00006
- **Viscosity:** (CENTISTOKES) 3.6 - 540
- **Stability indicator/materials to avoid:** Yes
- **Stability Condition to Avoid:** PCBs are very stable, fire-resistant compounds.

## **HAZARDOUS DECOMPOSITION PRODUCTS**

Carbon monoxide, carbon dioxide, hydrogen chloride, phenolics, aldehydes, furans, dioxins

## **WASTE DISPOSAL METHODS**

Consult the applicable PCB regulations prior to any disposal of PCBs or PCB-contaminated items.



## Safety Data Sheet (SDS)

SDS #: 582.5

Revision Date: September 22, 2014

### SECTION 1 — CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

## Perchloroethylene

Signal Word  
**WARNING**

Flinn Scientific, Inc. P.O. Box 219, Batavia, IL 60510 (800) 452-1261  
Chemtrec Emergency Phone Number: (800) 424-10104

Pictograms

### SECTION 2 — HAZARDS IDENTIFICATION

Hazard class: Flammable liquids (Category 2). Highly flammable liquid and vapor (H225). Keep away from heat, sparks, open flames, and hot surfaces. No smoking (P210).

Hazard class: Skin corrosion or irritation (Category 3). Causes mild skin irritation (H316).

Hazard class: Serious eye damage or irritation (Category 2A). Causes serious eye irritation (H319).

Hazard class: Specific target organ toxicity, single exposure; Narcotic effects (Category 3). May cause drowsiness or dizziness (H336). Avoid breathing mist, vapors or spray (P261).



### SECTION 3 — COMPOSITION, INFORMATION ON INGREDIENTS

Component Name	CAS Number	Formula	Formula Weight	Concentration
Perchloroethylene	127-18-4	$\text{CCl}_2=\text{CCl}_2$	165.82	
Synonyms: Tetrachloroethylene				

### SECTION 4 — FIRST AID MEASURES

Call a POISON CENTER or physician if you feel unwell (P312).

**If inhaled:** Remove victim to fresh air and keep at rest in a position comfortable for breathing (P304+P340).

**If in eyes:** Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do so. Continue rinsing (P305+P351+P338). **If eye irritation persists eyes:** Get medical advice or attention (P337+P313).

**If on skin or hair:** Immediately remove all contaminated clothing. Rinse skin with water (P303+P361+P353).

**If skin irritation occurs:** Get medical advice or attention (P332+P313).

### SECTION 5 — FIRE FIGHTING MEASURES

Nonflammable, noncombustible liquid.

When heated to decomposition, may emit toxic fumes.

In case of fire: Use a tri-class dry chemical fire extinguisher (P370+P378).

NFPA Code

H-2

F-0

R-0

### SECTION 6 — ACCIDENTAL RELEASE MEASURES

Ventilate area. Contain spill with sand or absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information. Absorb spills to prevent material damage (P390).

---

**SECTION 7 — HANDLING AND STORAGE**

---

Flinn Suggested Chemical Storage Pattern: Organic #4. Store with ethers, ketones, and halogenated hydrocarbons.

Keep container tightly closed (P233). Keep cool (P235). Ground or bond container and receiving equipment (P240). Use explosion-proof electrical and ventilating equipment (P241). Use only non-sparking tools (P242). Take precautionary measures against static discharge (P243). Use only in a hood or well-ventilated area (P271).

---

**SECTION 8 — EXPOSURE CONTROLS, PERSONAL PROTECTION**

---

Wear protective gloves, protective clothing, and eye protection (P280). Wash hands thoroughly after handling (P264). Use only in a hood or well-ventilated area (P271).

Exposure guidelines: PEL 100 ppm, Ceiling 200 ppm (OSHA); TLV 25 ppm, STEL 100 ppm (ACGIH)

---

**SECTION 9 — PHYSICAL AND CHEMICAL PROPERTIES**

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Clear, colorless liquid. Ether-like odor.

Soluble: Alcohol, ether, oils. Insoluble in water.

Boiling point: 120-122 °C

Melting point: -22 °C

Specific gravity: 1.6

Vapor density: 5.83

Vapor pressure: 13 mmHg

---

**SECTION 10 — STABILITY AND REACTIVITY**

---

Avoid contact with strong bases, strong acids, acid anhydrides and alcohols.

Shelf life: Indefinite, if stored properly.

---

**SECTION 11 — TOXICOLOGICAL INFORMATION**

---

Acute effects: Harmful liquid and fumes, irritant, nausea, dizziness and headache.

Chronic effects: Probable carcinogen, mutagen, nerves, heart, liver and kidneys. Target organs: N.A.

ORL-RAT LD<sub>50</sub>: 2629 mg/kg

IHL-RAT LC<sub>50</sub>: 34200 mg/m<sup>3</sup>/8H

SKN-RBT LD<sub>50</sub>: N.A.

---

**SECTION 12 — ECOLOGICAL INFORMATION**

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Data not yet available.

---

**SECTION 13 — DISPOSAL CONSIDERATIONS**

---

Please review all federal, state and local regulations that may apply before proceeding.

Flinn Suggested Disposal Method #4b is one option.

---

**SECTION 14 — TRANSPORT INFORMATION**

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Shipping name: Tetrachloroethylene; Hazard class: 6.1, Keep away from food; UN number: UN1897

---

**SECTION 15 — REGULATORY INFORMATION**

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TSCA-listed, EINECS-listed (204-825-9), RCRA code U210.

---

**SECTION 16 — OTHER INFORMATION**

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This Safety Data Sheet (SDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific, Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. The data should not be confused with local, state, federal or insurance mandates, regulations, or requirements and CONSTITUTE NO WARRANTY. Any use of this data and information must be determined by the science instructor to be in accordance with applicable local, state or federal laws and regulations. The conditions or methods of handling, storage, use and disposal of the product(s) described are beyond the control of Flinn Scientific, Inc. and may be beyond our knowledge. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THIS PRODUCT(S).

N.A. = Not available, not all health aspects of this substance have been fully investigated.

N/A = Not applicable

**Consult your copy of the Flinn Science Catalog/Reference Manual for additional information about laboratory chemicals.**

**Revision Date:** September 22, 2014

---

## SAFETY DATA SHEET

Version 5.4  
Revision Date 03/02/2015  
Print Date 06/20/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Phenanthrene

Product Number : P11409  
Brand : Aldrich

CAS-No. : 85-01-8

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302

Skin irritation (Category 2), H315

Eye irritation (Category 2A), H319

Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

Acute aquatic toxicity (Category 1), H400

Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H302

Harmful if swallowed.

H315

Causes skin irritation.

H319

Causes serious eye irritation.

H335

May cause respiratory irritation.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P261

Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P264

Wash skin thoroughly after handling.

P270

Do not eat, drink or smoke when using this product.

P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312	Call a POISON CENTER or doctor/ physician if you feel unwell.
P321	Specific treatment (see supplemental first aid instructions on this label).
P330	Rinse mouth.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Photosensitizer.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>14</sub> H <sub>10</sub>
Molecular weight	: 178.23 g/mol
CAS-No.	: 85-01-8
EC-No.	: 201-581-5

#### Hazardous components

Component	Classification	Concentration
<b>Phenanthrene</b>		
	Acute Tox. 4; Skin Irrit. 2; Eye Irrit. 2A; STOT SE 3; Aquatic Acute 1; Aquatic Chronic 1; H302, H315, H319, H335, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection.

For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Handle and store under inert gas.

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Phenanthrene	85-01-8	TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
	Remarks	1910.1002 As used in §1910.1000 (Table Z-1), coal tar pitch volatiles include		

		the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum (excluding asphalt), wood, and other organic matter. Asphalt (CAS 8052-42-4, and CAS 64742-93-4) is not covered under the 'coal tar pitch volatiles' standard OSHA specifically regulated carcinogen		
		TWA	0.100000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar products. cyclohexane-extractable fraction See Appendix C See Appendix A		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Phenanthrene	85-01-8	1-Hydroxypyrene (1-HP)		Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: solid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 98 - 100 °C (208 - 212 °F)
f) Initial boiling point and boiling range	340 °C (644 °F)
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	1.063 g/mL at 25 °C (77 °F)
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	log Pow: 4.57
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

No data available

---

**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

No data available



#### 10.4 Conditions to avoid

No data available

#### 10.5 Incompatible materials

Oxidizing agents

#### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

LD50 Oral - Mouse - 700.0 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

##### Skin corrosion/irritation

No data available

##### Serious eye damage/eye irritation

No data available

##### Respiratory or skin sensitisation

Causes photosensitivity. Exposure to light can result in allergic reactions resulting in dermatologic lesions, which can vary from sunburnlike responses to edematous, vesiculated lesions, or bullae

##### Germ cell mutagenicity

No data available

##### Carcinogenicity

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Phenanthrene)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

No data available

No data available

##### Specific target organ toxicity - single exposure

Inhalation - May cause respiratory irritation.

##### Specific target organ toxicity - repeated exposure

No data available

##### Aspiration hazard

No data available

##### Additional Information

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 3.2 mg/l - 96.0 h LC100 - other fish - 1.5 mg/l - 1.0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 0.86 mg/l - 24 h EC50 - Daphnia magna (Water flea) - 0.38 mg/l - 48 h
Toxicity to algae	EC50 - Chlorella vulgaris (Fresh water algae) - 1.20 mg/l - 3 h

### 12.2 Persistence and degradability

Biodegradability Result: 55 - 95 % - Partially biodegradable.

### 12.3 Bioaccumulative potential

Bioaccumulation Pimephales promelas (fathead minnow) - 28 d  
- 0.00255 mg/l

Bioconcentration factor (BCF): 5,100

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Phenanthrene)  
Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Phenanthrene)  
Marine pollutant: yes

### IATA

UN number: 3077 Class: 9 Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Phenanthrene)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

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## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Phenanthrene	85-01-8	2007-07-01

### SARA 311/312 Hazards

Acute Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Phenanthrene	85-01-8	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Phenanthrene	85-01-8	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Phenanthrene	85-01-8	2007-07-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

Phenanthrene

CAS-No.	Revision Date
85-01-8	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Eye Irrit.	Eye irritation
H302	Harmful if swallowed.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H400	Very toxic to aquatic life.

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.4

Revision Date: 03/02/2015

Print Date: 06/20/2016



## **MATERIAL SAFETY DATA SHEET**

**(POLYCHLORINATED BIPHENYLS)**

### **COMPOSITION/INFORMATION ON INGREDIENTS**

Ingredients Name: polychlorinated biphenyls (PCBs)

### **HAZARD IDENTIFICATION**

Reports of Carcinogenicity: YES

### **HEALTH HAZARDS ACUTE AND CHRONIC**

- **Eyes**: Moderately irritating to eye tissues.
- **Skin**: Can be absorbed through intact skin, may cause de-fatting, potential for chloracne.
- **Inhalation**: Possible liver injury.
- **Ingestion**: Slightly toxic; reasonably anticipated to be carcinogenic.

### **EFFECTS OF OVER-EXPOSURE**

Can cause dermatological symptoms; however, these are reversible upon removal of exposure source.

### **FIRST AID MEASURES**

- **Eyes**: Irrigate immediately with copious quantities of running water for at least 15 minutes if liquid or solid PCBs get into them.
- **Skin**: Contaminated clothing should be removed and the skin washed thoroughly with soap and water. Hot PCBs may cause thermal burns.
- **Inhalation**: Remove to fresh air; if skin rash or respiratory irritation persists, consult a physician (if electrical equipment arcs over, PCBs may decompose to produce hydrochloric acid).
- **Ingestion**: Consult a physician. Do not induce vomiting or give any oily laxatives. (If large amounts are ingested, gastric lavage is suggested).

**FIRE FIGHTING MEASURES**: Flash Point: >141 °C (285.8 °F)

**EXTINGUISHING MEDIA**: PCBs are fire-resistant compounds.

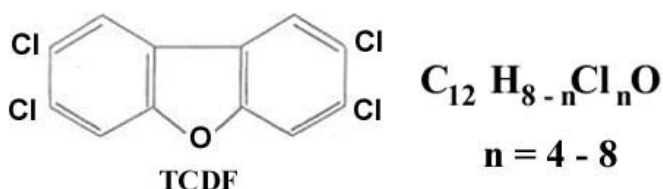
## **FIRE-FIGHTING PROCEDURES**

Standard fire-fighting wearing apparel and self-contained breathing apparatus should be worn when fighting fires that involve possible exposure to chemical combustion products. Fire fighting equipment should be thoroughly cleaned and decontaminated after use.

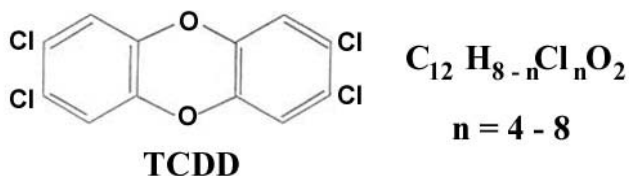
## **UNUSUAL FIRE/EXPLOSION HAZARD**

If a PCB transformer is involved in a fire-related incident, the owner of the transformer is required to report the incident. Consult and follow appropriate federal, provincial and local regulations.

***Note:*** When askarel liquid becomes involved in a fire, toxic by-products of combustion are typically produced including polychlorinated dibenzofurans and polychlorinated dibenzodioxins, both known carcinogens. The structures of these chemical species are as follows:



**2,3,7,8-tetrachlorodibenzofuran**



**2,3,7,8-tetrachloro-dibenzo-p-dioxin**

***Note:*** 2,3,7,8-tetrachloro-dibenzo-p-dioxin is one of the most potent teratogenic, mutagenic and carcinogenic agents known to man.

## **SPILL RELEASE PROCEDURES**

Cleanup & disposal of liquid PCBs are strictly regulated by the federal government. Ventilate area. Contain spill/leak. Remove spill by means of absorptive material. Spill clean-up personnel should use proper protective clothing. All wastes and residues containing PCBs should be collected, containerized, marked and disposed of in the manner prescribed by applicable federal, provincial and local laws.

## **HANDLING AND STORAGE PRECAUTIONS**

Care should be taken to prevent entry into the environment through spills, leakage, use, vaporization, or disposal of liquid. Avoid prolonged breathing of vapours or mists. Avoid contact with eyes or prolonged contact with skin. Comply with all federal, provincial and local regulations.

## **OTHER PRECAUTIONS**

Federal regulations require PCBs, PCB items, storage areas, transformer vaults, and transport vehicles to be appropriately labelled.

## **RESPIRATORY PROTECTION**

Use OSHA approved equipment when airborne exposure limits are exceeded. Full facepiece equipment is recommended and, if used, replaces need for face shield and/or chemical splash goggles. The respirator use limitations specified by the manufacturer must be observed.

## **VENTILATION**

Provide natural or mechanical ventilation to control exposure levels below airborne exposure levels.

**PROTECTIVE GLOVES:** Wear appropriate chemical resistant gloves to prevent skin contact.

**EYE PROTECTION:** Wear chemical splash goggles and have eye baths available.

## **OTHER PROTECTIVE EQUIPMENT**

Wear appropriate protective clothing. Provide a safety shower at any location where skin contact can occur.

## **WORK HYGIENIC PRACTICES**

Wash thoroughly after handling. Supplemental safety and health : none

## **PHYSICAL/CHEMICAL PROPERTIES**

- **Vapour pressure:** (mm Hg @100 °F) 0.005 - 0.00006
- **Viscosity:** (CENTISTOKES) 3.6 - 540
- **Stability indicator/materials to avoid:** Yes
- **Stability Condition to Avoid:** PCBs are very stable, fire-resistant compounds.

## **HAZARDOUS DECOMPOSITION PRODUCTS**

Carbon monoxide, carbon dioxide, hydrogen chloride, phenolics, aldehydes, furans, dioxins

## **WASTE DISPOSAL METHODS**

Consult the applicable PCB regulations prior to any disposal of PCBs or PCB-contaminated items.

## SAFETY DATA SHEET

Version 4.10  
Revision Date 06/30/2014  
Print Date 05/01/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Potassium

Product Number : 244856  
Brand : Aldrich  
Index-No. : 019-001-00-2

CAS-No. : 7440-09-7

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Substances and mixtures, which in contact with water, emit flammable gases (Category 1), H260

Skin corrosion (Category 1A), H314

Serious eye damage (Category 1), H318

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H260

In contact with water releases flammable gases which may ignite spontaneously.

H314

Causes severe skin burns and eye damage.

Precautionary statement(s)

P223

Keep away from any possible contact with water, because of violent reaction and possible flash fire.

P231 + P232

Handle under inert gas. Protect from moisture.

P260

Do not breathe dust or mist.

P264

Wash skin thoroughly after handling.

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.



P301 + P330 + P331 P303 + P361 + P353	IF SWALLOWED: rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/ physician.
P321	Specific treatment (see supplemental first aid instructions on this label).
P335 + P334	Brush off loose particles from skin. Immerse in cool water/ wrap in wet bandages.
P363	Wash contaminated clothing before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P402 + P404	Store in a dry place. Store in a closed container.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Reacts violently with water.  
May form explosive peroxides.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: K
Molecular Weight	: 39.10 g/mol
CAS-No.	: 7440-09-7
EC-No.	: 231-119-8
Index-No.	: 019-001-00-2

#### Hazardous components

Component	Classification	Concentration
<b>Potassium</b>		
	Water-react. 1; Skin Corr. 1A; Eye Dam. 1; H260, H314	-

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

no data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Dry powder

### 5.2 Special hazards arising from the substance or mixture

Potassium oxides

### 5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

### 5.4 Further information

no data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Do not flush with water. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid formation of dust and aerosols.

Provide appropriate exhaust ventilation at places where dust is formed. Keep away from sources of ignition - No smoking.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Never allow product to get in contact with water during storage.

Handle and store under inert gas.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

**Full contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

**Splash contact**

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

**Body Protection**

Complete suit protecting against chemicals, Flame retardant protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

- |   |  |
|---|--|
| a) Appearance                                   | Form: Ingots<br>Colour: grey               |
| b) Odour  | no data available                          |
| c) Odour Threshold                              | no data available                          |
| d) pH   | no data available                          |
| e) Melting point/freezing point                 | Melting point/range: 64 °C (147 °F) - lit. |
| f) Initial boiling point and boiling range      | 760 °C (1,400 °F) - lit.                   |
| g) Flash point                                  | not applicable                             |
| h) Evaporation rate                             | no data available                          |
| i) Flammability (solid, gas)                    | no data available                          |
| j) Upper/lower flammability or explosive limits | no data available                          |
| k) Vapour pressure                              | 0.12 hPa (0.09 mmHg) at 260 °C (500 °F)    |
| l) Vapour density                               | no data available                          |

m) Relative density	0.86 g/cm <sup>3</sup> at 25 °C (77 °F)
n) Water solubility	no data available
o) Partition coefficient: n-octanol/water	no data available
p) Auto-ignition temperature	no data available
q) Decomposition temperature	no data available
r) Viscosity	no data available
s) Explosive properties	no data available
t) Oxidizing properties	no data available

## 9.2 Other safety information

no data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

no data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

Test for peroxide formation before using or discard after 3 months.

### 10.3 Possibility of hazardous reactions

Reacts violently with water.

### 10.4 Conditions to avoid

Exposure to moisture.

### 10.5 Incompatible materials

Oxidizing agents, Carbon oxides, Reacts violently with water., Reacts with water to generate Hydrogen gas.

### 10.6 Hazardous decomposition products

Other decomposition products - no data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

Inhalation: no data available

Dermal: no data available

LD50 Intraperitoneal - mouse - 700 mg/kg

#### Skin corrosion/irritation

no data available

#### Serious eye damage/eye irritation

no data available

#### Respiratory or skin sensitisation

no data available

#### Germ cell mutagenicity

no data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a

carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

no data available

no data available

**Specific target organ toxicity - single exposure**

no data available

**Specific target organ toxicity - repeated exposure**

no data available

**Aspiration hazard**

no data available

**Additional Information**

RTECS: TS6460000

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

no data available

### 12.2 Persistence and degradability

no data available

### 12.3 Bioaccumulative potential

no data available

### 12.4 Mobility in soil

no data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

no data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

**DOT (US)**

UN number: 2257      Class: 4.3

Proper shipping name: Potassium

Marine pollutant: No

Poison Inhalation Hazard: No

Packing group: I

**IMDG**

UN number: 2257      Class: 4.3  
Proper shipping name: POTASSIUM  
Marine pollutant: No

Packing group: I

EMS-No: F-G, S-N

**IATA**

UN number: 2257      Class: 4.3  
Proper shipping name: Potassium  
IATA Passenger: Not permitted for transport

Packing group: I

---

**15. REGULATORY INFORMATION**

**SARA 302 Components**

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Reactivity Hazard, Acute Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Potassium	7440-09-7	1993-04-24

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Potassium	7440-09-7	1993-04-24

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Potassium	7440-09-7	1993-04-24

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Eye Dam.	Serious eye damage
H260	In contact with water releases flammable gases which may ignite spontaneously.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
Skin Corr.	Skin corrosion
Water-react.	Substances and mixtures, which in contact with water, emit flammable gases

**HMIS Rating**

Health hazard:	3
Chronic Health Hazard:	
Flammability:	3
Physical Hazard	3

**NFPA Rating**

Health hazard:	3
Fire Hazard:	0
Reactivity Hazard:	2
Special hazard.I:	W

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the

product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.10

Revision Date: 06/30/2014

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 3.9  
Revision Date 05/23/2016  
Print Date 06/21/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : *p*-Xylene

Product Number : 95680

Brand : Sigma-Aldrich

Index-No. : 601-022-00-9

CAS-No. : 106-42-3

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 3), H226

Acute toxicity, Inhalation (Category 4), H332

Acute toxicity, Dermal (Category 4), H312

Skin irritation (Category 2), H315

Acute aquatic toxicity (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H226

Flammable liquid and vapour.

H312 + H332

Harmful in contact with skin or if inhaled

H315

Causes skin irritation.

H401

Toxic to aquatic life.

Precautionary statement(s)

P210

Keep away from heat/sparks/open flames/hot surfaces. No smoking.

P233

Keep container tightly closed.

P240

Ground/bond container and receiving equipment.



P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P312	Call a POISON CENTER/doctor if you feel unwell.
P322	Specific measures (see supplemental first aid instructions on this label).
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P235	Store in a well-ventilated place. Keep cool.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms	: 1,4-Dimethylbenzene
Formula	: C <sub>8</sub> H <sub>10</sub>
Molecular weight	: 106.17 g/mol
CAS-No.	: 106-42-3
EC-No.	: 203-396-5
Index-No.	: 601-022-00-9

#### Hazardous components

Component	Classification	Concentration
<b>p-Xylene</b>		
	Flam. Liq. 3; Acute Tox. 4; Skin Irrit. 2; Aquatic Acute 2; H226, H312 + H332, H315, H401	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

No data available

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

Use water spray to cool unopened containers.

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### 6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
p-Xylene	106-42-3	TWA	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Eye & Upper Respiratory Tract irritation		

		Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Eye & Upper Respiratory Tract irritation Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		ST	150.000000 ppm 655.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100.000000 ppm 435.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	100.000000 ppm 435.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	150 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		

		TWA	100 ppm 435 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
p-Xylene	106-42-3	Methylhippuric acids	1.5g/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			
		Methylhippuric acids	1,500.000 0 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 30 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: liquid, clear Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	13.0 °C (55.4 °F)
f) Initial boiling point and boiling range	137.0 - 138.0 °C (278.6 - 280.4 °F)
g) Flash point	25.0 °C (77.0 °F) - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 7 %(V) Lower explosion limit: 1.1 %(V)
k) Vapour pressure	21.3 hPa (16.0 mmHg) at 37.7 °C (99.9 °F) 12.0 hPa (9.0 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density	No data available
m) Relative density	0.86 g/cm <sup>3</sup>
n) Water solubility	0.2 g/l
o) Partition coefficient: n-octanol/water	log Pow: 3.15
p) Auto-ignition temperature	529.0 °C (984.2 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

**9.2 Other safety information**

Surface tension	28.3 mN/m at 20.0 °C (68.0 °F)
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**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

Vapours may form explosive mixture with air.

**10.4 Conditions to avoid**

Heat, flames and sparks.

## 10.5 Incompatible materials

Strong oxidizing agents

## 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 5,000 mg/kg

LD50 Oral - Rat - male - 3,523 mg/kg

LC50 Inhalation - Rat - 4 h - 4550 ppm

Remarks: Lungs, Thorax, or Respiration:Chronic pulmonary edema. Liver:Other changes. Blood:Changes in cell count (unspecified).

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Moderate skin irritation - 4 h

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (p-Xylene)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

May cause reproductive disorders.

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: ZE2625000

narcosis, Lung irritation, chest pain, pulmonary edema, Central nervous system depression, Gastrointestinal disturbance, Liver injury may occur., Kidney injury may occur., Blood disorders

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 2.60 mg/l - 96 h
	LC50 - Carassius auratus (goldfish) - 18.00 mg/l - 24 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 35.50 - 63.10 mg/l - 48 h
Toxicity to algae	EC50 - Pseudokirchneriella subcapitata (green algae) - 3.20 - 4.40 mg/l - 72 h

## 12.2 Persistence and degradability

Biodegradability Result: 87.8 % - Readily biodegradable

## 12.3 Bioaccumulative potential

No data available

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1307	Class: 3	Packing group: III
Proper shipping name: Xylenes		
Reportable Quantity (RQ): 100 lbs		

Poison Inhalation Hazard: No

### IMDG

UN number: 1307	Class: 3	Packing group: III	EMS-No: F-E, S-D
Proper shipping name: XYLENES			

### IATA

UN number: 1307	Class: 3	Packing group: III
Proper shipping name: Xylenes		

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
p-Xylene	106-42-3	2007-07-01

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Flam. Liq.	Flammable liquids
H226	Flammable liquid and vapour.
H312	Harmful in contact with skin.
H312 + H332	Harmful in contact with skin or if inhaled
H315	Causes skin irritation.
H332	Harmful if inhaled.

**HMIS Rating**

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

**NFPA Rating**

Health hazard:	1
Fire Hazard:	3
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.9

Revision Date: 05/23/2016

Print Date: 06/21/2016



## SAFETY DATA SHEET

Version 4.8  
Revision Date 08/11/2015  
Print Date 05/01/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Pyrene

Product Number : 571245  
Brand : Aldrich

CAS-No. : 129-00-0

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Germ cell mutagenicity (Category 2), H341  
Specific target organ toxicity - repeated exposure (Category 1), Blood, H372  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H341

Suspected of causing genetic defects.

H372

Causes damage to organs (Blood) through prolonged or repeated exposure.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P260

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

P264

Wash skin thoroughly after handling.

P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Rapidly absorbed through skin.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : Benzo[def]phenanthrene

Formula : C<sub>16</sub>H<sub>10</sub>

Molecular weight : 202.25 g/mol

CAS-No. : 129-00-0

EC-No. : 204-927-3

#### Hazardous components

Component	Classification	Concentration
<b>Pyrene</b>		
	Muta. 2; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H341, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Pyrene	129-00-0	TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
	Remarks	1910.1002 As used in §1910.1000 (Table Z-1), coal tar pitch volatiles include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum (excluding asphalt), wood, and other organic matter. Asphalt (CAS 8052-42-4, and CAS 64742-93-4) is not covered under the 'coal tar pitch volatiles' standard OSHA specifically regulated carcinogen		
		TWA	0.100000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen		

		NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar products. cyclohexane-extractable fraction See Appendix C See Appendix A
--	--	---

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Pyrene	129-00-0	1-Hydroxypyrene (1-HP)		Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested:Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 30 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: crystalline Colour: yellow
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 145 - 148 °C (293 - 298 °F) - lit.
f) Initial boiling point and boiling range	390.0 - 395.0 °C (734.0 - 743.0 °F)
g) Flash point	> 200.0 °C (> 392.0 °F)
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	1.21 g/cm <sup>3</sup>
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	log Pow: 4.88
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

Bulk density	650 kg/m <sup>3</sup>
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## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Risk of dust explosion.

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 2,700 mg/kg

Remarks: Sense Organs and Special Senses (Nose, Eye, Ear, and Taste):Eye:Conjunctive irritation.

Behavioral:Excitement. Behavioral:Muscle contraction or spasticity.

LC50 Inhalation - Rat - 170.0 mg/m3

Remarks: Sense Organs and Special Senses (Nose, Eye, Ear, and Taste):Eye:Conjunctive irritation.

Behavioral:Excitement. Behavioral:Muscle contraction or spasticity.

Dermal: No data available

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Mild skin irritation - 24 h

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Mild eye irritation

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Laboratory experiments have shown mutagenic effects. In vitro tests showed mutagenic effects

Ames test

Result: positive

Mutation in mammalian somatic cells.

mouse lymphoma cells

Result: positive

#### Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Pyrene)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: OSHA specifically regulated carcinogen (Pyrene)

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

Causes damage to organs through prolonged or repeated exposure. - Blood

#### Aspiration hazard

No data available

**Additional Information**

RTECS: UR2450000

Inhalation studies in animals have caused: Liver toxicity, pulmonary pathologies, intragastric pathologies, neutropenia, leukopenia, anemia, Contact with skin can cause: hyperemia, weight loss, hematopoietic changes, Dermatitis, Chronic effects, leukocytosis

Kidney -

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Oncorhynchus mykiss (rainbow trout) - &gt; 2 mg/l - 96.0 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 0.002 - 0.003 mg/l - 48 h

**12.2 Persistence and degradability****12.3 Bioaccumulative potential**Bioaccumulation other fish - 48 h  
- 0.056 mg/l

Bioconcentration factor (BCF): 4,810

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

Avoid release to the environment.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 3077 Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Pyrene)

Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 3077 Class: 9

Packing group: III

EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Pyrene)

Marine pollutant: yes

**IATA**

UN number: 3077 Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Pyrene)

**Further information**

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

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**15. REGULATORY INFORMATION****SARA 302 Components**

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**

Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Pyrene	129-00-0	2008-11-03

**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Pyrene	129-00-0	2007-09-28

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H341	Suspected of causing genetic defects.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Muta.	Germ cell mutagenicity

**HMIS Rating**

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.8

Revision Date: 08/11/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.7  
Revision Date 11/13/2015  
Print Date 05/01/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Selenium

Product Number : 209651  
Brand : Aldrich  
Index-No. : 034-001-00-2

CAS-No. : 7782-49-2

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 3), H301  
Acute toxicity, Inhalation (Category 3), H331  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Chronic aquatic toxicity (Category 4), H413

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H301 + H331  
H373  
H413

Toxic if swallowed or if inhaled  
May cause damage to organs through prolonged or repeated exposure.  
May cause long lasting harmful effects to aquatic life.

Precautionary statement(s)

P260  
P264  
P270  
P271  
P273

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.  
Wash skin thoroughly after handling.  
Do not eat, drink or smoke when using this product.  
Use only outdoors or in a well-ventilated area.  
Avoid release to the environment.

P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Rinse mouth.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician.
P314	Get medical advice/ attention if you feel unwell.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: Se
Molecular weight	: 78.96 g/mol
CAS-No.	: 7782-49-2
EC-No.	: 231-957-4
Index-No.	: 034-001-00-2

#### Hazardous components

Component	Classification	Concentration
<b>Selenium</b>		
	Acute Tox. 3; STOT RE 2; Aquatic Chronic 4; H301 + H331, H373, H413	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Selenium/selenium oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Store under inert gas. Keep in a dry place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Selenium	7782-49-2	TWA	0.2 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Eye & Upper Respiratory Tract irritation		
		TWA	0.200000 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		Eye & Upper Respiratory Tract irritation		

		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.200000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.2 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	0.2 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.2 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation		

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: powder Colour: light grey
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 217 °C (423 °F) - lit.
f) Initial boiling point and boiling range	684.9 °C (1,264.8 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	4.81 g/cm <sup>3</sup> at 25 °C (77 °F)
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	log Pow: 5
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents, Do not store near acids., Amides, Carbides, Metals, Nickel, Nitric acid, Nitrogen trichloride, Oxygen, Potassium, Zinc

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 6,700 mg/kg

Remarks: Behavioral:Somnolence (general depressed activity). Lungs, Thorax, or Respiration:Dyspnea. Nutritional and Gross Metabolic:Changes in:Other changes.

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

Carcinogenicity - Mouse - Oral

Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Skin and Appendages: Other: Tumors.

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Selenium)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

Developmental Toxicity - Mouse - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

May cause damage to organs through prolonged or repeated exposure.

#### Aspiration hazard

No data available

#### Additional Information

RTECS: VS7700000

anemia, Vomiting, Diarrhoea, Cough, Difficulty in breathing, Acute selenium poisoning produces central nervous system effects, which include nervousness, convulsions, and drowsiness. Other signs of intoxication can include skin

eruptions, lassitude, gastrointestinal distress, teeth that are discolored or decayed, odorous ("garlic") breath, and partial loss of hair and nails. Chronic exposure by inhalation can produce symptoms that include pallor, coating of the tongue, anemia, irritation of the mucosa, lumbar pain, liver and spleen damage, as well as any of the other previously mentioned symptoms. Chronic contact with selenium compounds may cause garlic odor of breath and sweat, dermatitis, and moderate emotional instability., Dermatitis, garlic-like breath odor, pallor, nervousness, depression

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish                      mortality NOEC - Cyprinodon variegatus (sheepshead minnow) - 2 mg/l - 96.0 h

mortality LOEC - Oncorhynchus mykiss (rainbow trout) - 7.8 mg/l - 96.0 h

Toxicity to daphnia and other aquatic invertebrates      LC50 - Daphnia magna (Water flea) - 0.43 mg/l - 48 h

Toxicity to algae                      EC50 - Pseudokirchneriella subcapitata - 99 mg/l - 72 h

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

Bioaccumulation                      Lepomis macrochirus - 60 d  
- 640 µg/l

Bioconcentration factor (BCF): 7.7

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3288                      Class: 6.1                      Packing group: III

Proper shipping name: Toxic solid, inorganic, n.o.s. (Selenium)

Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3288                      Class: 6.1                      Packing group: III                      EMS-No: F-A, S-A

Proper shipping name: TOXIC SOLID, INORGANIC, N.O.S. (Selenium)

Marine pollutant: yes

### IATA



UN number: 3288      Class: 6.1      Packing group: III  
Proper shipping name: Toxic solid, inorganic, n.o.s. (Selenium)

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Selenium	7782-49-2	2007-07-01

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Selenium	7782-49-2	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Selenium	7782-49-2	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Selenium	7782-49-2	2007-07-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Chronic	Chronic aquatic toxicity
H301	Toxic if swallowed.
H301 + H331	Toxic if swallowed or if inhaled
H331	Toxic if inhaled.
H373	May cause damage to organs through prolonged or repeated exposure.
H413	May cause long lasting harmful effects to aquatic life.

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 11/13/2015

Print Date: 05/01/2016

Creation Date 12-Dec-1997

Revision Date 22-Aug-2011

Revision Number 9

**1. PRODUCT AND COMPANY IDENTIFICATION****Product Identifier****Product Description:**

Silver

**Cat No.**

S/1010/45

**Synonyms**

Argentum.

**Relevant identified uses of the substance or mixture and uses advised against****Recommended Use**

Laboratory chemicals

**Uses advised against**

No Information available

**Details of the supplier of the safety data sheet****Company**

Fisher Scientific UK

Bishop Meadow Rd

Loughborough, Leicestershire, Great Britain

LE115RG

Tel: 01509 231166

**E-mail address**

begel.sdsdesk@thermofisher.com

**Emergency Telephone Number**

Tel: 01509 231166 Chemtrec US: (800) 424-9300

Chemtrec EU: 001 (202) 483-7616

**2. HAZARDS IDENTIFICATION****Classification of the substance or mixture****REGULATION (EC) No 1272/2008**

Not hazardous

**Classification according to EU Directives 67/548/EEC or 1999/45/EC***For the full text of the R phrases mentioned in this Section, see Section 16***R -phrase(s)**

none

**Label Elements****Signal Word**

None

**Hazard Statements****Other Hazards**

No information available.

Silver

Revision Date 22-Aug-2011

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	EC No.	Weight %	CAS-No	Classification	GHSCLAS	REACH Reg. No.
Silver 7440-22-4	EEC No. 231-131-3	100	7440-22-4	-	-	-

For the full text of the R phrases mentioned in this Section, see Section 16

## 4. FIRST AID MEASURES

### Description of first aid measures

#### Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.

#### Skin Contact

Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. Obtain medical attention.

#### Ingestion

Clean mouth with water. Get medical attention.

#### Inhalation

Remove from exposure, lie down. Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Obtain medical attention.

#### Notes to Physician

Treat symptomatically

## 5. FIRE-FIGHTING MEASURES

### Extinguishing media

#### Suitable Extinguishing Media

Water spray. Carbon dioxide (CO<sub>2</sub>). Dry chemical. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. chemical foam.

#### Extinguishing media which must not be used for safety reasons

No information available.

#### Special hazards arising from the substance or mixture

Non-combustible.

#### Advice for fire-fighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Silver

Revision Date 22-Aug-2011

## 6. ACCIDENTAL RELEASE MEASURES

### Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation

### Environmental precautions

Prevent further leakage or spillage if safe to do so

### Methods and material for containment and cleaning up

Sweep up or vacuum up spillage and collect in suitable container for disposal.

## 7. HANDLING AND STORAGE

### Precautions for Safe Handling

Avoid contact with skin and eyes. Do not breathe dust. Do not breathe vapors or spray mist.

### Conditions for safe storage, including any incompatibilities

Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

### Specific End Uses

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

### Control parameters

#### Exposure limits

##### Component

Silver

European Union	The United Kingdom	France	Belgium	Spain
TWA: 0.1 mg/m <sup>3</sup>	STEL: 0.3 mg/m <sup>3</sup> TWA: 0.1 mg/m <sup>3</sup>	VME: 0.1 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>	VLA-ED: 0.1 mg/m <sup>3</sup>

##### Component

Silver

Italy	Portugal	The Netherlands	Finland	Denmark
TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.01 mg/m <sup>3</sup>

##### Component

Silver

Austria	Switzerland	Poland	Norway	Ireland
STEL: 0.1 mg/m <sup>3</sup> MAK: 0.1 mg/m <sup>3</sup> Ceiling: 0.1 mg/m <sup>3</sup>	STEL: 0.8 mg/m <sup>3</sup> MAK: 0.1 mg/m <sup>3</sup>	NDS: 0.05 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>	TWA: 0.1 mg/m <sup>3</sup>

#### Derived No Effect Level (DNEL)

No information available.

#### Predicted No Effect Concentration (PNEC)

No information available.

Silver

Revision Date 22-Aug-2011

## Exposure controls

### Engineering Measures

Ensure adequate ventilation, especially in confined areas

### Personal protective equipment

#### Eye Protection

Safety glasses with side-shields

#### Hand Protection

Protective gloves

#### Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure

#### Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced. Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

### Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice

### Environmental exposure controls

No information available.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### Physical State

Solid

### Appearance

Silver

### odor

odorless

### pH

No information available.

### Vapor Pressure

No information available.

### Boiling Point/Range

2212°C / 4013.6°F

### Melting Point/Range

960.5°C / 1760.9°F

### Flash Point

No information available.

### Autoignition Temperature

No information available.

### Specific Gravity

10.5

### Molecular Formula

Ag

### Molecular Weight

107.868

## 10. STABILITY AND REACTIVITY

### Reactivity

### Chemical Stability

Air sensitive.

### Possibility of Hazardous Reactions

#### Hazardous Polymerization

No information available. Hazardous polymerization does not occur.

#### Hazardous Reactions .

No information available.

### Conditions to Avoid

Exposure to air, Incompatible products.

### Incompatible Materials

Silver

Revision Date 22-Aug-2011

Acids, Strong acids, Strong bases, Ammonia, oxygen.

## Hazardous Decomposition Products

None under normal use

## 11. TOXICOLOGICAL INFORMATION

### Information on Toxicological Effects

#### Acute Toxicity

#### Component Information

Component  
Silver

LD50 Oral	LD50 Dermal	LC50 Inhalation
2000 mg/kg ( Rat )		

#### Chronic Toxicity

#### Carcinogenicity

There are no known carcinogenic chemicals in this product

#### Sensitization

No information available.

#### Mutagenic Effects

No information available

#### Reproductive Effects

No information available.

#### Developmental Effects

No information available.

#### Target Organs

No information available.

#### Other Adverse Effects

The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information

#### Endocrine Disruptor Information

None known

## 12. ECOLOGICAL INFORMATION

### Toxicity

#### Ecotoxicity effects

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
-----------	------------------	-----------------	----------	------------

Silver

Revision Date 22-Aug-2011

Silver	0.0062 mg/L LC50 96 h 0.064 mg/L LC50 96 h 0.00155-0.00293 mg/L LC50 96 h	0.00024 mg/L EC50 = 48 h
--------	--	-----------------------------

## Persistence and degradability

No information available

## Bioaccumulative potential

No information available.

## Mobility in soil

No information available.

## Results of PBT and vPvB assessment

## Other adverse effects

No information available

## 13. DISPOSAL CONSIDERATIONS

### Waste treatment methods

**Waste from Residues / Unused Products**

Dispose of in accordance with local regulations

**Contaminated Packaging**

Empty containers should be taken for local recycling, recovery or waste disposal

## 14. TRANSPORT INFORMATION

IMDG/IMO

Not regulated

ADR

Not regulated

IATA

Not regulated

## 15. REGULATORY INFORMATION



Silver

Revision Date 22-Aug-2011

## 15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

### International Inventories

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	CHINA	AICS	KECL
Silver	231-131-3	-		X	X	-	X	-	X	X	X

### Legend

**TSCA** - United States Toxic Substances Control Act Section 8(b) Inventory

**EINECS/ELINCS** - European Inventory Lists

**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List

**PICCS** - Philippines Inventory of Chemicals and Chemical Substances

**ENCS** - Japan Existing and New Chemical Substances

**CHINA** - China Inventory of Existing Chemical Substances

**AICS** - Inventory of Chemical Substances

**KECL** - Existing and Evaluated Chemical Substances

### Chemical Safety Assessment

## 16. OTHER INFORMATION

### Text of R phrases mentioned in Section 2-3

No information available.

Revision Date

22-Aug-2011

Revision Summary

Update to Format.

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

### Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of Safety Data Sheet

## SAFETY DATA SHEET

Version 4.13  
Revision Date 09/25/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Sodium

Product Number : 282057  
Brand : Aldrich  
Index-No. : 011-001-00-0

CAS-No. : 7440-23-5

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Substances and mixtures, which in contact with water, emit flammable gases (Category 1), H260  
Skin corrosion (Category 1B), H314  
Serious eye damage (Category 1), H318  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Chronic aquatic toxicity (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)  
H260

In contact with water releases flammable gases which may ignite spontaneously.

H314  
H336  
H411

Causes severe skin burns and eye damage.  
May cause drowsiness or dizziness.  
Toxic to aquatic life with long lasting effects.

Precautionary statement(s)  
P223  
P231 + P232

Do not allow contact with water.  
Handle under inert gas. Protect from moisture.

P260	Do not breathe dust or mist.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P335 + P334	Brush off loose particles from skin. Immerse in cool water/ wrap in wet bandages.
P363	Wash contaminated clothing before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391	Collect spillage.
P402 + P404	Store in a dry place. Store in a closed container.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.2 Mixtures

Formula : Na  
Molecular weight : 22.99 g/mol

#### Hazardous components

Component		Classification	Concentration
<b>Sodium</b>			
CAS-No.	7440-23-5	Water-react. 1; Skin Corr. 1B; Eye Dam. 1; H260, H314	>= 90 - <= 100 %
EC-No.	231-132-9		
Index-No.	011-001-00-0		
<b>Kerosine</b>			
CAS-No.	8008-20-6	Flam. Liq. 4; Skin Irrit. 2; STOT SE 3; Asp. Tox. 1; Aquatic Chronic 2; H227, H304, H315, H336, H411	>= 90 - <= 100 %
EC-No.	232-366-4		
Index-No.	649-404-00-4		

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

**If swallowed**

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Dry powder

**5.2 Special hazards arising from the substance or mixture**

Carbon oxides, Sodium oxides

Sodium oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

**6.3 Methods and materials for containment and cleaning up**

Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Do not flush with water.

Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed. Keep away from sources of ignition - No smoking.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

Never allow product to get in contact with water during storage.

Air sensitive.

Storage class (TRGS 510): Hazardous materials, which set free flammable gases upon contact with water

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Kerosine	8008-20-6	TWA	200.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Upper Respiratory Tract irritation Skin irritation Application restricted to conditions in which there are negligible aerosol exposures Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption varies		
		TWA	200 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Skin irritation Application restricted to conditions in which there are negligible aerosol exposures Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption varies		
		TWA	100.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		A refined petroleum solvent (predominantly C9-C16), which typically is 25% normal paraffins, 11% branched paraffins, 30% monocycloparaffins, 12% dicycloparaffins, 1% tricycloparaffins, 16% mononuclear aromatics & 5% dinuclear aromatics.		

Hazardous components without workplace control parameters

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

##### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min

Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### **Body Protection**

Complete suit protecting against chemicals, Flame retardant protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

a) Appearance	Form: Solid form Colour: grey
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 97.8 °C (208.0 °F) - lit.
f) Initial boiling point and boiling range	883 °C (1,621 °F) - lit.
g) Flash point	82 °C (180 °F) - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Reacts violently with water.

### 10.4 Conditions to avoid

Exposure to moisture

### 10.5 Incompatible materials

Oxidizing agents

### 10.6 Hazardous decomposition products

Reacts with water to form: - Reacts with water to liberate flammable and/or explosive gas.

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: VY0686000

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1428 Class: 4.3

Packing group: I

Proper shipping name: Sodium

Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 1428 Class: 4.3

Packing group: I

EMS-No: F-G, S-N

Proper shipping name: SODIUM

**IATA**

UN number: 1428 Class: 4.3

Packing group: I

Proper shipping name: Sodium

IATA Passenger: Not permitted for transport

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**SARA 311/312 Hazards**



Reactivity Hazard, Acute Health Hazard

#### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Sodium	7440-23-5	1993-04-24
Kerosine	8008-20-6	2007-03-01

#### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Sodium	7440-23-5	1993-04-24
Kerosine	8008-20-6	2007-03-01

#### New Jersey Right To Know Components

	CAS-No.	Revision Date
Sodium	7440-23-5	1993-04-24
Kerosine	8008-20-6	2007-03-01

#### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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## 16. OTHER INFORMATION

#### Full text of H-Statements referred to under sections 2 and 3.

Aquatic Chronic	Chronic aquatic toxicity
Asp. Tox.	Aspiration hazard
Eye Dam.	Serious eye damage
Flam. Liq.	Flammable liquids
H227	Combustible liquid.
H260	In contact with water releases flammable gases which may ignite spontaneously.
H304	May be fatal if swallowed and enters airways.
H314	Causes severe skin burns and eye damage.
H315	Causes skin irritation.
H318	Causes serious eye damage.
H336	May cause drowsiness or dizziness.
H411	Toxic to aquatic life with long lasting effects.
Skin Corr.	Skin corrosion
Skin Irrit.	Skin irritation
STOT SE	Specific target organ toxicity - single exposure
Water-react.	Substances and mixtures, which in contact with water, emit flammable gases

#### HMIS Rating

Health hazard:	3
Chronic Health Hazard:	
Flammability:	4
Physical Hazard	2

#### NFPA Rating

Health hazard:	3
Fire Hazard:	4
Reactivity Hazard:	2
Special hazard.I:	W

#### Further information

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.13

Revision Date: 09/25/2015

Print Date: 05/01/2016

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## Product Safety Assessment

### *Trichloroethylene*

#### Select a Topic:

[Names](#)  
[Product Overview](#)  
[Manufacture of Product](#)  
[Product Description](#)  
[Product Uses](#)  
[Exposure Potential](#)  
[Health Information](#)  
[Environmental Information](#)  
[Physical Hazard Information](#)  
[Regulatory Information](#)  
[Additional Information](#)  
[References](#)

#### Names

- CAS No. 79-01-6
- Trichloroethylene
- 1,1,2-trichloroethylene
- Ethylene Trichloride
- Trichloroethene
- Ethinyl trichloride
- Acetylene trichloride
- TCE
- Tri
- Trichlor
- Tric
- HI-TRI\* Solvent
- HI-TRI SMG Solvent
- NEU-TRI\* Solvent
- NEU-TRI E Solvent
- NEU-TRI L Solvent

#### Product Overview

- Trichloroethylene is a nonflammable, colorless liquid with a sweet odor.<sup>1</sup> See [Product Description](#).
- Trichloroethylene is used mainly as a solvent to remove grease from metal parts. It is also used as a general solvent and as an intermediate to make other chemicals.<sup>1</sup> See [Product Uses](#).
- Persons working with trichloroethylene should be provided with and instructed in the use of appropriate personal protective clothing and equipment, as required. Adequate ventilation should be provided in the workplace to minimize the possibility of inhalation, which may be hazardous. See [Exposure Potential](#).
- Trichloroethylene is moderately toxic if swallowed. Due to trichloroethylene's volatility, inhalation is the principal route of exposure. The initial effects of excessive inhalation exposure are dizziness, loss of coordination, sleepiness and symptoms of anesthesia. Excessive exposure may cause systemic injury or even death. The National Toxicology Program (NTP) has classified trichloroethylene as "reasonably anticipated to be a human carcinogen" and in 2013 the International Agency for Research on Cancer (IARC) changed the classification from "probably carcinogenic to humans" to "carcinogenic to humans"<sup>2,3</sup> See [Health Information](#).
- Because trichloroethylene evaporates easily, if it is released to the environment during production and use, most of it eventually reaches the air. Trichloroethylene that reaches groundwater may be difficult to remediate. Trichloroethylene is moderately toxic to aquatic organisms and does not bioaccumulate. See [Environmental Information](#).

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<sup>®</sup><sup>TM</sup>\*Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

- Trichloroethylene may thermally decompose upon exposure to open flames or hot surfaces. Involvement of trichloroethylene in a fire can result in the formation of toxic gases, including hydrogen chloride, chlorine, and phosgene.<sup>2</sup> See [Physical Hazard Information](#).

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## Manufacture of Product

- **Capacity**<sup>4</sup> – Dow is one of two companies that produce trichloroethylene in the United States. Dow produces trichloroethylene in Freeport, Texas. In 2011, global consumption of trichloroethylene was 429,500 metric tons (947 million pounds) versus global production capacity of 547,000 metric tons (1,206 million pounds).
- **Process**<sup>1,5</sup> – Dow produces trichloroethylene by a direct chlorination process, in which ethylene dichloride or other C2 chlorinated hydrocarbons are reacted with chlorine to form trichloroethylene and tetrachloroethylene, which are then separated by distillation. The “TRI/PER” process uses the light fractions of the residues from the manufacture of vinyl chloride as its major raw material.

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## Product Description

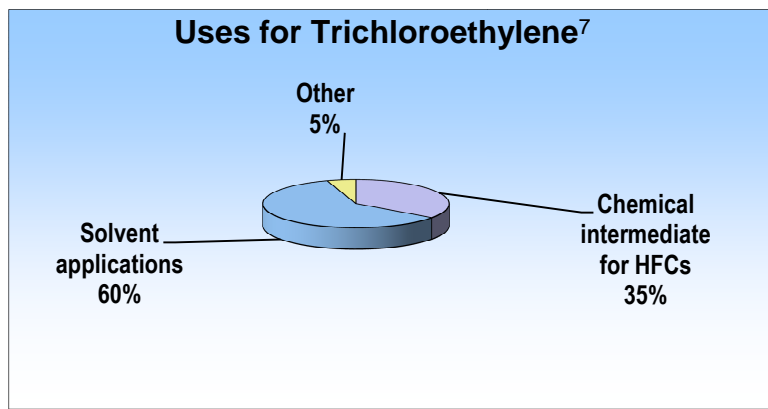
Trichloroethylene is a clear, heavy liquid with excellent solvency. Trichloroethylene has no flash point as determined by standard test methods. Its stability in the presence of common chemical stabilizers and low boiling point permit vapor degreasing with low heat input. Easily recycled, the solvent combines outstanding cleaning power with greater economy.<sup>6</sup>

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## Product Uses<sup>7,8,9</sup>

Trichloroethylene is an excellent solvent for greases, oils, fats, waxes, and tars. Therefore most of its global use is as a solvent for metal cleaning (degreasing) and across many other applications such as nonflammable adhesive formulations, as a low-temperature heat-transfer medium, and as a solvent in waterless dyeing and finishing operations. Trichloroethylene is also used in the production of lithium

ion batteries, polychlorinated aliphatics and certain flame-retardant chemicals. In the manufacture of polyvinyl chloride (PVC), trichloroethylene is used as a molecular weight control agent. Trichloroethylene is also used extensively as a chemical intermediate in the synthesis of hydrofluorocarbon (HFC) refrigerants, blowing agents, and some agricultural chemicals.



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## Exposure Potential<sup>2</sup>

Trichloroethylene is used in the production of industrial products and in industrial processes. The people most likely to be exposed to increased levels of trichloroethylene in the air are those who work in chemical facilities where it is made or used. Inhalation of vapors from trichloroethylene or products containing trichloroethylene should be minimized. Based on the uses for trichloroethylene, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a trichloroethylene manufacturing facility or in the various industrial or manufacturing facilities that use trichloroethylene. Trichloroethylene should be produced, distributed, stored, and used in closed systems. Those working with trichloroethylene in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Each manufacturing facility should have a thorough training program for employees and appropriate work processes and safety equipment in place to limit unnecessary trichloroethylene exposure. Persons working with trichloroethylene should be provided with and instructed in the use of appropriate personal protective clothing and equipment, as required. Adequate ventilation should be provided in the workplace to minimize the possibility of an inhalation hazard. Clothing items that cannot be decontaminated—such as shoes, belts, and watchbands—should be removed and disposed of properly after exposure. See [Health Information](#).
- **Consumer exposure to products containing trichloroethylene** – Dow does not sell trichloroethylene for direct consumer use. See [Health Information](#).
- **Environmental releases** – In the event of a spill, focus on containing the spill to prevent contamination of soil, surfaces or ground water. Mop or soak up the material immediately. Absorb with vermiculite or sawdust. Respiratory protection is necessary for cleaning up spills and leaks. Eliminate all sources of ignition immediately. Although trichloroethylene itself does not have a flash point, it can burn at room temperature. Ventilate the area of the leak or spill. Isolate the area until the vapor has dispersed. See [Environmental Information](#), [Health Information](#), and [Physical Hazard Information](#).
- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, the material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Positive pressure, self-contained breathing apparatus (SCBA) with a full-face mask approved by NIOSH is recommended for emergency work. Eliminate all sources of ignition immediately. Use only explosion-proof equipment; ground and bond all containers and handling equipment. In case of fire, deny any unnecessary entry into the area. Use water fog or fine spray. Avoid contact with this material during fire-fighting operations. If contact is likely, change to full chemical-resistant fire-fighting clothing with SCBA. During a fire, smoke may contain the original material in addition to combustion products of varying composition, which may be toxic and/or irritating. Clear non-emergency personnel from the area. Vapors are heavier than air and may travel a long distance and accumulate in low-lying areas. The public should be warned of downwind vapor explosion hazards. Keep vapors out of sewers. Follow emergency procedures carefully. See [Environmental Information](#), [Health Information](#), and [Physical Hazard Information](#).

For more information, see the relevant [Safety Data Sheet](#).

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## Health Information<sup>1,2,3</sup>

Brief contact may cause moderate skin irritation with local redness. Lengthy or repeated exposure may cause irritation and drying or flaking of the skin. Prolonged or widespread skin contact is unlikely to result in absorption of harmful amounts. Trichloroethylene may be absorbed through the skin and may cause numbness in fingers immersed in the liquid.

Very low toxicity if swallowed. However, if swallowed, do not induce vomiting.

Inhalation is the principal route of exposure for trichloroethylene. The initial effects of excessive inhalation exposure are dizziness, loss of coordination, sleepiness, and symptoms of anesthesia. Nausea may accompany these signs and symptoms. Excessive exposure may cause systemic injury (even death) and may increase sensitivity to epinephrine and increase the probability of irregular heartbeats. Do not administer sympathomimetic drugs (like epinephrine) unless absolutely necessary. Trichloroethylene exposure may also cause alcohol intolerance, which often causes temporary reddening of the skin (“degreaser’s flush”). Health effects have been

reported when people are exposed to the level of trichloroethylene at which its odor is noticeable. Effects reported at high levels include liver and kidney damage and changes in heart beat.

Several studies with mice and rats have suggested that high doses of trichloroethylene may cause liver, kidney, or lung cancer. The National Toxicology Program (NTP) has classified trichloroethylene as "reasonably anticipated to be a human carcinogen" and the International Agency for Research on Cancer (IARC) has listed it as "carcinogenic to humans" or Group 1.

Trichloroethylene has not caused birth defects in animal studies. Male reproductive toxicity effects were observed in laboratory animals in the presence of systemic toxicity at high. In vitro genetic toxicity studies were negative, and animal genetic toxicity studies were predominantly negative. Pure trichloroethylene (without additives) lacks genetic toxicity potential in most test.

For more information, see the relevant [Safety Data Sheet](#).

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### **Environmental Information**<sup>5</sup>

Because it evaporates easily, most of the trichloroethylene released to the environment (either during production or use) reaches the air, where it is found mainly as a gas. Even material that is in water will readily evaporate into the air. However, trichloroethylene is moderately toxic to aquatic organisms. Trichloroethylene that reaches groundwater may be difficult to remediate.

Trichloroethylene is not considered readily biodegradable, although biodegradation may occur slowly under both aerobic and anaerobic conditions. The potential mobility of trichloroethylene in the soil is high. Very little trichloroethylene breaks down in soil, and it can pass through the soil into underground water. It does not bioaccumulate (build up in the food chain).

For more information, see the relevant [Safety Data Sheet](#).

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### **Physical Hazard Information**<sup>2</sup>

Trichloroethylene is thermally stable at typical use temperatures. Thermal decomposition may occur if the material is near open flames or hot sources. Toxic gases can be released during fire or decomposition. The decomposition products depend upon temperature, air supply, and the presence of other materials, but can include hydrogen chloride, chlorine, and phosgene.

Avoid contact of trichloroethylene with alkali metal hydroxides and strong bases. It can react to form dichloroacetylene, which can spontaneously ignite in air. Avoid contact of trichloroethylene with strong oxidizers.

For more information, see the relevant [Safety Data Sheet](#).

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### **Regulatory Information**

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of trichloroethylene. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant [Safety Data Sheet](#) or [Technical Data Sheet](#).

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## Additional Information

- Safety Data Sheet (<http://www.dow.com/webapps/msds/msdssearch.aspx>)
- Contact Us (<http://www.dow.com/gco/contact/>)
- *Technical Information: NEU-TRI\* Solvent, HI-TRI\* Solvent: Stabilized Trichloroethylene*, The Dow Chemical Company, Form No. 100- 07080-1102 (<http://www.dow.com/gco/finder/index.htm>).
- *Toxicological Profile for Trichloroethylene*, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, September 1997 (<http://www.atsdr.cdc.gov/toxprofiles/tp19.pdf>).
- *Trichloroethylene ToxFAQs*, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, July 2003 (<http://www.atsdr.cdc.gov/tfacts19.pdf>)
- *Trichloroethylene White Paper*, Halogenated Solvents Industry Alliance, Inc. (HSIA), February 2001 ([http://www.hsia.org/white\\_papers/tri%20wp.htm](http://www.hsia.org/white_papers/tri%20wp.htm)).
- "Trichloroethylene," *EuroChlor Risk Assessment for the Marine Environment OSPARCOM Region – North Sea*, Eurochlor, June 1997

For more business information about trichloroethylene, visit Dow's [Chlorinated Organics](http://www.dow.com/gco) web site. ([www.dow.com/gco](http://www.dow.com/gco))

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## References

- <sup>1</sup> *Toxicological Profile for Trichloroethylene*, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, September 1997
- <sup>2</sup> *HI-TRI™ Solvent Material Safety Data Sheet*, The Dow Chemical Company
- <sup>3</sup> *Trichloroethylene ToxFAQs*, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, July 2003
- <sup>4</sup> Glauser, J. and Funada, C., *CEH Marketing Research Report: C2 Chlorinated Solvents*, SRI Consulting, Report 632.3000A; 2012
- <sup>5</sup> "Trichloroethylene," *EuroChlor Risk Assessment for the Marine Environment OSPARCOM Region – North Sea*, Eurochlor, June 1997
- <sup>6</sup> Dow Chlorinated Organics: Product website: (<http://www.dow.com/gco/prod>)
- <sup>7</sup> Linak, E., *Global Solvent Report: The Green Impact*, SRI Consulting, 2005
- <sup>8</sup> *Trichloroethylene White Paper*, Halogenated Solvents Industry Alliance, Inc. (HSIA), February 2001 (<http://hsia.org/news.asp>)
- <sup>9</sup> "2005 World Chlor-Alkali Analysis," Electronic resource from Chemical Market Associates, Inc., 2004. (<http://www.cmaiglobal.com/>)

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NOTICES:

As part of its 2015 Sustainability Goals, Dow has committed to make publicly available safety assessments for its products globally. This product safety assessment is intended to give general information about the chemical (or categories of chemicals) addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the relevant Safety Data Sheet, which should be consulted before use of the chemical. This product safety assessment does not replace required communication documents such as the Safety Data Sheet.

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**Form No. 233-00399-MM-0714X**





## SAFETY DATA SHEET

Version 3.9  
Revision Date 05/24/2016  
Print Date 07/04/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Tetrachloroethylene

Product Number : 02666  
Brand : Sigma-Aldrich  
Index-No. : 602-028-00-4

CAS-No. : 127-18-4

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Skin sensitisation (Category 1), H317  
Carcinogenicity (Category 2), H351  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Acute aquatic toxicity (Category 2), H401  
Chronic aquatic toxicity (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)

H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H411	Toxic to aquatic life with long lasting effects.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms	: Perchloroethylene PCE
Formula	: C <sub>2</sub> Cl <sub>4</sub>
Molecular weight	: 165.83 g/mol
CAS-No.	: 127-18-4
EC-No.	: 204-825-9
Index-No.	: 602-028-00-4

#### Hazardous components

Component	Classification	Concentration
<b>Tetrachloroethylene</b>		
	Skin Irrit. 2; Eye Irrit. 2A; Skin Sens. 1; Carc. 2; STOT SE 3; Aquatic Acute 2; Aquatic Chronic 2; H315, H317, H319, H336, H351, H411	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

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**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

No data available

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

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**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

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**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters**

**Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
Tetrachloroethylene	127-18-4	TWA	25.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		STEL	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		Potential Occupational Carcinogen Minimize workplace exposure concentrations. See Appendix A		
		See Table Z-2		
		TWA	100.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		CEIL	200.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Peak	300.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	25 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		STEL	100 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		Potential Occupational Carcinogen Minimize workplace exposure concentrations. See Appendix A		
		See Table Z-2		

		TWA	100 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		CEIL	200 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Peak	300 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	25 ppm 170 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		STEL	100 ppm 685 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		C	300 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		PEL	25 ppm 170 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Tetrachloroethylene	127-18-4	Tetrachloroethylene	3ppm	In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to shift (16 hours after exposure ceases)			
		Tetrachloroethylene	0.5000 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		Prior to shift (16 hours after exposure ceases)			
		Tetrachloroethylene	3ppm	In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)
		Prior to shift (16 hours after exposure ceases)			
		Tetrachloroethylene	0.5 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		Prior to shift (16 hours after exposure ceases)			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm  
Break through time: 49 min  
Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

- |   |  |
|---|--|
| a) Appearance                                   | Form: liquid, clear<br>Colour: colourless  |
| b) Odour  | No data available  |
| c) Odour Threshold                              | No data available  |
| d) pH   | No data available  |
| e) Melting point/freezing point                 | Melting point/range: -22 °C (-8 °F)  |
| f) Initial boiling point and boiling range      | 121 °C (250 °F)  |
| g) Flash point                                  | No data available  |
| h) Evaporation rate                             | No data available  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | No data available  |
| k) Vapour pressure                              | 25.3 hPa (19.0 mmHg) at 25.0 °C (77.0 °F)<br>17.3 hPa (13.0 mmHg) at 20.0 °C (68.0 °F) |
| l) Vapour density                               | No data available  |
| m) Relative density                             | 1.623 g/mL at 25 °C (77 °F)  |
| n) Water solubility                             | 0.15 g/l at 25 °C (77 °F)  |
| o) Partition coefficient: n-octanol/water       | log Pow: 2.53 at 23 °C (73 °F)   |
| p) Auto-ignition temperature                    | No data available  |
| q) Decomposition temperature                    | No data available  |
| r) Viscosity                                    | No data available  |

- s) Explosive properties      No data available  
t) Oxidizing properties      No data available

## 9.2 Other safety information

Surface tension      32.1 mN/m at 20 °C (68 °F)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents, Strong bases

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas  
Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - female - 3,005 mg/kg  
(OECD Test Guideline 401)

LC50 Inhalation - Rat - male and female - 6 h - 28 mg/l

LD50 Dermal - Rabbit - 5,000 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Skin irritation - 4 h  
(OECD Test Guideline 404)

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Mild eye irritation - 24 h

#### Respiratory or skin sensitisation

- Mouse

Result: May cause sensitisation by skin contact.  
(OECD Test Guideline 429)

#### Germ cell mutagenicity

Hamster

ovary

Result: negative

OECD Test Guideline 474

Mouse - male

Result: negative

#### Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2A - Group 2A: Probably carcinogenic to humans (Tetrachloroethylene)  
NTP: Reasonably anticipated to be a human carcinogen (Tetrachloroethylene)  
OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

May cause drowsiness or dizziness.

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

Repeated dose toxicity      Mouse - female - Oral - LOAEL : 390 mg/kg

RTECS: Not available

narcosis, Liver injury may occur., Kidney injury may occur.

---

**12. ECOLOGICAL INFORMATION**

**12.1 Toxicity**

Toxicity to fish                      LC50 - Oncorhynchus mykiss (rainbow trout) - 5 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates      EC50 - Daphnia magna (Water flea) - 7.50 mg/l - 48 h

Toxicity to algae                      static test EC50 - Skeletonema costatum - > 16 mg/l - 7 h

**12.2 Persistence and degradability**

Biodegradability                      aerobic - Exposure time 28 d  
Result: 11 % - Not readily biodegradable.  
(OECD Test Guideline 301C)

**12.3 Bioaccumulative potential**

Bioaccumulation                      Lepomis macrochirus (Bluegill) - 21 d  
- 0.00343 mg/l

Bioconcentration factor (BCF): 49

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Toxic to aquatic life with long lasting effects.



---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1897      Class: 6.1      Packing group: III  
Proper shipping name: Tetrachloroethylene  
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1897      Class: 6.1      Packing group: III      EMS-No: F-A, S-A  
Proper shipping name: TETRACHLOROETHYLENE  
Marine pollutant: yes

### IATA

UN number: 1897      Class: 6.1      Packing group: III  
Proper shipping name: Tetrachloroethylene

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Tetrachloroethylene	127-18-4	2007-07-01

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Tetrachloroethylene	127-18-4	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Tetrachloroethylene	127-18-4	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Tetrachloroethylene	127-18-4	2007-07-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

	CAS-No.	Revision Date
Tetrachloroethylene	127-18-4	2007-09-28

---

## 16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H401	Toxic to aquatic life.
H411	Toxic to aquatic life with long lasting effects.

#### HMIS Rating

Health hazard:	3
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

#### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

#### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

#### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.9

Revision Date: 05/24/2016

Print Date: 07/04/2016

## SAFETY DATA SHEET

Version 4.14  
Revision Date 06/02/2016  
Print Date 07/04/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Tetrahydrofuran

Product Number : 78445  
Brand : Sigma-Aldrich  
Index-No. : 603-025-00-0

CAS-No. : 109-99-9

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Acute toxicity, Oral (Category 4), H302  
Eye irritation (Category 2A), H319  
Carcinogenicity (Category 2), H351  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H225 Highly flammable liquid and vapour.  
H302 Harmful if swallowed.  
H319 Causes serious eye irritation.  
H335 May cause respiratory irritation.  
H351 Suspected of causing cancer.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and

	understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

May form explosive peroxides.  
May form explosive peroxides.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>4</sub> H <sub>8</sub> O
Molecular weight	: 72.11 g/mol
CAS-No.	: 109-99-9
EC-No.	: 203-726-8
Index-No.	: 603-025-00-0
Registration number	: 01-2119444314-46-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>Tetrahydrofuran</b>		
	Flam. Liq. 2; Acute Tox. 4; Eye Irrit. 2A; Carc. 2; STOT SE 3; H225, H302, H319, H335, H351	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

No data available

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

Use water spray to cool unopened containers.

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

**6.3 Methods and materials for containment and cleaning up**

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Dry residue is explosive. Store under inert gas. Test for peroxide formation periodically and before distillation.

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Tetrahydrofuran	109-99-9	TWA	50.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Upper Respiratory Tract irritation Kidney damage Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		
		STEL	100.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Kidney damage Confirmed animal carcinogen with unknown relevance to humans Danger of cutaneous absorption		
		TWA	200.000000 ppm 590.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	250.000000 ppm 735.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	200.000000 ppm 590.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		PEL	200 ppm 590 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	250 ppm 735 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Tetrahydrofuran	109-99-9	Tetrahydrofuran	2.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

#### Derived No Effect Level (DNEL)

Application Area	Exposure routes	Health effect	Value
Workers	Skin contact	Long-term systemic effects	25mg/kg BW/d
Consumers	Skin contact	Long-term systemic effects	15mg/kg BW/d
Workers	Inhalation	Long-term local effects	150 mg/m3
Workers	Inhalation	Long-term systemic effects	150 mg/m3
Consumers	Inhalation	Long-term systemic effects	62 mg/m3
Consumers	Inhalation	Acute local effects	150 mg/m3
Consumers	Inhalation	Acute systemic effects	150 mg/m3

## Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	2.13 mg/kg
Marine water	0.432 mg/l
Fresh water	4.32 mg/l
Marine sediment	2.33 mg/kg
Fresh water sediment	23.3 mg/kg
Onsite sewage treatment plant	4.6 mg/l

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.5 mm

Break through time: 12 min

Material tested: Camatril® (KCL 733 / Aldrich Z677590, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                           |  |
|---------------------------|--|
| a) Appearance             | Form: liquid, clear<br>Colour: colourless                            |
| b) Odour                  | ether-like   |
| c) Odour Threshold        | No data available  |
| d) pH                     | ca.7   |
| e) Melting point/freezing | Melting point/range: -108.44 °C (-163.19 °F) at 1,013.25 hPa (760.00 |

	point	mmHg)
f)	Initial boiling point and boiling range	65.0 - 67.0 °C (149.0 - 152.6 °F) at 1,013.25 hPa (760.00 mmHg)
g)	Flash point	-17.0 °C (1.4 °F) - closed cup
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 11.8 %(V) Lower explosion limit: 1.8 %(V)
k)	Vapour pressure	170 hPa (128 mmHg) at 20.0 °C (68.0 °F)
l)	Vapour density	ca.2.5 at 25 °C (77 °F) - (Air = 1.0)
m)	Relative density	0.89 g/cm3
n)	Water solubility	soluble
o)	Partition coefficient: n-octanol/water	log Pow: 0.46
p)	Auto-ignition temperature	215 °C (419 °F) at 1,013 hPa (760 mmHg)
q)	Decomposition temperature	No data available
r)	Viscosity	0.518 mm2/s at 25 °C (77 °F) - 0.403 mm2/s at 50 °C (122 °F) -
s)	Explosive properties	Not explosive, In use may form flammable/explosive vapour-air mixture.
t)	Oxidizing properties	The substance or mixture is not classified as oxidizing.

## 9.2 Other safety information

Relative vapour density ca.2.5 at 25 °C (77 °F) - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.  
Contains the following stabiliser(s):  
BHT (0.025 %)

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

### 10.5 Incompatible materials

Strong oxidizing agents, Acids

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides  
Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 1,650 mg/kg



LC50 Inhalation - Rat - 6 h - 14.7 mg/l

Remarks: Material may be irritating to mucous membranes and upper respiratory tract.

LD50 Dermal - Rat - > 2,000 mg/kg

No data available

#### **Skin corrosion/irritation**

Based on available data, the classification criteria are not met.

#### **Serious eye damage/eye irritation**

Eyes - Rabbit

Result: Risk of serious damage to eyes.

(Draize Test)

#### **Respiratory or skin sensitisation**

Based on available data, the classification criteria are not met.

#### **Germ cell mutagenicity**

In vivo tests did not show mutagenic effects

Ames test

S. typhimurium

Result: negative

#### **Carcinogenicity**

Suspected human carcinogens

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### **Reproductive toxicity**

No data available

No toxicity to reproduction

#### **Specific target organ toxicity - single exposure**

May cause drowsiness or dizziness. - Nervous system

May cause respiratory irritation.

#### **Specific target organ toxicity - repeated exposure**

The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

#### **Aspiration hazard**

No aspiration toxicity classification

#### **Additional Information**

RTECS: LU5950000

Central nervous system depression, Cough, chest pain, Difficulty in breathing, Exposure to high airborne concentrations can cause anesthetic effects.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 2,160 mg/l - 96 h

Toxicity to daphnia and other aquatic EC50 - Daphnia magna (Water flea) - 382 mg/l - 24 h

invertebrates

Toxicity to algae

Growth inhibition IC50 - Algae - 3,700 mg/l - 192 h

## 12.2 Persistence and degradability

Biodegradability

(OECD Test Guideline 301)

Remarks: According to the results of tests of biodegradability this product is not readily biodegradable.

## 12.3 Bioaccumulative potential

No bioaccumulation is to be expected (log Pow <= 4).

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 2056 Class: 3

Packing group: II

Proper shipping name: Tetrahydrofuran

Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 2056 Class: 3

Packing group: II

EMS-No: F-E, S-D

Proper shipping name: TETRAHYDROFURAN

### IATA

UN number: 2056 Class: 3

Packing group: II

Proper shipping name: Tetrahydrofuran

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

Tetrahydrofuran

CAS-No.  
109-99-9

Revision Date  
1993-04-24

## Pennsylvania Right To Know Components

Tetrahydrofuran

CAS-No.  
109-99-9

Revision Date  
1993-04-24

## New Jersey Right To Know Components

Tetrahydrofuran

CAS-No.  
109-99-9

Revision Date  
1993-04-24

## California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H302	Harmful if swallowed.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H351	Suspected of causing cancer.
STOT SE	Specific target organ toxicity - single exposure

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.14

Revision Date: 06/02/2016

Print Date: 07/04/2016

## SAFETY DATA SHEET

Version 4.6  
Revision Date 05/24/2016  
Print Date 06/21/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Thallium

Product Number : 277932  
Brand : Aldrich  
Index-No. : 081-001-00-3

CAS-No. : 7440-28-0

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 2), H300  
Acute toxicity, Inhalation (Category 2), H330  
Acute aquatic toxicity (Category 3), H402  
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H300 + H330  
H412

Fatal if swallowed or if inhaled  
Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P260  
P264  
P270  
P271  
P273  
P284

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.  
Wash skin thoroughly after handling.  
Do not eat, drink or smoke when using this product.  
Use only outdoors or in a well-ventilated area.  
Avoid release to the environment.  
Wear respiratory protection.

P301 + P310 + P330	IF SWALLOWED: Immediately call a POISON CENTER/doctor. Rinse mouth.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: TI
Molecular weight	: 204.38 g/mol
CAS-No.	: 7440-28-0
EC-No.	: 231-138-1
Index-No.	: 081-001-00-3

#### Hazardous components

Component	Classification	Concentration
<b>Thallium</b>		
	Acute Tox. 2; Aquatic Acute 3; Aquatic Chronic 3; H300 + H330, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.  
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Thallium	7440-28-0	TWA	0.100000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Alopecia Adopted values or notations enclosed are those for which changes are proposed in the NIC 2010 Revision or addition to the notice of intended changes See Notice of Intended Changes (NIC) Danger of cutaneous absorption		
		TWA	0.020000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Peripheral neuropathy Gastrointestinal damage 2015 Adoption Danger of cutaneous absorption		
		TWA	0.020000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Peripheral neuropathy Gastrointestinal damage Danger of cutaneous absorption varies		

		TWA	0.1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Skin designation		
		TWA	0.02 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Peripheral neuropathy Gastrointestinal damage Danger of cutaneous absorption varies		
		TWA	0.1 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		
		PEL	0.1 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: granular Colour: light grey
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 303 °C (577 °F) - lit.
f) Initial boiling point and boiling range	1,457 °C (2,655 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Air sensitive.

### 10.5 Incompatible materials

Strong acids, Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - thallium oxides



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## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### **Acute toxicity**

No data available

Dermal: No data available

No data available

#### **Skin corrosion/irritation**

No data available

#### **Serious eye damage/eye irritation**

No data available

#### **Respiratory or skin sensitisation**

No data available

#### **Germ cell mutagenicity**

No data available

#### **Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### **Reproductive toxicity**

Possible risk of congenital malformation in the fetus.

No data available

#### **Specific target organ toxicity - single exposure**

No data available

#### **Specific target organ toxicity - repeated exposure**

No data available

#### **Aspiration hazard**

No data available

#### **Additional Information**

RTECS: XG3425000

The most characteristic symptom of thallium exposure is alopecia (loss of hair). Cutaneous effects may include dry, scaly skin and impairment of nail growth often resulting in the appearance of crescent-shaped strips across fingernails and toenails (Mees' line). Other symptoms in acute poisoning relate chiefly to the gastrointestinal tract, nervous system, skin, eyes, and cardiovascular system. Acute poisoning results in swelling of the feet and legs, arthralgia, vomiting, insomnia, hyperesthesia and paresthesia of the hands and feet, mental confusion, polyneuritis with severe pain in the legs and loins, partial paralysis of the legs, angina-like pains, nephritis, wasting and weakness, and lymphocytosis and eosinophilia. In chronic poisoning, central and peripheral nervous system abnormalities may persist including ataxia, tremor, incoordination, paralysis of extremities, endocrine disorders, memory loss, and psychoses

may develop., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish                      LC50 - Cyprinodon variegatus (sheepshead minnow) - 21.0 mg/l - 96.0 h  
mortality NOEC - Cyprinodon variegatus (sheepshead minnow) - 14.0 mg/l - 96.0 h

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3288              Class: 6.1                      Packing group: II  
Proper shipping name: Toxic solid, inorganic, n.o.s. (Thallium)  
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3288              Class: 6.1                      Packing group: II                      EMS-No: F-A, S-A  
Proper shipping name: TOXIC SOLID, INORGANIC, N.O.S. (Thallium)

### IATA

UN number: 3288              Class: 6.1                      Packing group: II  
Proper shipping name: Toxic solid, inorganic, n.o.s. (Thallium)

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:  
CAS-No.                      Revision Date

Thallium 7440-28-0 2007-07-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Thallium	7440-28-0	2007-07-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Thallium	7440-28-0	2007-07-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Thallium	7440-28-0	2007-07-01

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H300	Fatal if swallowed.
H300 + H330	Fatal if swallowed or if inhaled

**HMIS Rating**

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	4
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.6

Revision Date: 05/24/2016

Print Date: 06/21/2016

## SAFETY DATA SHEET

Version 5.6  
Revision Date 05/24/2016  
Print Date 06/21/2016

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1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Toluene

Product Number : 89680  
Brand : Sigma-Aldrich  
Index-No. : 601-021-00-3

CAS-No. : 108-88-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

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2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225  
Skin irritation (Category 2), H315  
Reproductive toxicity (Category 2), H361  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Aspiration hazard (Category 1), H304  
Acute aquatic toxicity (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H225 Highly flammable liquid and vapour.  
H304 May be fatal if swallowed and enters airways.  
H315 Causes skin irritation.  
H336 May cause drowsiness or dizziness.  
H361 Suspected of damaging fertility or the unborn child.  
H373 May cause damage to organs through prolonged or repeated exposure.  
H401 Toxic to aquatic life.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: C <sub>7</sub> H <sub>8</sub>
Molecular weight	: 92.14 g/mol
CAS-No.	: 108-88-3
EC-No.	: 203-625-9
Index-No.	: 601-021-00-3
Registration number	: 01-2119471310-51-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>Toluene</b>		
	Flam. Liq. 2; Skin Irrit. 2; Repr. 2; STOT SE 3; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; H225, H304, H315, H336, H361, H373, H401	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

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**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

No data available

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

Use water spray to cool unopened containers.

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Flammable liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Toluene	108-88-3	TWA	100 ppm 375 mg/m <sup>3</sup>	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		STEL	150 ppm 560 mg/m <sup>3</sup>	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	200 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
	Remarks	Z37.12-1967		
		CEIL	300 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.12-1967		
		Peak	500 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.12-1967		
		TWA	20 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Visual impairment Female reproductive Pregnancy loss 2015 Adoption Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100 ppm 375 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits
		ST	150 ppm 560 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Toluene	108-88-3	Toluene	0.0200 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to last shift of workweek			
		Toluene	0.0300 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			
		o-Cresol	0.3000 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

#### Splash contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |                                       |
|--|---------------------------------------|
| a) Appearance                              | Form: liquid<br>Colour: colourless    |
| b) Odour                                   | aromatic                              |
| c) Odour Threshold                         | No data available                     |
| d) pH                                      | No data available                     |
| e) Melting point/freezing point            | Melting point/range: -93 °C (-135 °F) |
| f) Initial boiling point and boiling range | 110 - 111 °C (230 - 232 °F)           |
| g) Flash point                             | 4.0 °C (39.2 °F) - closed cup         |
| h) Evaporation rate                        | No data available                     |
| i) Flammability (solid, gas)               | No data available                     |



j)	Upper/lower flammability or explosive limits	Upper explosion limit: 7 %(V) Lower explosion limit: 1.2 %(V)
k)	Vapour pressure	29.1 hPa (21.8 mmHg) at 20.0 °C (68.0 °F)
l)	Vapour density	No data available
m)	Relative density	0.865 g/mL at 25 °C (77 °F)
n)	Water solubility	0.5 g/l at 15 °C (59 °F)
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	535.0 °C (995.0 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - > 5,580 mg/kg

LC50 Inhalation - Rat - 4 h - 12,500 - 28,800 mg/m<sup>3</sup>

LD50 Dermal - Rabbit - 12,196 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Skin irritation - 24 h

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation

(OECD Test Guideline 405)

### **Respiratory or skin sensitisation**

No data available

### **Germ cell mutagenicity**

Rat

Liver

DNA damage

### **Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

### **Reproductive toxicity**

Damage to fetus possible

Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation

Paternal Effects: Spermatogenesis (including genetic material, sperm morphology, motility, and count).

Experiments have shown reproductive toxicity effects in male and female laboratory animals.

Developmental Toxicity - Rat - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus).

### **Specific target organ toxicity - single exposure**

No data available

### **Specific target organ toxicity - repeated exposure**

No data available

### **Aspiration hazard**

No data available

### **Additional Information**

RTECS: XS5250000

Lung irritation, chest pain, pulmonary edema, Inhalation studies on toluene have demonstrated the development of inflammatory and ulcerous lesions of the penis, prepuce, and scrotum in animals., Central nervous system

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 7.63 mg/l - 96 h
	NOEC - Pimephales promelas (fathead minnow) - 5.44 mg/l - 7 d
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 8.00 mg/l - 24 h
	Immobilization EC50 - Daphnia magna (Water flea) - 6 mg/l - 48 h
Toxicity to algae	EC50 - Chlorella vulgaris (Fresh water algae) - 245.00 mg/l - 24 h
	EC50 - Pseudokirchneriella subcapitata (green algae) - 10.00 mg/l - 24 h

### **12.2 Persistence and degradability**

Biodegradability Result: - Readily biodegradable

### **12.3 Bioaccumulative potential**

Bioconcentration factor (BCF): 90

No data available

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Toxic to aquatic life.

### 13.1 Waste treatment methods

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Dispose of as unused product.

UN number: 1294      Class: 3  
Proper shipping name: Toluene  
Reportable Quantity (RQ): 100 lbs

Packing group: II

Poison Inhalation Hazard: No

UN number: 1294      Class: 3  
Proper shipping name: TOLUENE

Packing group: II

EMS-No: F-E, S-D

UN number: 1294      Class: 3  
Proper shipping name: Toluene

Packing group: II

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

The following components are subject to reporting levels established by SARA Title III, Section 313:

Toluene	CAS-No. 108-88-3	Revision Date 2007-07-01
---------	---------------------	-----------------------------

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Toluene	CAS-No. 108-88-3	Revision Date 2007-07-01
---------	---------------------	-----------------------------

Toluene	CAS-No. 108-88-3	Revision Date 2007-07-01
---------	---------------------	-----------------------------

## CAS-No. Revision Date

Toluene

108-88-3

2007-07-01

**California Prop. 65 Components**

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

Toluene

CAS-No.  
108-88-3

Revision Date  
2009-02-01

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
Asp. Tox.	Aspiration hazard
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H336	May cause drowsiness or dizziness.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
H401	Toxic to aquatic life.
Repr.	Reproductive toxicity
Skin Irrit.	Skin irritation

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.6

Revision Date: 05/24/2016

Print Date: 06/21/2016



## 1. PRODUCT AND COMPANY IDENTIFICATION

### 1.1 Product identifiers

Product name : trans-Chlordane

Product Number : ERC-004

Brand : Cerilliant

CAS-No. : 5103-74-2

### 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

### 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

### 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

## 2. HAZARDS IDENTIFICATION

### 2.1 Classification of the substance or mixture

#### GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 4), H302  
Carcinogenicity (Category 2), H351  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)

H302

Harmful if swallowed.

H351

Suspected of causing cancer.

H410

Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P264

Wash skin thoroughly after handling.

P270

Do not eat, drink or smoke when using this product.

P273

Avoid release to the environment.

P281

Use personal protective equipment as required.

P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P330	Rinse mouth.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Molecular weight	: 409.78 g/mol
CAS-No.	: 5103-74-2
EC-No.	: 225-826-0

#### Hazardous components

Component	Classification	Concentration
<b>trans-Chlordane</b>		
	Acute Tox. 4; Carc. 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H410	90 - 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.  
For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

##### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

##### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: crystalline Colour: white
b) Odour	odourless
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	1.590 g/cm <sup>3</sup>
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available



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## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Mouse - 275 mg/kg

LD50 Oral - Rat - 1,100 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (trans-Chlordane)

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish

LC50 - *Lepomis macrochirus* - 0.05 mg/l - 96 h

## 12.2 Persistence and degradability

No data available

## 12.3 Bioaccumulative potential

No data available

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Very toxic to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (trans-Chlordane)  
Reportable Quantity (RQ):  
Marine pollutant: No  
Poison Inhalation Hazard: No

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (trans-Chlordane)  
Marine pollutant: Marine pollutant

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (trans-Chlordane)

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
trans-Chlordane	5103-74-2	

### New Jersey Right To Know Components

CAS-No.	Revision Date
---------	---------------

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.5

Revision Date: 08/14/2014

Print Date: 07/04/2016

## SAFETY DATA SHEET

Version 4.8  
Revision Date 05/24/2016  
Print Date 07/04/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Trichloroethylene

Product Number : 46267  
Brand : Sigma-Aldrich  
Index-No. : 602-027-00-9

CAS-No. : 79-01-6

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Skin irritation (Category 2), H315  
Eye irritation (Category 2A), H319  
Germ cell mutagenicity (Category 2), H341  
Carcinogenicity (Category 1B), H350  
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336  
Acute aquatic toxicity (Category 3), H402  
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H412	Harmful to aquatic life with long lasting effects.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear eye protection/ face protection.
P280	Wear protective gloves.
P281	Use personal protective equipment as required.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms	: TCE Trichloroethene
Formula	: C <sub>2</sub> HCl <sub>3</sub>
Molecular weight	: 131.39 g/mol
CAS-No.	: 79-01-6
EC-No.	: 201-167-4
Index-No.	: 602-027-00-9

#### Hazardous components

Component	Classification	Concentration
<b>Trichloroethylene</b> Included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH)		
	Skin Irrit. 2; Eye Irrit. 2A; Muta. 2; Carc. 1B; STOT SE 3; Aquatic Acute 3; Aquatic Chronic 3; H315, H319, H336, H341, H350, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

No data available

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Light sensitive. Handle and store under inert gas.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters****Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
Trichloroethylene	79-01-6	TWA	10.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment cognitive decrement Renal toxicity Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen		
		STEL	25.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment cognitive decrement Renal toxicity Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen		
		Potential Occupational Carcinogen See Appendix C See Appendix A		
		See Table Z-2		
		TWA	100.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.19-1967		
		CEIL	200.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.19-1967		
		Peak	300.000000 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.19-1967		
		TWA	100 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.19-1967		
		CEIL	200 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.19-1967		
		Peak	300 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.19-1967		
		STEL	100 ppm 537 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		C	300 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		PEL	25 ppm 135 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

#### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Trichloroethylene	79-01-6	Trichloroacetic acid	15.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)

	Remarks	End of shift at end of workweek			
		Trichloroethanol	0.5000 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Trichloroethylene		In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Trichloroethylene		In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.



---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: liquid, clear Colour: colourless
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -84.8 °C (-120.6 °F) - lit.
f) Initial boiling point and boiling range	86.7 °C (188.1 °F) - lit.
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Upper explosion limit: 10.5 %(V) Lower explosion limit: 8 %(V)
k) Vapour pressure	81.3 hPa (61.0 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density	No data available
m) Relative density	1.463 g/cm <sup>3</sup> at 25 °C (77 °F)
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	log Pow: 2.29log Pow: 5
p) Auto-ignition temperature	410.0 °C (770.0 °F)
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Oxidizing agents, Strong bases, Magnesium

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 4,920 mg/kg

LC50 Inhalation - Mouse - 4 h - 8450 ppm

LD50 Dermal - Rabbit - > 20,000 mg/kg

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Severe skin irritation - 24 h

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Eye irritation - 24 h

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Laboratory experiments have shown mutagenic effects.

In vitro tests showed mutagenic effects

#### Carcinogenicity

This product is or contains a component that has been reported to be probably carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Possible human carcinogen

IARC: 1 - Group 1: Carcinogenic to humans (Trichloroethylene)

NTP: Reasonably anticipated to be a human carcinogen (Trichloroethylene)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: KX4550000

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Exposure to and/or consumption of alcohol may increase toxic effects., Gastrointestinal disturbance, Kidney injury may occur., narcosis  
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish

LC50 - Pimephales promelas (fathead minnow) - 41 mg/l - 96.0 h

LOEC - other fish - 11 mg/l - 10.0 d

NOEC - Oryzias latipes - 40 mg/l - 10.0 d

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 18.00 mg/l - 48 h

Toxicity to algae IC50 - Pseudokirchneriella subcapitata (green algae) - 175.00 mg/l - 96 h

## 12.2 Persistence and degradability

No data available

## 12.3 Bioaccumulative potential

Does not bioaccumulate.

## 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life with long lasting effects.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1710      Class: 6.1      Packing group: III  
Proper shipping name: Trichloroethylene  
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1710      Class: 6.1      Packing group: III      EMS-No: F-A, S-A  
Proper shipping name: TRICHLOROETHYLENE

### IATA

UN number: 1710      Class: 6.1      Packing group: III  
Proper shipping name: Trichloroethylene

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Trichloroethylene	79-01-6	2007-07-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

Trichloroethylene

CAS-No.  
79-01-6Revision Date  
2007-07-01**Pennsylvania Right To Know Components**

Trichloroethylene

CAS-No.  
79-01-6Revision Date  
2007-07-01**New Jersey Right To Know Components**

Trichloroethylene

CAS-No.  
79-01-6Revision Date  
2007-07-01**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

Trichloroethylene

CAS-No.  
79-01-6Revision Date  
2011-09-01

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

Trichloroethylene

CAS-No.  
79-01-6Revision Date  
2011-09-01

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H402	Harmful to aquatic life.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.8

Revision Date: 05/24/2016

Print Date: 07/04/2016

## SAFETY DATA SHEET

Version 4.17  
Revision Date 03/03/2015  
Print Date 05/01/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Trichlorofluoromethane

Product Number : 254991

Brand : Aldrich

CAS-No. : 75-69-4

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Dermal (Category 4), H312

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Warning

Hazard statement(s)

H312 : Harmful in contact with skin.

Precautionary statement(s)

P280 : Wear protective gloves/ protective clothing.  
P302 + P352 + P312 : IF ON SKIN: Wash with plenty of soap and water. Call a POISON CENTER or doctor/ physician if you feel unwell.  
P363 : Wash contaminated clothing before reuse.  
P501 : Dispose of contents/ container to an approved waste disposal plant.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

---

**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Synonyms : Fluorotrichloromethane  
CFC-11

Formula : CCl<sub>3</sub>F CCl<sub>3</sub>F  
Molecular weight : 137.37 g/mol  
CAS-No. : 75-69-4  
EC-No. : 200-892-3

#### Hazardous components

Component	Classification	Concentration
<b>Trichlorofluoromethane</b>		
	Acute Tox. 4; H312	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas, Hydrogen fluoride

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.  
For personal protection see section 8.

### 6.2 Environmental precautions

Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.  
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Recommended storage temperature 2 - 8 °C

Contents under pressure.

Storage class (TRGS 510): Non Combustible Liquids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Trichlorofluoromethane	75-69-4	C	1,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Cardiac sensitization Not classifiable as a human carcinogen		
		C	1,000.000000 ppm 5,600.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1,000.000000 ppm 5,600.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

##### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min



Material tested: Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |   |
|---|---|
| a) Appearance                                   | Form: liquid, clear<br>Colour: colourless   |
| b) Odour  | No data available   |
| c) Odour Threshold                              | No data available   |
| d) pH   | No data available   |
| e) Melting point/freezing point                 | -110.99 - -109.99 °C (-167.78 - -165.98 °F)   |
| f) Initial boiling point and boiling range      | 23.7 °C (74.7 °F) - lit.  |
| g) Flash point                                  | No data available   |
| h) Evaporation rate                             | No data available   |
| i) Flammability (solid, gas)                    | No data available   |
| j) Upper/lower flammability or explosive limits | No data available   |
| k) Vapour pressure                              | 885.7 hPa (664.3 mmHg) at 20.0 °C (68.0 °F)<br>2,701.2 hPa (2,026.1 mmHg) at 55.0 °C (131.0 °F) |
| l) Vapour density                               | No data available   |
| m) Relative density                             | 1.494 g/cm <sup>3</sup> at 25 °C (77 °F)  |
| n) Water solubility                             | 1 g/l   |
| o) Partition coefficient: n-octanol/water       | log Pow: 2.53   |
| p) Auto-ignition temperature                    | No data available   |
| q) Decomposition temperature                    | No data available   |
| r) Viscosity                                    | No data available   |
| s) Explosive properties                         | No data available   |

t) Oxidizing properties      No data available

## 9.2 Other safety information

Surface tension      18.0 mN/m at 25.0 °C (77.0 °F)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents, Sodium/sodium oxides, Potassium, Magnesium, Aluminum, Zinc

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - > 15,000 mg/kg

LC50 Inhalation - Rat - 0.3 h - 130000 ppm

Remarks: Behavioral:Tremor. Behavioral:Convulsions or effect on seizure threshold. Respiratory disorder

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC:      No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP:      No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA:      No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: PB6125000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated., Nausea, Dizziness, Headache, Vomiting, Diarrhoea, Abdominal pain, Weakness, Unconsciousness

Liver -

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 3082

Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substance, liquid, n.o.s. (Trichlorofluoromethane)

Reportable Quantity (RQ): 5000 lbs

Poison Inhalation Hazard: No

**IMDG**

Not dangerous goods

**IATA**

Not dangerous goods

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Trichlorofluoromethane	75-69-4	2007-07-01

**SARA 311/312 Hazards**

Acute Health Hazard

**Massachusetts Right To Know Components**

Trichlorofluoromethane	CAS-No. 75-69-4	Revision Date 2007-07-01
------------------------	--------------------	-----------------------------

#### **Pennsylvania Right To Know Components**

Trichlorofluoromethane	CAS-No. 75-69-4	Revision Date 2007-07-01
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#### **New Jersey Right To Know Components**

Trichlorofluoromethane	CAS-No. 75-69-4	Revision Date 2007-07-01
------------------------	--------------------	-----------------------------

#### **California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## **16. OTHER INFORMATION**

### **Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
H312	Harmful in contact with skin.

#### **HMIS Rating**

Health hazard:	1
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

#### **NFPA Rating**

Health hazard:	1
Fire Hazard:	0
Reactivity Hazard:	0

#### **Further information**

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#### **Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.17

Revision Date: 03/03/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.8  
Revision Date 12/04/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Trichloromethanesulfenyl chloride

Product Number : 332895

Brand : Aldrich

CAS-No. : 594-42-3

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 3), H301  
Acute toxicity, Inhalation (Category 1), H330  
Acute toxicity, Dermal (Category 3), H311  
Skin corrosion (Category 1B), H314  
Serious eye damage (Category 1), H318  
Acute aquatic toxicity (Category 3), H402  
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H301 + H311

H314

H330

H412

Toxic if swallowed or in contact with skin

Causes severe skin burns and eye damage.

Fatal if inhaled.

Harmful to aquatic life with long lasting effects.

Precautionary statement(s)

P260

P264

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

Wash skin thoroughly after handling.

P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P284	Wear respiratory protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/ physician.
P320	Specific treatment is urgent (see supplemental first aid instructions on this label).
P361	Remove/Take off immediately all contaminated clothing.
P363	Wash contaminated clothing before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Lachrymator.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : Perchloromethyl mercaptan

Formula : CCl<sub>4</sub>S  
Molecular weight : 185.89 g/mol  
CAS-No. : 594-42-3  
EC-No. : 209-840-4

#### Hazardous components

Component	Classification	Concentration
<b>Perchloromethyl mercaptan</b>		
	Acute Tox. 3; Acute Tox. 1; Acute Tox. 3; Skin Corr. 1B; Eye Dam. 1; Aquatic Acute 3; Aquatic Chronic 3; H301 + H311, H314, H330, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

**In case of eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

**If swallowed**

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Carbon oxides, Sulphur oxides, Hydrogen chloride gas

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Normal measures for preventive fire protection.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Moisture sensitive.

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters****Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
Perchloromethyl mercaptan	594-42-3	TWA	0.100000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Eye irritation		
		TWA	0.1 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation		
		TWA	0.100000 ppm 0.800000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	0.100000 ppm 0.800000 mg/m3	USA. NIOSH Recommended Exposure Limits

## 8.2 Exposure controls

### Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

### Personal protective equipment

#### Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: > 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

##### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: > 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.



---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: clear, liquid Colour: yellow
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	146 - 148 °C (295 - 298 °F) - lit.
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	139.234 hPa (104.434 mmHg) at 20 °C (68 °F) 208.851 hPa (156.651 mmHg) at 55 °C (131 °F)
l) Vapour density	6.42 - (Air = 1.0)
m) Relative density	1.7 g/cm <sup>3</sup> at 25 °C (77 °F)
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

Relative vapour density 6.42 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents, Strong bases

## 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 82.6 mg/kg

LC50 Inhalation - Rat - 1 h - 11 ppm

LD50 Intraperitoneal - Rat - 25 mg/kg

Remarks: Behavioral:Somnolence (general depressed activity). Lungs, Thorax, or Respiration:Dyspnea. Skin and Appendages: Other: Hair.

#### Skin corrosion/irritation

Skin - Rabbit

#### Serious eye damage/eye irritation

Eyes - Rabbit

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

#### Additional Information

RTECS: PB0370000

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Harmful to aquatic life.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1670      Class: 6.1      Packing group: I

Proper shipping name: Perchloromethyl mercaptan

Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: Hazard zone B

**IMDG**

UN number: 1670      Class: 6.1      Packing group: I

EMS-No: F-A, S-A

Proper shipping name: PERCHLOROMETHYL MERCAPTAN

Marine pollutant: yes

**IATA**

UN number: 1670      Class: 6.1

Proper shipping name: Perchloromethyl mercaptan

IATA Passenger: Not permitted for transport

IATA Cargo: Not permitted for transport

---

**15. REGULATORY INFORMATION****SARA 302 Components**

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Perchloromethyl mercaptan	594-42-3	2007-07-01

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Perchloromethyl mercaptan	594-42-3	2007-07-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Perchloromethyl mercaptan	594-42-3	2007-07-01

**Pennsylvania Right To Know Components**

Perchloromethyl mercaptan

CAS-No.  
594-42-3

Revision Date  
2007-07-01

### New Jersey Right To Know Components

Perchloromethyl mercaptan

CAS-No.  
594-42-3

Revision Date  
2007-07-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Eye Dam.	Serious eye damage
H301	Toxic if swallowed.
H301 + H311	Toxic if swallowed or in contact with skin
H311	Toxic in contact with skin.
H314	Causes severe skin burns and eye damage.

### HMIS Rating

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	4
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.8

Revision Date: 12/04/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 4.6  
Revision Date 04/24/2015  
Print Date 06/20/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Vanadium

Product Number : 262935  
Brand : Aldrich

CAS-No. : 7440-62-2

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

## 2.2 GHS Label elements, including precautionary statements

Not a hazardous substance or mixture.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

---

3. COMPOSITION/INFORMATION ON INGREDIENTS

## 3.1 Substances

Formula : V  
Molecular weight : 50.94 g/mol  
CAS-No. : 7440-62-2  
EC-No. : 231-171-1

## Hazardous components

Component	Classification	Concentration
Vanadium		
		<= 100 %

---

4. FIRST AID MEASURES

## 4.1 Description of first aid measures

## If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration.

**In case of skin contact**

Wash off with soap and plenty of water.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Vanadium/vanadium oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

No data available

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Avoid dust formation. Avoid breathing vapours, mist or gas.  
For personal protection see section 8.

**6.2 Environmental precautions**

No special environmental precautions required.

**6.3 Methods and materials for containment and cleaning up**

Sweep up and shovel. Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.  
Provide appropriate exhaust ventilation at places where dust is formed.  
For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

Handle and store under inert gas. Keep in a dry place.  
Storage class (TRGS 510): Non Combustible Solids

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****8.1 Control parameters**

**Components with workplace control parameters**

Component	CAS-No.	Value	Control parameters	Basis
Vanadium	7440-62-2	TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	3.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

## 8.2 Exposure controls

### Appropriate engineering controls

General industrial hygiene practice.

### Personal protective equipment

#### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

No special environmental precautions required.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                           |   |
|---------------------------|---|
| a) Appearance             | Form: powder<br>Colour: grey                    |
| b) Odour                  | No data available                               |
| c) Odour Threshold        | No data available                               |
| d) pH                     | No data available                               |
| e) Melting point/freezing | Melting point/range: 1,890 °C (3,434 °F) - lit. |

point

- |    |  |  |
|----|--|--|
| f) | Initial boiling point and boiling range      | 3,380 °C (6,116 °F) - lit.             |
| g) | Flash point                                  | No data available                      |
| h) | Evaporation rate                             | No data available                      |
| i) | Flammability (solid, gas)                    | No data available                      |
| j) | Upper/lower flammability or explosive limits | No data available                      |
| k) | Vapour pressure                              | 10.67 hPa (8.00 mmHg) at 20 °C (68 °F) |
| l) | Vapour density                               | No data available                      |
| m) | Relative density                             | 6.11 g/mL at 25 °C (77 °F)             |
| n) | Water solubility                             | No data available                      |
| o) | Partition coefficient: n-octanol/water       | No data available                      |
| p) | Auto-ignition temperature                    | No data available                      |
| q) | Decomposition temperature                    | No data available                      |
| r) | Viscosity                                    | No data available                      |
| s) | Explosive properties                         | No data available                      |
| t) | Oxidizing properties                         | No data available                      |

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong acids, Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available



**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

Carcinogenicity - Rat - Intramuscular

Tumorigenic: Equivocal tumorigenic agent by RTECS criteria. Tumorigenic: Tumors at site of application.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: YW1355000

metallic taste, greenish-black discoloration of the tongue, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

**Product**

Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

**DOT (US)**

Not dangerous goods

**IMDG**

Not dangerous goods

**IATA**

Not dangerous goods

---

## 15. REGULATORY INFORMATION

**SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Vanadium	7440-62-2	2007-03-01

**SARA 311/312 Hazards**

No SARA Hazards

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Vanadium	7440-62-2	2007-03-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Vanadium	7440-62-2	2007-03-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Vanadium	7440-62-2	2007-03-01

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

**HMIS Rating**

Health hazard: 0

Chronic Health Hazard:

Flammability: 0

Physical Hazard 0

**NFPA Rating**

Health hazard: 0

Fire Hazard: 0

Reactivity Hazard: 0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.6

Revision Date: 04/24/2015

Print Date: 06/20/2016

## SAFETY DATA SHEET

Version 3.11  
Revision Date 12/01/2015  
Print Date 05/01/2016

---

1. PRODUCT AND COMPANY IDENTIFICATION

## 1.1 Product identifiers

Product name : Vinyl chloride

Product Number : 387622  
Brand : Aldrich  
Index-No. : 602-023-00-7

CAS-No. : 75-01-4

## 1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

## 1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

## 1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

---

2. HAZARDS IDENTIFICATION

## 2.1 Classification of the substance or mixture

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable gases (Category 1), H220  
Gases under pressure (Liquefied gas), H280  
Carcinogenicity (Category 1A), H350

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Danger

Hazard statement(s)

H220 : Extremely flammable gas.  
H280 : Contains gas under pressure; may explode if heated.  
H350 : May cause cancer.

Precautionary statement(s)

P201 : Obtain special instructions before use.  
P202 : Do not handle until all safety precautions have been read and understood.  
P210 : Keep away from heat/sparks/open flames/hot surfaces. No smoking.  
P281 : Use personal protective equipment as required.  
P308 + P313 : IF exposed or concerned: Get medical advice/ attention.

P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381	Eliminate all ignition sources if safe to do so.
P405	Store locked up.
P410 + P403	Protect from sunlight. Store in a well-ventilated place.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

May form explosive peroxides.

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : Chloroethylene

Formula : C<sub>2</sub>H<sub>3</sub>Cl

Molecular weight : 62.50 g/mol

CAS-No. : 75-01-4

EC-No. : 200-831-0

Index-No. : 602-023-00-7

#### Hazardous components

Component	Classification	Concentration
<b>Vinyl chloride</b>		
	Flam. Gas 1; Press. Gas Liquefied gas; Carc. 1A; SA ; H220, H280, H350,	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

Use water spray to cool unopened containers.

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Clean up promptly by sweeping or vacuum.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Contents under pressure. Light sensitive.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Vinyl chloride	75-01-4	TWA	1 ppm	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	1 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Liver damage Lung cancer Confirmed human carcinogen		
		STEL	5 ppm	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	1 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		STEL	5 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		See 1910.1017		
		Potential Occupational Carcinogen See Appendix A		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Splash contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 120 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |   |
|--|---|
| a) Appearance                              | Form: Liquefied gas   |
| b) Odour                                   | No data available   |
| c) Odour Threshold                         | No data available   |
| d) pH                                      | No data available   |
| e) Melting point/freezing point            | Melting point/range: -153.8 °C (-244.8 °F) - lit.                 |
| f) Initial boiling point and boiling range | -13.4 °C (7.9 °F) - lit.  |
| g) Flash point                             | -61.0 °C (-77.8 °F) - closed cup                                  |
| h) Evaporation rate                        | No data available   |
| i) Flammability (solid, gas)               | No data available   |
| j) Upper/lower flammability or             | Upper explosion limit: 33 %(V)<br>Lower explosion limit: 3.6 %(V) |

explosive limits

- |   |  |
|---|--|
| k) Vapour pressure                        | No data available                        |
| l) Vapour density                         | No data available                        |
| m) Relative density                       | 0.911 g/cm <sup>3</sup> at 25 °C (77 °F) |
| n) Water solubility                       | No data available                        |
| o) Partition coefficient: n-octanol/water | No data available                        |
| p) Auto-ignition temperature              | No data available                        |
| q) Decomposition temperature              | No data available                        |
| r) Viscosity                              | No data available                        |
| s) Explosive properties                   | No data available                        |
| t) Oxidizing properties                   | No data available                        |

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

Contains the following stabiliser(s):

Hydroquinone ( $\geq 0$  -  $\leq 0.0001$  %)

Phenol ( $\geq 0$  -  $\leq 0.01$  %)

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

### 10.5 Incompatible materials

Chemically active metals, Copper

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

LC50 Inhalation - Rat - 0.3 h - 180000 ppm

Remarks: Behavioral:Tremor. Behavioral:Convulsions or effect on seizure threshold. Respiratory disorder

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available



**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

This is or contains a component that has been reported to be carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Human carcinogen.

IARC: 1 - Group 1: Carcinogenic to humans (Vinyl chloride)

NTP: Known to be human carcinogen (Vinyl chloride)

OSHA: OSHA specifically regulated carcinogen (Vinyl chloride)

**Reproductive toxicity**

No data available

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: KU9625000

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Central nervous system -

Stomach - Irregularities - Based on Human Evidence (Phenol)

Liver - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1086      Class: 2.1  
Proper shipping name: Vinyl chloride, stabilized  
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1086      Class: 2.1  
Proper shipping name: VINYL CHLORIDE, STABILIZED

EMS-No: F-D, S-U

### IATA

UN number: 1086      Class: 2.1  
Proper shipping name: Vinyl chloride, stabilized  
IATA Passenger: Not permitted for transport

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Phenol	108-95-2	2007-07-01
Hydroquinone	123-31-9	2007-07-01

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Vinyl chloride	75-01-4	2007-07-01

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Vinyl chloride	75-01-4	2007-07-01
Phenol	108-95-2	2007-07-01
Hydroquinone	123-31-9	2007-07-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Vinyl chloride	75-01-4	2007-07-01
Phenol	108-95-2	2007-07-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Vinyl chloride	75-01-4	2007-07-01

### California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.

Vinyl chloride

CAS-No.	Revision Date
75-01-4	2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

	May displace oxygen and cause rapid suffocation.
Carc.	Carcinogenicity
Flam. Gas	Flammable gases
H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.
H350	May cause cancer.
Press. Gas	Gases under pressure
SA	Simple Asphyxiant

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	4
Physical Hazard	3

### NFPA Rating

Health hazard:	2
Fire Hazard:	4
Reactivity Hazard:	0

### Further information

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 3.11

Revision Date: 12/01/2015

Print Date: 05/01/2016

## SAFETY DATA SHEET

Version 5.8  
Revision Date 10/12/2015  
Print Date 05/01/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Zinc

Product Number : 96454  
Brand : Sigma-Aldrich

CAS-No. : 7440-66-6

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Combustible dust,  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Warning

Hazard statement(s)

H410

May form combustible dust concentrations in air  
Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273

Avoid release to the environment.

P391

Collect spillage.

P501

Dispose of contents/ container to an approved waste disposal plant.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS**

Combustible dust

---

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.2 Mixtures

Formula : Zn  
Molecular weight : 65.39 g/mol

##### Hazardous components

Component		Classification	Concentration
<b>Zinc powder (stabilized)</b>			
CAS-No.	7440-66-6	Aquatic Acute 1; Aquatic Chronic 1; H410	<= 100 %
EC-No.	231-175-3		
Index-No.	030-001-01-9		
<b>Zinc oxide</b>			
CAS-No.	1314-13-2	Aquatic Acute 1; Aquatic Chronic 1; H410	>= 5 - < 10 %
EC-No.	215-222-5		
Index-No.	030-013-00-7		

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Special powder against metal fire Dry sand Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

##### Unsuitable extinguishing media

Water

#### 5.2 Special hazards arising from the substance or mixture

Zinc/zinc oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): Non Combustible Solids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Zinc oxide	1314-13-2	TWA	2.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	metal fume fever		
		STEL	10.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		metal fume fever		

		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	10.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	15.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	15.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

**Respiratory protection**

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES****9.1 Information on basic physical and chemical properties**

a) Appearance	Form: powder Colour: grey
b) Odour	odourless
c) Odour Threshold	No data available
d) pH	Not applicable
e) Melting point/freezing point	Melting point/range: 420 °C (788 °F) - lit.
f) Initial boiling point and boiling range	907 °C (1,665 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	May form combustible dust concentrations in air
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	Not applicable
l) Vapour density	No data available
m) Relative density	7.133 g/mL at 25 °C (77 °F)
n) Water solubility	insoluble
o) Partition coefficient: n-octanol/water	Not applicable
p) Auto-ignition temperature	does not ignite
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	During processing, dust may form explosive mixture in air.
t) Oxidizing properties	No data available

**9.2 Other safety information**

Bulk density	1.8 - 3.2 kg/m <sup>3</sup>
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**10. STABILITY AND REACTIVITY****10.1 Reactivity**

No data available

**10.2 Chemical stability**

Stable under recommended storage conditions.

**10.3 Possibility of hazardous reactions**

Dust may form explosive mixture in air.



#### 10.4 Conditions to avoid

No data available

#### 10.5 Incompatible materials

Strong oxidizing agents, Acids and bases

#### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

No data available (Zinc powder (stabilized))

Inhalation: No data available (Zinc powder (stabilized))

Dermal: No data available (Zinc powder (stabilized))

No data available (Zinc powder (stabilized))

##### Skin corrosion/irritation

No data available (Zinc powder (stabilized))

##### Serious eye damage/eye irritation

No data available (Zinc powder (stabilized))

##### Respiratory or skin sensitisation

Did not cause sensitisation on laboratory animals. (Zinc powder (stabilized))

##### Germ cell mutagenicity

No data available (Zinc powder (stabilized))

##### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

No data available (Zinc powder (stabilized))

No data available (Zinc powder (stabilized))

##### Specific target organ toxicity - single exposure

No data available (Zinc powder (stabilized))

##### Specific target organ toxicity - repeated exposure

No data available

##### Aspiration hazard

No data available (Zinc powder (stabilized))

##### Additional Information

RTECS: ZG8600000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Effects due to ingestion may include:, chills, dry throat, sweet taste, Fever, Cough, Nausea, Vomiting, Weakness, Contact with eyes or skin may cause:, Irritation (Zinc powder (stabilized))

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish	LC50 - Cyprinus carpio (Carp) - 450 µg/l - 96 h (Zinc powder (stabilized))
Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 0.068 mg/l - 48 h (Zinc powder (stabilized))
	mortality NOEC - Daphnia (water flea) - 0.101 - 0.14 mg/l - 7 d (Zinc powder (stabilized))

### 12.2 Persistence and degradability

The methods for determining the biological degradability are not applicable to inorganic substances.

### 12.3 Bioaccumulative potential

Bioaccumulation	Algae - 7 d at 16 °C - 5 µg/l (Zinc powder (stabilized))
	Bioconcentration factor (BCF): 466

### 12.4 Mobility in soil

No data available (Zinc powder (stabilized))

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Very toxic to aquatic life with long lasting effects.

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Zinc powder (stabilized))  
Reportable Quantity (RQ): 1020 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Zinc powder (stabilized))  
Marine pollutant: yes

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Zinc powder (stabilized))

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Zinc oxide	1314-13-2	2007-03-01
Zinc powder (stabilized)	7440-66-6	1993-04-24

### SARA 311/312 Hazards

No SARA Hazards

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

	May form combustible dust concentrations in air
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

### HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.8

Revision Date: 10/12/2015

Print Date: 05/01/2016

## 1 Identification

### Product identifier

**Product name:** Xylenes

**Stock number:** L13317

**CAS Number:**

1330-20-7

**EC number:**

215-535-7

**Index number:**

601-022-00-9

**Relevant identified uses of the substance or mixture and uses advised against.**

**Identified use:** SU24 Scientific research and development

**Details of the supplier of the safety data sheet**

**Manufacturer/Supplier:**

Alfa Aesar

Thermo Fisher Scientific Chemicals, Inc.

30 Bond Street

Ward Hill, MA 01835-8099

Tel: 800-343-0660

Fax: 800-322-4757

Email: tech@alfa.com

www.alfa.com

**Information Department:** Health, Safety and Environmental Department

**Emergency telephone number:**

During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660. After normal business hours, call Carechem 24 at (866) 928-0789.

## 2 Hazard(s) identification

**Classification of the substance or mixture in accordance with 29 CFR 1910 (OSHA HCS)**



GHS02 Flame

Flam. Liq. 3 H226 Flammable liquid and vapour.



GHS07

Acute Tox. 4 H312 Harmful in contact with skin.

Acute Tox. 4 H332 Harmful if inhaled.

Skin Irrit. 2 H315 Causes skin irritation.

**Hazards not otherwise classified** No information known.

**Label elements**

**GHS label elements** The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)

**Hazard pictograms**



GHS02 GHS07

**Signal word** Warning

**Hazard statements**

H226 Flammable liquid and vapour.

H312+H332 Harmful in contact with skin or if inhaled.

H315 Causes skin irritation.

**Precautionary statements**

P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.

P262 Do not get in eyes, on skin, or on clothing.

P302+P352 IF ON SKIN: Wash with plenty of water/...

**WHMIS classification**

B2 - Flammable liquid

D2B - Toxic material causing other toxic effects



**Classification system**

**HMIS ratings (scale 0-4)**

**(Hazardous Materials Identification System)**

HEALTH 2 Health (acute effects) = 2

FIRE 3 Flammability = 3

REACTIVITY 1 Physical Hazard = 1

**Other hazards**

**Results of PBT and vPvB assessment**

PBT: Not applicable.

vPvB: Not applicable.

## 3 Composition/information on ingredients

**Chemical characterization:** Substances

**CAS# Description:**

1330-20-7 Xylenes

**Identification number(s):**

**EC number:** 215-535-7

**Index number:** 601-022-00-9

Product name: **Xylenes**

(Contd. of page 2)

**Exposure controls**

**Personal protective equipment**

**General protective and hygienic measures**

The usual precautionary measures for handling chemicals should be followed.

Keep away from foodstuffs, beverages and feed.

Remove all soiled and contaminated clothing immediately.

Wash hands before breaks and at the end of work.

Avoid contact with the eyes and skin.

Maintain an ergonomically appropriate working environment.

**Breathing equipment:** Use suitable respirator when high concentrations are present.

**Protection of hands:**

Impervious gloves

Check protective gloves prior to each use for their proper condition.

The selection of suitable gloves not only depends on the material, but also on quality. Quality will vary from manufacturer to manufacturer.

**Penetration time of glove material (in minutes)** Not determined

**Eye protection:** Safety glasses

**Body protection:** Protective work clothing.

**9 Physical and chemical properties**

**Information on basic physical and chemical properties**

**General information**

**Appearance:**

**Form:** Liquid

**Color:** Colorless

**Odor:** Aromatic

**Odor threshold:** Not determined.

**pH-value:** Not determined.

**Change in condition**

**Melting point/Melting range:** <-25 °C (<-13 °F)

**Boiling point/Boiling range:** 137-144 °C (279-291 °F)

**Sublimation temperature / start:** Not determined

**Flash point:** 29 °C (84 °F)

**Flammability (solid, gaseous)** Not determined.

**Ignition temperature:** 465 °C (869 °F)

**Decomposition temperature:** Not determined

**Auto igniting:** Not determined.

**Danger of explosion:** Product is not explosive. However, formation of explosive air/vapor mixtures is possible.

**Explosion limits:**

**Lower:** 1 Vol %

**Upper:** 7 Vol %

**Vapor pressure at 20 °C (68 °F):** 10 hPa (8 mm Hg)

**Density at 20 °C (68 °F):** 0.86 g/cm<sup>3</sup> (7.177 lbs/gal)

**Relative density** Not determined.

**Vapor density** Not determined.

**Evaporation rate** Not determined.

**Solubility in / Miscibility with**

**Water at 20 °C (68 °F):** 0.2 g/l

**Partition coefficient (n-octanol/water):** Not determined.

**Viscosity:**

**dynamic at 20 °C (68 °F):** 0.6 mPas

**kinematic:** Not determined.

**Other information** No further relevant information available.

**10 Stability and reactivity**

**Reactivity** No information known.

**Chemical stability** Stable under recommended storage conditions.

**Thermal decomposition / conditions to be avoided:** Decomposition will not occur if used and stored according to specifications.

**Possibility of hazardous reactions** Reacts with strong oxidizing agents

**Conditions to avoid** No further relevant information available.

**Incompatible materials:** Oxidizing agents

**Hazardous decomposition products:** Carbon monoxide and carbon dioxide

**11 Toxicological information**

**Information on toxicological effects**

**Acute toxicity:**

Harmful if inhaled.

Harmful in contact with skin.

Danger through skin absorption.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains acute toxicity data for this substance.

**LD/LC50 values that are relevant for classification:**

Oral LD50 4300 mg/kg (rat)

**Skin irritation or corrosion:** Causes skin irritation.

**Eye irritation or corrosion:** May cause irritation

**Sensitization:** No sensitizing effects known.

**Germ cell mutagenicity:** No effects known.

**Carcinogenicity:**

EPA-I: Data are inadequate for an assessment of human carcinogenic potential.

IARC-3: Not classifiable as to carcinogenicity to humans.

ACGIH A4: Not classifiable as a human carcinogen. Inadequate data on which to classify the agent in terms of its carcinogenicity in humans and/or animals.

**Reproductive toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains reproductive data for this substance.

**Specific target organ system toxicity - repeated exposure:** No effects known.

**Specific target organ system toxicity - single exposure:** No effects known.

**Aspiration hazard:** No effects known.

**Subacute to chronic toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains multiple dose toxicity data for this substance.

**Additional toxicological information:** To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.

USA

(Contd. on page 4)

**Product name: Xylenes**

(Contd. of page 4)

**Prop 65 - Developmental toxicity, female** Substance is not listed.

**Prop 65 - Developmental toxicity, male** Substance is not listed.

**Information about limitation of use:**

For use only by technically qualified individuals.

This product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.

**Other regulations, limitations and prohibitive regulations**

**Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006.** Substance is not listed.

**The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.**

Substance is not listed.

**Annex XIV of the REACH Regulations (requiring Authorisation for use)** Substance is not listed.

**Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

## 16 Other information

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

**Department issuing SDS:** Global Marketing Department

**Date of preparation / last revision** 11/23/2015 / -

**Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

HMS: Hazardous Materials Identification System (USA)

WHMIS: Workplace Hazardous Materials Information System (Canada)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

vPvB: very Persistent and very Bioaccumulative

ACGIH: American Conference of Governmental Industrial Hygienists (USA)

OSHA: Occupational Safety and Health Administration (USA)

NTP: National Toxicology Program (USA)

IARC: International Agency for Research on Cancer

EPA: Environmental Protection Agency (USA)

USA

## 1 Identification

### Product identifier

**Product name:** 2-Butanone

**Stock number:** L13185

**CAS Number:**

78-93-3

**EC number:**

201-159-0

**Index number:**

606-002-00-3

**Relevant identified uses of the substance or mixture and uses advised against.**

**Identified use:** SU24 Scientific research and development

### Details of the supplier of the safety data sheet

#### Manufacturer/Supplier:

Alfa Aesar

Thermo Fisher Scientific Chemicals, Inc.

30 Bond Street

Ward Hill, MA 01835-8099

Tel: 800-343-0660

Fax: 800-322-4757

Email: tech@alfa.com

www.alfa.com

**Information Department:** Health, Safety and Environmental Department

**Emergency telephone number:**

During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660. After normal business hours, call Carechem 24 at (866) 928-0789.

## 2 Hazard(s) identification

### Classification of the substance or mixture in accordance with 29 CFR 1910 (OSHA HCS)



GHS02 Flame

Flam. Liq. 2 H225 Highly flammable liquid and vapor.



GHS07

Eye Irrit. 2 H319 Causes serious eye irritation.

STOT SE 3 H336 May cause drowsiness or dizziness.

**Hazards not otherwise classified** No information known.

### Label elements

**GHS label elements** The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)

### Hazard pictograms



GHS02 GHS07

### Signal word Danger

### Hazard statements

H225 Highly flammable liquid and vapor.

H319 Causes serious eye irritation.

H336 May cause drowsiness or dizziness.

### Precautionary statements

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P261 Avoid breathing dust/fume/gas/mist/vapours/spray.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

### WHMIS classification

B2 - Flammable liquid

D2B - Toxic material causing other toxic effects



### Classification system

### HMIS ratings (scale 0-4)

### (Hazardous Materials Identification System)

HEALTH 1 Health (acute effects) = 1

FIRE 3 Flammability = 3

REACTIVITY 1 Physical Hazard = 1

### Other hazards

### Results of PBT and vPvB assessment

PBT: Not applicable.

vPvB: Not applicable.

## 3 Composition/information on ingredients

### Chemical characterization: Substances

### CAS# Description:

78-93-3 2-Butanone

**Identification number(s):**

**EC number:** 201-159-0

**Index number:** 606-002-00-3



**Product name: 2-Butanone**

(Contd. of page 2)

**Exposure controls**

**Personal protective equipment**

**General protective and hygienic measures**

The usual precautionary measures for handling chemicals should be followed.

Keep away from foodstuffs, beverages and feed.

Remove all soiled and contaminated clothing immediately.

Wash hands before breaks and at the end of work.

Avoid contact with the eyes.

Avoid contact with the eyes and skin.

Maintain an ergonomically appropriate working environment.

**Breathing equipment:** Use suitable respirator when high concentrations are present.

**Recommended filter device for short term use:**

Use a respirator with multi-purpose combination (US) or type ABEK (EN 14387) as a backup to engineering controls. Risk assessment should be performed to determine if air-purifying respirators are appropriate. Only use equipment tested and approved under appropriate government standards such as NIOSH (USA) or CEN (EU).

**Protection of hands:**

Impervious gloves

Check protective gloves prior to each use for their proper condition.

The selection of suitable gloves not only depends on the material, but also on quality. Quality will vary from manufacturer to manufacturer.

**Material of gloves** Butyl rubber, BR

**Penetration time of glove material (in minutes)** 292

**Glove thickness** 0.3 mm

**Eye protection:** Safety glasses

**Body protection:** Protective work clothing.

**9 Physical and chemical properties**

**Information on basic physical and chemical properties**

**General Information**

**Appearance:**

<b>Form:</b>	Liquid
<b>Color:</b>	Colorless
<b>Odor:</b>	Characteristic
<b>Odor threshold:</b>	Not determined.

<b>pH-value:</b>	Not determined.
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**Change in condition**

<b>Melting point/Melting range:</b>	-87 °C (-125 °F)
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<b>Boiling point/Boiling range:</b>	80 °C (176 °F)
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<b>Sublimation temperature / start:</b>	Not determined
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<b>Flash point:</b>	-3 °C (27 °F)
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<b>Flammability (solid, gaseous)</b>	Not determined.
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<b>Ignition temperature:</b>	514 °C (957 °F)
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<b>Decomposition temperature:</b>	Not determined
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<b>Auto igniting:</b>	Not determined.
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**Danger of explosion:** Product is not explosive. However, formation of explosive air/vapor mixtures is possible.

**Explosion limits:**

<b>Lower:</b>	1.8 Vol %
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<b>Upper:</b>	11.5 Vol %
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<b>Vapor pressure at 20 °C (68 °F):</b>	101 hPa (76 mm Hg)
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<b>Density at 20 °C (68 °F):</b>	0.805 g/cm <sup>3</sup> (6.718 lbs/gal)
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<b>Relative density</b>	Not determined.
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<b>Vapor density</b>	Not determined.
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<b>Evaporation rate</b>	Not determined.
-------------------------	-----------------

**Solubility in / Miscibility with**

<b>Water at 20 °C (68 °F):</b>	290 g/l
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<b>Partition coefficient (n-octanol/water):</b>	Not determined.
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**Viscosity:**

<b>dynamic at 15 °C (59 °F):</b>	0.423 mPas
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<b>kinematic:</b>	Not determined.
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**Other information** No further relevant information available.

**10 Stability and reactivity**

**Reactivity** No information known.

**Chemical stability** Stable under recommended storage conditions.

**Thermal decomposition / conditions to be avoided:** Decomposition will not occur if used and stored according to specifications.

**Possibility of hazardous reactions** Reacts with strong oxidizing agents

**Conditions to avoid** No further relevant information available.

**Incompatible materials:**

Oxidizing agents

Bases

Reducing agents

Amines

**Hazardous decomposition products:** Carbon monoxide and carbon dioxide

**11 Toxicological information**

**Information on toxicological effects**

**Acute toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains acute toxicity data for this substance.

**LD/LC50 values that are relevant for classification:**

Oral	LD50	2737 mg/kg (rat)
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Dermal	LD50	6480 mg/kg (rabbit)
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**Skin irritation or corrosion:** Repeated exposure may cause skin dryness or cracking.

**Eye irritation or corrosion:** Causes serious eye irritation.

**Sensitization:** No sensitizing effects known.

**Germ cell mutagenicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains mutation data for this substance.

**Carcinogenicity:** No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA or ACGIH.

**Reproductive toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains reproductive data for this substance.

**Specific target organ system toxicity - repeated exposure:** No effects known.

(Contd. on page 4)  
USA

**Product name: 2-Butanone**

(Contd. of page 4)

P405 Store locked up.  
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

**National regulations**

All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance Inventory.  
All components of this product are listed on the Canadian Domestic Substances List (DSL).

**SARA Section 313 (specific toxic chemical listings)**

78-93-3 | 2-Butanone

**California Proposition 65**

Prop 65 - Chemicals known to cause cancer Substance is not listed.

Prop 65 - Developmental toxicity Substance is not listed.

Prop 65 - Developmental toxicity, female Substance is not listed.

Prop 65 - Developmental toxicity, male Substance is not listed.

Information about limitation of use: For use only by technically qualified individuals.

**Other regulations, limitations and prohibitive regulations**

Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006. Substance is not listed.

The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the

market and use must be observed.

Substance is not listed.

Annex XIV of the REACH Regulations (requiring Authorisation for use) Substance is not listed.

Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

**16 Other information**

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Department issuing SDS: Global Marketing Department

Date of preparation / last revision 01/21/2016 / -

**Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

HMIS: Hazardous Materials Identification System (USA)

WHMIS: Workplace Hazardous Materials Information System (Canada)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

vPvB: very Persistent and very Bioaccumulative

ACGIH: American Conference of Governmental Industrial Hygienists (USA)

OSHA: Occupational Safety and Health Administration (USA)

NTP: National Toxicology Program (USA)

IARC: International Agency for Research on Cancer

EPA: Environmental Protection Agency (USA)

Flam. Liq. 2: Flammable liquids, Hazard Category 2

Eye Irrit. 2: Serious eye damage/eye irritation, Hazard Category 2

STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3

USA

## SAFETY DATA SHEET

Date Printed: 01/04/2018

Date Revised: 05/15/2015

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### SECTION 1. IDENTIFICATION

**Product Name:** Antimony Metal

**Product Number:** All applicable American Elements product codes, e.g. SB-E-02 , SB-E-03 , SB-E-04 , SB-E-05 , SB-E-06 , SB-E-07

**CAS #:** 7440-36-0

**Relevant identified uses of the substance:** Scientific research and development

**Supplier details:**

American Elements  
10884 Weyburn Ave.  
Los Angeles, CA 90024  
Tel: +1 310-208-0551  
Fax: +1 310-208-0351

**Emergency telephone number:**

Domestic, North America: +1 800-424-9300  
International: +1 703-527-3887

---

### SECTION 2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

The substance is not classified as hazardous to health or the environment according to the CLP regulation.

Classification according to Directive 67/548/EEC or Directive 1999/45/EC

N/A

Information concerning particular hazards for human and environment:

No data available

Hazards not otherwise classified

No data available

Label elements

Labelling according to Regulation (EC) No 1272/2008

N/A

Hazard pictograms

N/A

Signal word

N/A

Hazard statements

N/A

Suitable extinguishing agents  
Special powder for metal fires. Do not use water.  
For safety reasons unsuitable extinguishing agents  
Water  
Special hazards arising from the substance or mixture  
If this product is involved in a fire, the following can be released:  
Antimony oxides  
Advice for firefighters  
Protective equipment:  
Wear self-contained respirator.  
Wear fully protective impervious suit.

---

## **SECTION 6. ACCIDENTAL RELEASE MEASURES**

Personal precautions, protective equipment and emergency procedures  
Use personal protective equipment. Keep unprotected persons away.  
Ensure adequate ventilation  
Environmental precautions:  
Do not allow material to be released to the environment without official permits.  
Do not allow product to enter drains, sewage systems, or other water courses.  
Do not allow material to penetrate the ground or soil.  
Methods and materials for containment and cleanup:  
Pick up mechanically.  
Prevention of secondary hazards:  
No special measures required.  
Reference to other sections  
See Section 7 for information on safe handling  
See Section 8 for information on personal protection equipment.  
See Section 13 for disposal information.

---

## **SECTION 7. HANDLING AND STORAGE**

Handling  
Precautions for safe handling  
Keep container tightly sealed.  
Store in cool, dry place in tightly closed containers.  
Information about protection against explosions and fires:  
No data available  
Conditions for safe storage, including any incompatibilities  
Requirements to be met by storerooms and receptacles:  
No special requirements.  
Information about storage in one common storage facility:  
Store away from oxidizing agents.  
Store away from halogens.  
Further information about storage conditions:  
Keep container tightly sealed.  
Store in cool, dry conditions in well-sealed containers.  
Specific end use(s)  
No data available

Explosion limits:  
Lower: No data available  
Upper: No data available  
Vapor pressure: N/A  
Density at 20 °C (68 °F): 6.68 g/cm<sup>3</sup> (55.745 lbs/gal)  
Relative density: No data available.  
Vapor density: N/A  
Evaporation rate: N/A  
Solubility in Water (H<sub>2</sub>O): Insoluble  
Partition coefficient (n-octanol/water): No data available.  
Viscosity:  
Dynamic: N/A  
Kinematic: N/A  
Other information  
No data available

---

## SECTION 10. STABILITY AND REACTIVITY

Reactivity  
No data available  
Chemical stability  
Stable under recommended storage conditions.  
Thermal decomposition / conditions to be avoided:  
Decomposition will not occur if used and stored according to specifications.  
Possibility of hazardous reactions  
No dangerous reactions known  
Conditions to avoid  
No data available  
Incompatible materials:  
Oxidizing agents  
Halogens  
Hazardous decomposition products:  
Antimony oxides

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## SECTION 11. TOXICOLOGICAL INFORMATION

Information on toxicological effects  
Acute toxicity:  
The Registry of Toxic Effects of Chemical Substances (RTECS) contains acute toxicity data for this substance.  
LD/LC50 values that are relevant for classification: Oral LD50 100 mg/kg (rat)  
Skin irritation or corrosion: No irritant effect.  
Eye irritation or corrosion: May cause irritation  
Sensitization: No sensitizing effects known.  
Germ cell mutagenicity: No effects known.  
Carcinogenicity:  
No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA or ACGIH.  
The Registry of Toxic Effects of Chemical Substances (RTECS) contains tumorigenic and/or carcinogenic and/or neoplastic data for this substance.  
Reproductive toxicity: No effects known.

N/A  
Packing group  
DOT, IMDG, IATA  
N/A  
Environmental hazards:  
N/A  
Special precautions for user  
N/A  
Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code  
N/A  
Transport/Additional information:  
DOT  
Marine Pollutant (DOT):  
No

---

## **SECTION 15. REGULATORY INFORMATION**

Safety, health and environmental regulations/legislation specific for the substance or mixture  
National regulations

All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance Inventory.

All components of this product are listed on the Canadian Domestic Substances List (DSL).

SARA Section 313 (specific toxic chemical listings)

7440-36-0 Antimony

California Proposition 65

Prop 65 - Chemicals known to cause cancer

Substance is not listed.

Prop 65 - Developmental toxicity

Substance is not listed.

Prop 65 - Developmental toxicity, female

Substance is not listed.

Prop 65 - Developmental toxicity, male

Substance is not listed.

Information about limitation of use:

For use only by technically qualified individuals.

This product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.

Other regulations, limitations and prohibitive regulations

Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006.

Substance is not listed.

The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.

Substance is not listed.

Annex XIV of the REACH Regulations (requiring Authorisation for use)

Substance is not listed.

REACH - Pre-registered substances

Substance is listed.

Chemical safety assessment:

A Chemical Safety Assessment has not been carried out.

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## SAFETY DATA SHEET

Date Printed: 01/04/2018

Date Revised: 05/15/2015

### SECTION 1. IDENTIFICATION

**Product Name:** Arsenic Metal

**Product Number:** All applicable American Elements product codes, e.g. AS-E-03 , AS-E-04 , AS-E-05 , AS-E-06 , AS-E-07

**CAS #:** 7440-38-2

**Relevant identified uses of the substance:** Scientific research and development

**Supplier details:**

American Elements  
10884 Weyburn Ave.  
Los Angeles, CA 90024  
Tel: +1 310-208-0551  
Fax: +1 310-208-0351

**Emergency telephone number:**

Domestic, North America: +1 800-424-9300  
International: +1 703-527-3887

### SECTION 2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

GHS06 Skull and crossbones

Acute Tox. 3 H301 Toxic if swallowed.

Acute Tox. 3 H331 Toxic if inhaled.

Hazards not otherwise classified

No data available

Label elements

Labelling according to Regulation (EC) No 1272/2008

The substance is classified and labeled according to the CLP regulation.

Hazard pictograms



Signal word

Danger

Hazard statements

H301+H331 Toxic if swallowed or if inhaled.

Seek immediate medical advice.  
In case of skin contact:  
Immediately wash with soap and water; rinse thoroughly.  
Seek immediate medical advice.  
In case of eye contact:  
Rinse opened eye for several minutes under running water. Consult a physician.  
If swallowed:  
Do not induce vomiting; immediately call for medical help.  
Information for doctor  
Most important symptoms and effects, both acute and delayed  
No data available  
Indication of any immediate medical attention and special treatment needed  
No data available

---

## **SECTION 5. FIREFIGHTING MEASURES**

Extinguishing media  
Suitable extinguishing agents  
Product is not flammable. Use fire-fighting measures that suit the surrounding fire.  
Special hazards arising from the substance or mixture  
If this product is involved in a fire, the following can be released:  
Arsenic oxides (AS<sub>2</sub>O<sub>x</sub>)  
Advice for firefighters  
Protective equipment:  
Wear self-contained respirator.  
Wear fully protective impervious suit.

---

## **SECTION 6. ACCIDENTAL RELEASE MEASURES**

Personal precautions, protective equipment and emergency procedures  
Use personal protective equipment. Keep unprotected persons away.  
Ensure adequate ventilation  
Environmental precautions:  
Do not allow product to enter drains, sewage systems, or other water courses.  
Methods and materials for containment and cleanup:  
Dispose of contaminated material as waste according to section 13.  
Ensure adequate ventilation.  
Prevention of secondary hazards:  
No special measures required.  
Reference to other sections  
See Section 7 for information on safe handling  
See Section 8 for information on personal protection equipment.  
See Section 13 for disposal information.

---

## **SECTION 7. HANDLING AND STORAGE**

Handling  
Precautions for safe handling  
Keep container tightly sealed.  
Store in cool, dry place in tightly closed containers.



Breathing equipment:

Use self-contained respiratory protective device in emergency situations.

Recommended filter device for short term use:

Use a respirator with type P100 (USA) or P3 (EN 143) cartridges as a backup to engineering controls.

Risk assessment should be performed to determine if air-purifying respirators are appropriate. Only use equipment tested and approved under appropriate government standards.

Protection of hands:

Impervious gloves

Inspect gloves prior to use.

Suitability of gloves should be determined both by material and quality, the latter of which may vary by manufacturer.

Material of gloves

Nitrile rubber, NBR

Penetration time of glove material (in minutes)

480

Glove thickness

0.11 mm

Eye protection:

Safety glasses

Body protection:

Protective work clothing

---

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance:

Form: Various forms (powder/flake/crystalline/beads, etc.)

Color: Grey

Odor: Odorless

Odor threshold: No data available.

pH: N/A

Melting point/Melting range: 817 °C (1503 °F)

Boiling point/Boiling range: 614 °C (1137 °F)

Sublimation temperature / start: No data available

Flammability (solid, gas)

No data available.

Ignition temperature: No data available

Decomposition temperature: No data available

Autoignition: No data available.

Danger of explosion: No data available.

Explosion limits:

Lower: No data available

Upper: No data available

Vapor pressure at 267 °C (513 °F): 0.01 hPa

Density at 20 °C (68 °F): 5.778 g/cm<sup>3</sup> (48.217 lbs/gal)

Relative density

No data available.

Vapor density

N/A

Evaporation rate

N/A

Solubility in Water (H<sub>2</sub>O): Insoluble

Partition coefficient (n-octanol/water): No data available.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains tumorigenic and/or carcinogenic and/or neoplastic data for this substance.

Reproductive toxicity:

The Registry of Toxic Effects of Chemical Substances (RTECS) contains reproductive data for this substance.

Specific target organ system toxicity - repeated exposure:

No effects known.

Specific target organ system toxicity - single exposure:

No effects known.

Aspiration hazard:

No effects known.

Subacute to chronic toxicity:

The Registry of Toxic Effects of Chemical Substances (RTECS) contains multiple dose toxicity data for this substance.

Additional toxicological information:

To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.

Carcinogenic categories

OSHA-Ca (Occupational Safety & Health Administration)

Substance is listed

---

## SECTION 12. ECOLOGICAL INFORMATION

Toxicity

Aquatic toxicity:

No data available

Persistence and degradability

No data available

Bioaccumulative potential

No data available

Mobility in soil

No data available

Ecotoxical effects:

Remark:

Very toxic for aquatic organisms

Additional ecological information:

Do not allow product to reach groundwater, water courses, or sewage systems, even in small quantities.

Danger to drinking water if even extremely small quantities leak into the ground.

Also poisonous for fish and plankton in water bodies.

May cause long lasting harmful effects to aquatic life.

Avoid transfer into the environment.

Very toxic for aquatic organisms

Results of PBT and vPvB assessment

PBT:

N/A

vPvB:

N/A

Other adverse effects

No data available

---

## SECTION 15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture  
National regulations

All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance Inventory.

All components of this product are listed on the Canadian Domestic Substances List (DSL).

SARA Section 313 (specific toxic chemical listings)

7440-38-2 Arsenic

California Proposition 65

Prop 65 - Chemicals known to cause cancer

Substance is not listed.

Prop 65 - Developmental toxicity

Substance is not listed.

Prop 65 - Developmental toxicity, female

Substance is not listed.

Prop 65 - Developmental toxicity, male

Substance is not listed.

Information about limitation of use:

For use only by technically qualified individuals.

Other regulations, limitations and prohibitive regulations

Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006.

Substance is not listed.

The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.

Substance is not listed.

Annex XIV of the REACH Regulations (requiring Authorisation for use)

Substance is not listed.

Chemical safety assessment:

A Chemical Safety Assessment has not been carried out.

---

## SECTION 16. OTHER INFORMATION

Safety Data Sheet according to Regulation (EC) No. 1907/2006 (REACH). The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. American Elements shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale. COPYRIGHT 1997-2018 AMERICAN ELEMENTS. LICENSED GRANTED TO MAKE UNLIMITED PAPER COPIES FOR INTERNAL USE ONLY.

## 1 Identification

### Product identifier

**Product name:** **Benzo[a]pyrene**

**Stock number:** 15856

**CAS Number:**

50-32-8

**EC number:**

200-028-5

**Index number:**

601-032-00-3

**Relevant identified uses of the substance or mixture and uses advised against.**

**Identified use:** SU24 Scientific research and development

### Details of the supplier of the safety data sheet

#### Manufacturer/Supplier:

Alfa Aesar

Thermo Fisher Scientific Chemicals, Inc.

30 Bond Street

Ward Hill, MA 01835-8099

Tel: 800-343-0660

Fax: 800-322-4757

Email: tech@alfa.com

www.alfa.com

**Information Department:** Health, Safety and Environmental Department

#### Emergency telephone number:

During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660. After normal business hours, call Carechem 24 at (866) 928-0789.

## 2 Hazard(s) identification

### Classification of the substance or mixture in accordance with 29 CFR 1910 (OSHA HCS)



GHS08 Health hazard

Muta. 1B H340 May cause genetic defects.

Carc. 1B H350 May cause cancer.

Repr. 1B H360 May damage fertility or the unborn child.



GHS07

Skin Sens. 1 H317 May cause an allergic skin reaction.

**Hazards not otherwise classified** No information known.

### Label elements

**GHS label elements** The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)

### Hazard pictograms



GHS07 GHS08

### Signal word

**Danger**

### Hazard statements

H317 May cause an allergic skin reaction.

H340 May cause genetic defects.

H350 May cause cancer.

H360 May damage fertility or the unborn child.

### Precautionary statements

P261 Avoid breathing dust/fume/gas/mist/vapours/spray.

P280 Wear protective gloves/protective clothing/eye protection/face protection.

P281 Use personal protective equipment as required.

P363 Wash contaminated clothing before reuse.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

### WHMIS classification

D2A - Very toxic material causing other toxic effects



### Classification system

**HMIS ratings (scale 0-4)**

**(Hazardous Materials Identification System)**

HEALTH 2 Health (acute effects) = 2

FIRE 1 Flammability = 1

REACTIVITY 1 Physical Hazard = 1

### Other hazards

**Results of PBT and vPvB assessment**

**PBT:** Not applicable.

**vPvB:** Not applicable.

## 3 Composition/information on ingredients

### Chemical characterization: Substances

#### CAS# Description:

50-32-8 Benzo[a]pyrene

**Identification number(s):**

**EC number:** 200-028-5

**Product name:** Benzo[a]pyrene

(Contd. of page 2)

**Breathing equipment:** Use suitable respirator when high concentrations are present.

**Protection of hands:**

Impervious gloves

Check protective gloves prior to each use for their proper condition.

The selection of suitable gloves not only depends on the material, but also on quality. Quality will vary from manufacturer to manufacturer.

**Penetration time of glove material (in minutes)** Not determined

**Eye protection:** Safety glasses

**Body protection:** Protective work clothing.

## 9 Physical and chemical properties

**Information on basic physical and chemical properties**

**General Information**

**Appearance:**

**Form:** Crystalline

**Color:** Not determined

**Odor:** Not determined

**Odor threshold:** Not determined.

**pH-value:** Not applicable.

**Change in condition**

**Melting point/Melting range:** 177-180 °C (351-356 °F)

**Boiling point/Boiling range:** 495 °C (923 °F)

**Sublimation temperature / start:** Not determined

**Flammability (solid, gaseous)** Not determined.

**Ignition temperature:** Not determined

**Decomposition temperature:** Not determined

**Auto igniting:** Not determined.

**Danger of explosion:** Not determined.

**Explosion limits:**

**Lower:** Not determined

**Upper:** Not determined

**Vapor pressure:** Not applicable.

**Density at 20 °C (68 °F):** 1.28 g/cm<sup>3</sup> (10.682 lbs/gal)

**Relative density** Not determined.

**Vapor density** Not applicable.

**Evaporation rate** Not applicable.

**Solubility in / Miscibility with**

**Water:** Not determined

**Partition coefficient (n-octanol/water):** Not determined.

**Viscosity:**

**dynamic:** Not applicable.

**kinematic:** Not applicable.

**Other information** No further relevant information available.

## 10 Stability and reactivity

**Reactivity** No information known.

**Chemical stability** Stable under recommended storage conditions.

**Thermal decomposition / conditions to be avoided:** Decomposition will not occur if used and stored according to specifications.

**Possibility of hazardous reactions** No dangerous reactions known

**Conditions to avoid** No further relevant information available.

**Incompatible materials:** Oxidizing agents

**Hazardous decomposition products:** Carbon monoxide and carbon dioxide

## 11 Toxicological information

**Information on toxicological effects**

**Acute toxicity:** The Registry of Toxic Effects of Chemical Substances (RTECS) contains acute toxicity data for components in this product.

**LD/LC50 values that are relevant for classification:** No data

**Skin irritation or corrosion:** May cause irritation

**Eye irritation or corrosion:** May cause irritation

**Sensitization:** May cause an allergic skin reaction.

**Germ cell mutagenicity:**

May cause genetic defects.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains mutation data for this substance.

**Carcinogenicity:**

May cause cancer.

EPA-B2: Probable human carcinogen, sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies.

IARC-1: Carcinogenic to humans; sufficient evidence of carcinogenicity.

NTP-R: Reasonably anticipated to be a carcinogen; limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

ACGIH A2: Suspected human carcinogen: Agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) considered relevant to worker exposure. Available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains tumorigenic and/or carcinogenic and/or neoplastic data for this substance.

**Reproductive toxicity:**

May damage fertility or the unborn child.

The Registry of Toxic Effects of Chemical Substances (RTECS) contains reproductive data for this substance.

**Specific target organ system toxicity - repeated exposure:** No effects known.

**Specific target organ system toxicity - single exposure:** No effects known.

**Aspiration hazard:** No effects known.

**Subacute to chronic toxicity:** No effects known.

**Additional toxicological information:** To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.

## 12 Ecological information

**Toxicity**

**Aquatic toxicity:** No further relevant information available.

**Persistence and degradability** No further relevant information available.

**Bioaccumulative potential** No further relevant information available.

**Mobility in soil** No further relevant information available.

**Ecotoxicological effects:**

**Remark:** Very toxic for aquatic organisms

(Contd. on page 4)  
USA

**Product name: Benzo[a]pyrene**

(Contd. of page 4)

**California Proposition 65**

**Prop 65 - Chemicals known to cause cancer**

50-32-8 | Benzo[a]pyrene

**Prop 65 - Developmental toxicity** Substance is not listed.

**Prop 65 - Developmental toxicity, female** Substance is not listed.

**Prop 65 - Developmental toxicity, male** Substance is not listed.

**Information about limitation of use:**

Workers are not allowed to be exposed to this hazardous material. Exceptions can be made by the authorities in certain cases.

For use only by technically qualified individuals.

This product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.

**Other regulations, limitations and prohibitive regulations**

**Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006.** Substance is not listed.

**The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.**

Substance is not listed.

**Annex XIV of the REACH Regulations (requiring Authorisation for use)** Substance is not listed.

**Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

**16 Other information**

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

**Department issuing SDS:** Global Marketing Department

**Date of preparation / last revision** 11/23/2015 / -

**Abbreviations and acronyms:**

RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)

ICAO: International Civil Aviation Organization

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

HMIS: Hazardous Materials Identification System (USA)

WHMIS: Workplace Hazardous Materials Information System (Canada)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

vPvB: very Persistent and very Bioaccumulative

ACGIH: American Conference of Governmental Industrial Hygienists (USA)

OSHA: Occupational Safety and Health Administration (USA)

NTP: National Toxicology Program (USA)

IARC: International Agency for Research on Cancer

EPA: Environmental Protection Agency (USA)

## **ATTACHMENT F**

### **JOBSITE SAFETY INSPECTION CHECKLIST**

## Jobsite Safety Inspection Checklist

**Date:** \_\_\_\_\_ **Inspected By:** \_\_\_\_\_

**Location:** \_\_\_\_\_ **Project #:** \_\_\_\_\_

Check one of the following: **A:** Acceptable **NA:** Not Applicable **D:** Deficiency

	A	NA	D	Remark
1. CHASP available onsite for inspection?				
2. Health & Safety Compliance agreement (in CHASP) appropriately signed by Langan employees and contractors?				
3. Hospital route map with directions posted on site?				
4. Emergency Notification List posted on site?				
5. First Aid kit available and properly stocked?				
6. Personnel trained in CPR/First Aid on site?				
7. MSDSs readily available, and all workers knowledgeable about the specific chemicals and compounds to which they may be exposed?				
8. Appropriate PPE being worn by Langan employees and contractors?				
9. Project site safe practices ("Standing Orders") posted?				
10. Project staff have 40-hr./8-hr./Supervisor HAZWOPER training?				
11. Project staff medically cleared to work in hazardous waste sites and fit-tested to wear respirators, if needed?				
12. Respiratory protection readily available?				
13. Health & Safety Incident Report forms available?				
14. Air monitoring instruments calibrated daily and results recorded on the Daily Instrument Calibration check sheet?				
15. Air monitoring readings recorded on the air monitoring data sheet/field log book?				
16. Subcontract workers have received 40-hr./8-hr./Spvsnr. HAZWOPER training, as appropriate?				
17. Subcontract workers medically cleared to work on site, and fit-tested for respirator wear?				
18. Subcontract workers have respirators readily available?				
19. Mark outs of underground utilities done prior to initiating any subsurface activities?				
20. Decontamination procedures being followed as outlined in CHASP?				
21. Are tools in good condition and properly used?				
22. Drilling performed in areas free from underground objects including utilities?				



23. Adequate size/type fire extinguisher supplied?				
24. Equipment at least 20 feet from overhead power lines?				
25. Evidence that drilling operator is responsible for the safety of his rig.				
26. Trench sides shored, layer back, or boxed?				
27. Underground utilities located and authorities contacted before digging?				
28. Ladders in trench (25-foot spacing)?				
29. Excavated material placed more than 2 feet away from excavation edge?				
30. Public protected from exposure to open excavation?				
31. People entering the excavation regarding it as a permit-required confined space and following appropriate procedures?				
32. Confined space entry permit is completed and posted?				
33. All persons knowledgeable about the conditions and characteristics of the confined space?				
34. All persons engaged in confined space operations have been trained in safe entry and rescue (non-entry)?				
35. Full body harnesses, lifelines, and hoisting apparatus available for rescue needs?				
36. Attendant and/or supervisor certified in basic first aid and CPR?				
37. Confined space atmosphere checked before entry and continuously while the work is going on?				
38. Results of confined space atmosphere testing recorded?				
39. Evidence of coordination with off-site rescue services to perform entry rescue, if needed?				
40. Are extension cords rated for this work being used and are they properly maintained?				
41. Are GFCIs provided and being used?				

Unsafe Acts:

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Notes:

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# **ATTACHMENT G**

## **JOB SAFETY ANALYSIS FORM**

# LANGAN

## Job Safety Analysis (JSA) Health and Safety

**JSA TITLE:**

**DATE CREATED:**

**CREATED BY:**

**JSA NUMBER:**

**REVISION DATE:**

**REVISED BY:**

Langan employees must review and revise the Job Safety Analysis (JSA) as needed to address the any site specific hazards not identified. Employees must provide their signatures on the last page of the JSA indicating they have review the JSA and are aware the potential hazards associated with this work and will follow the provided preventive or corrective measures.

**PERSONAL PROTECTIVE EQUIPMENT REQUIRED: (PPE):**    ☐ Required    ☒ As Needed

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Steel-toed boots   | <input type="checkbox"/> Nitrile gloves                | <input type="checkbox"/> Dermal Protection (Specify)   |
| <input type="checkbox"/> Long-sleeved shirt | <input type="checkbox"/> Leather/ Cut-resistant gloves | <input type="checkbox"/> High visibility vest/clothing |
| <input type="checkbox"/> Safety glasses     | <input type="checkbox"/> Face Shield                   | <input type="checkbox"/> Hard hat                      |

**ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT NEEDED (Provide specific type(s) or descriptions)**

☐ Air Monitoring:    ☐ Respirators:    ☐ Other:

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE ACTION
1.	1. 2.	1a. 1b. 2a. 2b.
2.	1.	1
Additional items identified in the field.		
Additional Items.		

**If additional items are identified during daily work activities, please notify all relevant personnel about the change and document on this JSA.**



## Job Safety Analysis (JSA) Health and Safety

**JSA Title:** Subsurface Investigation

**JSA Number:** JSA030-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

### PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety Goggles	<input type="checkbox"/> Face Shield	<input type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input checked="" type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	
<input checked="" type="checkbox"/> Other: Dielectric Overshoes, Sun Block				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
1. Transport equipment to work area	1. Back/strain 2. Slip/Trip/Falls 3. Traffic 4. Cuts/abrasions/contusions from equipment 5. Accidents due to vehicle operations	1. Use proper lifting techniques/Use wheeled transport 2. Minimize distance to work area/unobstructed path to work area/follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves, Langan approved safety shoes) 5. Observe posted speed limits/ Wear seat belts at all times
2. Traffic	1. Hit by moving vehicle	1. Use traffic cones and signage/ Use High visibility traffic vests and clothing/ Caution tape when working near active roadways.
3. Field Work (drilling, resistivity testing, and inspection)	1. Biological Hazards: insects, rats, snakes, poisonous plants, and other animals 2. Heat stress/injuries 3. Cold Stress/injuries 4. High Energy Transmission Lines 5. Underground Utilities 6. Electrical (soil resistivity testing)	1. Inspect work area to identify biological hazards. Wear light colored long sleeve shirt and long pants/ Use insect repellant as necessary/ Beware of tall grass, bushes, woods and other areas where ticks may live/ Avoid leaving garbage on site to prevent attracting animals/ Identify and avoid contact with poisonous plants/Beware of rats, snakes, or stray animals. 2. Wear proper clothing (light colored)/ drink plenty of water/ take regular breaks/use sun block 3. Wear proper clothing/ dress in layers/ take regular breaks. 4. Avoid direct contact with high energy transmission lines/ position equipment at least 15 feet or as required by PSE&G from the transmission lines/ wear proper PPE (dielectric overshoes 15 kV minimum rating). 5. Call one-call service before performing intrusive field work/ Review utility mark-outs and available utility drawings (with respect to proposed work locations)/ Follow Underground Utility Guidelines

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
		6. See AGI Sting R1 operating manual for specific concerns during operating instrument
4.All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries 5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress 10. Eye Injuries	7. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 8. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 9. Wear Langan approved safety shoes 10. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 11. Wear high visibility clothing & vest / Use cones or signs to designate work area 12. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 13. Wear proper hearing protection 14. Wear hard hat / Avoid areas were overhead hazards exist. 15. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 16. Wear safety glasses
Additional items.		
Additional Items identified while in the field.  (Delete row if not needed.)		

<u>Print Name</u>	<u>Sign Name</u>	<u>Date</u>
<b><u>Prepared by:</u></b>		
<b><u>Reviewed by:</u></b>		



## Job Safety Analysis (JSA) Health and Safety

**JSA Title:** Field Sampling

**JSA Number:** JSA022-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

### PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Safety Goggles	<input type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input checked="" type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	

☐ Other:

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
5. Unpack/Transport equipment to work area.	6. Back Strains 7. Slip/Trips/Falls 8. Cuts/Abrasions from equipment 9. Contusions from dropped equipment	6. Use proper lifting techniques/Use wheeled transport 7. Minimize distance to work area/Unobstructed path to work area/follow good housekeeping procedures. Mark slip/trip/fall hazards with orange safety cones. 8. Wear proper PPE (leather gloves, long sleeves). 9. Wear proper PPE (Langan approved safety shoes).
6. Initial Site Arrival-Site Assessment	1. Traffic	1. Situational awareness (be alert of your surroundings). Secure area from through traffic.
7. Surface Water Sampling	1. Contaminated media. Skin/eye contact with biological agents and/or chemicals.	1. Wear appropriate PPE (Safety glasses, appropriate gloves). Review (M)SDS for all chemicals being.
8. Sampling from bridges	1. Struck by vehicles	1. Wear appropriate PPE (Safety Vest). Use buddy system and orange safety cones.
9. Icing of Samples/ Transporting coolers/equipment from work area.	11. Back Strains 12. Slips/Trips/Falls 13. Cuts/Abrasions from equipment 14. Pinch/Crushing Hazards.	17. Drain coolers of water. Use proper lifting techniques. Use wheeled transport. 18. Have unobstructed path from work area. Aware of surroundings. 19. Wear proper PPE (Leather gloves, long sleeves) 20. Wear proper PPE (Leather gloves, long sleeves)
10. Site Departure	1. Contaminated PPE/Vehicle	1. Contaminated PPE should be disposed of on-site. Remove boots and soiled clothing for secure storage in trunk. Wash hands promptly.
11. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
	3. Foot injuries 4. Back injuries 15. Traffic 16. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 17. High Noise levels 18. Overhead hazards 19. Heat Stress/ Cold Stress 20. Eye Injuries	2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 21. Wear high visibility clothing & vest / Use cones or signs to designate work area 22. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 23. Wear hearing protection 24. Wear hard hat / Avoid areas where overhead hazards exist. 25. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Take breaks as necessary to avoid heat/cold stress 26. Wear safety glasses
Additional items.		
Additional Items identified while in the field.  (Delete row if not needed.)		

<u>Print Name</u>	<u>Sign Name</u>	<u>Date</u>
<b><u>Prepared by:</u></b>		
<b><u>Reviewed by:</u></b>		

**JSA Title:** Equipment Transportation and Set-Up

**JSA Number:** JSA012-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

**PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):**

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Safety Goggles	<input type="checkbox"/> Face Shield	<input type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	
<input type="checkbox"/> Other:				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
12. Transport equipment to work area	10. Back Strain 11. Slips/ Trips/ Falls 12. Traffic 13. Cuts/abrasions from equipment 14. Contusions from dropped equipment	1. Use proper lifting techniques / Use wheeled transport 2. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 3. Wear proper PPE (high visibility vest or clothing) 4. Wear proper PPE (leather gloves, long sleeves) 5. Wear proper PPE (safety shoes)
13. Moving equipment to its planned location	2. Pinch Hazard 3. Slips/ Trips/ Falls	1. Wear proper PPE (leather gloves) 2. Be aware of potential trip hazards / Practice good housekeeping procedures / Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint
14. Equipment Set-up	2. Pinch Hazard 3. Cuts/abrasions to knuckles/hands 4. Back Strain	1. Wear proper PPE (leather gloves) 2. Wear proper PPE (leather gloves) 3. Use proper lifting techniques / Use wheeled transport
15. All activities	21. Slips/ Trips/ Falls 22. Hand injuries, cuts or lacerations during manual handling of materials 23. Foot injuries 24. Back injuries 25. Traffic 26. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 27. High Noise levels 28. Overhead hazards 29. Heat Stress/ Cold Stress 30. Eye Injuries	27. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 28. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 29. Wear Langan approved safety shoes 30. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 31. Wear high visibility clothing & vest / Use cones or signs to designate work area



JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
4. All activities (cont'd)		32. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 33. Wear hearing protection 34. Wear hard hat / Avoid areas where overhead hazards exist. 35. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 36. Wear safety glasses
Additional items.		
Additional Items identified while in the field.		
(Delete row if not needed.)		

<u>Print Name</u>	<u>Sign Name</u>	<u>Date</u>
<b><u>Prepared by:</u></b>		
<b><u>Reviewed by:</u></b>		

**JSA Title:** 55-gallon Drum Sampling

**JSA Number:** JSA043-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

**PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):**

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input checked="" type="checkbox"/> Safety Goggles	<input checked="" type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Nitrile Gloves	<input checked="" type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	
<input checked="" type="checkbox"/> Other: All Drums are required to be labeled. Langan employees do not open or move undocumented drums or unlabeled drums without proper project manager authorization.				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
16. Unpack/Transport equipment to work area.	15. Back Strains 16. Slip/Trips/Falls 17. Cuts/Abrasions from equipment 4. Contusions from dropped equipment	10. Use proper lifting techniques/Use wheeled transport 11. Minimize distance to work area/Unobstructed path to work area/follow good housekeeping procedures. Mark slip/trip/fall hazards with orange safety cones. 12. Wear proper PPE (leather gloves, long sleeves). 4. Wear proper PPE (Langan approved safety shoes).
17. Open Drums	1. Hand Injuries, cuts or lacerations when untightening drum locking bolt, removing drum lid strap, or removing lid. 2. Pressure from drums.	1. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves. Use non-metallic mallet and non-sparking tools/wrenches. 2. Open drum slowly to relieve pressure. Wear proper PPE: face shield and goggles; correct gloves; and over garments.
18. Collecting Soil/Fluid Sample	4. Irritation to eye from vapor, soil dust, or splashing 5. Irritation to exposed skin	2. Wear proper eye protection including safety glasses/ face shield/goggles and when necessary, splash guard. If dust or vapor phase is present, wear appropriate safety breathing gear (1/2 mask or full face mask with correct filter) 3. Wear proper skin protection including nitrile gloves.
19. Closing Drums	1. Hand Injuries, cuts or lacerations when untightening drum locking bolt, removing drum lid strap, or removing lid.	2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves. Use non-metallic mallet and non-sparking tools/wrenches.
20. Moving Drums	2. Hand Injuries, cuts or lacerations when untightening drum locking bolt, removing drum lid strap, or removing lid. 3. Back Strains	2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves. Use non-metallic mallet and non-sparking tools/wrenches. 3. Use proper lifting techniques/Use wheeled transport

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
21. All activities	31. Slips/ Trips/ Falls 32. Hand injuries, cuts or lacerations during manual handling of materials 33. Foot injuries 34. Back injuries 35. Traffic 36. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 37. High Noise levels 38. Overhead hazards 39. Heat Stress/ Cold Stress 40. Eye Injuries	37. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 38. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 39. Wear Langan approved safety shoes 40. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 41. Wear high visibility clothing & vest / Use cones or signs to designate work area 42. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 43. Wear hearing protection 44. Wear hard hat / Avoid areas were overhead hazards exist. 45. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress 46. Wear safety glasses
Additional items.		
Additional Items identified while in the field.  (Delete row if not needed.)		

<u>Print Name</u>	<u>Sign Name</u>	<u>Date</u>
<b><u>Prepared by:</u></b>		
<b><u>Reviewed by:</u></b>		

**JSA Title:** Direct-Push Soil Borings

**JSA Number:** JSA004-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

### PERSONAL PROTECTIVE EQUIPMENT REQUIRED:

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Safety Goggles	<input type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input checked="" type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	
<input checked="" type="checkbox"/> Other: Half-face respirator, dust cartridges, PID (if applicable)				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
22. Move equipment to work site	18. Back strain when lifting equipment  19. Slips/ Trips/ Falls while moving equipment  20. Traffic (if applicable) 21. Pinched fingers or running over toes during geoprobe set-up 22. Overturn drilling rig while transporting to loading dock on flat-bed tow truck	13. Use proper lifting technique (use legs for bending and lifting and not the back)/ Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle 14. Use proper lifting technique (use legs for bending and lifting and not the back) / Use wheeled transport for heavy equipment / Get assistance when handling loads greater than 50 lbs. / Minimize distance to vehicle / Have unobstructed path to vehicle or collection point / Do not lift/walk with boxes that are heavy/difficult to lift 15. Wear high visibility safety vests or clothing / Exercise caution 16. Wear proper PPE (cut-resistant gloves) / Stay alert, be aware of geoprobe rig at all times 17. Drill rig should be parked in center of flat-bed tow truck / Emergency brake shall be used at all times during transport on the flat-bed truck/ All unnecessary personnel should stay away from the flat-bed truck during moving activities
23. Calibration of monitoring equipment	6. Skin or eye contact with calibration chemicals 7. Pinch fingers in monitoring equipment	4. Wear proper PPE (safety glasses/ goggles) 5. Wear proper PPE (leather gloves)
24. Set-up geoprobe rig	5. Geoprobe rig movement	3. All field personnel should stay clear of the geoprobe rig while moving / Use a spotter when backing up the geoprobe
25. Advance geoprobe rods below ground surface to desired depth	4. Underground utilities 5. High noise levels	4. Clean all subsurface soil borings to a minimum of 5 feet below grade 5. Wear proper PPE (hearing protection)
26. Remove and open acetate liner	41. Pinched fingers while removing macrocore 42. Cuts/lacerations when cutting acetate liner open 43. Exposure to hazardous vapors	1. Wear proper PPE (nitrile gloves, cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Do not place face over acetate liner when opening / Monitor hazardous vapors in air with PID / Upgrade PPE as necessary based on levels contained in the Health and Safety Plan

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
5. Remove and open acetate liner (cont'd)	44. Skin contact with contaminated soil	4. Wear proper PPE (nitrile gloves)
27. Sample Collections a) Monitor parameters b) Prepare sample containers and labels	1. Contact with potentially contaminated soil 2. Lacerations from broken sample bottles 3. Back strain while transporting full coolers 4. Internal exposure to contaminants and metals through inhalation of dust  5. Slips/ Trips/ Falls	1. Use monitoring devices / Wear proper PPE (safety glasses, nitrile gloves) 2. Do not over-tighten bottle caps / Handle bottles safely to prevent breakage 6. Use proper lifting techniques / Do not lift heavy loads without assistance 7. Avoid creating dust / If necessary, wear a half mask respirator with applicable dust cartridge / Inspect respirator for damage and cleanliness prior to use / Clean respirator after each use and store in a clean, secure location 8. Be alert / Follow good housekeeping procedures
28. Remove excess soil from acetate liner and place in 55-gallon drum (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Cuts/lacerations from acetate liner 2. Pinched fingers/hand while opening/closing drum 3. Skin contact with contaminated soil 4. Soil debris in eyes	1. Wear proper PPE (cut-resistant or leather gloves) 2. Wear proper PPE (cut-resistant or leather gloves) 3. Wear proper PPE (nitrile gloves) 4. Wear proper PPE (safety glasses)
8. Transport drums to central staging location (IF NOT PERFORMED BY LANGAN, REMOVE!)	1. Back, arm or shoulder strain from moving drums 2. Pinch fingers/hand in drum cart when moving drums 3. Pinch fingers/hand when operating lift-gate on vehicle 4. Contact with potentially contaminated groundwater when moving improperly sealed drums 5. Slips when moving drums 6. Drop drum on feet/toes	47. Use drum cart for moving drums / Use proper lifting techniques / Do not lift heavy loads without assistance 48. Wear proper PPE (cut-resistant or leather gloves)  49. Wear proper PPE (cut-resistant or leather gloves)  50. Wear proper PPE (nitrile gloves underneath work gloves)  51. Follow good housekeeping procedures / Ensure route to move drum and storage space is free from obstructions 52. Wear proper PPE (safety shoes) / Work in a safe manner to prevent dropped drum
9. All activities	1. Slips/ Trips/ Falls 2. Hand injuries, cuts or lacerations during manual handling of materials 3. Foot injuries 4. Back injuries  5. Traffic 6. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 7. High Noise levels 8. Overhead hazards 9. Heat Stress/ Cold Stress	1. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 2. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 3. Wear Langan approved safety shoes 4. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 5. Wear high visibility clothing & vest / Use cones or signs to designate work area 6. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 7. Wear hearing protection 8. Wear hard hat / Avoid areas where overhead hazards exist. 9. Wear proper attire for weather conditions (sunscreen or protective clothing in sunlight, layers for cold weather) / Drink plenty of fluids to avoid dehydration / Takes breaks as necessary to avoid heat/cold stress



JSA Title: Site Inspection

JSA Number: JSA024-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

### PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Safety Goggles	<input type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input checked="" type="checkbox"/> Rubber Boots
<input checked="" type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input checked="" type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	

☐ Other:

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
29. Jobsite Pre-briefing	23. None	18. Review JSA, SOP's, and discuss hazards that may be present and control measures for present hazards while on-site.
2. Working near railroads	1. Passing Trains. 2. Slip/Trips/Falls.	1. Wear reflective vest/ Stay away from tracks/ Do not cross tracks within 10 ft. of train car or when there is a train within view/listen for train horn. 2. Be aware of tripping hazards/ Follow good housekeeping procedures/ Mark significant hazards with spray paint or cones.
3. Walking around site	6. Uneven terrain 7. Wildlife: Stray animals, mice/rats, vectors (i.e. mosquitoes, bees, etc.) 8. Weather: Heat/cold stress 9. Slip/Trips/Falls 10. Foot injuries 11. Eye injuries	9. Pay attention to surrounding area (puddles, wet, frozen, uneven areas); Mark with cones or spray paint. 10. Use bug spray/ Avoid stray animals/Use repellent when needed. 11. Dress for the correct weather situation/ Use sunscreen or protective clothing in sunlight, layers in cold weather/ Drink plenty of fluids/ Take breaks when needed. 4. Be aware of tripping hazards/ Follow good housekeeping procedures/ Mark significant hazards with spray paint or cones. 5. Wear proper PPE (Langan approved safety shoes)/ Change wet socks during cold weather. 6. Wear proper PPE (safety glasses/goggles).
4. Working near road	1. Passing vehicles 2. Slip/Trips/Falls	1. Wear reflective vest/ Stay away from roadway/ Use buddy system/ Place signage or cones when needed. 2. Be aware of tripping hazards/ Follow good housekeeping procedures/ Mark significant hazards with spray paint or cones.
5. All activities	45. Slips/ Trips/ Falls 46. Hand injuries, cuts or lacerations during manual handling of materials 47. Foot injuries 48. Back injuries 49. Traffic	53. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 54. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 55. Wear Langan approved safety shoes





**JSA Title:** Building Construction Oversight

**JSA Number:** JSA006-01

A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.

**PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):**

<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Safety Goggles	<input checked="" type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input checked="" type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	
<input type="checkbox"/> Other:				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
30. Transport equipment to work area	24. Back Strain 25. Slips/ Trips/ Falls 26. Traffic 27. Cuts/abrasions from equipment 28. Contusions from dropped equipment	6. Use proper lifting techniques / Use wheeled transport 7. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 8. Wear proper PPE (high visibility vest or clothing) 9. Wear proper PPE (leather gloves, long sleeves) 10. Wear proper PPE (safety shoes)
31. Drilling/anchor bolt installation	8. Hazards associated with drilling, flying objects, heavy equipment, ground level hazards and dust 9. Slips/ Trips/ Falls 10. Hazards associated with concrete work	3. Maintain a safe distance from drilling operation / Wear proper PPE (hard hat, safety glasses, safety shoes, safety vest) 4. Be aware of potential trip hazards / Follow good housekeeping procedures / Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint / Wear the proper PPE (safety shoes) 5. Maintain a safe distance from pouring operation
32. Steel building erection	6. Overhead hazards, falling objects 7. Pinching/crushing hazards	5. Wear proper PPE (hard hat, safety glasses, safety vest) / Be aware of overhead hazards and maintain a safe distance of at least 10 ft. 6. All personnel should make others aware of moving objects or their intent to move objects / Avoid areas where pinching and crushing hazards are possible
33. All activities	55. Slips/ Trips/ Falls 56. Hand injuries, cuts or lacerations during manual handling of materials 57. Foot injuries 58. Back injuries 59. Traffic 60. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 61. High Noise levels 62. Overhead hazards	63. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 64. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 65. Wear Langan approved safety shoes 66. Use proper lifting techniques / Consider load location, task repetition, and load weight when evaluating what is safe or unsafe to lift / Obtain assistance when possible



**JSA Title:** Geotechnical Drilling

**JSA Number:** JSA014-01

**A Job Safety Analysis (JSA) must identify all job steps required to complete the task, the potential hazards employees could be exposed to while performing the job step and the preventative/corrective actions required to reduce/mitigate the identified potential hazards. Employees must certify that they have either prepared the JSA or have reviewed the JSA and are aware of the potential hazards associated with this task and will follow the provided preventive/corrective actions.**

PERSONAL PROTECTIVE EQUIPMENT (Required or to be worn as needed):				
<input checked="" type="checkbox"/> Safety Shoes	<input checked="" type="checkbox"/> Long Sleeves	<input checked="" type="checkbox"/> Safety Vest (Class 2)	<input checked="" type="checkbox"/> Hard Hat	<input checked="" type="checkbox"/> Hearing Protection
<input checked="" type="checkbox"/> Safety Glasses	<input type="checkbox"/> Safety Goggles	<input checked="" type="checkbox"/> Face Shield	<input checked="" type="checkbox"/> Nitrile Gloves	<input type="checkbox"/> PVC Gloves
<input checked="" type="checkbox"/> Leather Gloves	<input type="checkbox"/> Cut Resist. Gloves	<input type="checkbox"/> Fall Protection	<input type="checkbox"/> Fire Resistant Clothing	<input type="checkbox"/> Rubber Boots
<input type="checkbox"/> Insect/Animal Repellent	<input type="checkbox"/> Ivy Blocker/Cleaner	<input type="checkbox"/> Traffic Cones/Signs	<input type="checkbox"/> Life Vest/Jacket	
<input checked="" type="checkbox"/> Other: Nomex (as needed)				

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
34. Transport equipment to work area	29. Back Strain 30. Slips/ Trips/ Falls 31. Traffic 32. Cuts/abrasions from equipment 33. Contusions from dropped equipment	11. Use proper lifting techniques / Use wheeled transport 12. Minimize distance to work area / Have unobstructed path to work area / Follow good housekeeping procedures 13. Wear proper PPE (high visibility vest or clothing) 14. Wear proper PPE (leather gloves, long sleeves) 15. Wear proper PPE (safety shoes)
35. Set-up HSA/SPT rig	11. Slips/ Trips/ Falls 12. Pinch Hazards 13. High noise levels 14. Clothing entanglement 15. Electrocution/falling equipment and debris from raising HSA/SPT rig mast 16. Carbon monoxide poisoning 17. HSA/SPT rig roll-over 18. HSA/SPT rig movement	6. Be aware of potential trip hazards / Follow good housekeeping procedures / Mark significant below-grade hazards (i.e. holes, trenches) with safety cones or spray paint 7. Wear proper PPE (leather gloves) 8. Wear proper PPE (hearing protection) 9. Wear proper attire for HSA/SPT rig (no loose clothing, strings, etc.) 10. Wear proper PPE (hard hats) / Be aware of locations at all times / Look up, down and around before raising mast / Check HSA/SPT drill rig mast for loose objects/debris before raising 11. Stand upwind of rig engine 12. Do not move rig with mast raising / Set stabilizers prior to raising mast / Inspect work area / If area appears unstable, the boring locations should be moved. 13. All field personnel should stay clear of rig while moving / Use a spotter when backing up the rig
36. Advance HSA/SPT rods, augers and casing below ground surface	8. Strain wrist/bruise palm 9. Pinched fingers 10. Back strain 11. Clothing entanglement 12. Carbon monoxide poisoning 13. Bruised/Broken toes/feet	7. Wear proper PPE (leather gloves) / Use proper technique for preparing rods / Use second person, if necessary 8. Wear proper PPE (leather gloves) 9. Use proper lifting techniques / Obtain assistance if needed 10. Wear proper attire for HSA/SPT rig (no loose clothing, strings, etc.) 11. Stand upwind of the rig

JOB STEPS	POTENTIAL HAZARDS	PREVENTATIVE / CORRECTIVE ACTION
37. Advance HSA/SPT rods, augers and casing below ground surface (cont'd)	14. High noise levels	12. Wear proper PPE (safety shoes) 13. Wear proper PPE (hearing protection)
38. Remove and open split spoon	12. Pinched fingers 13. Cuts/lacerations 14. Skin contact with contaminated soil and groundwater	1. Wear proper PPE (nitrile and leather gloves) 2. Wear proper PPE (leather gloves) 3. Wear proper PPE (nitrile gloves, safety glasses)
39. Repeat steps 3 and 4 until desired depth is reached	1. See steps 3 and 4	1. See steps 3 and 4
40. Remove HSA/SPT rods, augers and casing and place in storage rack	1. Clothing entanglement 2. Back strain 3. Pinched fingers 4. Carbon monoxide poisoning 5. High noise levels	1. Wear proper attire for HSA/SPT rig (no loose clothing, strings, etc.) 2. Use proper lifting techniques / Obtain assistance if needed 3. Wear proper PPE (leather gloves) 4. Stand upwind of rig engine 5. Wear proper PPE (hearing protection)
41. Tremie-grout borehole with a cement-bentonite grout mixture	1. Splash cement/bentonite grout on face/eyes 2. Back strain 3. Pinched fingers	1. Wear proper PPE (safety glasses) 2. Use proper lifting techniques / Obtain assistance if needed 3. Wear proper PPE (nitrile gloves, leather gloves)
42. Decontaminate equipment	1. Contact with potentially impacted material 2. Contact with sharp pieces of equipment	1. Wear proper PPE (safety glasses, nitrile gloves) 2. Wear proper PPE (leather gloves)
43. Patch soil boring location to return to pre-existing conditions (i.e. concrete, asphalt, grass)	1. Cuts/lacerations 2. Splashed concrete on face/eyes 3. Hammer fingers/hands when patching asphalt	1. Wear proper PPE (leather gloves) / Use scissors for cutting 2. Use proper PPE (safety glasses) 3. Be aware of hands/fingers during hammering / Wear proper PPE (leather gloves)
44. All activities	65. Slips/ Trips/ Falls 66. Hand injuries, cuts or lacerations during manual handling of materials 67. Foot injuries 68. Back injuries 69. Traffic 70. Wildlife: Stray dogs, Mice/rats, Vectors (i.e. mosquitoes, bees, etc.) 71. High Noise levels 72. Overhead hazards 73. Heat Stress/ Cold Stress 74. Eye Injuries	73. Be aware of potential trip hazards / Follow good housekeeping procedures/ Mark significant hazards 74. Inspect for jagged/sharp edges, and rough or slippery surfaces / Keep fingers away from pinch points / Wipe off greasy, wet, slippery or dirty objects before handling / Wear leather/ cut-resistant gloves 75. Wear Langan approved safety shoes 76. Use proper lifting techniques / Consider load location, task repetition, and load weigh when evaluating what is safe or unsafe to lift / Obtain assistance when possible 77. Wear high visibility clothing & vest / Use cones or signs to designate work area 78. Be aware of surroundings at all times, including the presence of wildlife/ Do not approach stray dogs / Carry/use dog/animal repellant / Use bug spray when needed 79. Wear hearing protection 80. Wear hard hat / Avoid areas where overhead hazards exist.



# **ATTACHMENT H**

## **TAILGATE SAFETY BRIEFING FORM**

## **LANGAN TAILGATE SAFETY BRIEFING**

Date: \_\_\_\_\_

Time: \_\_\_\_\_

Leader: \_\_\_\_\_

Location: \_\_\_\_\_

Work Task:

---

---

### **SAFETY TOPICS (provide some detail of discussion points)**

Chemical Exposure Hazards and Control: \_\_\_\_\_

---

Physical Hazards and Control: \_\_\_\_\_

Air Monitoring: \_\_\_\_\_

PPE: \_\_\_\_\_

---

Communications: \_\_\_\_\_

Safe Work Practices: \_\_\_\_\_

---

Emergency Response: \_\_\_\_\_

Hospital/Medical Center Location: \_\_\_\_\_

Phone Nos.: \_\_\_\_\_

Other: \_\_\_\_\_

### **FOR FOLLOW-UP (the issues, responsibilities, due dates, etc.)**

---

---

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### **ATTENDEES**

PRINT NAME	COMPANY	SIGNATURE

---

# STORMWATER POLLUTION PREVENTION PLAN

for

**NYPD 116<sup>th</sup> Precinct Station House  
Block 13265, Lot 30  
244-04 North Conduit Avenue  
Queens, New York 11422**

*Prepared For:*

**NYC Department of Design and Construction  
30-30 Thomson Ave  
New York, NY 11101**

*Prepared By:*

**Langan Engineering, Environmental, Surveying, Landscape  
Architecture and Geology D.P.C.  
360 West 31<sup>st</sup> Street, 8<sup>th</sup> Floor  
New York, New York 10001**

---

**Christopher Vitolano  
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**WARNING:** IT IS A VIOLATION OF THE NYS  
EDUCATION LAW ARTICLE 145 FOR ANY  
PERSON, UNLESS HE IS ACTING UNDER THE  
DIRECTION OF A LICENSED PROFESSIONAL  
ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

**10 May 2019  
170495201**

**LANGAN**



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## 1.0 INTRODUCTION

The NYPD 116<sup>th</sup> Precinct ("Project") is located at 244-04 North Conduit Avenue, Queens, New York (See Figures 1, 2, and 3). The approximately 2.9-acre site is bound by North Conduit Avenue, two existing NYC DOT lots, and the Long Island Rail Road. The proposed development will construct a new multi-level police precinct stationhouse, existing police precinct satellite office, associated parking lots, fueling station and pedestrian plaza.

The proposed project will disturb more than one acre; therefore, the project must obtain coverage under the New York State Department of Environmental Conservation (NYSDEC) SPDES *General Permit for Stormwater Discharges from Construction Activity* (GP-0-15-002). The SPDES permit requires preparing a Stormwater Pollution Prevention Plan (SWPPP) and compliance with the NYS Stormwater Design Standards for Water Quality and Water Quantity.

The stormwater analyses presented here have been prepared in accordance with the following state standards:

- New York State Standards and Specifications for Erosion and Sediment Control, November 2016;
- New York State Department of Environmental Conservation (NYSDEC) Stormwater Management Design Manual, January 2015; and
- NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity Permit No. GP-0-15-002.

## 2.0 PROJECT/SITE DESCRIPTION

### 2.1 Existing Site Description

The eastern portion of the site and western edge of the site are developed with an asphalt at-grade parking lot and gravel parking area. The north east corner of the site consists of vegetation and trees. The western portion of the site is comprised of NYPD's 105<sup>th</sup> Precinct satellite building and an at-grade parking lot. There is a grass lawn fronting the 105<sup>th</sup> Precinct satellite building. Site grades range from approximate elevations of 25 feet to 21 feet (NAVD88 Datum). The site is bound to the north by North Conduit Avenue, to the south by the Long Island Rail Road, and by neighboring lots to the east and west.

The topography of the site generally runs from higher elevations at the northwest portion of the site to lower elevations along the eastern edge of the site. According to the site survey, existing stormwater runoff is collected in catch basins and conveyed within underground piping to dry wells where the stormwater is infiltrated.

A storm sewer borders the site to the north, ranging in size from 24-inch to 38-inch x 24-inch is located within North Conduit Avenue. A 10-inch sanitary sewer within North Conduit

Avenue borders the site the north. The sites existing storm flows are assumed to be infiltrated onsite through the on-site dry wells.

The entire site is located outside of any Special Flood Hazard Areas according to the latest preliminary Flood Insurance Rate Maps issued by FEMA (January 30, 2015). The relevant part of the FEMA Flood Insurance Rate Map is presented in the figures.

## **2.2 Soil Conditions**

According to the Natural Resources Conservation Service (NRCS) Soil Survey, on-site soils primarily consist of Urban land-Flatbush complex (0 to 3% slopes) (See Figure 6 – Soils Map). The NRCS classifies Urban land-Flatbush complex (UFA) as hydrologic soil group B. The south portion slopes up to the LIRR tracks. This portion of the site consists of Urban land-Greenbelt complex (15 to 25 percent slopes, low impervious surface). The NRCS classifies Urban land-Greenbelt complex (UGDI) as hydrologic soil group B.

## **2.3 Historic Structures, Archeological and Culture Resources**

The NYS Office of Parks, Recreation, and Historic Preservation (OPRHP) issued a letter on May 1, 2019, indicating that the proposed project will have no impact on archaeological and/or historic resources listed in or eligible for the New York State and National Registers of Historic Places (see Appendix G NYS OPRHP Cultural Resource Information System Response Letter).

## **3.0 STORMWATER DESIGN CRITERIA**

The project's design methodology for stormwater management including compliance with water quantity and quality requirements is as follows:

### **3.1 Water Quantity**

The proposed stormwater runoff from the site will be retained on-site. Stormwater quantity requirements are under the jurisdiction of the NYCDEP. The proposed stormwater system has been designed to comply with NYCDEP quantity regulations. (see Appendix D - Site Connection Proposal). For storm events exceeding the NYC DEP design storm, all flows that exceed the capacity of the retention chambers will pass through an overflow pipe that connects to the NYCDEP storm sewer.

### **3.2 Water Quality**

The water quality volume, denoted as  $WQ_v$ , is the volume of runoff dictated by NYSDEC methodology to capture and treat 90% of the average annual stormwater runoff volume to improve the quality of the runoff leaving the site. The  $WQ_v$  is directly related to the amount of contributory impervious coverage created at a project site. This volume is calculated using the following equation as prescribed by NYSDEC Stormwater Management Manual:

$$WQ_v = \frac{P R_v A}{12}$$

Where:

P = 90% rainfall event number (Figure 4.1 NYSDEC Manual)

$R_v = 0.05 + 0.009(I)$ , where I is percent impervious coverage

A = Contributory Site Area in Acres

This construction project includes both new development and redevelopment activities; therefore, a summation of the new development and redevelopment was used to determine the  $WQ_v$  for the project site. The stormwater management practices for the new development portion of the project were designed in accordance with the sizing criteria in Chapter 4 of the NYSDEC Stormwater Management Manual, and the redevelopment activities portion of the project were designed in accordance with the sizing criteria in Chapter 9.

In addition, the runoff reduction volume (RRv) requirement requires that the water quality volume is reduced by application of a combination of green infrastructure and standard stormwater management with RRv capacity practices. The RRv is calculated using the following equation as prescribed by NYSDEC Stormwater Management Manual:

$$RRv = \frac{P R_v A_i}{12}$$

Where:

P = 90% rainfall event number (Figure 4.1 NYSDEC Manual)

$R_v = 0.05 + 0.009(I)$ , where I is 100 percent impervious

$A_i = (S)(A_{ic})$

$A_{ic}$  = Total area of new impervious cover

S = Hydrologic Soil Group Specific Reduction Factor

We evaluated the green infrastructure and  $WQ_v$  treatment methods identified in the current NYSDEC Stormwater Management Design Manual and selected the most appropriate methods to treat the stormwater for the project site. The site is designed to treat over 100% of the  $WQ_v$  and will meet the minimum RRv requirement, which is discussed in greater detail in Section 4.2 of this report.

## **4.0 PROPOSED STORMWATER MANAGEMENT DESIGN**

### **4.1 Proposed Development**

The proposed development includes the construction of a 45,000-square-foot two story building with a below-grade cellar in the eastern portion of the site. A new at-grade parking lot will border the new building to the south. The building will be occupied by the NYPD as their 116<sup>th</sup> Precinct stationhouse. The existing NYPD 105<sup>th</sup> Precinct satellite office building

will remain on the western portion of the site. A new at-grade parking lot will boarder the existing building to the north. A new pedestrian plaza will be constructed in between the 116<sup>th</sup> Stationhouse and 105<sup>th</sup> satellite office building.

Under present conditions, stormwater runoff throughout the site sheet flows to on-site catch basins. Storm runoff from the existing building collects in roof gutters and connect to the site storm drainage system. The site storm drainage system is then routed to a series of drywells and infiltrated. There is no evidence of any existing stormwater connections from the site to the existing storm sewers North Conduit Avenue.

Under the proposed conditions, all stormwater runoff will be retained onsite. Runoff from the site will be collected in on-site catch basins. Storm runoff from the proposed and existing buildings will be collected by roof drains and gutters. Stormwater from the catch basins and buildings will be conveyed to the proposed infiltration chambers located beneath the parking surfaces. There are four separate retention systems consisting of infiltration chambers and stone spaced around the project site. Each retention system has been sized accordingly to its tributary area. The stormwater will then be infiltrated, in accordance with NYCDOB and NYCDEP criteria. The proposed site connection has been approved by the NYCDEP.

#### **4.2 Proposed Water Quality**

The NYSDEC Stormwater Management Design Manual (Manual) requires that water quality treatment of 90% of the average annual stormwater runoff volume be provided. The water quality volume (WQ<sub>v</sub>) is directly associated to the quantity of proposed impervious area within a project site.

Redevelopment projects require 50% removal of Total Suspended Solids (TSS) for 75% of the calculated WQ<sub>v</sub>. New construction projects are required to treat for 80% removal of TSS for 100% of the calculated WQ<sub>v</sub>. The total required WQ<sub>v</sub> for the site was calculated based on the summation of the WQ<sub>v</sub> for the portion of the site that is considered new development and the WQ<sub>v</sub> for the portion of the site that is considered redevelopment, which was multiplied by a factor of 0.75. Treatment of the WQ<sub>v</sub> will be provided by infiltration practices that capture and temporarily store the WQ<sub>v</sub> before allowing it to infiltrate into the soil. Per the Manual, infiltration practices meet the established water quality goals. (See Appendix C – Water Quality).

Building roof runoff and site surface runoff will be conveyed to infiltration systems located throughout the site. There are four localized infiltration systems located throughout the site designed to capture runoff near the source. The runoff reduction volume (RRv) requirements are satisfied by providing infiltration that exceeds the minimum required RRv. The RRv calculations are included in Appendix C. Infiltration is an approved practice for water quality treatment to achieve 80% TSS and 40% TP removal and for runoff reduction.

## **5.0 EROSION AND SEDIMENT CONTROLS**

### **5.1 Erosion and Sediment Control Measures**

Temporary and permanent soil erosion and sediment control measures have been designed and located to minimize the amount of sediment carried by stormwater runoff and discharge to adjacent surface waters or to on-site drainage structures. The soil erosion and sediment control design was completed in accordance with the "New York State Standards and Specifications for Erosion and Sediment Control," November 2016. The following summarizes the planned erosion and sediment control practices for the project.

#### Silt Fence

A 20-inch high silt fence shall be placed along the down gradient edge of the site. The purpose of the silt fencing is to reduce the runoff velocity and encourage deposition of any sediment before it leaves the site. The filter cloth shall be embedded securely in the ground as per the standard detail. Silt fencing shall be inspected regularly for fabric integrity, embedded depth and sediment accumulation. A silt fence shall also encircle temporary stockpile areas.

#### Inlet Protection

All new catch basins and area drains within the limit of disturbance or in the vicinity of construction activities shall have fabric inlet protection installed to prevent sediment-laden runoff from entering the storm drain system. The fabric shall be securely fastened on a frame and staked and embedded into the ground. Inlet protection for inlets located within paved areas shall be installed in accordance with the standards and include, but are not limited to, products such as compost filter socks, sand bags, and manufactured surface barriers. The inlet protection shall be inspected regularly for fabric integrity, embedded depth and sediment accumulation.

#### Vegetative Measures

Any disturbed area where the earthwork is completed and not subject to construction traffic, should not be left exposed more than 14 days and shall immediately receive a temporary seeding in accordance with the "New York State Standards and Specifications for Erosion and Sediment Control", November 2016. Mulch may be used if the season prevents the establishment of a temporary cover. Permanent stabilization shall be performed as soon as possible after completion of grading.

#### Stabilized Construction Access

A stabilized pad of aggregate underlain with filter fabric shall be located at the site entrance to reduce or eliminate the tracking of sediment onto surrounding streets. The pad thickness

shall be constantly maintained to the specified dimensions by adding rock. At the end of each construction day, all sediment deposited on surrounding streets shall be removed and returned to the site.

#### Temporary Stockpile

If needed, stockpiles shall be within the work area and encircled with a silt fence to prevent the spread of sediment from the stockpile to the rest of the site outside of the work area. To the extent practicable, stockpiles shall be located at least 20 feet from fences, catch basins and site boundaries. Any temporary stockpile inactive for more than 14 days shall be stabilized or covered. Permanent stabilization shall be performed as soon as possible after completion of grading.

#### Temporary Perimeter Dike/Swale

If needed, temporary swales will be constructed to direct flows away from site boundaries. The swales shall be constructed in accordance with the New York State Standards and Specifications for Erosion and Sediment Control and as needed throughout construction, and shall be directed towards appropriately sized sediment trapping device, or other collection area for removal, to prevent sediment from entering the city right of way.

#### Temporary Sediment Basins and Traps

Temporary sediment basins and traps shall be constructed to intercept sediment laden runoff, reduce the amount of sediment leaving the disturbed areas, and protect drainage ways, properties, and rights-of-way. Temporary sediment basins and traps shall be inspected at least every seven days. All damage caused by soil erosion and construction equipment shall be repaired upon discovery. Accumulated sediment shall be removed from the sediment basin or trap when it reaches 50 percent of the design capacity and must not exceed 50 percent. Sediment must not be placed downstream from the embankment, adjacent to a stream, or floodplain. Sediment traps shall be sized to retain the required storage volume of 3,600 CF per acre of drainage area. Discharge from the sediment trap shall be in accordance with New York State Standards and Specifications for Erosion and Sediment Control criteria, i.e. infiltration, pumped to tank, or discharge to the city sewer with appropriate DEP permitting.

### **5.2 Other Controls**

#### Waste Disposal

Solid, sanitary and toxic waste must be disposed of properly in accordance with local, state and federal regulations. It is prohibited to burn, bury or pour out onto ground or into the storm sewers any solvents, paints, stains, gasoline, diesel fuel, used motor oil, hydraulic fluid, anti-freeze, cement curing compounds, or other toxic or hazardous wastes. Wash out of cement trucks should occur in a designated diked area where the washings can be collected and



disposed of properly when they harden. The contractor shall be responsible for proper disposal of all waste off site.

#### Dust Control

Generation of dust shall be minimized by limiting the extent of exposed soils and reestablishing vegetative cover in these areas as soon as possible. Additional and/or temporary methods to minimize dust may include wetting, mulching, spray adhesives, stone covering, and wind barriers.

### **5.3 Construction Sequence**

The Overall Soil Erosion and Sediment Control Plan includes a general sequence of construction. A detailed sequence of construction and phasing plans are being developed by the contractor and shall be kept in the SWPPP upon completion. The contractor is required to keep the SWPPP updated with the most current construction schedule. Refer to the Soil Erosion and Sediment Control Plans and Detail Sheet in the plan set for additional details. Contractor shall adjust and implement proposed and additional soil erosion and sediment control and stormwater management control measures as needed to coordinate with detailed construction schedule as part of means and methods of construction. Contractor shall ensure that adequate soil erosion and sediment control and stormwater management control measures are provided at all times.

### **5.4 Stabilization**

The contractor shall initiate stabilization measures as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site that has temporarily or permanently ceased. This requirement does not apply in the following instance:

Where the initiation of stabilization measures by the 14th day after construction activity temporarily or permanently ceased is precluded by snow cover or frozen ground conditions, stabilization measures shall be initiated as soon as practicable.

### **5.5 Inspections/Reporting**

Unless otherwise notified by the NYSDEC, the owner or operator shall have a qualified inspector conduct site inspections in accordance with the permit requirements; for a site with on-going soil disturbance activities, a qualified inspector shall conduct a site inspection at least once every seven calendar days.

At a minimum, each inspection report shall include and/or address the following:

1. Date and time of inspection;

2. Name and title of person(s) performing inspection;
3. A description of the weather and soil conditions (e.g. dry, wet, saturated) at the time of inspection;
4. A description of the condition of the runoff at all points of discharge from the construction site. This shall include identification of any discharges of sediment from the construction site. Include discharges from conveyance systems (i.e. pipes, culverts, ditches, etc.) and overland flow;
5. Identification of all erosion and sediment control practices that need repair or maintenance;
6. Identification of all erosion and sediment control practices and pollution prevention measures that were not installed properly or are not functioning as designed and need to be reinstalled or replaced;
7. Description and sketch of areas with active soil disturbance activity, areas that have been disturbed but are inactive at the time of the inspection, and areas that have been stabilized (temporary and/or final) since the last inspection;
8. Current phase of construction of all post-construction stormwater management practices and identification of all construction that is not in conformance with the SWPPP and technical standards;
9. Corrective action(s) that must be taken to install, repair, replace or maintain erosion and sediment control practices; and to correct deficiencies identified with the construction of the post-construction stormwater management practice(s);
10. Identification and status of all corrective actions that were required by previous inspection; and
11. Digital photographs, with date stamp, clearly showing the condition of all practices that have been identified as needing corrective actions. The qualified inspector shall attach paper color copies of the digital photographs to the inspection report being maintained onsite within seven calendar days of the date of the inspection. The qualified inspector shall also take digital photographs, with date stamp, that clearly show the condition of the practice(s) after the corrective action has been completed. The qualified inspector shall attach paper color copies of the digital photographs to the inspection report that documents the completion of the corrective action work within seven (7) calendar days of that inspection.

The qualified inspector shall notify the owner or operator and appropriate contractor (or subcontractor) of any corrective actions that need to be taken. The contractor (or subcontractor) shall begin implementing the corrective action within one business day of this notification and shall complete the corrective actions in a reasonable amount of time. All inspection reports shall be signed by the qualified inspector.

The construction manager shall maintain a record of all inspection reports in a site log book. An example is provided in Appendix E. The site log book shall be maintained on site and be made available to the permitting authority upon request. The construction manager shall post at the site in a publicly accessible location, a summary of the site inspection activities on a monthly basis. The construction manager shall prepare a written summary confirming its compliance with the SWPPP at a minimum frequency of every month.

Before filing the Notice of Termination (NOT) or the end-of-permit term, the owner/operator shall have the qualified inspector perform a final site inspection. The qualified inspector shall certify that all disturbed areas have achieved final stabilization, and all temporary erosion and sediment control measures have been removed and that all post-construction stormwater management practices have been constructed in conformance with the SWPPP by signing the "Final Stabilization" and "Post-Construction Stormwater Management Practice" certification statements on the NOT.

## **5.6 Installation and Maintenance**

The contractor shall be responsible for installing and maintaining all temporary erosion control measures. The contractor shall also be responsible for installing permanent control measures. The operator shall be responsible for maintaining all permanent control measures.

All temporary erosion control measures installed on the project site shall be observed and maintained to ensure that they are operating as intended as follows:

- Temporary measures will be inspected by the contractor. Any necessary repairs, replacements, or upgrades will be made immediately.
- Accumulated sediments will be removed as required to keep the measures functional. In the case of silt fencing and hay bales (if applicable), remove deposits where accumulations reach ½ the height of the fence or bale. In the case of sediment traps, remove deposits whenever their capacity has been reduced by 50% from the design capacity.
- All erosion of the silt fence will be repaired immediately with compacted backfill.
- Disturbed areas, stockpile areas, areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system or downstream.
- Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.
- Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

- The permanent storm drainage system shall be inspected and cleaned of all sediment before completion of project.

## **6.0 STORMWATER MANAGEMENT FACILITY MAINTENANCE**

Stormwater management facilities for the project site have been designed for long-term water quality and water quantity performance. Sample checklists have been provided as part of Appendices E and F. Refer to Appendix F for the maintenance requirements for the Contech ChamberMaxx infiltration system.

## **7.0 CONTRACTOR RESPONSIBILITY**

The NYC Department of Design and Construction is responsible for ensuring that all contractors and subcontractors associated with site-work construction activities identified within the SWPPP agree to implement applicable provisions of the SWPPP and sign a copy of the contractor's certification statement (see Appendix H) before construction begins.

## **8.0 SWPPP CERTIFICATION STATEMENT**

The NYC Department of Design and Construction is the owner/operator of the project for the purpose of this permit (see Appendix I). The owner/operator must sign a copy of the owner/operator certification statement before the NOI can be submitted. If the electronic NOI is submitted by the SWPPP preparer, then the SWPPP Preparer Form must be filled out before submitting the electronic NOI.

## **9.0 RETENTION OF RECORDS**

The owner/operator, NYC Department of Design and Construction, must keep the SWPPP current so that it at all times accurately documents the erosion and sediment control practices being used or will be used during construction, and all post-construction stormwater management practices that will be constructed on the site. At a minimum, the owner or operator shall amend the SWPPP:

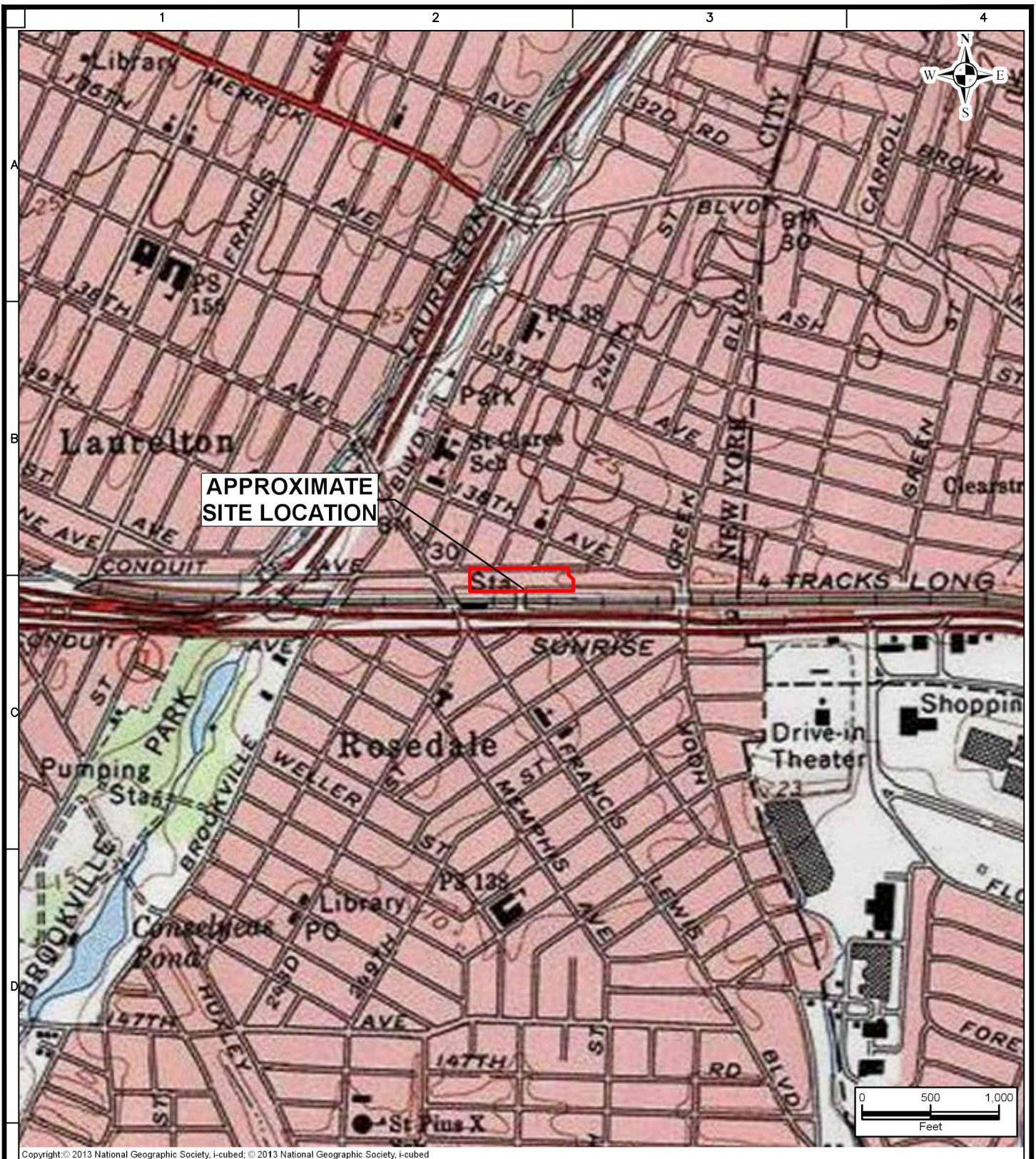
- Whenever the current provisions prove to be ineffective in minimizing pollutants in stormwater discharges from the site;
- Whenever there is a change in design, construction, or operation at the construction site that has or could have an effect on the discharge of pollutants; and
- To address issues or deficiencies identified during an inspection by the qualified inspector, the New York State Department of Environmental Conservation or other regulatory authority.

The owner/operator, NYC Department of Design and Construction, shall retain a copy of the most current SWPPP at the construction site from the date construction begins at the site until the date construction at the site is completed and the Notice of Termination is submitted.

The owner/operator, NYC Department of Design and Construction, shall retain a copy of the NOI, NOI Acknowledgment Letter, SWPPP, and any inspection reports that were prepared in conjunction with this permit for at least five years from the date the site achieves final stabilization, unless NYSDEC specifies another period in writing.

## FIGURES





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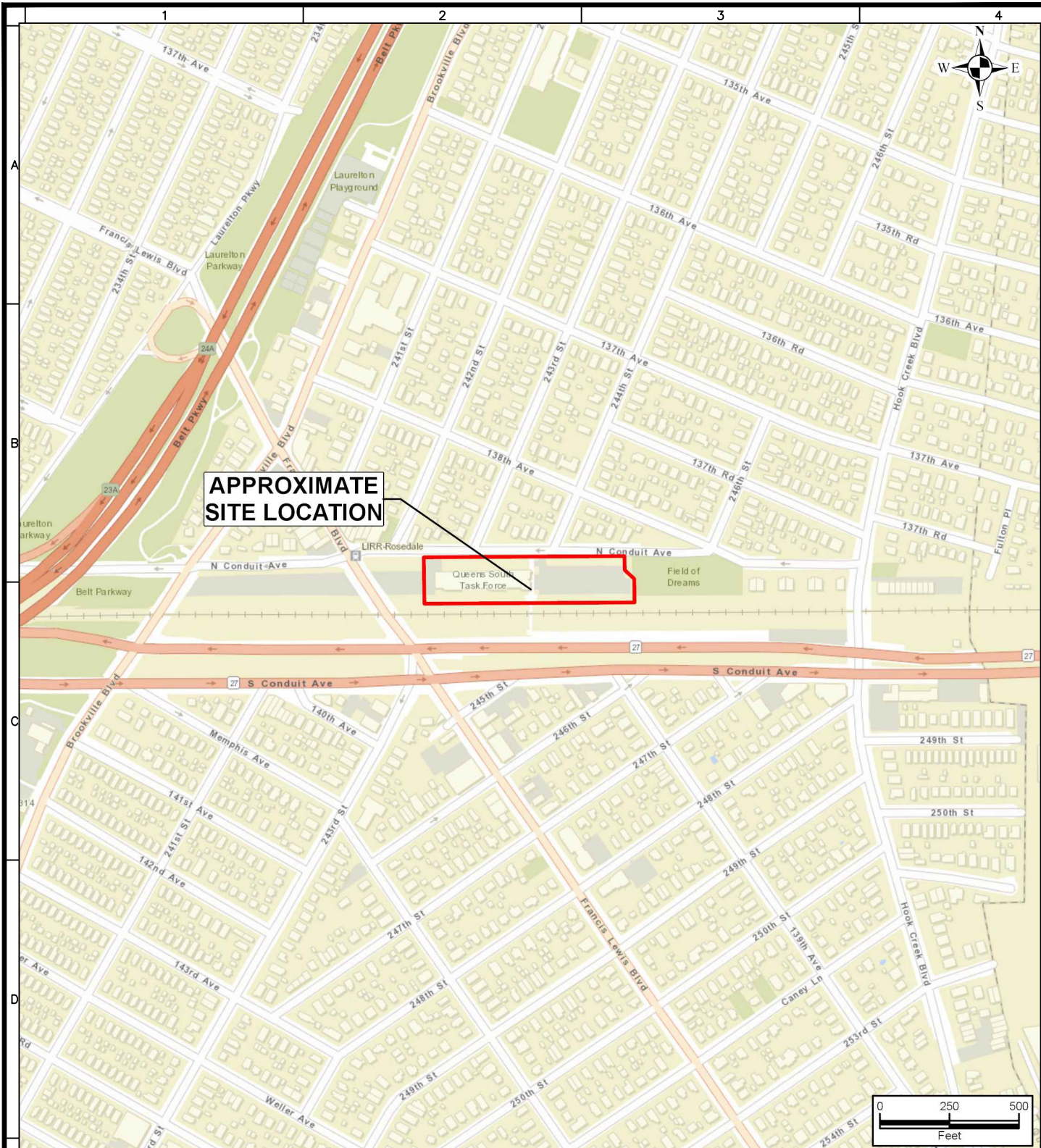
Project  
**NYPD 116TH  
PRECINCT**  
BLOCK No. 13265, LOT No. 30  
QUEENS NEW YORK

Drawing Title  
**SITE LOCATION  
MAP**

Project No.  
170495201  
Date  
04/24/2019  
Drawn By  
KR/BC/JH  
Checked By  
CTV

Figure No.  
**1**  
Sheet 1 of 1





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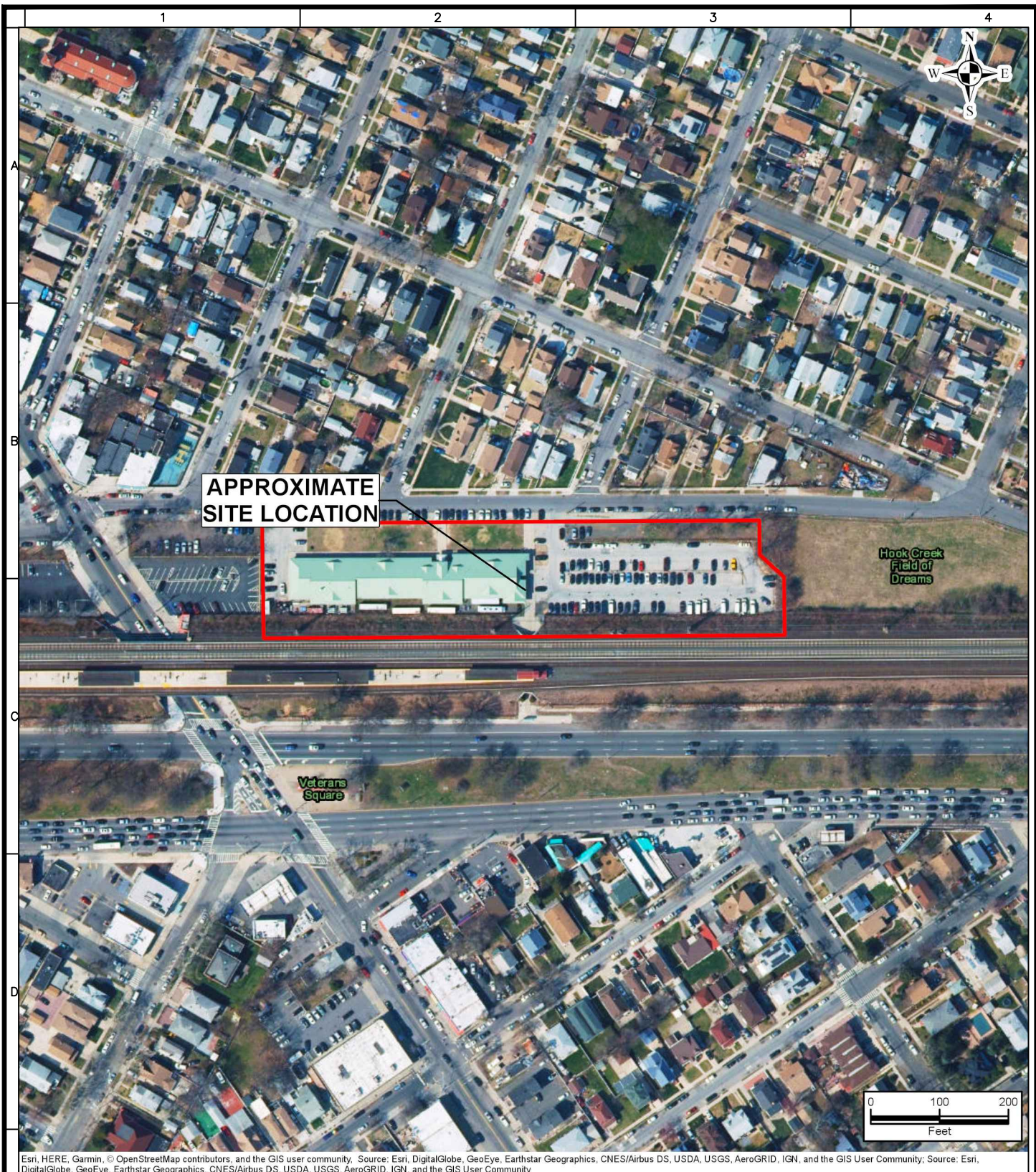
Project  
**NYPD 116TH  
PRECINCT**  
BLOCK No. 13265, LOT No. 30  
QUEENS NEW YORK

Drawing Title  
**VICINITY MAP**

Project No.  
170495201  
Date  
04/24/2019  
Drawn By  
KR/BC/JH  
Checked By  
CTV

Figure No.  
**2**  
Sheet 1 of 1





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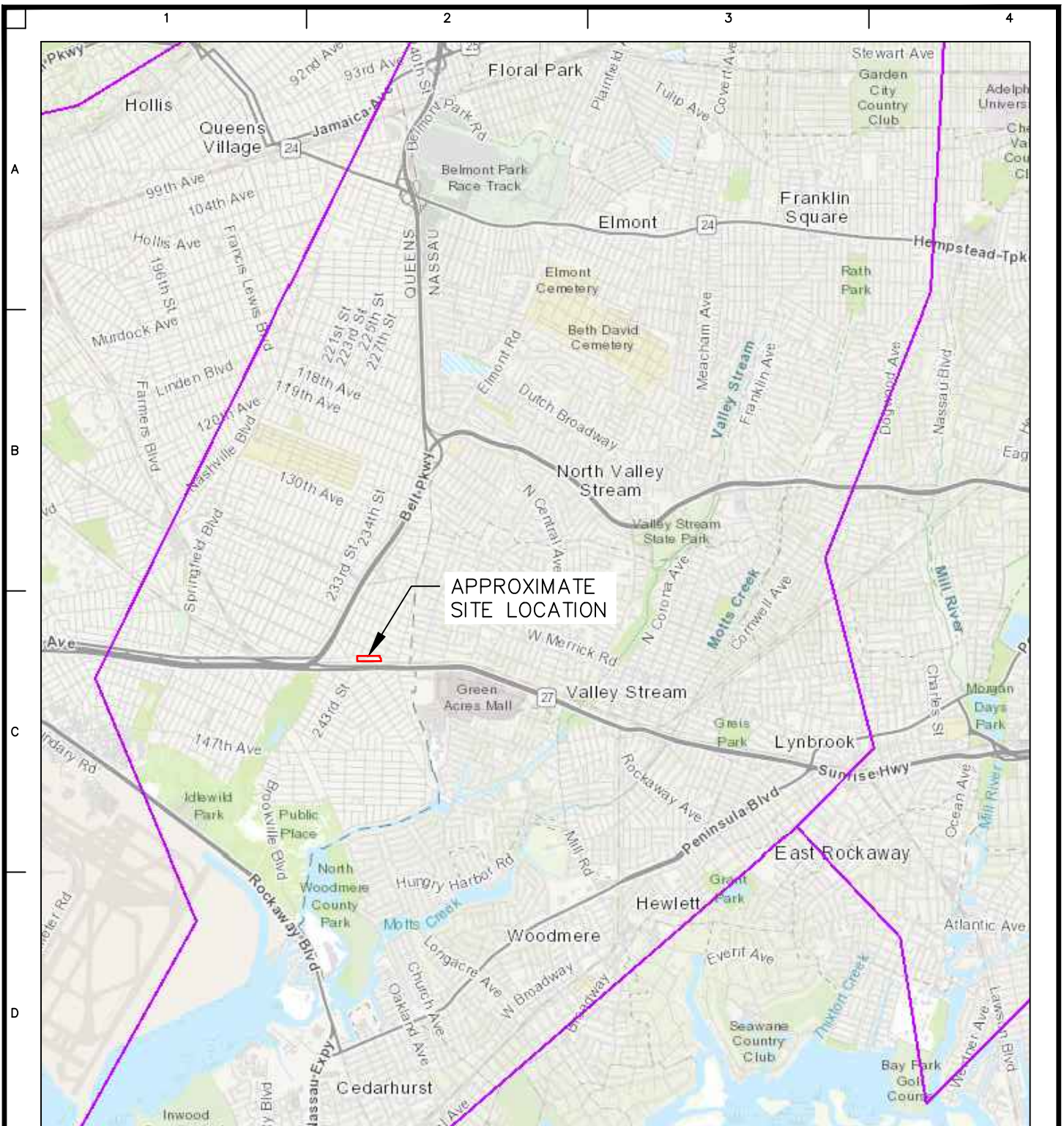
Project  
**NYPD 116TH  
 PRECINCT**  
 BLOCK No. 13265, LOT No. 30  
 QUEENS NEW YORK

Drawing Title  
**AERIAL  
 PHOTOGRAPH**

Project No.  
 170495201  
 Date  
 04/24/2019  
 Drawn By  
 KR/BC/JH  
 Checked By  
 CTV

Figure No.  
**3**  
 Sheet 1 of 1





Map References: Aerial Imagery Provided by ESRI World Aerial Imagery Basemap (2019)

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## LEGEND

- Approximate Site Location
- HUC-12 Watersheds

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Project

**NYPD 116TH  
PRECINCT**

BLOCK No. 13265, LOT No. 30  
QUEENS

QUEENS

NEW YORK

Drawing Title

**HUC-12  
WATERSHED  
MAP**

Project No.

170495201

Date

04/24/2019

Drawn By

KR/BC/JH

Checked By

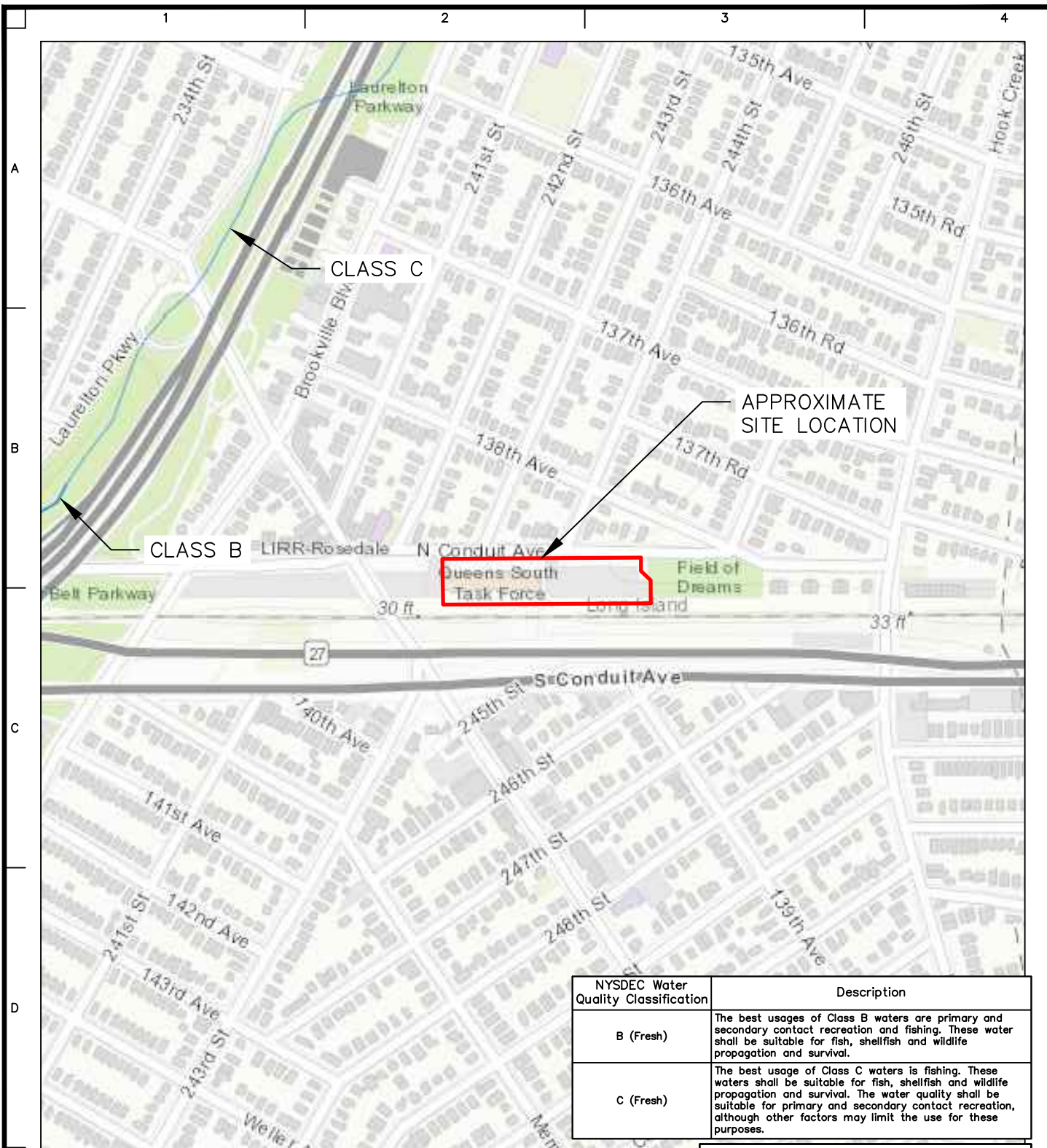
CTV

Figure No.

**4**

Sheet 1 of 1





Map References: Aerial Imagery Provided by ESRI World Aerial Imagery Basemap (2019)

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NYSDEC Water Quality Classification	Description
B (Fresh)	The best usages of Class B waters are primary and secondary contact recreation and fishing. These water shall be suitable for fish, shellfish and wildlife propagation and survival.
C (Fresh)	The best usage of Class C waters is fishing. These waters shall be suitable for fish, shellfish and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

## LEGEND

- Approximate Site Location
- NYSDC Surface Waterbody

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**NYPD 116TH  
PRECINCT**

BLOCK No. 13265, LOT No. 30  
QUEENS

QUEENS

NEW YORK

Drawing Title

**NYSDEC  
SURFACE  
WATERS MAP**

Project No.

170495201

Date

04/24/2019

Drawn By

KR/BC/JH

Checked By

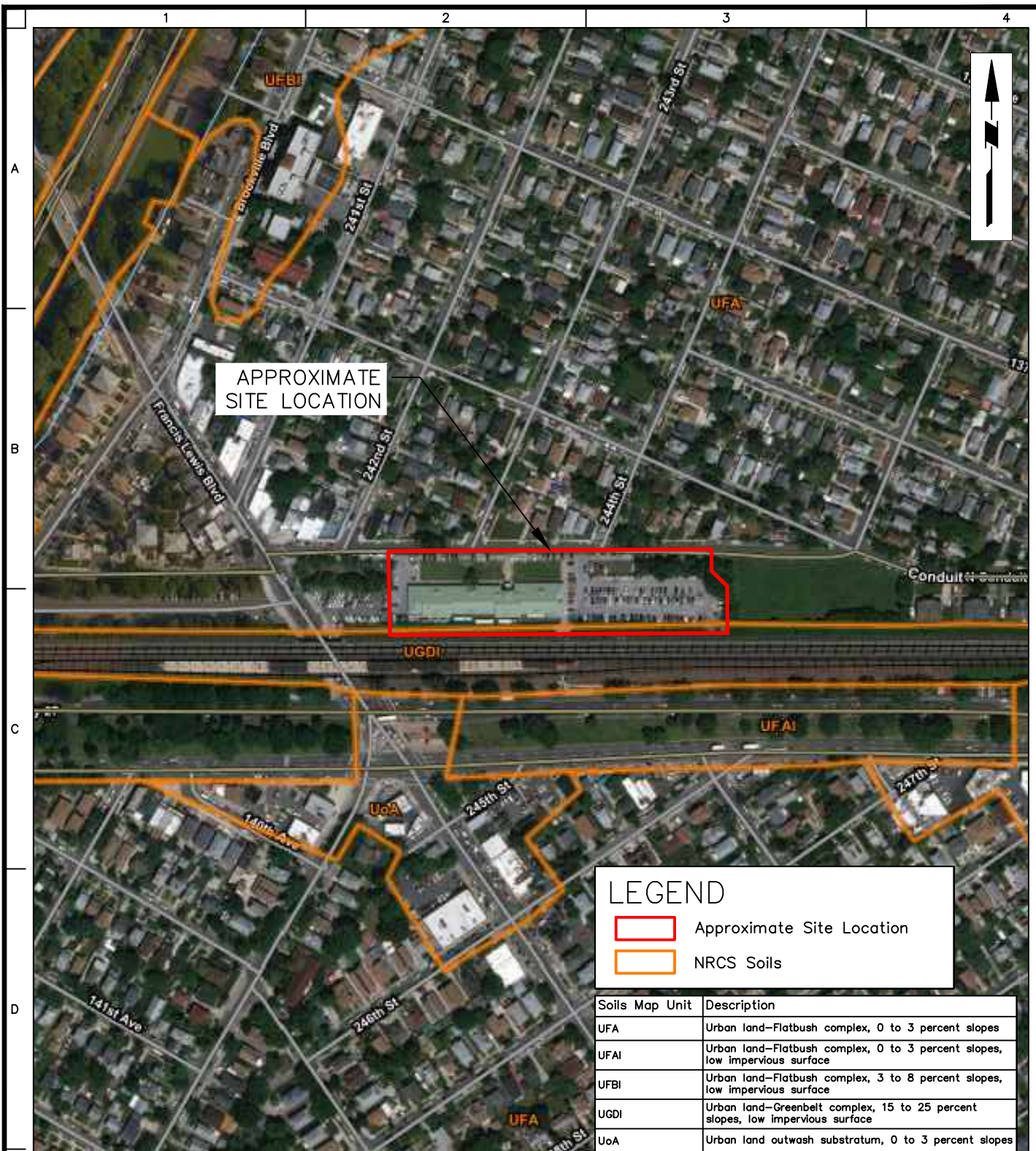
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Figure No.

**5**

Sheet 1 of 1





Map References: Aerial Imagery Provided by ESRI World Aerial Imagery Basemap (2019)

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Project

**NYPD 116TH  
PRECINCT**

BLOCK No. 13265, LOT No. 30  
QUEENS QUEENS

QUEENS

NEW YORK

Drawing Title

**NRCS SOILS  
MAP**

Project No.

170495201

Date

04/24/2019

Drawn By

KR/BC/JH

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CTV

Figure No.

**6**

Sheet 1 of 1





Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; FEMA RiskMap CDS

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Project

**NYPD 116TH  
PRECINCT**

BLOCK No. 13265, LOT No. 30  
QUEENS QUEENS

QUEENS

NEW YORK

Drawing Title

**FEMA  
PRELIMINARY  
FIRM MAP**

Project No.

170495201

Date

04/24/2019

Drawn By

KR/BC/JH

Checked By

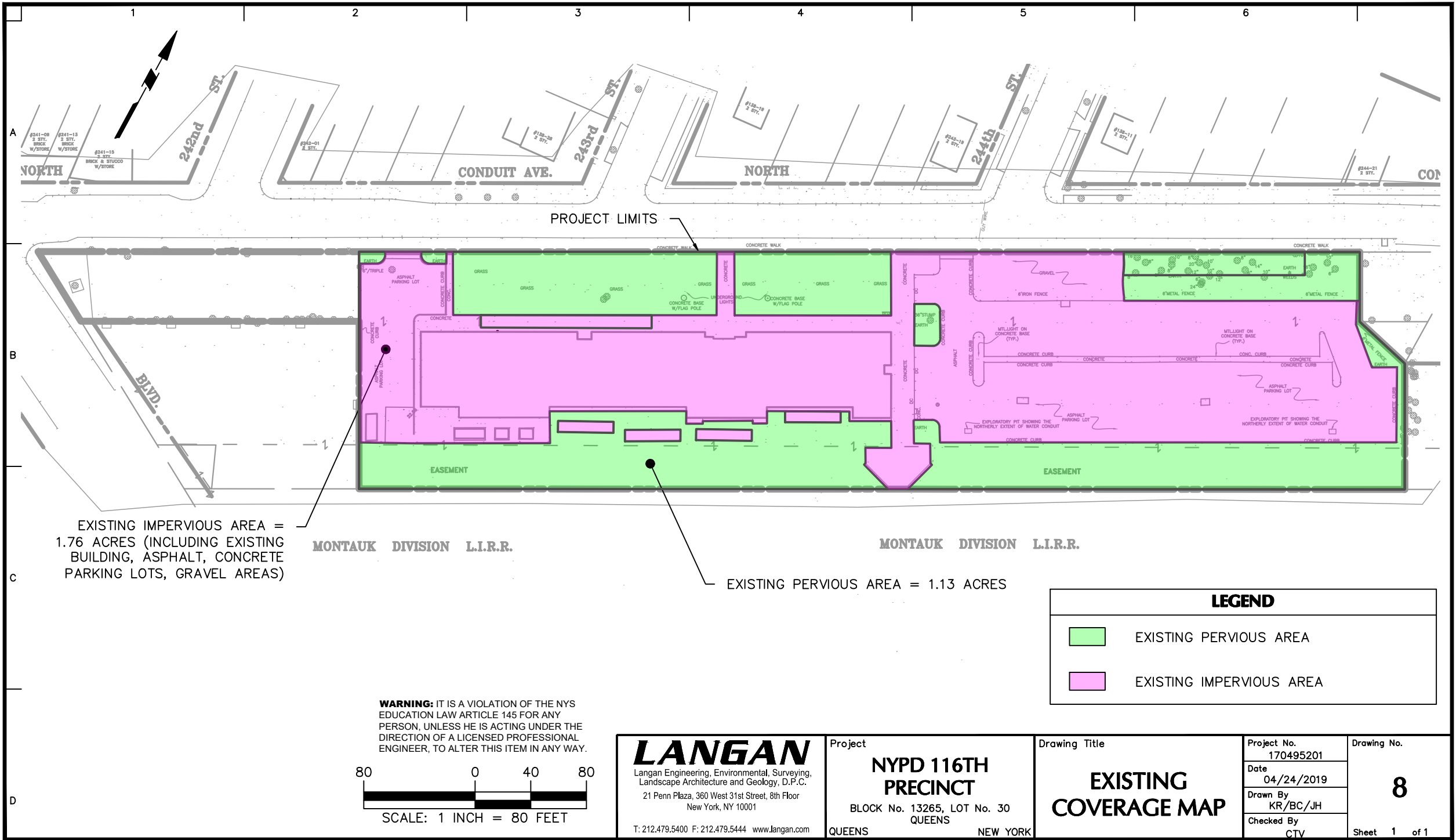
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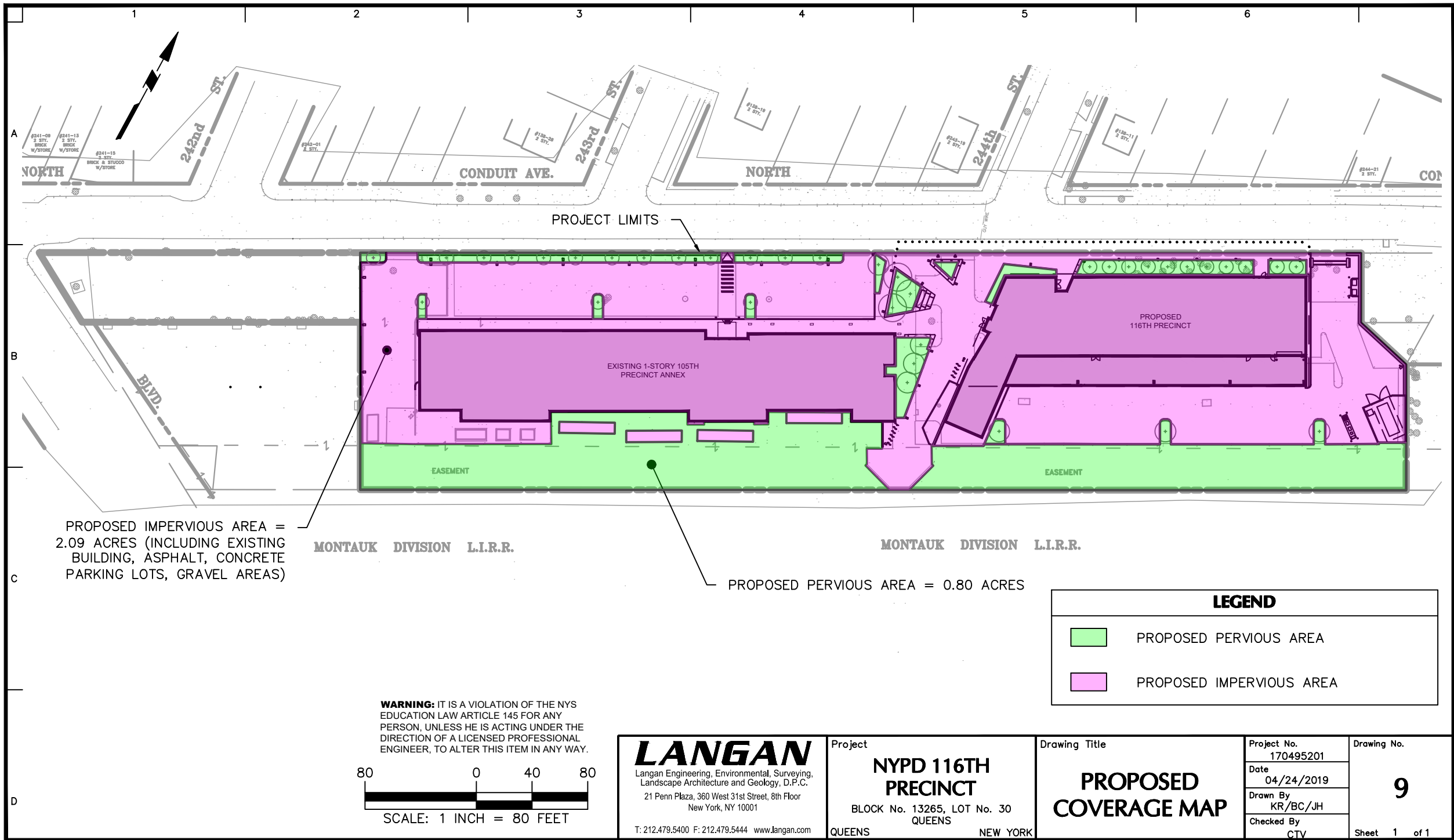
Figure No.

**7**

Sheet 1 of 1

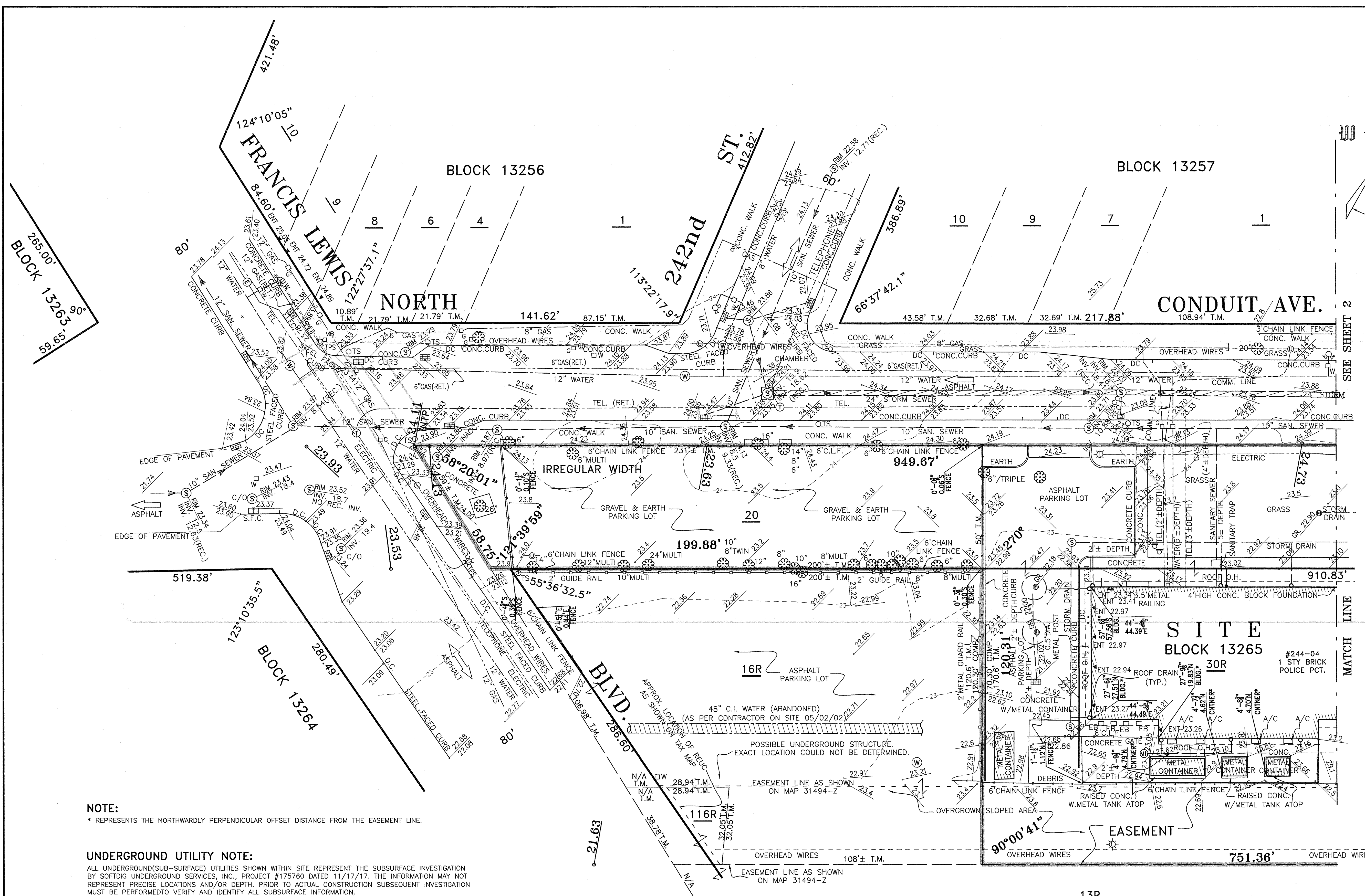






## **DRAWINGS**





### LEGEND

LEGAL GRADE .....  
 INTERPOLATED GRADE .....  
 EXISTING ELEVATION .....  
 OFFSETS .....  
 BUILDING .....  
 WALLS .....  
 FENCE .....  
 GUIDE RAIL .....  
 SEWER .....  
 WATER .....  
 GAS .....  
 ELECTRIC .....  
 TELEPHONE .....  
 FIRE ALARM & OR CABLE .....  
 STEAM .....  
 OVERHEAD UTILITY LINE .....  
 U.S. PIERHEAD LINE .....  
 U.S. BULKHEAD LINE .....  
 U.S. PIERHEAD & BULKHEAD LINE .....  
 CATCHBASIN .....  
 FIRE HYDRANT .....  
 VALVE .....  
 TREE & TRUNK DIAMETER .....  
 DEPRESSED CURB .....  
 TAX LOT NUMBER .....  
 TAX LOT LINE & DIMENSION .....  
 EASEMENT LINE .....  
 STREET LINE & DIMENSION .....  
 SITE LINE & DIMENSION .....  
 LOT CROSSES LINE .....  
 PAINTED LINE .....

**SYMBOLS**

MANHOLES  
 (S) SEWER  
 (E) ELECTRIC  
 (S) STEAM  
 (S) SUBWAY  
 (M) MANHOLE (NO ID)  
 (S) FROM RECORD MAP  
 (W) WATER  
 (G) GAS  
 (F) N.Y.F.D.  
 (T) TELEPHONE  
 (E) BECO or CTES  
 (C) CABLE TV IRON

OTS  
 (P) PARKING METER  
 (C) COAL CHUTE  
 (V) VENT PIPE  
 (F) FIRE ALARM BOX  
 (T) TRAFFIC CONTROL BOX  
 (M) MUNI METER  
 (M) MAILBOX  
 (P) PAY PHONE  
 (E) ELECTRIC BOX  
 (F) OIL FILL  
 (M) MONUMENT  
 (S) STANDPIPE  
 (S) SPRINKLER  
 (R) ROUND DRAIN  
 (S) SQUARE DRAIN  
 (S) SIGN  
 (B) BORING HOLE  
 (M) MONITORING WELL  
 (W) LINKWIRE WIFI

GUY WIRE  
 (T) TRAFFIC SIGNAL  
 (PS) PEDESTRIAN SIGNAL  
 (TPS) TRAFFIC SIGNAL W/PEDESTRIAN SIGNAL  
 (W) WOOD UTILITY POLE  
 (W-F) WOOD UTILITY POLE W/FIRE ALARM BOX  
 (W-PS) WOOD UTILITY POLE W/PEDESTRIAN SIGNAL  
 (W-T) WOOD UTILITY POLE W/TRAFFIC SIGNAL  
 (W-TPS) WOOD UTILITY POLE W/TRAFFIC SIGNAL & PED. SIGNAL  
 (W-L) WOOD UTILITY POLE W/STREET LIGHT  
 (W-L-PS) WOOD UTILITY POLE W/STREET LIGHT & FIRE ALARM BOX  
 (W-L-TPS) WOOD UTILITY POLE W/STREET LIGHT & PEDESTRIAN SIGNAL  
 (W-L-T) WOOD UTILITY POLE W/STREET LIGHT & TRAFFIC SIGNAL  
 (W-L-TPS) WOOD UTILITY POLE W/STREET LIGHT, TRAF. SIGNAL & PED. SIGNAL  
 (PS) METAL STREET LIGHT W/PEDESTRIAN SIGNAL  
 (T) METAL STREET LIGHT W/TRAFFIC SIGNAL  
 (TPS) METAL STREET LIGHT W/TRAFFIC SIGNAL & PEDESTRIAN SIGNAL

**NOTES**

ALL ELEVATIONS SHOWN ON THIS SURVEY REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1888 (NAVD88). TO CONVERT THIS DATUM TO QUEENS HIGHWAY DATUM, SUBTRACT 1.625 FEET FROM EACH ELEVATION. PROPOSED ELECTRICAL LINES WITHIN PROPERTY ARE TAKEN FROM 1837-1 PLAN PROVIDED BY NYCCDC.

ALL SUBSURFACE INFORMATION SHOWN IS TAKEN FROM VARIOUS MAPS AND IS NOT GUARANTEED FOR ACCURACY OR COMPLETENESS. CONSULT WITH THE APPROPRIATE UTILITY COMPANY PRIOR TO ANY DESIGN IMPROVEMENTS.

ALL DIMENSIONS SHOWN ARE IN THE U.S. STANDARD OF MEASUREMENT.

ALL ENCROACHMENTS SHOWN TO POLES OR TREES REFER TO THE CENTER OF SAME.

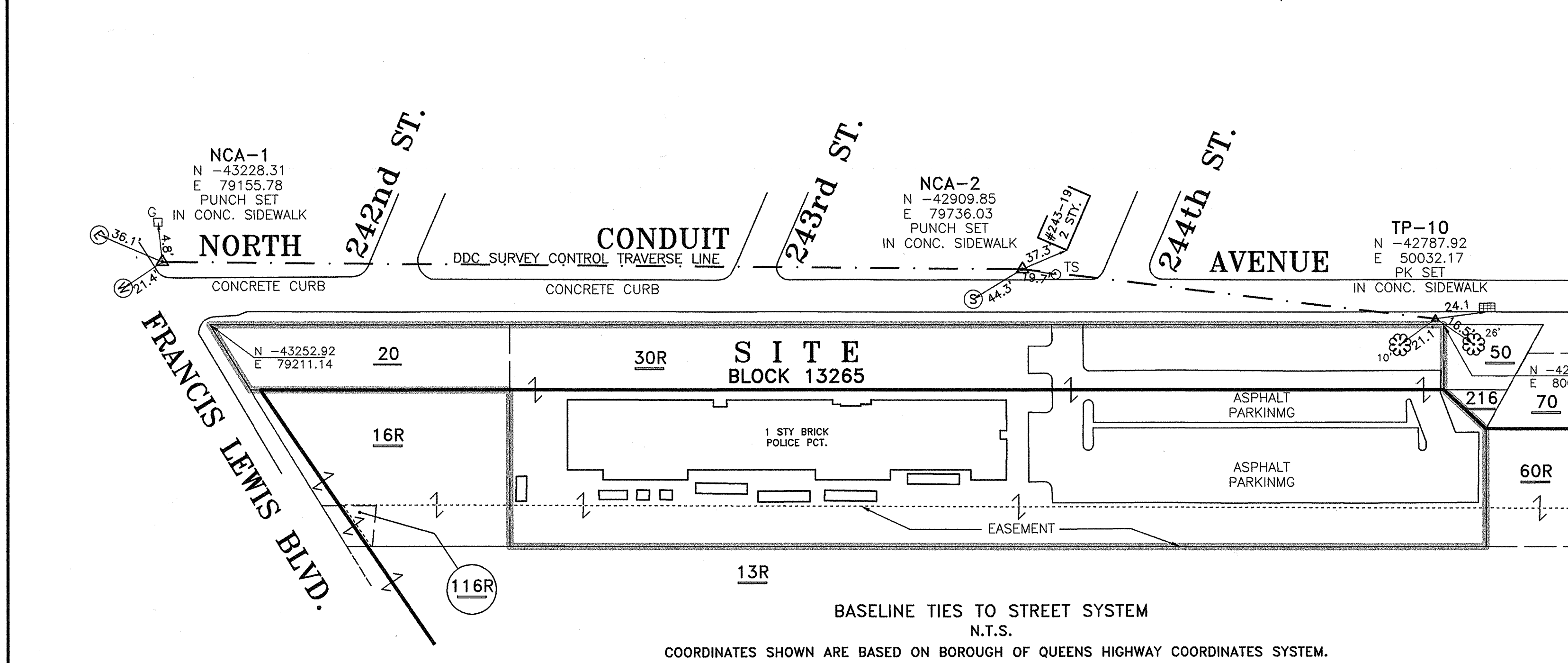
SITE COMPRISES: LOTS 20 AND 30 IN BLOCK 13265 AS SHOWN ON THE "TAX MAP" OF THE CITY OF NEW YORK.

FIELD SURVEY COMPLETED: 08/11/2017, UPDATED 9/19/2017

\*ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S BLUE INKED OR EMBOSSED SEAL SHALL BE CONSIDERED TO BE A TRUE VALID COPY\*

\*UNAUTHORIZED ALTERATIONS OR ADDITION TO A LAND SURVEYING DRAWING BEARING A LICENSED PROFESSIONAL LAND SURVEYOR'S SEAL IS A VIOLATION OF ARTICLE 145, SECTION 7209 PARAGRAPH 2 OF THE NEW YORK STATE EDUCATION LAW\*

ALL INFORMATION ON THIS MAP, EXCEPT THAT PERTAINING TO THE PROPERTY LINE, IS FOR REFERENCE ONLY. THIS IS TO CERTIFY THAT THERE ARE NO VISIBLE STREAMS OR VISIBLE NATURAL WATER COURSES ACROSS THE PROPERTY AS SHOWN ON THIS SURVEY.



## MONTAUK DIVISION L.I.R.R.

BENCHMARK	ELEVATION	DESCRIPTION
BM VP502	24.82	CUT IN CONCRETE ABUTMENT FOR L.I.R.R. OVERPASS AT EAST SIDE OF FRANCIS LEWIS BLVD., CUT IS 0.8' SOUTH OF NORTH EAST CORNER OF ABOVE MENTIONED ABUTMENT AND 3.3' ABOVE SIDEWALK
LS-72716	23.16	CUT ON NORTH SIDE OF CONCRETE BASE OF MOST WESTERLY FLAG POLE IN FRONT OF POLICE PCT. #105 (242-20 NORTH CONDUIT AVENUE)
B.M. 5433	20.99	CUT ON THE NORTH SIDE OF CONCRETE BASE ON THE MOST NORTHERLY STEEL COLUMN AT THE WEST SIDE OF BROOKVILLE BLVD. CUT IS ABOUT 130 FEET SOUTH OF OF NORTH CONDUIT AVENUE L.I.R.R. BRIDGE.

PARTY CHIEF <u>V.PRIGOV</u>		COMPUTATION <u>A.VOLOVICH</u> CHECKED <u>O.OLIVER</u>		DRAFTED <u>G.KOLODZIEJSKI</u> CHECKED <u>C.WILLIAMS</u>		FIELD EDITED	
KURT KRAEMER, L.S. DEPUTY DIRECTOR SITE ENGINEERING		OLTON OLIVER, L.S. DIRECTOR SITE ENGINEERING		JEAN M. JEAN-LOUIS ASSISTANT COMMISSIONER DIVISION OF PROGRAM MANAGEMENT			

NO.	DATE	DESCRIPTIONS	BY	APPR'D
2	9/11/18	UPDATED LOCATION OF WATER CONDUIT	A.V.	O.O.
1	9/19/17	UPDATED TOPO	G.K.	C.W.
		REVISIONS		

PO002-116

3219 D

T3219D1Rev2G7151

**DIVISION OF PROGRAM MANAGEMENT**

**116th POLICE PRECINCT**

244-04 NORTH CONDUIT AVENUE

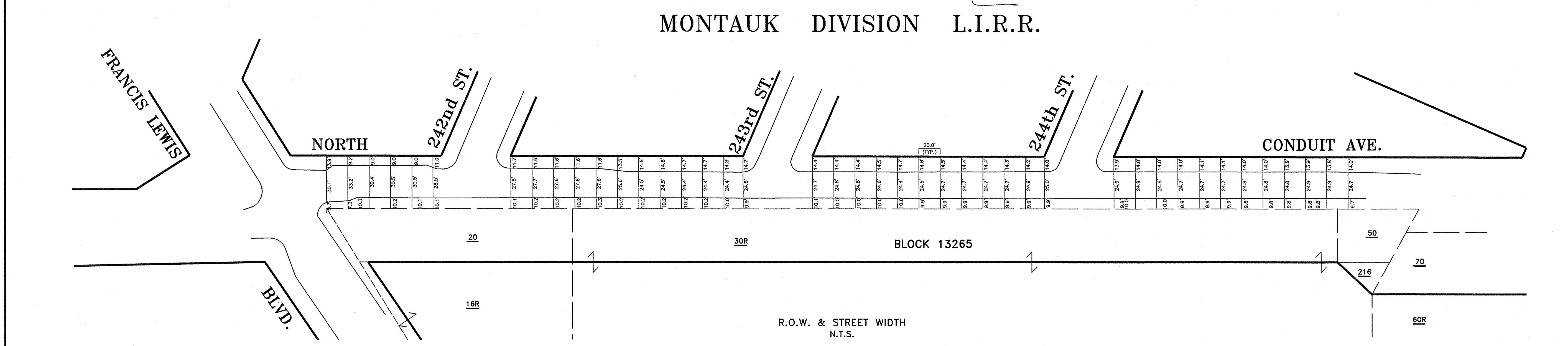
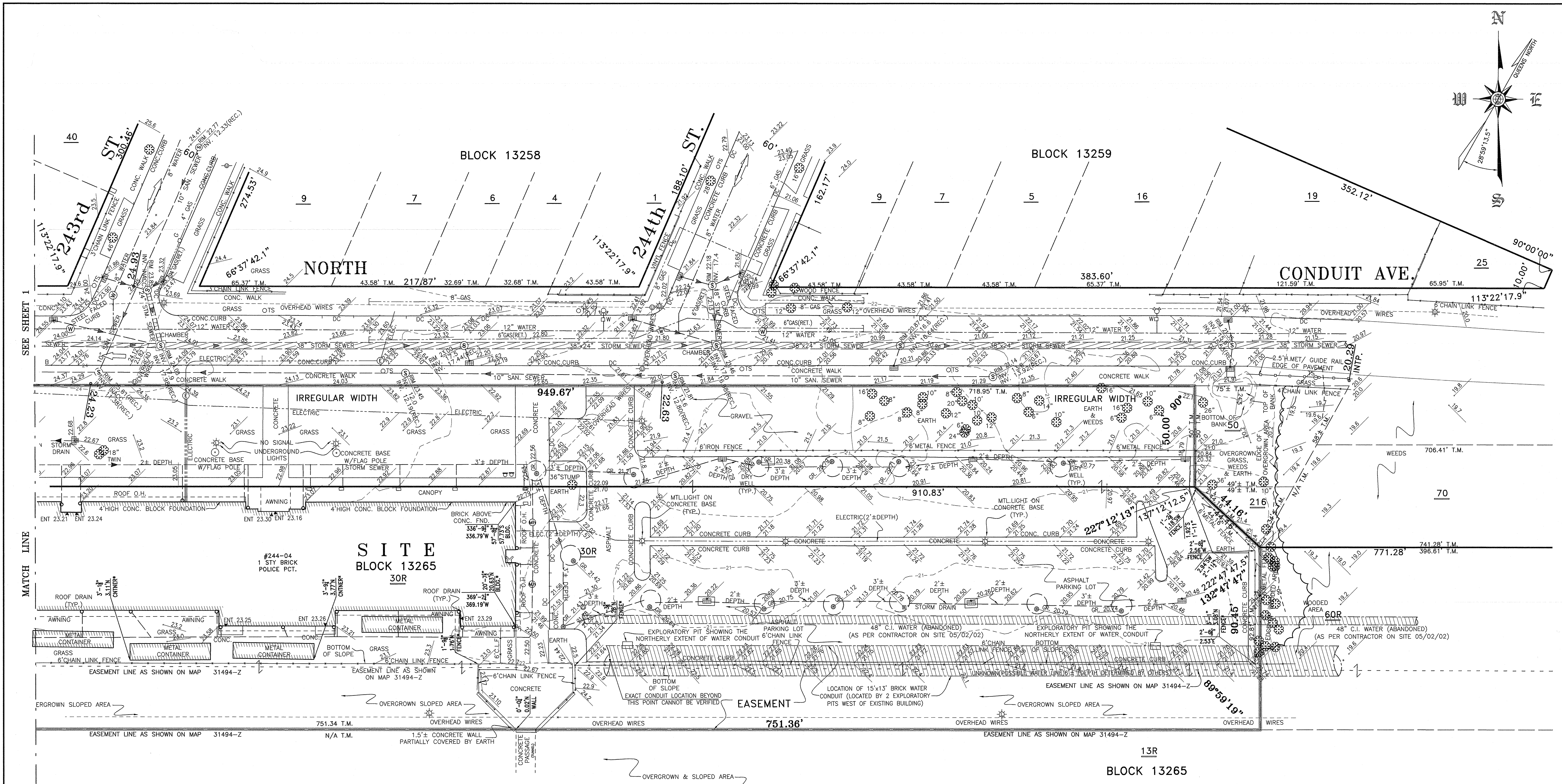
BOROUGH OF QUEENS

**TOPOGRAPHICAL & PROPERTY LINE MAP**

DATE: 08/25/17

SHEET: 1 OF 2





PARTY CHIEF V. PRIGOV		KURT KRAEMER, L.S. DEPUTY DIRECTOR SITE ENGINEERING		OLTON OLIVER, L.S. DEPUTY DIRECTOR SITE ENGINEERING		JEAN M. JEAN-LOUIS ASSISTANT COMMISSIONER DIVISION OF PROGRAM MANAGEMENT			
COMPUTATION A. VOLOVICH CHECKED O. OLIVER									
DRAFTED G. KOLODZIEJSKI CHECKED C. WILLIAMS									
FIELD EDITED									

PO002-116 3219 D		T3219D2Rev2G7151	
116th POLICE PRECINCT		244-04 NORTH CONDUIT AVENUE BOROUGH OF QUEENS	
TOPOGRAPHICAL & PROPERTY LINE MAP			
DATE 08/14/17	20' 0' 20' 40'	SHEET 2 OF 2	











- 1 REINFORCED SILT FENCE  
N.T.S.



- ② SILT SACK INLET PROTECTION  
N.T.S.



- 3 STABILIZED CONSTRUCTION ENTRANCE  
N.T.S.



- 4 TREE PROTECTION  
N.T.S.



- 5 SOIL STOCKPILE  
N.T.S.



- MAINTENANCE:

6 SEDIMENT FILTER  
N.T.S.



- 7 ABOVE GROUND TEMPORARY CONCRETE WASHOUT FACILITY  
N.T.S.

- NOTES:

- ADAPTED FROM NEW YORK STATE STANDARDS AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL

NTS

- 8 PERIMETER DIKE OR SWALE  
N.T.S.



- MAINTENANCE:

9	HAY BALE SEDIMENT FILTER
	N.T.S.

DOB APPROVAL STAMP

<i>T / Security</i>	<i>Graphic Design</i>
DVI Communications Inc.	Via Collective
1 Park Place, Suite 906	594 Dean Street
New York, NY 10007	Brooklyn, NY 11238

### Key Plan

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[illegible]

## DIVISION OF PUBLIC BUILDINGS

CAPITAL PROJECT NUMBER:

PO002-116

# PROJECT 116th Precinct Station House

244-04 North Conduit Ave  
Queens, NY 11422

FOR THE:  
New York Police Department  
Police Plaza  
New York, NY 10007

DRAWING TITLE:

## Soil Erosion and Sediment Control Details

SEAL & SIGNATURE	DATE: April 26, 2019	
	PROJECT NO: 1741	
	DRAWN BY: BCC	
	CHECKED BY: JH	
	DRAWING NUMBER: <b>C-152.00</b>	
	CADO FILE No:	

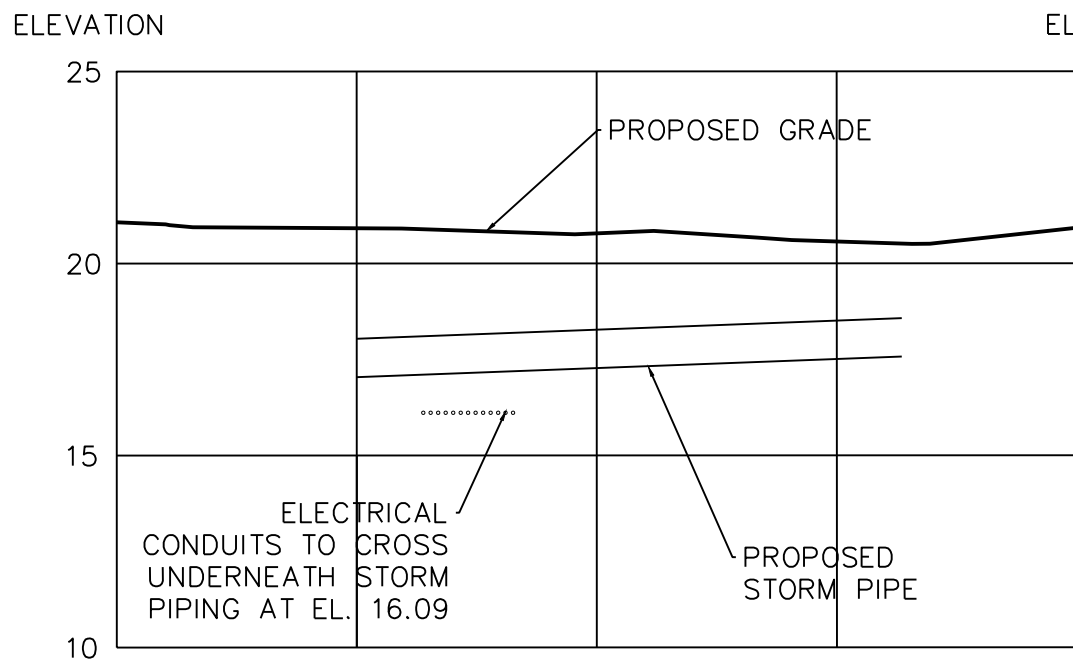


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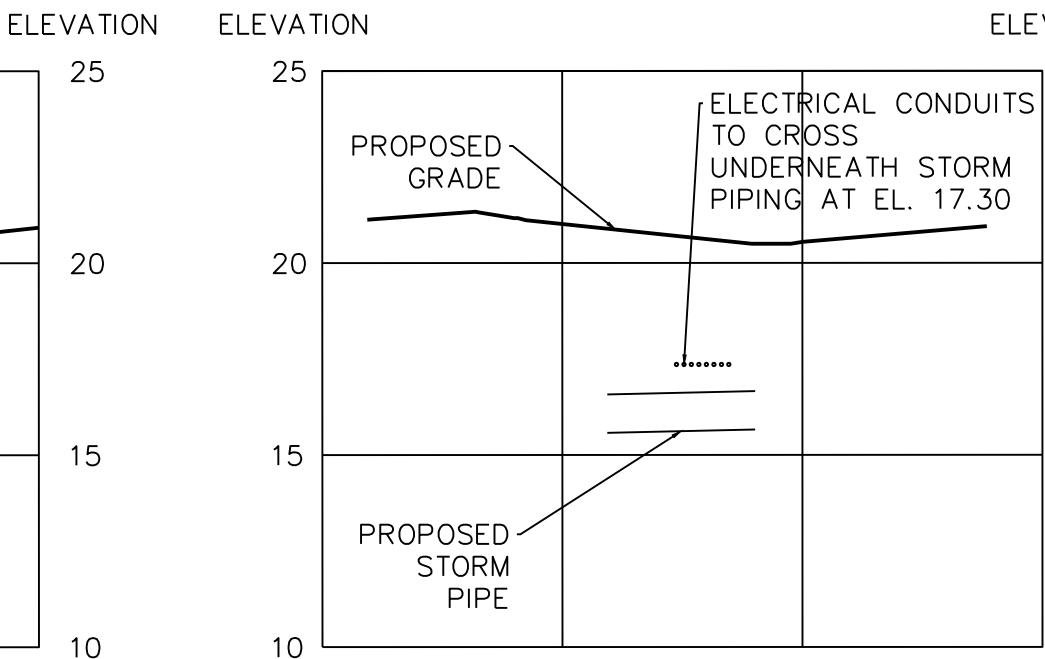
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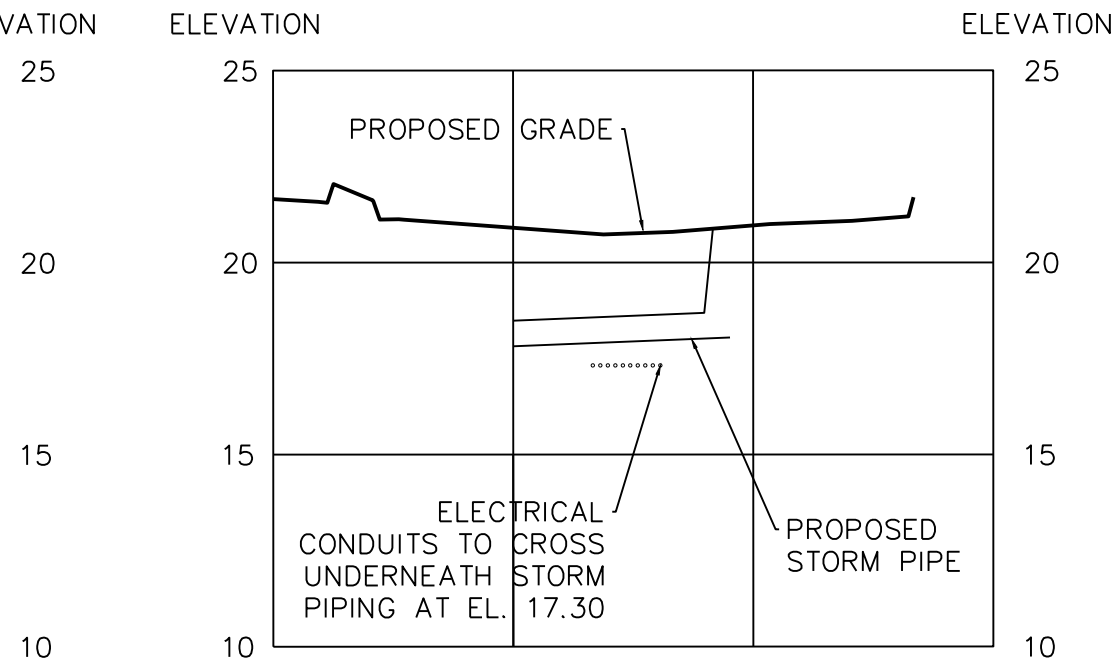
- BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244-04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/17.
- ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), AS PER THE AFOREMENTIONED DRAWINGS.
- NUMBER AND LOCATIONS OF ALL EXISTING UNDERGROUND UTILITIES MUST BE FIELD VERIFIED BEFORE ANY CONSTRUCTION.
- ALL PIPE LENGTHS SHALL BE FIELD VERIFIED.
- SITE CONTRACTOR SHALL BRING ALL SITE UTILITIES TO WITHIN 5 FT OF THE BUILDING, PLUGGED AND MARKED UNLESS OTHERWISE NOTED. BUILDING CONTRACTOR TO MAKE CONNECTION BETWEEN BUILDING LATERALS AND SITE UTILITIES.
- CONTRACTOR MUST PROVIDE 48 HOURS NOTICE IN ADVANCE OF WORK TO THE CITY OF NEW YORK DEPARTMENT OF BUILDINGS SEWER DEPARTMENT, IN ORDER TO SCHEDULE INSPECTION OF ALL STORM SEWER LINE WORK PRIOR TO BACKFILLING.
- THE CONTRACTOR SHALL BE SOLELY AND FULLY RESPONSIBLE FOR ALL EXCAVATION WORK INCLUDING BUT NOT LIMITED TO THE DESIGN, INSTALLATION AND MAINTENANCE OF SHEETING AND SHORING, PROTECTION OF SLOPES, PROTECTION OF ADJACENT STRUCTURES, UNDERPINNING AND DEWATERING IN ACCORDANCE WITH NEW YORK CITY BUILDING CODE.
- CONTRACTOR TO ENGAGE A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NEW YORK TO PREPARE DETAILS OF UNDERPINNING, COFFERDAMS, BRACING, AND OTHER CONSTRUCTION REQUIRED FOR PROTECTION OF EXCAVATIONS AND SUPPORT OF ADJACENT PROPERTIES OR BUILDINGS. THESE DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR GENERAL REVIEW, WHICH DOES NOT RELIEVE THE CONTRACTOR'S ENGINEER OF RESPONSIBILITY FOR ADEQUACY OF THE DESIGN PER SPEC. 02200. THE CONTRACTOR'S ENGINEER SHALL FILE FORM PW-1 WITH THE BUILDING DEPARTMENT, THEREBY BECOMING THE ENGINEER OF RECORD FOR SUCH PROTECTION WORK AND IS RESPONSIBLE FOR STABILITY OF ALL SLOPES AND BRACING AND FOR PREPARATION OF ALL DESIGN AND SHOP DRAWINGS AND THEIR APPROVAL BY THE BUILDING DEPARTMENT.
- BEFORE CONSTRUCTION, THE EXACT LOCATION OF THE ROOF DRAIN LATERALS AND UTILITY CONNECTIONS SHALL BE COORDINATED WITH THE ARCHITECTURAL, PLUMBING, MECHANICAL, AND ELECTRIC DRAWINGS.
- ALL EXISTING ROOF DRAINS SHALL BE CLEANED AND INSPECTED FOR DAMAGE PRIOR TO CONNECTION TO THE NEW RETENTION SYSTEM.
- ALL ELEVATIONS SHOWN RELATE TO FINISH GRADE.



CROSS SECTION A



CROSS SECTION B



CROSS SECTION C



DOB APPROVAL STAMP

DattnerArchitects

1385 Broadway, 15th Floor  
New York, NY 10018

tel 212 247 2660  
www.dattner.com

#### Structural Engineer

Thornton Tomasetti  
51 Madison Avenue  
New York, NY 10010-1603

#### Lighting Design

Domingo Gonzalez Associates  
29 Broadway, 3rd floor  
New York, NY 10007

#### MEP / Fire Protection Engineer

Jacob Feinberg Katz & Michaeli  
134 W. 37th Street, 12th floor  
New York, NY 10018

#### Vertical Transportation

Van Deusen & Associates, Inc.  
120 Eagle Rock Avenue, Suite 310  
East Hanover, NJ 07936

#### Landscape Architect

Starr Whitehouse  
89 Maiden Lane, Suite 1901  
New York, NY 10038

#### Acoustical

Cerami Consultants  
404 5th Avenue  
New York, NY 10018

#### Civil / Geotechnical Engineer

Langan Engineering  
21 Penn Plaza  
360 West 31st Street, 8th floor  
New York, NY 10001

#### Fuel Systems

P.W. Grosser Consulting  
1 Penn Plaza, 36th floor  
New York, NY 10119

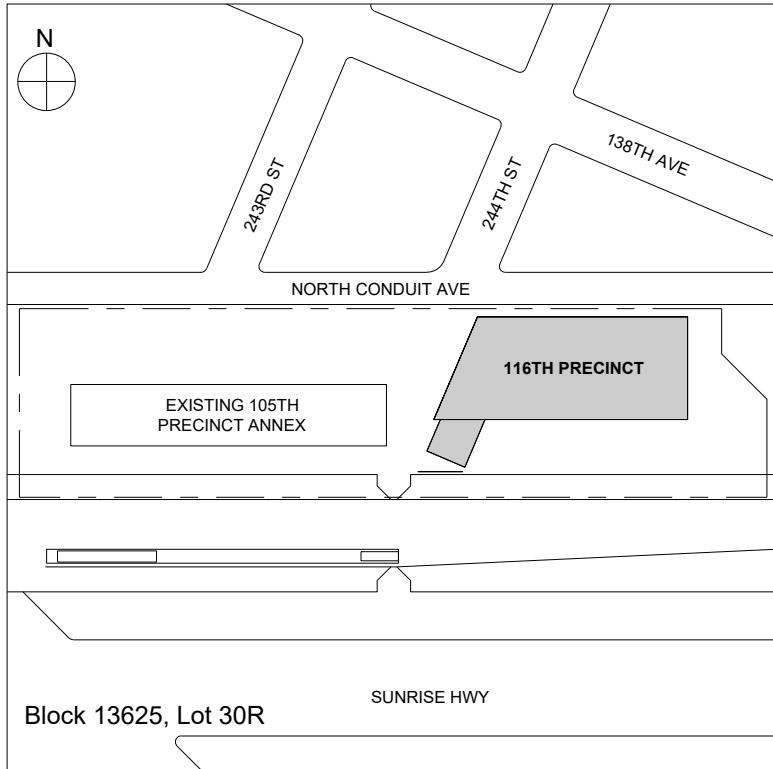
#### IT / Security

DVI Communications Inc.  
11 Park Place, Suite 906  
New York, NY 10007

#### Graphic Design

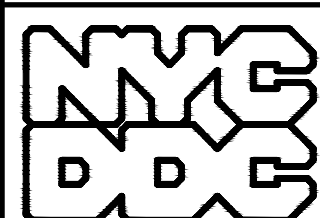
Via Collective  
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Issue: 100% CONSTRUCTION DOCUMENTS



Key Plan

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**Department of  
Design and  
Construction**

DIVISION OF PUBLIC BUILDINGS

CAPITAL PROJECT NUMBER:

PO002-116

PROJECT

**116th Precinct Station  
House**

244-04 North Conduit Ave  
Queens, NY 11422

FOR THE:

New York Police Department  
1 Police Plaza  
New York, NY 10007

DRAWING TITLE:

**Grading and  
Drainage Plan 1**

SEAL & SIGNATURE

DATE: **April 26, 2019**  
PROJECT NO: **1741**  
DRAWN BY: **BCC**  
CHECKED BY: **JH**  
DRAWING NUMBER:  
**C-300.00**  
CADO FILE No:

Plotted: 5/25/2018 4:11:50 PM



1. BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244.04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/17.
2. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), AS PER THE AFOREMENTIONED DRAWINGS.
3. NUMBER AND LOCATIONS OF ALL EXISTING UNDERGROUND UTILITIES MUST BE FIELD VERIFIED BEFORE ANY CONSTRUCTION.
4. ALL PIPE LENGTHS SHALL BE FIELD VERIFIED.
5. SITE CONTRACTOR SHALL BRING ALL SITE UTILITIES TO WITHIN 5 FT OF THE BUILDING, PLUGGED AND MARKED UNLESS OTHERWISE NOTED. BUILDING CONTRACTOR TO MAKE CONNECTION BETWEEN BUILDING LATERALS AND SITE UTILITIES.
6. CONTRACTOR MUST PROVIDE 48 HOURS NOTICE IN ADVANCE OF WORK TO THE CITY OF NEW YORK DEPARTMENT OF BUILDINGS SEWER DEPARTMENT, IN ORDER TO SCHEDULE INSPECTION OF ALL STORM SEWER LINE WORK PRIOR TO BACKFILLING.
7. THE CONTRACTOR SHALL BE SOLELY AND FULLY RESPONSIBLE FOR ALL EXCAVATION WORK INCLUDING BUT NOT LIMITED TO THE DESIGN, INSTALLATION AND MAINTENANCE OF SHEETING AND SHORING, PROTECTION OF SLOPES, PROTECTION OF ADJACENT STRUCTURES, UNDERPINNING AND DEWATERING IN ACCORDANCE WITH NEW YORK CITY BUILDING CODE.
8. CONTRACTOR TO ENGAGE A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NEW YORK TO PREPARE DETAILS OF UNDERPINNING, COFFERDAMS, BRACING, AND OTHER CONSTRUCTION REQUIRED FOR PROTECTION OF EXCAVATIONS AND SUPPORT OF ADJACENT PROPERTIES OR BUILDINGS. THESE DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR GENERAL REVIEW, WHICH DOES NOT RELIEVE THE CONTRACTOR'S ENGINEER OF RESPONSIBILITY FOR ADEQUACY OF THE DESIGN PER SPEC. 02200. THE CONTRACTOR'S ENGINEER SHALL FILE FORM PW-1 WITH THE BUILDING DEPARTMENT, THEREBY BECOMING THE ENGINEER OF RECORD FOR SUCH PROTECTION WORK AND IS RESPONSIBLE FOR STABILITY OF ALL SLOPES AND BRACING AND FOR PREPARATION OF ALL DESIGN AND SHOP DRAWINGS AND THEIR APPROVAL BY THE BUILDING DEPARTMENT.
9. BEFORE CONSTRUCTION, THE EXACT LOCATION OF THE ROOF DRAIN LATERALS AND UTILITY CONNECTIONS SHALL BE COORDINATED WITH THE ARCHITECTURAL, PLUMBING, MECHANICAL, AND ELECTRIC DRAWINGS.
10. ALL EXISTING ROOF DRAINS SHALL BE CLEANED AND INSPECTED FOR DAMAGE PRIOR TO CONNECTION TO THE NEW RETENTION SYSTEM.
11. ALL ELEVATIONS SHOWN RELATE TO FINISH GRADE.

20 0 5 10 20

SCALE IN FEET



**Department of  
Design and  
Construction**

## Grading and Drainage Plan 2

SEAL & SIGNATURE	DATE: April 26, 2019	
	PROJECT NO: 1741	
	DRAWN BY: BCC	
	CHECKED BY: JH	
	DRAWING NUMBER: <b>C-301.00</b>	
	CADO FILE No:	

## **APPENDIX A**

### **NYSDEC SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES GP-0-15-002**





Department of  
Environmental  
Conservation

NEW YORK STATE  
DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
SPDES GENERAL PERMIT  
FOR STORMWATER DISCHARGES

From

**CONSTRUCTION ACTIVITY**

Permit No. GP-0-15-002

Issued Pursuant to Article 17, Titles 7, 8 and Article 70  
of the Environmental Conservation Law

Effective Date: January 29, 2015

Expiration Date: January 28, 2020

Modification Date:

July 14, 2015 – Correction of typographical error in definition of “New Development”,  
Appendix A

November 23, 2016 – Updated to require the use of the New York State Standards and  
Specifications for Erosion and Sediment Control, dated November  
2016. The use of this standard will be required as of February 1,  
2017.

John J. Ferguson  
Chief Permit Administrator

  
Authorized Signature

11-14-16  
Date

Address: NYS DEC  
Division of Environmental Permits  
625 Broadway, 4th Floor  
Albany, N.Y. 12233-1750



## PREFACE

Pursuant to Section 402 of the Clean Water Act ("CWA"), stormwater *discharges* from certain *construction activities* are unlawful unless they are authorized by a *National Pollutant Discharge Elimination System ("NPDES")* permit or by a state permit program. New York's *State Pollutant Discharge Elimination System ("SPDES")* is a NPDES-approved program with permits issued in accordance with the *Environmental Conservation Law ("ECL")*.

This general permit ("permit") is issued pursuant to Article 17, Titles 7, 8 and Article 70 of the ECL. An *owner or operator* may obtain coverage under this permit by submitting a Notice of Intent ("NOI") to the Department. Copies of this permit and the NOI for New York are available by calling (518) 402-8109 or at any New York State Department of Environmental Conservation ("the Department") regional office (see Appendix G). They are also available on the Department's website at:

<http://www.dec.ny.gov/>

An *owner or operator* of a *construction activity* that is eligible for coverage under this permit must obtain coverage prior to the *commencement of construction activity*. Activities that fit the definition of "*construction activity*", as defined under 40 CFR 122.26(b)(14)(x), (15)(i), and (15)(ii), constitute construction of a point source and therefore, pursuant to Article 17-0505 of the ECL, the *owner or operator* must have coverage under a SPDES permit prior to *commencing construction activity*. They cannot wait until there is an actual *discharge* from the construction site to obtain permit coverage.

**\*Note: The italicized words/phrases within this permit are defined in Appendix A.**

**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES  
FROM CONSTRUCTION ACTIVITIES**

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(Part I)

## Part I. PERMIT COVERAGE AND LIMITATIONS

### A. Permit Application

This permit authorizes stormwater *discharges* to *surface waters of the State* from the following *construction activities* identified within 40 CFR Parts 122.26(b)(14)(x), 122.26(b)(15)(i) and 122.26(b)(15)(ii), provided all of the eligibility provisions of this permit are met:

1. *Construction activities* involving soil disturbances of one (1) or more acres; including disturbances of less than one acre that are part of a *larger common plan of development or sale* that will ultimately disturb one or more acres of land; excluding *routine maintenance activity* that is performed to maintain the original line and grade, hydraulic capacity or original purpose of a facility;
2. *Construction activities* involving soil disturbances of less than one (1) acre where the Department has determined that a *SPDES* permit is required for stormwater *discharges* based on the potential for contribution to a violation of a *water quality standard* or for significant contribution of *pollutants* to *surface waters of the State*.
3. *Construction activities* located in the watershed(s) identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.

### B. Effluent Limitations Applicable to Discharges from Construction Activities

*Discharges* authorized by this permit must achieve, at a minimum, the effluent limitations in Part I.B.1. (a) – (f) of this permit. These limitations represent the degree of effluent reduction attainable by the application of best practicable technology currently available.

1. Erosion and Sediment Control Requirements - The *owner or operator* must select, design, install, implement and maintain control measures to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. The selection, design, installation, implementation, and maintenance of these control measures must meet the non-numeric effluent limitations in Part I.B.1.(a) – (f) of this permit and be in accordance with the New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016, using sound engineering judgment. Where control measures are not designed in conformance with the design criteria included in the technical standard, the *owner or operator* must include in the Stormwater Pollution Prevention Plan (“SWPPP”) the reason(s) for the deviation or alternative design and provide information

(Part I.B.1)

which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

a. **Erosion and Sediment Controls.** Design, install and maintain effective erosion and sediment controls to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. At a minimum, such controls must be designed, installed and maintained to:

- (i) *Minimize* soil erosion through application of runoff control and soil stabilization control measure to *minimize pollutant discharges*;
- (ii) Control stormwater *discharges* to *minimize* channel and streambank erosion and scour in the immediate vicinity of the *discharge* points;
- (iii) *Minimize* the amount of soil exposed during *construction activity*;
- (iv) *Minimize* the disturbance of *steep slopes*;
- (v) *Minimize* sediment *discharges* from the site;
- (vi) Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas and maximize stormwater infiltration to reduce *pollutant discharges*, unless *infeasible*;
- (vii) *Minimize* soil compaction. Minimizing soil compaction is not required where the intended function of a specific area of the site dictates that it be compacted; and
- (viii) Unless *infeasible*, preserve a sufficient amount of topsoil to complete soil restoration and establish a uniform, dense vegetative cover.

b. **Soil Stabilization.** In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the current soil disturbance activity ceased. For construction sites that *directly discharge* to one of the 303(d) segments listed in Appendix E or is located in one of the watersheds listed in Appendix C, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. See Appendix A for definition of *Temporarily Ceased*.

c. **Dewatering.** *Discharges* from dewatering activities, including *discharges*

(Part I.B.1.c)

from dewatering of trenches and excavations, must be managed by appropriate control measures.

d. **Pollution Prevention Measures.** Design, install, implement, and maintain effective pollution prevention measures to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. At a minimum, such measures must be designed, installed, implemented and maintained to:

- (i) *Minimize* the *discharge* of *pollutants* from equipment and vehicle washing, wheel wash water, and other wash waters. This applies to washing operations that use clean water only. Soaps, detergents and solvents cannot be used;
- (ii) *Minimize* the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste and other materials present on the site to precipitation and to stormwater. Minimization of exposure is not required in cases where the exposure to precipitation and to stormwater will not result in a *discharge* of *pollutants*, or where exposure of a specific material or product poses little risk of stormwater contamination (such as final products and materials intended for outdoor use) ; and
- (iii) Prevent the *discharge* of *pollutants* from spills and leaks and implement chemical spill and leak prevention and response procedures.

e. **Prohibited Discharges.** The following *discharges* are prohibited:

- (i) Wastewater from washout of concrete;
- (ii) Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;
- (iii) Fuels, oils, or other *pollutants* used in vehicle and equipment operation and maintenance;
- (iv) Soaps or solvents used in vehicle and equipment washing; and
- (v) Toxic or hazardous substances from a spill or other release.

f. **Surface Outlets.** When discharging from basins and impoundments, the outlets shall be designed, constructed and maintained in such a manner that sediment does not leave the basin or impoundment and that erosion



(Part I.B.1.f)

at or below the outlet does not occur.

### **C. Post-construction Stormwater Management Practice Requirements**

1. The *owner or operator* of a *construction activity* that requires post-construction stormwater management practices pursuant to Part III.C. of this permit must select, design, install, and maintain the practices to meet the *performance criteria* in the New York State Stormwater Management Design Manual ("Design Manual"), dated January 2015, using sound engineering judgment. Where post-construction stormwater management practices ("SMPs") are not designed in conformance with the *performance criteria* in the Design Manual, the *owner or operator* must include in the SWPPP the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.
2. The *owner or operator* of a *construction activity* that requires post-construction stormwater management practices pursuant to Part III.C. of this permit must design the practices to meet the applicable *sizing criteria* in Part I.C.2.a., b., c. or d. of this permit.

#### **a. Sizing Criteria for New Development**

- (i) Runoff Reduction Volume ("RRv"): Reduce the total Water Quality Volume ("WQv") by application of RR techniques and standard SMPs with RRv capacity. The total WQv shall be calculated in accordance with the criteria in Section 4.2 of the Design Manual.
- (ii) Minimum RRv and Treatment of Remaining Total WQv: *Construction activities* that cannot meet the criteria in Part I.C.2.a.(i) of this permit due to *site limitations* shall direct runoff from all newly constructed *impervious areas* to a RR technique or standard SMP with RRv capacity unless *infeasible*. The specific *site limitations* that prevent the reduction of 100% of the WQv shall be documented in the SWPPP. For each *impervious area* that is not directed to a RR technique or standard SMP with RRv capacity, the SWPPP must include documentation which demonstrates that all options were considered and for each option explains why it is considered *infeasible*.

**In no case shall the runoff reduction achieved from the newly constructed *impervious areas* be less than the Minimum RRv as calculated using the criteria in Section 4.3 of the Design Manual.** The remaining portion of the total WQv

(Part I.C.2.a.ii)

that cannot be reduced shall be treated by application of standard SMPs.

- (iii) Channel Protection Volume (“Cpv”): Provide 24 hour extended detention of the post-developed 1-year, 24-hour storm event; remaining after runoff reduction. The Cpv requirement does not apply when:
  - (1) Reduction of the entire Cpv is achieved by application of runoff reduction techniques or infiltration systems, or
  - (2) The site *discharges* directly to tidal waters, or fifth order or larger streams.
- (iv) Overbank Flood Control Criteria (“Qp”): Requires storage to attenuate the post-development 10-year, 24-hour peak *discharge* rate (Qp) to predevelopment rates. The Qp requirement does not apply when:
  - (1) the site *discharges* directly to tidal waters or fifth order or larger streams, or
  - (2) A downstream analysis reveals that overbank control is not required.
- (v) Extreme Flood Control Criteria (“Qf”): Requires storage to attenuate the post-development 100-year, 24-hour peak *discharge* rate (Qf) to predevelopment rates. The Qf requirement does not apply when:
  - (1) the site *discharges* directly to tidal waters or fifth order or larger streams, or
  - (2) A downstream analysis reveals that overbank control is not required.

**b. Sizing Criteria for New Development in Enhanced Phosphorus Removal Watershed**

- (i) Runoff Reduction Volume (RRv): Reduce the total Water Quality Volume (WQv) by application of RR techniques and standard SMPs with RRv capacity. The total WQv is the runoff volume from the 1-year, 24 hour design storm over the post-developed watershed and shall be calculated in accordance with the criteria in Section 10.3 of the Design Manual.
- (ii) Minimum RRv and Treatment of Remaining Total WQv: *Construction activities* that cannot meet the criteria in Part I.C.2.b.(i) of this permit due to *site limitations* shall direct runoff from all newly constructed *impervious areas* to a RR technique or

(Part I.C.2.b.ii)

standard SMP with RRv capacity unless *infeasible*. The specific *site limitations* that prevent the reduction of 100% of the WQv shall be documented in the SWPPP. For each *impervious area* that is not directed to a RR technique or standard SMP with RRv capacity, the SWPPP must include documentation which demonstrates that all options were considered and for each option explains why it is considered *infeasible*.

**In no case shall the runoff reduction achieved from the newly constructed *impervious areas* be less than the Minimum RRv as calculated using the criteria in Section 10.3 of the Design Manual.** The remaining portion of the total WQv that cannot be reduced shall be treated by application of standard SMPs.

- (iii) Channel Protection Volume (Cpv): Provide 24 hour extended detention of the post-developed 1-year, 24-hour storm event; remaining after runoff reduction. The Cpv requirement does not apply when:
  - (1) Reduction of the entire Cpv is achieved by application of runoff reduction techniques or infiltration systems, or
  - (2) The site *discharges* directly to tidal waters, or fifth order or larger streams.
- (iv) Overbank Flood Control Criteria (Qp): Requires storage to attenuate the post-development 10-year, 24-hour peak *discharge* rate (Qp) to predevelopment rates. The Qp requirement does not apply when:
  - (1) the site *discharges* directly to tidal waters or fifth order or larger streams, or
  - (2) A downstream analysis reveals that overbank control is not required.
- (v) Extreme Flood Control Criteria (Qf): Requires storage to attenuate the post-development 100-year, 24-hour peak *discharge* rate (Qf) to predevelopment rates. The Qf requirement does not apply when:
  - (1) the site *discharges* directly to tidal waters or fifth order or larger streams, or
  - (2) A downstream analysis reveals that overbank control is not required.

**c. Sizing Criteria for Redevelopment Activity**

(Part I.C.2.c.i)

- (i) Water Quality Volume (WQv): The WQv treatment objective for *redevelopment activity* shall be addressed by one of the following options. *Redevelopment activities* located in an Enhanced Phosphorus Removal Watershed (see Part III.B.3. and Appendix C of this permit) shall calculate the WQv in accordance with Section 10.3 of the Design Manual. All other *redevelopment activities* shall calculate the WQv in accordance with Section 4.2 of the Design Manual.
  - (1) Reduce the existing *impervious cover* by a minimum of 25% of the total disturbed, *impervious area*. The Soil Restoration criteria in Section 5.1.6 of the Design Manual must be applied to all newly created pervious areas, or
  - (2) Capture and treat a minimum of 25% of the WQv from the disturbed, *impervious area* by the application of standard SMPs; or reduce 25% of the WQv from the disturbed, *impervious area* by the application of RR techniques or standard SMPs with RRv capacity., or
  - (3) Capture and treat a minimum of 75% of the WQv from the disturbed, *impervious area* as well as any additional runoff from tributary areas by application of the alternative practices discussed in Sections 9.3 and 9.4 of the Design Manual., or
  - (4) Application of a combination of 1, 2 and 3 above that provide a weighted average of at least two of the above methods. Application of this method shall be in accordance with the criteria in Section 9.2.1(B) (IV) of the Design Manual.

If there is an existing post-construction stormwater management practice located on the site that captures and treats runoff from the *impervious area* that is being disturbed, the WQv treatment option selected must, at a minimum, provide treatment equal to the treatment that was being provided by the existing practice(s) if that treatment is greater than the treatment required by options 1 – 4 above.

- (ii) Channel Protection Volume (Cpv): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.
- (iii) Overbank Flood Control Criteria (Qp): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.

(Part I.C.2.c.iv)

- (iv) Extreme Flood Control Criteria (Qf): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.

**d. *Sizing Criteria for Combination of Redevelopment Activity and New Development***

Construction projects that include both *New Development* and *Redevelopment Activity* shall provide post-construction stormwater management controls that meet the *sizing criteria* calculated as an aggregate of the *Sizing Criteria* in Part I.C.2.a. or b. of this permit for the *New Development* portion of the project and Part I.C.2.c of this permit for *Redevelopment Activity* portion of the project.

**D. Maintaining Water Quality**

The Department expects that compliance with the conditions of this permit will control *discharges* necessary to meet applicable *water quality standards*. It shall be a violation of the *ECL* for any discharge to either cause or contribute to a violation of *water quality standards* as contained in Parts 700 through 705 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York, such as:

1. There shall be no increase in turbidity that will cause a substantial visible contrast to natural conditions;
2. There shall be no increase in suspended, colloidal or settleable solids that will cause deposition or impair the waters for their best usages; and
3. There shall be no residue from oil and floating substances, nor visible oil film, nor globules of grease.

If there is evidence indicating that the stormwater *discharges* authorized by this permit are causing, have the reasonable potential to cause, or are contributing to a violation of the *water quality standards*; the *owner or operator* must take appropriate corrective action in accordance with Part IV.C.5. of this general permit and document in accordance with Part IV.C.4. of this general permit. To address the *water quality standard* violation the *owner or operator* may need to provide additional information, include and implement appropriate controls in the SWPPP to correct the problem, or obtain an individual SPDES permit.

If there is evidence indicating that despite compliance with the terms and conditions of this general permit it is demonstrated that the stormwater *discharges* authorized by this permit are causing or contributing to a violation of *water quality standards*, or

(Part I.D)

if the Department determines that a modification of the permit is necessary to prevent a violation of *water quality standards*, the authorized *discharges* will no longer be eligible for coverage under this permit. The Department may require the *owner or operator* to obtain an individual SPDES permit to continue discharging.

**E. Eligibility Under This General Permit**

1. This permit may authorize all *discharges* of stormwater from *construction activity to surface waters of the State* and *groundwaters* except for ineligible *discharges* identified under subparagraph F. of this Part.
2. Except for non-stormwater *discharges* explicitly listed in the next paragraph, this permit only authorizes stormwater *discharges* from *construction activities*.
3. Notwithstanding paragraphs E.1 and E.2 above, the following non-stormwater *discharges* may be authorized by this permit: *discharges* from firefighting activities; fire hydrant flushings; waters to which cleansers or other components have not been added that are used to wash vehicles or control dust in accordance with the SWPPP, routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; uncontaminated *groundwater* or spring water; uncontaminated *discharges* from construction site de-watering operations; and foundation or footing drains where flows are not contaminated with process materials such as solvents. For those entities required to obtain coverage under this permit, and who *discharge* as noted in this paragraph, and with the exception of flows from firefighting activities, these *discharges* must be identified in the SWPPP. Under all circumstances, the *owner or operator* must still comply with *water quality standards* in Part I.D of this permit.
4. The *owner or operator* must maintain permit eligibility to *discharge* under this permit. Any *discharges* that are not compliant with the eligibility conditions of this permit are not authorized by the permit and the *owner or operator* must either apply for a separate permit to cover those ineligible *discharges* or take steps necessary to make the *discharge* eligible for coverage.

**F. Activities Which Are Ineligible for Coverage Under This General Permit**

All of the following are **not** authorized by this permit:

(Part I.F)

1. *Discharges after construction activities* have been completed and the site has undergone *final stabilization*;
2. *Discharges* that are mixed with sources of non-stormwater other than those expressly authorized under subsection E.3. of this Part and identified in the SWPPP required by this permit;
3. *Discharges* that are required to obtain an individual SPDES permit or another SPDES general permit pursuant to Part VII.K. of this permit;
4. *Construction activities* or *discharges from construction activities* that may adversely affect an endangered or threatened species unless the *owner or operator* has obtained a permit issued pursuant to 6 NYCRR Part 182 for the project or the Department has issued a letter of non-jurisdiction for the project. All documentation necessary to demonstrate eligibility shall be maintained on site in accordance with Part II.C.2 of this permit.
5. *Discharges* which either cause or contribute to a violation of *water quality standards* adopted pursuant to the *ECL* and its accompanying regulations;
6. *Construction activities* for residential, commercial and institutional projects:
  - a. Where the *discharges* from the *construction activities* are tributary to waters of the state classified as AA or AA-s; and
  - b. Which disturb one or more acres of land with no existing *impervious cover*; and
  - c. Which are undertaken on land with a Soil Slope Phase that is identified as an E or F, or the map unit name is inclusive of 25% or greater slope, on the United States Department of Agriculture ("USDA") Soil Survey for the County where the disturbance will occur.
7. *Construction activities* for linear transportation projects and linear utility projects:
  - a. Where the *discharges* from the *construction activities* are tributary to waters of the state classified as AA or AA-s; and
  - b. Which disturb two or more acres of land with no existing *impervious cover*; and
  - c. Which are undertaken on land with a Soil Slope Phase that is identified as an E or F, or the map unit name is inclusive of 25% or greater slope, on the USDA Soil Survey for the County where the disturbance will occur.

(Part I.F.8)

8. *Construction activities* that have the potential to affect an *historic property*, unless there is documentation that such impacts have been resolved. The following documentation necessary to demonstrate eligibility with this requirement shall be maintained on site in accordance with Part II.C.2 of this permit and made available to the Department in accordance with Part VII.F of this permit:
  - a. Documentation that the *construction activity* is not within an archeologically sensitive area indicated on the sensitivity map, and that the *construction activity* is not located on or immediately adjacent to a property listed or determined to be eligible for listing on the National or State Registers of Historic Places, and that there is no new permanent building on the construction site within the following distances from a building, structure, or object that is more than 50 years old, or if there is such a new permanent building on the construction site within those parameters that NYS Office of Parks, Recreation and Historic Preservation (OPRHP), a Historic Preservation Commission of a Certified Local Government, or a qualified preservation professional has determined that the building, structure, or object more than 50 years old is not historically/archeologically significant.
    - 1-5 acres of disturbance - 20 feet
    - 5-20 acres of disturbance - 50 feet
    - 20+ acres of disturbance - 100 feet, or
  - b. DEC consultation form sent to OPRHP, and copied to the NYS DEC Agency Historic Preservation Officer (APO), and
    - (i) the State Environmental Quality Review (SEQR) Environmental Assessment Form (EAF) with a negative declaration or the Findings Statement, with documentation of OPRHP's agreement with the resolution; or
    - (ii) documentation from OPRHP that the *construction activity* will result in No Impact; or
    - (iii) documentation from OPRHP providing a determination of No Adverse Impact; or
    - (iv) a Letter of Resolution signed by the owner/operator, OPRHP and the DEC APO which allows for this *construction activity* to be eligible for coverage under the general permit in terms of the State Historic Preservation Act (SHPA); or
  - c. Documentation of satisfactory compliance with Section 106 of the National Historic Preservation Act for a coterminous project area:
    - (i) No Affect
    - (ii) No Adverse Affect



(Part I.F.8.c.iii)

(iii) Executed Memorandum of Agreement, or

d. Documentation that:

(i) SHPA Section 14.09 has been completed by NYS DEC or another state agency.

9. *Discharges from construction activities* that are subject to an existing SPDES individual or general permit where a SPDES permit for *construction activity* has been terminated or denied; or where the *owner or operator* has failed to renew an expired individual permit.

## Part II. OBTAINING PERMIT COVERAGE

### A. Notice of Intent (NOI) Submittal

1. An *owner or operator* of a *construction activity* that is not subject to the requirements of a *regulated, traditional land use control MS4* must first prepare a SWPPP in accordance with all applicable requirements of this permit and then submit a completed NOI form to the Department in order to be authorized to *discharge* under this permit. An *owner or operator* shall use either the electronic (eNOI) or paper version of the NOI that the Department prepared. Both versions of the NOI are located on the Department's website (<http://www.dec.ny.gov/>). The paper version of the NOI shall be signed in accordance with Part VII.H. of this permit and submitted to the following address.

**NOTICE OF INTENT  
NYS DEC, Bureau of Water Permits  
625 Broadway, 4<sup>th</sup> Floor  
Albany, New York 12233-3505**

2. An *owner or operator* of a *construction activity* that is subject to the requirements of a *regulated, traditional land use control MS4* must first prepare a SWPPP in accordance with all applicable requirements of this permit and then have its SWPPP reviewed and accepted by the *regulated, traditional land use control MS4* prior to submitting the NOI to the Department. The *owner or operator* shall have the "MS4 SWPPP Acceptance" form signed in accordance with Part VII.H., and then submit that form along with a completed NOI to the Department. An *owner or operator* shall use either the electronic (eNOI) or paper version of the NOI.

The paper version of the NOI shall be signed in accordance with Part VII.H. of this permit and submitted to the address in Part II.A.1.

(Part II.A.2)

The requirement for an *owner or operator* to have its SWPPP reviewed and accepted by the *MS4* prior to submitting the NOI to the Department does not apply to an *owner or operator* that is obtaining permit coverage in accordance with the requirements in Part II.E. (Change of Owner or Operator) or where the *owner or operator* of the *construction activity* is the *regulated, traditional land use control MS4*.

3. The *owner or operator* shall have the SWPPP preparer sign the “SWPPP Preparer Certification” statement on the NOI prior to submitting the form to the Department.
4. As of the date the NOI is submitted to the Department, the *owner or operator* shall make the NOI and SWPPP available for review and copying in accordance with the requirements in Part VII.F. of this permit.

**B. Permit Authorization**

1. An *owner or operator* shall not *commence construction activity* until their authorization to *discharge* under this permit goes into effect.
2. Authorization to *discharge* under this permit will be effective when the *owner or operator* has satisfied all of the following criteria:
  - a. project review pursuant to the State Environmental Quality Review Act (“SEQRA”) have been satisfied, when SEQRA is applicable. See the Department’s website (<http://www.dec.ny.gov/>) for more information,
  - b. where required, all necessary Department permits subject to the *Uniform Procedures Act* (“UPA”) (see 6 NYCRR Part 621) have been obtained, unless otherwise notified by the Department pursuant to 6 NYCRR 621.3(a)(4). *Owners or operators of construction activities* that are required to obtain UPA permits must submit a preliminary SWPPP to the appropriate DEC Permit Administrator at the Regional Office listed in Appendix F at the time all other necessary UPA permit applications are submitted. The preliminary SWPPP must include sufficient information to demonstrate that the *construction activity* qualifies for authorization under this permit,
  - c. the final SWPPP has been prepared, and
  - d. a complete NOI has been submitted to the Department in accordance with the requirements of this permit.
3. An *owner or operator* that has satisfied the requirements of Part II.B.2 above

(Part II.B.3)

will be authorized to *discharge* stormwater from their *construction activity* in accordance with the following schedule:

- a. For *construction activities* that are not subject to the requirements of a *regulated, traditional land use control MS4*:
  - (i) Five (5) business days from the date the Department receives a complete electronic version of the NOI (eNOI) for *construction activities* with a SWPPP that has been prepared in conformance with the design criteria in the technical standard referenced in Part III.B.1 and the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C.; or
  - (ii) Sixty (60) business days from the date the Department receives a complete NOI (electronic or paper version) for *construction activities* with a SWPPP that has not been prepared in conformance with the design criteria in technical standard referenced in Part III.B.1. or, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C., the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, or;
  - (iii) Ten (10) business days from the date the Department receives a complete paper version of the NOI for *construction activities* with a SWPPP that has been prepared in conformance with the design criteria in the technical standard referenced in Part III.B.1 and the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C.
- b. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4*:
  - (i) Five (5) business days from the date the Department receives both a complete electronic version of the NOI (eNOI) and signed “MS4 SWPPP Acceptance” form, or
  - (ii) Ten (10) business days from the date the Department receives both a complete paper version of the NOI and signed “MS4 SWPPP Acceptance” form.

4. The Department may suspend or deny an *owner’s or operator’s* coverage

(Part II.B.4)

under this permit if the Department determines that the SWPPP does not meet the permit requirements. In accordance with statute, regulation, and the terms and conditions of this permit, the Department may deny coverage under this permit and require submittal of an application for an individual SPDES permit based on a review of the NOI or other information pursuant to Part II.

5. Coverage under this permit authorizes stormwater *discharges* from only those areas of disturbance that are identified in the NOI. If an *owner or operator* wishes to have stormwater *discharges* from future or additional areas of disturbance authorized, they must submit a new NOI that addresses that phase of the development, unless otherwise notified by the Department. The *owner or operator* shall not *commence construction activity* on the future or additional areas until their authorization to *discharge* under this permit goes into effect in accordance with Part II.B. of this permit.

### **C. General Requirements For Owners or Operators With Permit Coverage**

1. The *owner or operator* shall ensure that the provisions of the SWPPP are implemented from the *commencement of construction activity* until all areas of disturbance have achieved *final stabilization* and the Notice of Termination ("NOT") has been submitted to the Department in accordance with Part V. of this permit. This includes any changes made to the SWPPP pursuant to Part III.A.4. of this permit.
2. The *owner or operator* shall maintain a copy of the General Permit (GP-0-15-002), NOI, *NOI Acknowledgment Letter*, SWPPP, MS4 SWPPP Acceptance form, inspection reports, and all documentation necessary to demonstrate eligibility with this permit at the construction site until all disturbed areas have achieved *final stabilization* and the NOT has been submitted to the Department. The documents must be maintained in a secure location, such as a job trailer, on-site construction office, or mailbox with lock. The secure location must be accessible during normal business hours to an individual performing a compliance inspection.
3. The *owner or operator* of a *construction activity* shall not disturb greater than five (5) acres of soil at any one time without prior written authorization from the Department or, in areas under the jurisdiction of a *regulated, traditional land use control MS4*, the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*). At a minimum, the *owner or operator* must comply with the following requirements in order to be authorized to disturb greater than five (5) acres of soil at any one time:
  - a. The *owner or operator* shall

(Part II.C.3.a)

have a *qualified inspector* conduct **at least** two (2) site inspections in accordance with Part IV.C. of this permit every seven (7) calendar days, for as long as greater than five (5) acres of soil remain disturbed. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.

- b. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. The soil stabilization measures selected shall be in conformance with the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016.
  - c. The *owner or operator* shall prepare a phasing plan that defines maximum disturbed area per phase and shows required cuts and fills.
  - d. The *owner or operator* shall install any additional site specific practices needed to protect water quality.
  - e. The *owner or operator* shall include the requirements above in their SWPPP.
4. In accordance with statute, regulations, and the terms and conditions of this permit, the Department may suspend or revoke an *owner's or operator's* coverage under this permit at any time if the Department determines that the SWPPP does not meet the permit requirements. Upon a finding of significant non-compliance with the practices described in the SWPPP or violation of this permit, the Department may order an immediate stop to all activity at the site until the non-compliance is remedied. The stop work order shall be in writing, describe the non-compliance in detail, and be sent to the *owner or operator*.
5. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4*, the *owner or operator* shall notify the *regulated, traditional land use control MS4* in writing of any planned amendments or modifications to the post-construction stormwater management practice component of the SWPPP required by Part III.A. 4. and 5. of this permit. Unless otherwise notified by the *regulated, traditional land use control MS4*, the *owner or operator* shall have the SWPPP amendments or modifications reviewed and accepted by the *regulated, traditional land use control MS4* prior to commencing construction of the post-construction stormwater management practice

(Part II.D)

#### **D. Permit Coverage for Discharges Authorized Under GP-0-10-001**

1. Upon renewal of SPDES General Permit for Stormwater Discharges from *Construction Activity* (Permit No. GP-0-10-001), an *owner or operator* of a *construction activity* with coverage under GP-0-10-001, as of the effective date of GP-0-15-002, shall be authorized to *discharge* in accordance with GP-0-15-002, unless otherwise notified by the Department.

An *owner or operator* may continue to implement the technical/design components of the post-construction stormwater management controls provided that such design was done in conformance with the technical standards in place at the time of initial project authorization. However, they must comply with the other, non-design provisions of GP-0-15-002.

#### **E. Change of *Owner or Operator***

1. When property ownership changes or when there is a change in operational control over the construction plans and specifications, the original *owner or operator* must notify the new *owner or operator*, in writing, of the requirement to obtain permit coverage by submitting a NOI with the Department. Once the new *owner or operator* obtains permit coverage, the original *owner or operator* shall then submit a completed NOT with the name and permit identification number of the new *owner or operator* to the Department at the address in Part II.A.1. of this permit. If the original *owner or operator* maintains ownership of a portion of the *construction activity* and will disturb soil, they must maintain their coverage under the permit.

Permit coverage for the new *owner or operator* will be effective as of the date the Department receives a complete NOI, provided the original *owner or operator* was not subject to a sixty (60) business day authorization period that has not expired as of the date the Department receives the NOI from the new *owner or operator*.

(Part III)

### Part III. STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

#### A. General SWPPP Requirements

1. A SWPPP shall be prepared and implemented by the *owner or operator* of each *construction activity* covered by this permit. The SWPPP must document the selection, design, installation, implementation and maintenance of the control measures and practices that will be used to meet the effluent limitations in Part I.B. of this permit and where applicable, the post-construction stormwater management practice requirements in Part I.C. of this permit. The SWPPP shall be prepared prior to the submittal of the NOI. The NOI shall be submitted to the Department prior to the *commencement of construction activity*. A copy of the completed, final NOI shall be included in the SWPPP.
2. The SWPPP shall describe the erosion and sediment control practices and where required, post-construction stormwater management practices that will be used and/or constructed to reduce the *pollutants* in stormwater *discharges* and to assure compliance with the terms and conditions of this permit. In addition, the SWPPP shall identify potential sources of pollution which may reasonably be expected to affect the quality of stormwater *discharges*.
3. All SWPPPs that require the post-construction stormwater management practice component shall be prepared by a *qualified professional* that is knowledgeable in the principles and practices of stormwater management and treatment.
4. The *owner or operator* must keep the SWPPP current so that it at all times accurately documents the erosion and sediment controls practices that are being used or will be used during construction, and all post-construction stormwater management practices that will be constructed on the site. At a minimum, the *owner or operator* shall amend the SWPPP:
  - a. whenever the current provisions prove to be ineffective in minimizing *pollutants* in stormwater *discharges* from the site;
  - b. whenever there is a change in design, construction, or operation at the construction site that has or could have an effect on the *discharge* of *pollutants*; and
  - c. to address issues or deficiencies identified during an inspection by the *qualified inspector*, the Department or other regulatory authority.
5. The Department may notify the *owner or operator* at any time that the

(Part III.A.5)

SWPPP does not meet one or more of the minimum requirements of this permit. The notification shall be in writing and identify the provisions of the SWPPP that require modification. Within fourteen (14) calendar days of such notification, or as otherwise indicated by the Department, the *owner or operator* shall make the required changes to the SWPPP and submit written notification to the Department that the changes have been made. If the *owner or operator* does not respond to the Department's comments in the specified time frame, the Department may suspend the *owner's or operator's* coverage under this permit or require the *owner or operator* to obtain coverage under an individual SPDES permit in accordance with Part II.C.4. of this permit.

6. Prior to the *commencement of construction activity*, the *owner or operator* must identify the contractor(s) and subcontractor(s) that will be responsible for installing, constructing, repairing, replacing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) that will be responsible for constructing the post-construction stormwater management practices included in the SWPPP. The *owner or operator* shall have each of the contractors and subcontractors identify at least one person from their company that will be responsible for implementation of the SWPPP. This person shall be known as the *trained contractor*. The *owner or operator* shall ensure that at least one *trained contractor* is on site on a daily basis when soil disturbance activities are being performed.

The *owner or operator* shall have each of the contractors and subcontractors identified above sign a copy of the following certification statement below before they commence any *construction activity*:

"I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the *qualified inspector* during a site inspection. I also understand that the *owner or operator* must comply with the terms and conditions of the most current version of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for stormwater *discharges* from *construction activities* and that it is unlawful for any person to cause or contribute to a violation of *water quality standards*. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for knowing violations"

In addition to providing the certification statement above, the certification page must also identify the specific elements of the SWPPP that each contractor and subcontractor will be responsible for and include the name and title of the person providing the signature; the name and title of the



(Part III.A.6)

*trained contractor* responsible for SWPPP implementation; the name, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification statement is signed. The *owner or operator* shall attach the certification statement(s) to the copy of the SWPPP that is maintained at the construction site. If new or additional contractors are hired to implement measures identified in the SWPPP after construction has commenced, they must also sign the certification statement and provide the information listed above.

7. For projects where the Department requests a copy of the SWPPP or inspection reports, the *owner or operator* shall submit the documents in both electronic (PDF only) and paper format within five (5) business days, unless otherwise notified by the Department.

**B. Required SWPPP Contents**

1. Erosion and sediment control component - All SWPPPs prepared pursuant to this permit shall include erosion and sediment control practices designed in conformance with the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016. Where erosion and sediment control practices are not designed in conformance with the design criteria included in the technical standard, the *owner or operator* must demonstrate *equivalence* to the technical standard. At a minimum, the erosion and sediment control component of the SWPPP shall include the following:
  - a. Background information about the scope of the project, including the location, type and size of project;
  - b. A site map/construction drawing(s) for the project, including a general location map. At a minimum, the site map shall show the total site area; all improvements; areas of disturbance; areas that will not be disturbed; existing vegetation; on-site and adjacent off-site surface water(s); floodplain/floodway boundaries; wetlands and drainage patterns that could be affected by the *construction activity*; existing and final contours ; locations of different soil types with boundaries; material, waste, borrow or equipment storage areas located on adjacent properties; and location(s) of the stormwater *discharge(s)*;
  - c. A description of the soil(s) present at the site, including an identification of the Hydrologic Soil Group (HSG);
  - d. A construction phasing plan and sequence of operations describing the intended order of *construction activities*, including clearing and grubbing, excavation and grading, utility and infrastructure installation and any other

(Part III.B.1.d)

activity at the site that results in soil disturbance;

- e. A description of the minimum erosion and sediment control practices to be installed or implemented for each *construction activity* that will result in soil disturbance. Include a schedule that identifies the timing of initial placement or implementation of each erosion and sediment control practice and the minimum time frames that each practice should remain in place or be implemented;
- f. A temporary and permanent soil stabilization plan that meets the requirements of this general permit and the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016, for each stage of the project, including initial land clearing and grubbing to project completion and achievement of *final stabilization*;
- g. A site map/construction drawing(s) showing the specific location(s), size(s), and length(s) of each erosion and sediment control practice;
- h. The dimensions, material specifications, installation details, and operation and maintenance requirements for all erosion and sediment control practices. Include the location and sizing of any temporary sediment basins and structural practices that will be used to divert flows from exposed soils;
- i. A maintenance inspection schedule for the contractor(s) identified in Part III.A.6. of this permit, to ensure continuous and effective operation of the erosion and sediment control practices. The maintenance inspection schedule shall be in accordance with the requirements in the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016;
- j. A description of the pollution prevention measures that will be used to control litter, construction chemicals and construction debris from becoming a *pollutant* source in the stormwater *discharges*;
- k. A description and location of any stormwater *discharges* associated with industrial activity other than construction at the site, including, but not limited to, stormwater *discharges* from asphalt plants and concrete plants located on the construction site; and
- l. Identification of any elements of the design that are not in conformance with the design criteria in the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016. Include the reason for the deviation or alternative design

(Part III.B.1.I)

and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

2. Post-construction stormwater management practice component – The *owner or operator* of any construction project identified in Table 2 of Appendix B as needing post-construction stormwater management practices shall prepare a SWPPP that includes practices designed in conformance with the applicable *sizing criteria* in Part I.C.2.a., c. or d. of this permit and the *performance criteria* in the technical standard, New York State Stormwater Management Design Manual dated January 2015

Where post-construction stormwater management practices are not designed in conformance with the *performance criteria* in the technical standard, the *owner or operator* must include in the SWPPP the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

The post-construction stormwater management practice component of the SWPPP shall include the following:

- a. Identification of all post-construction stormwater management practices to be constructed as part of the project. Include the dimensions, material specifications and installation details for each post-construction stormwater management practice;
- b. A site map/construction drawing(s) showing the specific location and size of each post-construction stormwater management practice;
- c. A Stormwater Modeling and Analysis Report that includes:
  - (i) Map(s) showing pre-development conditions, including watershed/subcatchments boundaries, flow paths/routing, and design points;
  - (ii) Map(s) showing post-development conditions, including watershed/subcatchments boundaries, flow paths/routing, design points and post-construction stormwater management practices;
  - (iii) Results of stormwater modeling (i.e. hydrology and hydraulic analysis) for the required storm events. Include supporting calculations (model runs), methodology, and a summary table that compares pre and post-development runoff rates and volumes for the different storm events;
  - (iv) Summary table, with supporting calculations, which demonstrates

(Part III.B.2.c.iv)

that each post-construction stormwater management practice has been designed in conformance with the *sizing criteria* included in the Design Manual;

- (v) Identification of any *sizing criteria* that is not required based on the requirements included in Part I.C. of this permit; and
  - (vi) Identification of any elements of the design that are not in conformance with the *performance criteria* in the Design Manual. Include the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the Design Manual;
- d. Soil testing results and locations (test pits, borings);
  - e. Infiltration test results, when required; and
  - f. An operations and maintenance plan that includes inspection and maintenance schedules and actions to ensure continuous and effective operation of each post-construction stormwater management practice. The plan shall identify the entity that will be responsible for the long term operation and maintenance of each practice.
3. Enhanced Phosphorus Removal Standards - All construction projects identified in Table 2 of Appendix B that are located in the watersheds identified in Appendix C shall prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the applicable *sizing criteria* in Part I.C.2. b., c. or d. of this permit and the *performance criteria*, Enhanced Phosphorus Removal Standards included in the Design Manual. At a minimum, the post-construction stormwater management practice component of the SWPPP shall include items 2.a - 2.f. above.

### **C. Required SWPPP Components by Project Type**

Unless otherwise notified by the Department, *owners or operators of construction activities* identified in Table 1 of Appendix B are required to prepare a SWPPP that only includes erosion and sediment control practices designed in conformance with Part III.B.1 of this permit. *Owners or operators of the construction activities* identified in Table 2 of Appendix B shall prepare a SWPPP that also includes post-construction stormwater management practices designed in conformance with Part III.B.2 or 3 of this permit.

(Part IV)

## **Part IV. INSPECTION AND MAINTENANCE REQUIREMENTS**

### **A. General Construction Site Inspection and Maintenance Requirements**

1. The *owner or operator* must ensure that all erosion and sediment control practices (including pollution prevention measures) and all post-construction stormwater management practices identified in the SWPPP are inspected and maintained in accordance with Part IV.B. and C. of this permit.
2. The terms of this permit shall not be construed to prohibit the State of New York from exercising any authority pursuant to the ECL, common law or federal law, or prohibit New York State from taking any measures, whether civil or criminal, to prevent violations of the laws of the State of New York, or protect the public health and safety and/or the environment.

### **B. Contractor Maintenance Inspection Requirements**

1. The *owner or operator* of each *construction activity* identified in Tables 1 and 2 of Appendix B shall have a *trained contractor* inspect the erosion and sediment control practices and pollution prevention measures being implemented within the active work area daily to ensure that they are being maintained in effective operating condition at all times. If deficiencies are identified, the contractor shall begin implementing corrective actions within one business day and shall complete the corrective actions in a reasonable time frame.
2. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and *temporary stabilization* measures have been applied to all disturbed areas, the *trained contractor* can stop conducting the maintenance inspections. The *trained contractor* shall begin conducting the maintenance inspections in accordance with Part IV.B.1. of this permit as soon as soil disturbance activities resume.
3. For construction sites where soil disturbance activities have been shut down with partial project completion, the *trained contractor* can stop conducting the maintenance inspections if all areas disturbed as of the project shutdown date have achieved *final stabilization* and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational.

### **C. Qualified Inspector Inspection Requirements**

(Part IV.C)

The *owner or operator* shall have a *qualified inspector* conduct site inspections in conformance with the following requirements:

[Note: The *trained contractor* identified in Part III.A.6. and IV.B. of this permit **cannot** conduct the *qualified inspector* site inspections unless they meet the *qualified inspector* qualifications included in Appendix A. In order to perform these inspections, the *trained contractor* would have to be a:

- licensed Professional Engineer,
- Certified Professional in Erosion and Sediment Control (CPESC),
- Registered Landscape Architect, or
- someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided they have received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity].

1. A *qualified inspector* shall conduct site inspections for all *construction activities* identified in Tables 1 and 2 of Appendix B, with the exception of:
  - a. the construction of a single family residential subdivision with 25% or less *impervious cover* at total site build-out that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres and is not located in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E;
  - b. the construction of a single family home that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres and is not located in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E;
  - c. construction on agricultural property that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres; and
  - d. *construction activities* located in the watersheds identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.
2. Unless otherwise notified by the Department, the *qualified inspector* shall conduct site inspections in accordance with the following timetable:
  - a. For construction sites where soil disturbance activities are on-going, the *qualified inspector* shall conduct a site inspection at least once every seven (7) calendar days.
  - b. For construction sites where soil disturbance activities are on-going and

(Part IV.C.2.b)

the *owner or operator* has received authorization in accordance with Part II.C.3 to disturb greater than five (5) acres of soil at any one time, the *qualified inspector* shall conduct at least two (2) site inspections every seven (7) calendar days. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.

- c. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and *temporary stabilization* measures have been applied to all disturbed areas, the *qualified inspector* shall conduct a site inspection at least once every thirty (30) calendar days. The *owner or operator* shall notify the DOW Water (SPDES) Program contact at the Regional Office (see contact information in Appendix F) or, in areas under the jurisdiction of a *regulated, traditional land use control MS4*, the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*) in writing prior to reducing the frequency of inspections.
- d. For construction sites where soil disturbance activities have been shut down with partial project completion, the *qualified inspector* can stop conducting inspections if all areas disturbed as of the project shutdown date have achieved *final stabilization* and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational. The *owner or operator* shall notify the DOW Water (SPDES) Program contact at the Regional Office (see contact information in Appendix F) or, in areas under the jurisdiction of a *regulated, traditional land use control MS4*, the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*) in writing prior to the shutdown. If soil disturbance activities are not resumed within 2 years from the date of shutdown, the *owner or operator* shall have the *qualified inspector* perform a final inspection and certify that all disturbed areas have achieved *final stabilization*, and all temporary, structural erosion and sediment control measures have been removed; and that all post-construction stormwater management practices have been constructed in conformance with the SWPPP by signing the “*Final Stabilization*” and “*Post-Construction Stormwater Management Practice*” certification statements on the NOT. The *owner or operator* shall then submit the completed NOT form to the address in Part II.A.1 of this permit.
- e. For construction sites that directly *discharge* to one of the 303(d) segments listed in Appendix E or is located in one of the watersheds listed in Appendix C, the *qualified inspector* shall conduct at least two (2) site inspections every seven (7) calendar days. The two (2) inspections shall

(Part IV.C.2.e)

be separated by a minimum of two (2) full calendar days.

3. At a minimum, the *qualified inspector* shall inspect all erosion and sediment control practices and pollution prevention measures to ensure integrity and effectiveness, all post-construction stormwater management practices under construction to ensure that they are constructed in conformance with the SWPPP, all areas of disturbance that have not achieved *final stabilization*, all points of *discharge* to natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the construction site, and all points of *discharge* from the construction site.
4. The *qualified inspector* shall prepare an inspection report subsequent to each and every inspection. At a minimum, the inspection report shall include and/or address the following:
  - a. Date and time of inspection;
  - b. Name and title of person(s) performing inspection;
  - c. A description of the weather and soil conditions (e.g. dry, wet, saturated) at the time of the inspection;
  - d. A description of the condition of the runoff at all points of *discharge* from the construction site. This shall include identification of any *discharges* of sediment from the construction site. Include *discharges* from conveyance systems (i.e. pipes, culverts, ditches, etc.) and overland flow;
  - e. A description of the condition of all natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the construction site which receive runoff from disturbed areas. This shall include identification of any *discharges* of sediment to the surface waterbody;
  - f. Identification of all erosion and sediment control practices and pollution prevention measures that need repair or maintenance;
  - g. Identification of all erosion and sediment control practices and pollution prevention measures that were not installed properly or are not functioning as designed and need to be reinstalled or replaced;
  - h. Description and sketch of areas with active soil disturbance activity, areas that have been disturbed but are inactive at the time of the inspection, and areas that have been stabilized (temporary and/or final) since the last inspection;



(Part IV.C.4.i)

- i. Current phase of construction of all post-construction stormwater management practices and identification of all construction that is not in conformance with the SWPPP and technical standards;
  - j. Corrective action(s) that must be taken to install, repair, replace or maintain erosion and sediment control practices and pollution prevention measures; and to correct deficiencies identified with the construction of the post-construction stormwater management practice(s);
  - k. Identification and status of all corrective actions that were required by previous inspection; and
  - l. Digital photographs, with date stamp, that clearly show the condition of all practices that have been identified as needing corrective actions. The *qualified inspector* shall attach paper color copies of the digital photographs to the inspection report being maintained onsite within seven (7) calendar days of the date of the inspection. The *qualified inspector* shall also take digital photographs, with date stamp, that clearly show the condition of the practice(s) after the corrective action has been completed. The *qualified inspector* shall attach paper color copies of the digital photographs to the inspection report that documents the completion of the corrective action work within seven (7) calendar days of that inspection.
5. Within one business day of the completion of an inspection, the *qualified inspector* shall notify the *owner or operator* and appropriate contractor or subcontractor identified in Part III.A.6. of this permit of any corrective actions that need to be taken. The contractor or subcontractor shall begin implementing the corrective actions within one business day of this notification and shall complete the corrective actions in a reasonable time frame.
6. All inspection reports shall be signed by the *qualified inspector*. Pursuant to Part II.C.2. of this permit, the inspection reports shall be maintained on site with the SWPPP.

## **Part V. TERMINATION OF PERMIT COVERAGE**

### **A. Termination of Permit Coverage**

- 1. An *owner or operator* that is eligible to terminate coverage under this permit must submit a completed NOT form to the address in Part II.A.1 of this permit. The NOT form shall be one which is associated with this permit, signed in accordance with Part VII.H of this permit.

(Part V.A.2)

2. An *owner or operator* may terminate coverage when one or more the following conditions have been met:
  - a. Total project completion - All *construction activity* identified in the SWPPP has been completed; and all areas of disturbance have achieved *final stabilization*; and all temporary, structural erosion and sediment control measures have been removed; and all post-construction stormwater management practices have been constructed in conformance with the SWPPP and are operational;
  - b. Planned shutdown with partial project completion - All soil disturbance activities have ceased; and all areas disturbed as of the project shutdown date have achieved *final stabilization*; and all temporary, structural erosion and sediment control measures have been removed; and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational;
  - c. A new *owner or operator* has obtained coverage under this permit in accordance with Part II.E. of this permit.
  - d. The *owner or operator* obtains coverage under an alternative SPDES general permit or an individual SPDES permit.
3. For *construction activities* meeting subdivision 2a. or 2b. of this Part, the *owner or operator* shall have the *qualified inspector* perform a final site inspection prior to submitting the NOT. The *qualified inspector* shall, by signing the “*Final Stabilization*” and “*Post-Construction Stormwater Management Practice* certification statements on the NOT, certify that all the requirements in Part V.A.2.a. or b. of this permit have been achieved.
4. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4* and meet subdivision 2a. or 2b. of this Part, the *owner or operator* shall have the *regulated, traditional land use control MS4* sign the “*MS4 Acceptance*” statement on the NOT in accordance with the requirements in Part VII.H. of this permit. The *regulated, traditional land use control MS4* official, by signing this statement, has determined that it is acceptable for the *owner or operator* to submit the NOT in accordance with the requirements of this Part. The *regulated, traditional land use control MS4* can make this determination by performing a final site inspection themselves or by accepting the *qualified inspector’s* final site inspection certification(s) required in Part V.A.3. of this permit.

(Part V.A.5)

5. For *construction activities* that require post-construction stormwater management practices and meet subdivision 2a. of this Part, the *owner or operator* must, prior to submitting the NOT, ensure one of the following:
  - a. the post-construction stormwater management practice(s) and any right-of-way(s) needed to maintain such practice(s) have been deeded to the municipality in which the practice(s) is located,
  - b. an executed maintenance agreement is in place with the municipality that will maintain the post-construction stormwater management practice(s),
  - c. for post-construction stormwater management practices that are privately owned, the *owner or operator* has a mechanism in place that requires operation and maintenance of the practice(s) in accordance with the operation and maintenance plan, such as a deed covenant in the *owner or operator's* deed of record,
  - d. for post-construction stormwater management practices that are owned by a public or private institution (e.g. school, university, hospital), government agency or authority, or public utility; the *owner or operator* has policy and procedures in place that ensures operation and maintenance of the practices in accordance with the operation and maintenance plan.

## **Part VI. REPORTING AND RETENTION OF RECORDS**

### **A. Record Retention**

The *owner or operator* shall retain a copy of the NOI, NOI Acknowledgment Letter, SWPPP, MS4 SWPPP Acceptance form and any inspection reports that were prepared in conjunction with this permit for a period of at least five (5) years from the date that the Department receives a complete NOT submitted in accordance with Part V. of this general permit.

### **B. Addresses**

With the exception of the NOI, NOT, and MS4 SWPPP Acceptance form (which must be submitted to the address referenced in Part II.A.1 of this permit), all written correspondence requested by the Department, including individual permit applications, shall be sent to the address of the appropriate DOW Water (SPDES) Program contact at the Regional Office listed in Appendix F.

(Part VII)

## **Part VII. STANDARD PERMIT CONDITIONS**

### **A. Duty to Comply**

The *owner or operator* must comply with all conditions of this permit. All contractors and subcontractors associated with the project must comply with the terms of the SWPPP. Any non-compliance with this permit constitutes a violation of the Clean Water Act (CWA) and the ECL and is grounds for an enforcement action against the *owner or operator* and/or the contractor/subcontractor; permit revocation, suspension or modification; or denial of a permit renewal application. Upon a finding of significant non-compliance with this permit or the applicable SWPPP, the Department may order an immediate stop to all *construction activity* at the site until the non-compliance is remedied. The stop work order shall be in writing, shall describe the non-compliance in detail, and shall be sent to the *owner or operator*.

If any human remains or archaeological remains are encountered during excavation, the *owner or operator* must immediately cease, or cause to cease, all *construction activity* in the area of the remains and notify the appropriate Regional Water Engineer (RWE). *Construction activity* shall not resume until written permission to do so has been received from the RWE.

### **B. Continuation of the Expired General Permit**

This permit expires five (5) years from the effective date. If a new general permit is not issued prior to the expiration of this general permit, an *owner or operator* with coverage under this permit may continue to operate and *discharge* in accordance with the terms and conditions of this general permit, if it is extended pursuant to the State Administrative Procedure Act and 6 NYCRR Part 621, until a new general permit is issued.

### **C. Enforcement**

Failure of the *owner or operator*, its contractors, subcontractors, agents and/or assigns to strictly adhere to any of the permit requirements contained herein shall constitute a violation of this permit. There are substantial criminal, civil, and administrative penalties associated with violating the provisions of this permit. Fines of up to \$37,500 per day for each violation and imprisonment for up to fifteen (15) years may be assessed depending upon the nature and degree of the offense.

### **D. Need to Halt or Reduce Activity Not a Defense**

It shall not be a defense for an *owner or operator* in an enforcement action that it would have been necessary to halt or reduce the *construction activity* in order to maintain compliance with the conditions of this permit.

(Part VII.E)

### **E. Duty to Mitigate**

The *owner or operator* and its contractors and subcontractors shall take all reasonable steps to *minimize* or prevent any *discharge* in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

### **F. Duty to Provide Information**

The *owner or operator* shall furnish to the Department, within a reasonable specified time period of a written request, all documentation necessary to demonstrate eligibility and any information to determine compliance with this permit or to determine whether cause exists for modifying or revoking this permit, or suspending or denying coverage under this permit, in accordance with the terms and conditions of this permit. The NOI, SWPPP and inspection reports required by this permit are public documents that the *owner or operator* must make available for review and copying by any person within five (5) business days of the *owner or operator* receiving a written request by any such person to review these documents. Copying of documents will be done at the requester's expense.

### **G. Other Information**

When the *owner or operator* becomes aware that they failed to submit any relevant facts, or submitted incorrect information in the NOI or in any of the documents required by this permit, or have made substantive revisions to the SWPPP (e.g. the scope of the project changes significantly, the type of post-construction stormwater management practice(s) changes, there is a reduction in the sizing of the post-construction stormwater management practice, or there is an increase in the disturbance area or *impervious area*), which were not reflected in the original NOI submitted to the Department, they shall promptly submit such facts or information to the Department using the contact information in Part II.A. of this permit. Failure of the *owner or operator* to correct or supplement any relevant facts within five (5) business days of becoming aware of the deficiency shall constitute a violation of this permit.

### **H. Signatory Requirements**

1. All NOIs and NOTs shall be signed as follows:

a. For a corporation these forms shall be signed by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(i) a president, secretary, treasurer, or vice-president of the

(Part VII.H.1.a.i)

corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or

- (ii) the manager of one or more manufacturing, production or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;
  - b. For a partnership or sole proprietorship these forms shall be signed by a general partner or the proprietor, respectively; or
  - c. For a municipality, State, Federal, or other public agency these forms shall be signed by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:
    - (i) the chief executive officer of the agency, or
    - (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).
2. The SWPPP and other information requested by the Department shall be signed by a person described in Part VII.H.1. of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:
- a. The authorization is made in writing by a person described in Part VII.H.1. of this permit;
  - b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of *equivalent* responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named

(Part VII.H.2.b)

individual or any individual occupying a named position) and,

- c. The written authorization shall include the name, title and signature of the authorized representative and be attached to the SWPPP.
3. All inspection reports shall be signed by the *qualified inspector* that performs the inspection.
4. The MS4 SWPPP Acceptance form shall be signed by the principal executive officer or ranking elected official from the *regulated, traditional land use control MS4*, or by a duly authorized representative of that person.

It shall constitute a permit violation if an incorrect and/or improper signatory authorizes any required forms, SWPPP and/or inspection reports.

#### **I. Property Rights**

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations. *Owners or operators* must obtain any applicable conveyances, easements, licenses and/or access to real property prior to *commencing construction activity*.

#### **J. Severability**

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

#### **K. Requirement to Obtain Coverage Under an Alternative Permit**

1. The Department may require any *owner or operator* authorized by this permit to apply for and/or obtain either an individual SPDES permit or another SPDES general permit. When the Department requires any *discharger* authorized by a general permit to apply for an individual SPDES permit, it shall notify the *discharger* in writing that a permit application is required. This notice shall include a brief statement of the reasons for this decision, an application form, a statement setting a time frame for the *owner or operator* to file the application for an individual SPDES permit, and a deadline, not sooner than 180 days from *owner or operator* receipt of the notification letter, whereby the authorization to

(Part VII.K.1)

*discharge* under this general permit shall be terminated. Applications must be submitted to the appropriate Permit Administrator at the Regional Office. The Department may grant additional time upon demonstration, to the satisfaction of the Department, that additional time to apply for an alternative authorization is necessary or where the Department has not provided a permit determination in accordance with Part 621 of this Title.

2. When an individual SPDES permit is issued to a discharger authorized to *discharge* under a general SPDES permit for the same *discharge(s)*, the general permit authorization for outfalls authorized under the individual SPDES permit is automatically terminated on the effective date of the individual permit unless termination is earlier in accordance with 6 NYCRR Part 750.

#### **L. Proper Operation and Maintenance**

The *owner or operator* shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the *owner or operator* to achieve compliance with the conditions of this permit and with the requirements of the SWPPP.

#### **M. Inspection and Entry**

The *owner or operator* shall allow an authorized representative of the Department, EPA, applicable county health department, or, in the case of a construction site which *discharges* through an *MS4*, an authorized representative of the *MS4* receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the *owner's or operator's* premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;
2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and
3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment), practices or operations regulated or required by this permit.
4. Sample or monitor at reasonable times, for purposes of assuring permit compliance or as otherwise authorized by the Act or ECL, any substances or parameters at any location.



(Part VII.N)

#### **N. Permit Actions**

This permit may, at any time, be modified, suspended, revoked, or renewed by the Department in accordance with 6 NYCRR Part 621. The filing of a request by the *owner or operator* for a permit modification, revocation and reissuance, termination, a notification of planned changes or anticipated noncompliance does not limit, diminish and/or stay compliance with any terms of this permit.

#### **O. Definitions**

Definitions of key terms are included in Appendix A of this permit.

#### **P. Re-Opener Clause**

1. If there is evidence indicating potential or realized impacts on water quality due to any stormwater discharge associated with *construction activity* covered by this permit, the *owner or operator* of such discharge may be required to obtain an individual permit or alternative general permit in accordance with Part VII.K. of this permit or the permit may be modified to include different limitations and/or requirements.
2. Any Department initiated permit modification, suspension or revocation will be conducted in accordance with 6 NYCRR Part 621, 6 NYCRR 750-1.18, and 6 NYCRR 750-1.20.

#### **Q. Penalties for Falsification of Forms and Reports**

In accordance with 6NYCRR Part 750-2.4 and 750-2.5, any person who knowingly makes any false material statement, representation, or certification in any application, record, report or other document filed or required to be maintained under this permit, including reports of compliance or noncompliance shall, upon conviction, be punished in accordance with ECL §71-1933 and or Articles 175 and 210 of the New York State Penal Law.

#### **R. Other Permits**

Nothing in this permit relieves the *owner or operator* from a requirement to obtain any other permits required by law.

## APPENDIX A

### Definitions

**Alter Hydrology from Pre to Post-Development Conditions** - means the post-development peak flow rate(s) has increased by more than 5% of the pre-developed condition for the design storm of interest (e.g. 10 yr and 100 yr).

**Combined Sewer** - means a sewer that is designed to collect and convey both “sewage” and “stormwater”.

**Commence (Commencement of) Construction Activities** - means the initial disturbance of soils associated with clearing, grading or excavation activities; or other construction related activities that disturb or expose soils such as demolition, stockpiling of fill material, and the initial installation of erosion and sediment control practices required in the SWPPP. See definition for “*Construction Activity(ies)*” also.

**Construction Activity(ies)** - means any clearing, grading, excavation, filling, demolition or stockpiling activities that result in soil disturbance. Clearing activities can include, but are not limited to, logging equipment operation, the cutting and skidding of trees, stump removal and/or brush root removal. Construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

**Direct Discharge (to a specific surface waterbody)** - means that runoff flows from a construction site by overland flow and the first point of discharge is the specific surface waterbody, or runoff flows from a construction site to a separate storm sewer system and the first point of discharge from the separate storm sewer system is the specific surface waterbody.

**Discharge(s)** - means any addition of any pollutant to waters of the State through an outlet or point source.

**Environmental Conservation Law (ECL)** - means chapter 43-B of the Consolidated Laws of the State of New York, entitled the Environmental Conservation Law.

**Equivalent (Equivalence)** – means that the practice or measure meets all the performance, longevity, maintenance, and safety objectives of the technical standard and will provide an equal or greater degree of water quality protection.

**Final Stabilization** - means that all soil disturbance activities have ceased and a uniform, perennial vegetative cover with a density of eighty (80) percent over the entire pervious surface has been established; or other equivalent stabilization measures, such as permanent landscape mulches, rock rip-rap or washed/crushed stone have been applied

on all disturbed areas that are not covered by permanent structures, concrete or pavement.

**General SPDES permit** - means a SPDES permit issued pursuant to 6 NYCRR Part 750-1.21 and Section 70-0117 of the ECL authorizing a category of discharges.

**Groundwater(s)** - means waters in the saturated zone. The saturated zone is a subsurface zone in which all the interstices are filled with water under pressure greater than that of the atmosphere. Although the zone may contain gas-filled interstices or interstices filled with fluids other than water, it is still considered saturated.

**Historic Property** – means any building, structure, site, object or district that is listed on the State or National Registers of Historic Places or is determined to be eligible for listing on the State or National Registers of Historic Places.

**Impervious Area (Cover)** - means all impermeable surfaces that cannot effectively infiltrate rainfall. This includes paved, concrete and gravel surfaces (i.e. parking lots, driveways, roads, runways and sidewalks); building rooftops and miscellaneous impermeable structures such as patios, pools, and sheds.

**Infeasible** – means not technologically possible, or not economically practicable and achievable in light of best industry practices.

**Larger Common Plan of Development or Sale** - means a contiguous area where multiple separate and distinct *construction activities* are occurring, or will occur, under one plan. The term “plan” in “larger common plan of development or sale” is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, marketing plan, advertisement, drawing, permit application, State Environmental Quality Review Act (SEQRA) environmental assessment form or other documents, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating that *construction activities* may occur on a specific plot.

For discrete construction projects that are located within a larger common plan of development or sale that are at least 1/4 mile apart, each project can be treated as a separate plan of development or sale provided any interconnecting road, pipeline or utility project that is part of the same “common plan” is not concurrently being disturbed.

**Minimize** – means reduce and/or eliminate to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practices.

**Municipal Separate Storm Sewer (MS4)** - a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters,

ditches, man-made channels, or storm drains):

- (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to surface waters of the State;
- (ii) Designed or used for collecting or conveying stormwater;
- (iii) Which is not a *combined sewer*; and
- (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

**National Pollutant Discharge Elimination System (NPDES)** - means the national system for the issuance of wastewater and stormwater permits under the Federal Water Pollution Control Act (Clean Water Act).

**New Development** – means any land disturbance that does not meet the definition of Redevelopment Activity included in this appendix.

**NOI Acknowledgment Letter** - means the letter that the Department sends to an owner or operator to acknowledge the Department's receipt and acceptance of a complete Notice of Intent. This letter documents the owner's or operator's authorization to discharge in accordance with the general permit for stormwater discharges from *construction activity*.

**Owner or Operator** - means the person, persons or legal entity which owns or leases the property on which the *construction activity* is occurring; and/or an entity that has operational control over the construction plans and specifications, including the ability to make modifications to the plans and specifications.

**Performance Criteria** – means the design criteria listed under the “Required Elements” sections in Chapters 5, 6 and 10 of the technical standard, New York State Stormwater Management Design Manual, dated January 2015. It does not include the Sizing Criteria (i.e. WQv, RRv, Cpv, Qp and Qf ) in Part I.C.2. of the permit.

**Pollutant** - means dredged spoil, filter backwash, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, municipal, agricultural waste and ballast discharged into water; which may cause or might reasonably be expected to cause pollution of the waters of the state in contravention of the standards or guidance values adopted as provided in 6 NYCRR Parts 700 et seq .

**Qualified Inspector** - means a person that is knowledgeable in the principles and practices of erosion and sediment control, such as a licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, or other Department endorsed individual(s).

It can also mean someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided that person has training in the principles and practices of erosion and sediment control. Training in the principles and practices of erosion and sediment control means that the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect has received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. After receiving the initial training, the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect shall receive four (4) hours of training every three (3) years.

It can also mean a person that meets the *Qualified Professional* qualifications in addition to the *Qualified Inspector* qualifications.

Note: Inspections of any post-construction stormwater management practices that include structural components, such as a dam for an impoundment, shall be performed by a licensed Professional Engineer.

**Qualified Professional** - means a person that is knowledgeable in the principles and practices of stormwater management and treatment, such as a licensed Professional Engineer, Registered Landscape Architect or other Department endorsed individual(s). Individuals preparing SWPPPs that require the post-construction stormwater management practice component must have an understanding of the principles of hydrology, water quality management practice design, water quantity control design, and, in many cases, the principles of hydraulics. All components of the SWPPP that involve the practice of engineering, as defined by the NYS Education Law (see Article 145), shall be prepared by, or under the direct supervision of, a professional engineer licensed to practice in the State of New York..

**Redevelopment Activity(ies)** – means the disturbance and reconstruction of existing impervious area, including impervious areas that were removed from a project site within five (5) years of preliminary project plan submission to the local government (i.e. site plan, subdivision, etc.).

**Regulated, Traditional Land Use Control MS4** - means a city, town or village with land use control authority that is required to gain coverage under New York State DEC's SPDES General Permit For Stormwater Discharges from Municipal Separate Stormwater Sewer Systems (MS4s).

**Routine Maintenance Activity** - means *construction activity* that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility, including, but not limited to:

- Re-grading of gravel roads or parking lots,
- Stream bank restoration projects (does not include the placement of spoil material),
- Cleaning and shaping of existing roadside ditches and culverts that maintains the approximate original line and grade, and hydraulic capacity of the ditch,
- Cleaning and shaping of existing roadside ditches that does not maintain the approximate original grade, hydraulic capacity and purpose of the ditch if the changes to the line and grade, hydraulic capacity or purpose of the ditch are installed to improve water quality and quantity controls (e.g. installing grass lined ditch),
- Placement of aggregate shoulder backing that makes the transition between the road shoulder and the ditch or embankment,
- Full depth milling and filling of existing asphalt pavements, replacement of concrete pavement slabs, and similar work that does not expose soil or disturb the bottom six (6) inches of subbase material,
- Long-term use of equipment storage areas at or near highway maintenance facilities,
- Removal of sediment from the edge of the highway to restore a previously existing sheet-flow drainage connection from the highway surface to the highway ditch or embankment,
- Existing use of Canal Corp owned upland disposal sites for the canal, and
- Replacement of curbs, gutters, sidewalks and guide rail posts.

**Site limitations** – means site conditions that prevent the use of an infiltration technique and or infiltration of the total WQv. Typical site limitations include: seasonal high groundwater, shallow depth to bedrock, and soils with an infiltration rate less than 0.5 inches/hour. The existence of site limitations shall be confirmed and documented using actual field testing (i.e. test pits, soil borings, and infiltration test) or using information from the most current United States Department of Agriculture (USDA) Soil Survey for the County where the project is located.

**Sizing Criteria** – means the criteria included in Part I.C.2 of the permit that are used to size post-construction stormwater management control practices. The criteria include; Water Quality Volume (WQv), Runoff Reduction Volume (RRv), Channel Protection Volume (Cpv), Overbank Flood (Qp), and Extreme Flood (Qf).

**State Pollutant Discharge Elimination System (SPDES)** - means the system established pursuant to Article 17 of the ECL and 6 NYCRR Part 750 for issuance of permits authorizing discharges to the waters of the state.

**Steep Slope** – means land area with a Soil Slope Phase that is identified as an E or F, or

the map unit name is inclusive of 25% or greater slope, on the United States Department of Agriculture ("USDA") Soil Survey for the County where the disturbance will occur.

**Surface Waters of the State** - shall be construed to include lakes, bays, sounds, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic ocean within the territorial seas of the state of New York and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface waters), which are wholly or partially within or bordering the state or within its jurisdiction. Waters of the state are further defined in 6 NYCRR Parts 800 to 941.

**Temporarily Ceased** – means that an existing disturbed area will not be disturbed again within 14 calendar days of the previous soil disturbance.

**Temporary Stabilization** - means that exposed soil has been covered with material(s) as set forth in the technical standard, New York Standards and Specifications for Erosion and Sediment Control, to prevent the exposed soil from eroding. The materials can include, but are not limited to, mulch, seed and mulch, and erosion control mats (e.g. jute twisted yarn, excelsior wood fiber mats).

**Total Maximum Daily Loads (TMDLs)** - A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. It is a calculation of the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet *water quality standards*, and an allocation of that amount to the pollutant's sources. A TMDL stipulates wasteload allocations (WLAs) for point source discharges, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

**Trained Contractor** - means an employee from the contracting (construction) company, identified in Part III.A.6., that has received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. After receiving the initial training, the *trained contractor* shall receive four (4) hours of training every three (3) years.

It can also mean an employee from the contracting (construction) company, identified in Part III.A.6., that meets the *qualified inspector* qualifications (e.g. licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, or someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided they have received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity).

The *trained contractor* is responsible for the day to day implementation of the SWPPP.

**Uniform Procedures Act (UPA) Permit** - means a permit required under 6 NYCRR Part

621 of the Environmental Conservation Law (ECL), Article 70.

**Water Quality Standard** - means such measures of purity or quality for any waters in relation to their reasonable and necessary use as promulgated in 6 NYCRR Part 700 et seq.



## APPENDIX B

### Required SWPPP Components by Project Type

**Table 1**  
**CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP**  
**THAT ONLY INCLUDES EROSION AND SEDIMENT CONTROLS**

<p><b>The following construction activities that involve soil disturbances of one (1) or more acres of land, but less than five (5) acres:</b></p> <ul style="list-style-type: none"> <li>• Single family home <u>not</u> located in one of the watersheds listed in Appendix C or <u>not directly discharging</u> to one of the 303(d) segments listed in Appendix E</li> <li>• Single family residential subdivisions with 25% or less impervious cover at total site build-out and <u>not</u> located in one of the watersheds listed in Appendix C and <u>not</u> directly discharging to one of the 303(d) segments listed in Appendix E</li> <li>• Construction of a barn or other agricultural building, silo, stock yard or pen.</li> </ul>
<p><b>The following construction activities that involve soil disturbances of one (1) or more acres of land:</b></p> <ul style="list-style-type: none"> <li>• Installation of underground, linear utilities; such as gas lines, fiber-optic cable, cable TV, electric, telephone, sewer mains, and water mains</li> <li>• Environmental enhancement projects, such as wetland mitigation projects, stormwater retrofits and stream restoration projects</li> <li>• Bike paths and trails</li> <li>• Sidewalk construction projects that are not part of a road/ highway construction or reconstruction project</li> <li>• Slope stabilization projects</li> <li>• Slope flattening that changes the grade of the site, but does not significantly change the runoff characteristics</li> <li>• Spoil areas that will be covered with vegetation</li> <li>• Land clearing and grading for the purposes of creating vegetated open space (i.e. recreational parks, lawns, meadows, fields), excluding projects that <i>alter hydrology from pre to post development</i> conditions</li> <li>• Athletic fields (natural grass) that do not include the construction or reconstruction of <i>impervious area</i> and do not <i>alter hydrology from pre to post development</i> conditions</li> <li>• Demolition project where vegetation will be established and no redevelopment is planned</li> <li>• Overhead electric transmission line project that does not include the construction of permanent access roads or parking areas surfaced with <i>impervious cover</i></li> <li>• Structural practices as identified in Table II in the "Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State", excluding projects that involve soil disturbances of less than five acres and construction activities that include the construction or reconstruction of impervious area</li> </ul>
<p><b>The following construction activities that involve soil disturbances between five thousand (5000) square feet and one (1) acre of land:</b></p> <ul style="list-style-type: none"> <li>• All construction activities located in the watersheds identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.</li> </ul>

**Table 2**  
**CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP THAT INCLUDES**  
**POST-CONSTRUCTION STORMWATER MANAGEMENT PRACTICES**

**The following construction activities that involve soil disturbances of one (1) or more acres of land:**

- Single family home located in one of the watersheds listed in Appendix C or *directly discharging* to one of the 303(d) segments listed in Appendix E
- Single family residential subdivisions located in one of the watersheds listed in Appendix C or *directly discharging* to one of the 303(d) segments listed in Appendix E
- Single family residential subdivisions that involve soil disturbances of between one (1) and five (5) acres of land with greater than 25% impervious cover at total site build-out
- Single family residential subdivisions that involve soil disturbances of five (5) or more acres of land, and single family residential subdivisions that involve soil disturbances of less than five (5) acres that are part of a larger common plan of development or sale that will ultimately disturb five or more acres of land
- Multi-family residential developments; includes townhomes, condominiums, senior housing complexes, apartment complexes, and mobile home parks
- Airports
- Amusement parks
- Campgrounds
- Cemeteries that include the construction or reconstruction of impervious area (>5% of disturbed area) or *alter the hydrology from pre to post development* conditions
- Commercial developments
- Churches and other places of worship
- Construction of a barn or other agricultural building(e.g. silo) and structural practices as identified in Table II in the "Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State" that include the construction or reconstruction of *impervious area*, excluding projects that involve soil disturbances of less than five acres.
- Golf courses
- Institutional, includes hospitals, prisons, schools and colleges
- Industrial facilities, includes industrial parks
- Landfills
- Municipal facilities; includes highway garages, transfer stations, office buildings, POTW's and water treatment plants
- Office complexes
- Sports complexes
- Racetracks, includes racetracks with earthen (dirt) surface
- Road construction or reconstruction
- Parking lot construction or reconstruction
- Athletic fields (natural grass) that include the construction or reconstruction of impervious area (>5% of disturbed area) or *alter the hydrology from pre to post development* conditions
- Athletic fields with artificial turf
- Permanent access roads, parking areas, substations, compressor stations and well drilling pads, surfaced with *impervious cover*, and constructed as part of an over-head electric transmission line project, wind-power project, cell tower project, oil or gas well drilling project, sewer or water main project or other linear utility project
- All other construction activities that include the construction or reconstruction of *impervious area* or *alter the hydrology from pre to post development* conditions, and are not listed in Table 1

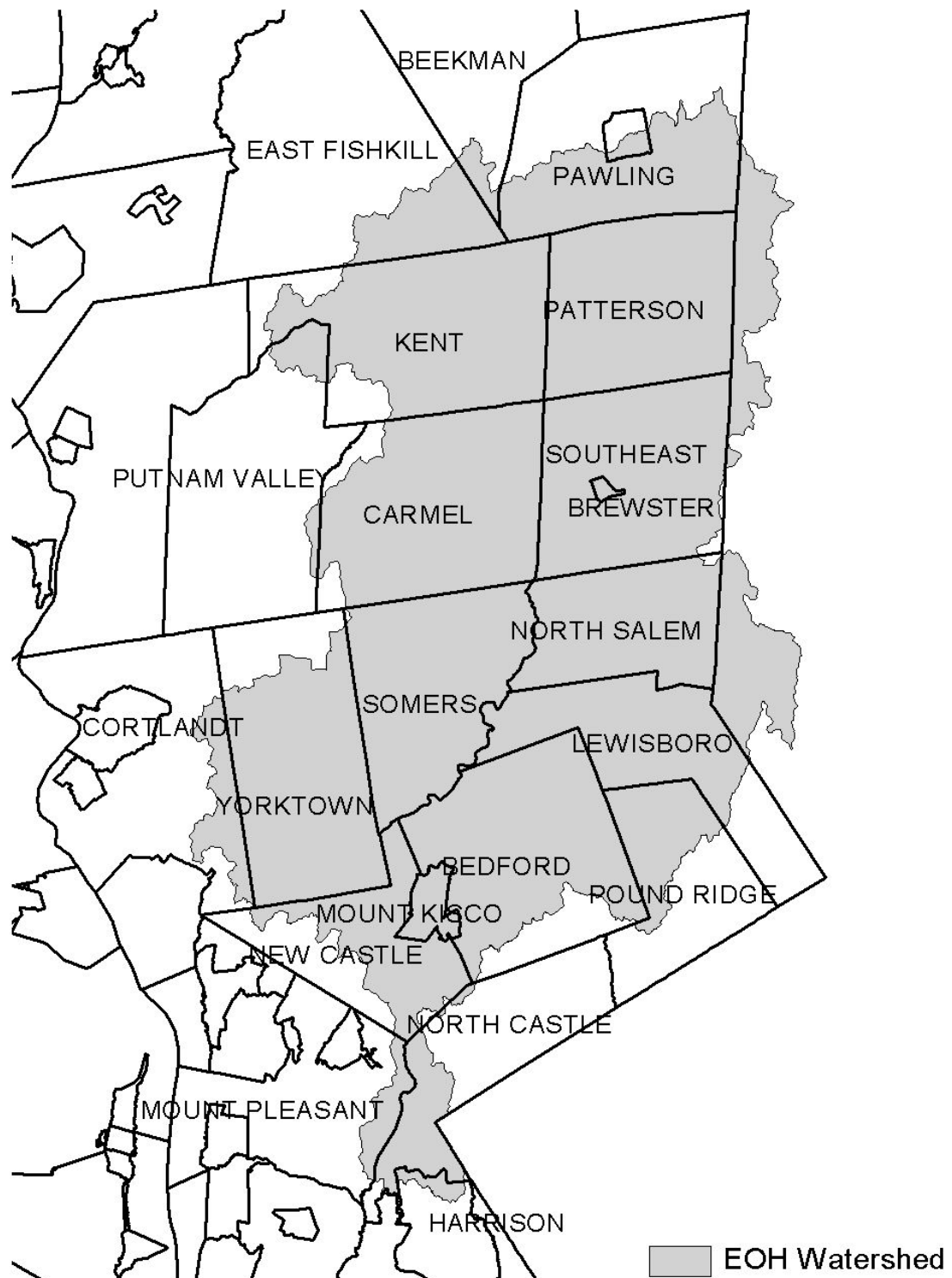
## APPENDIX C

### Watersheds Where Enhanced Phosphorus Removal Standards Are Required

Watersheds where *owners or operators* of construction activities identified in Table 2 of Appendix B must prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the Enhanced Phosphorus Removal Standards included in the technical standard, New York State Stormwater Management Design Manual (“Design Manual”).

- Entire New York City Watershed located east of the Hudson River - Figure 1
- Onondaga Lake Watershed - Figure 2
- Greenwood Lake Watershed -Figure 3
- Oscawana Lake Watershed – Figure 4
- Kinderhook Lake Watershed – Figure 5

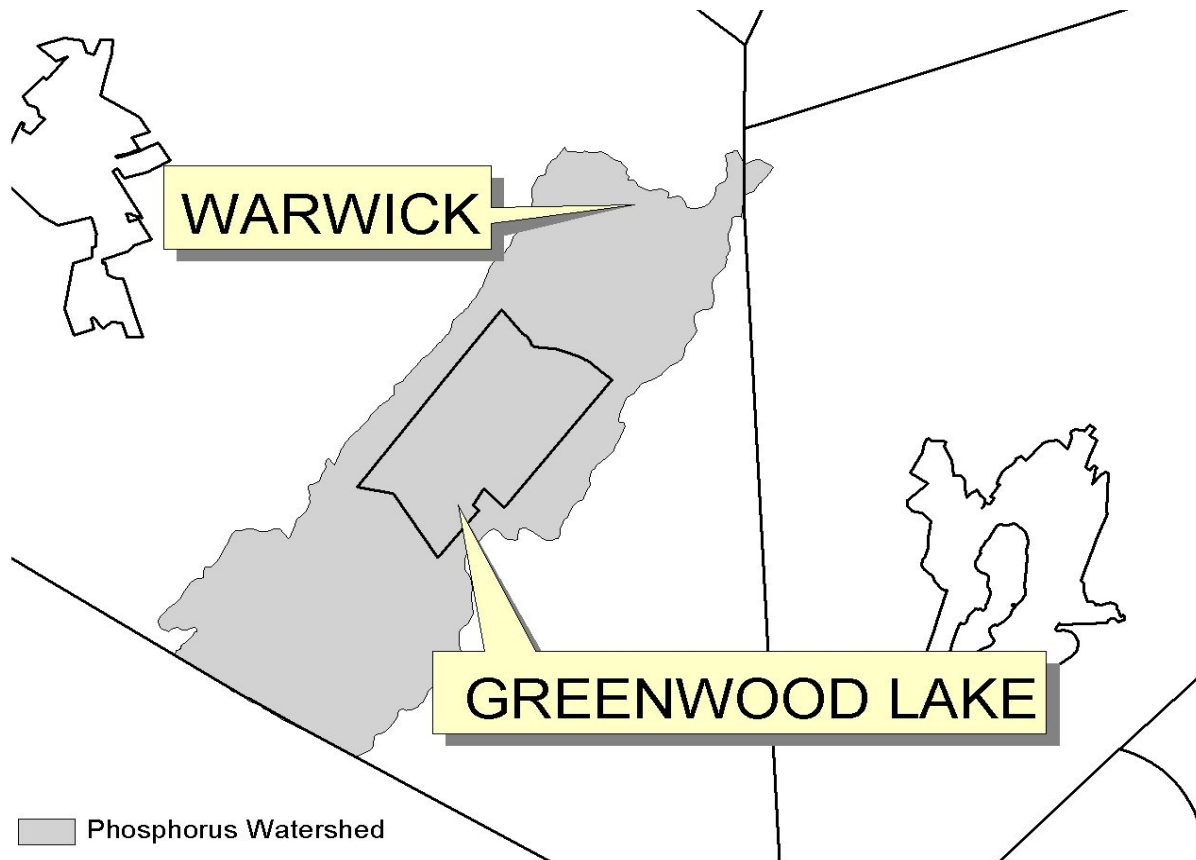
**Figure 1 - New York City Watershed East of the Hudson**



**Figure 2 - Onondaga Lake Watershed**



**Figure 3 - Greenwood Lake Watershed**



**Figure 4 - Oscawana Lake Watershed**

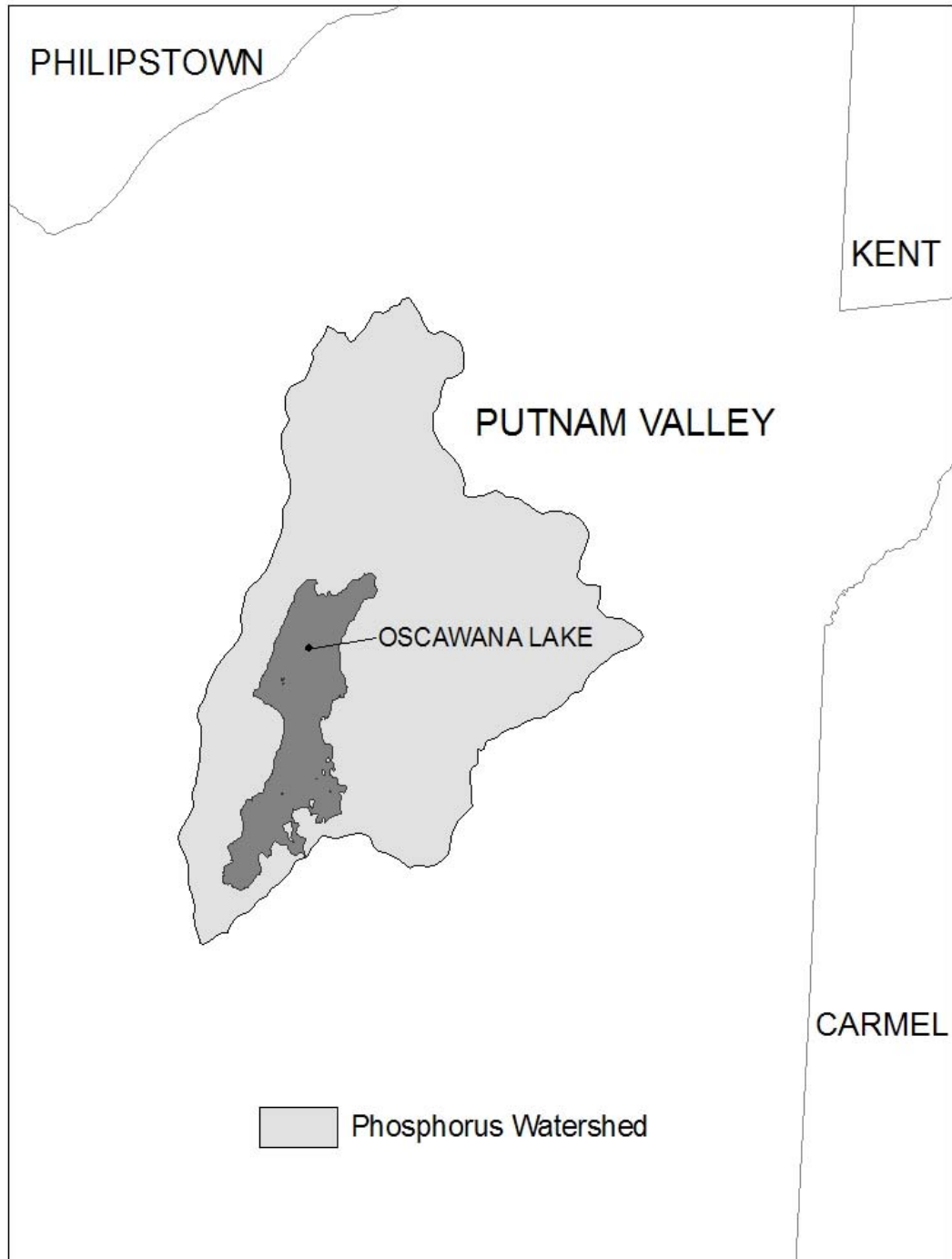
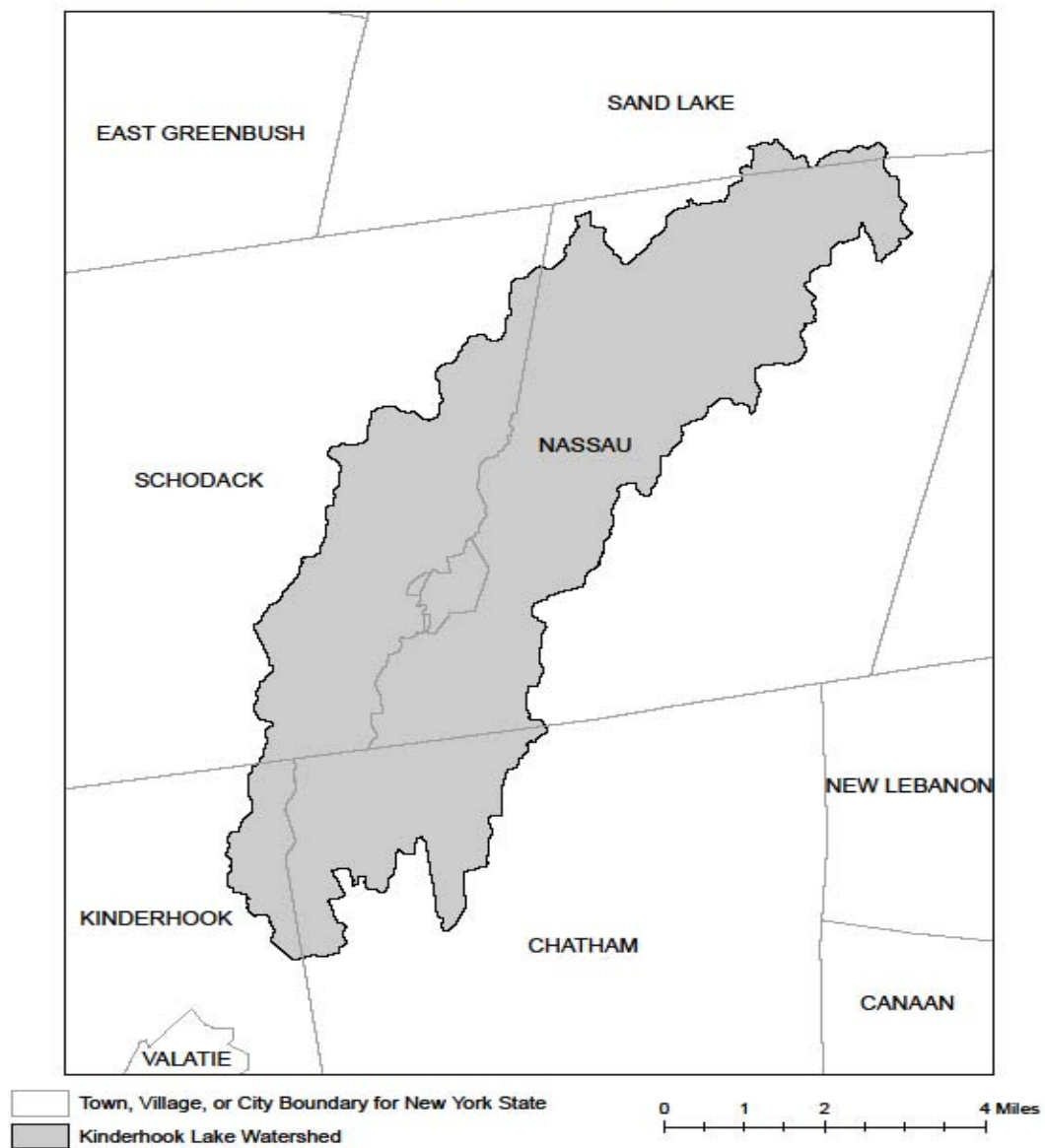


Figure 5: Kinderhook Lake Watershed





## APPENDIX D

**Watersheds where *owners or operators* of construction activities that involve soil disturbances between five thousand (5000) square feet and one (1) acre of land must obtain coverage under this permit.**

Entire New York City Watershed that is located east of the Hudson River - See Figure 1 in Appendix C
--

## APPENDIX E

List of 303(d) segments impaired by pollutants related to *construction activity* (e.g. silt, sediment or nutrients). *Owners or operators* of single family home and single family residential subdivisions with 25% or less total impervious cover at total site build-out that involve soil disturbances of one or more acres of land, but less than 5 acres, and *directly discharge* to one of the listed segments below shall prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the New York State Stormwater Management Design Manual (“Design Manual”), dated January 2015.

COUNTY	WATERBODY	COUNTY	WATERBODY
Albany	Ann Lee (Shakers) Pond, Stump Pond	Greene	Sleepy Hollow Lake
Albany	Basic Creek Reservoir	Herkimer	Steele Creek tribs
Allegheny	Amity Lake, Saunders Pond	Kings	Hendrix Creek
Bronx	Van Cortlandt Lake	Lewis	Mill Creek/South Branch and tribs
Broome	Whitney Point Lake/Reservoir	Livingston	Conesus Lake
Broome	Fly Pond, Deer Lake	Livingston	Jaycox Creek and tribs
Broome	Minor Tribs to Lower Susquehanna (north)	Livingston	Mill Creek and minor tribs
Cattaraugus	Allegheny River/Reservoir	Livingston	Bradner Creek and tribs
Cattaraugus	Case Lake	Livingston	Christie Creek and tribs
Cattaraugus	Linlyco/Club Pond	Monroe	Lake Ontario Shoreline, Western
Cayuga	Duck Lake	Monroe	Mill Creek/Blue Pond Outlet and tribs
Chautauqua	Chautauqua Lake, North	Monroe	Rochester Embayment - East
Chautauqua	Chautauqua Lake, South	Monroe	Rochester Embayment - West
Chautauqua	Bear Lake	Monroe	Unnamed Trib to Honeoye Creek
Chautauqua	Chadakoin River and tribs	Monroe	Genesee River, Lower, Main Stem
Chautauqua	Lower Cassadaga Lake	Monroe	Genesee River, Middle, Main Stem
Chautauqua	Middle Cassadaga Lake	Monroe	Black Creek, Lower, and minor tribs
Chautauqua	Findley Lake	Monroe	Buck Pond
Clinton	Great Chazy River, Lower, Main Stem	Monroe	Long Pond
Columbia	Kinderhook Lake	Monroe	Cranberry Pond
Columbia	Robinson Pond	Monroe	Mill Creek and tribs
Dutchess	Hillside Lake	Monroe	Shipbuilders Creek and tribs
Dutchess	Wappinger Lakes	Monroe	Minor tribs to Irondequoit Bay
Dutchess	Fall Kill and tribs	Monroe	Thomas Creek/White Brook and tribs
Erie	Green Lake	Nassau	Glen Cove Creek, Lower, and tribs
Erie	Scajaquada Creek, Lower, and tribs	Nassau	LI Tribs (fresh) to East Bay
Erie	Scajaquada Creek, Middle, and tribs	Nassau	East Meadow Brook, Upper, and tribs
Erie	Scajaquada Creek, Upper, and tribs	Nassau	Hempstead Bay
Erie	Rush Creek and tribs	Nassau	Hempstead Lake
Erie	Ellicott Creek, Lower, and tribs	Nassau	Grant Park Pond
Erie	Beeman Creek and tribs	Nassau	Beaver Lake
Erie	Murder Creek, Lower, and tribs	Nassau	Camaans Pond
Erie	South Branch Smoke Cr, Lower, and tribs	Nassau	Halls Pond
Erie	Little Sister Creek, Lower, and tribs	Nassau	LI Tidal Tribs to Hempstead Bay
Essex	Lake George (primary county: Warren)	Nassau	Massapequa Creek and tribs
Genesee	Black Creek, Upper, and minor tribs	Nassau	Reynolds Channel, east
Genesee	Tonawanda Creek, Middle, Main Stem	Nassau	Reynolds Channel, west
Genesee	Oak Orchard Creek, Upper, and tribs	Nassau	Silver Lake, Lofts Pond
Genesee	Bowen Brook and tribs	Nassau	Woodmere Channel
Genesee	Bigelow Creek and tribs	Niagara	Hyde Park Lake
Genesee	Black Creek, Middle, and minor tribs	Niagara	Lake Ontario Shoreline, Western
Genesee	LeRoy Reservoir	Niagara	Bergholtz Creek and tribs
Greene	Schoharie Reservoir	Oneida	Ballou, Nail Creeks
		Onondaga	Ley Creek and tribs
		Onondaga	Onondaga Creek, Lower and tribs

## APPENDIX E

### List of 303(d) segments impaired by pollutants related to construction activity, cont'd.

COUNTY	WATERBODY	COUNTY	WATERBODY
Onondaga	Onondaga Creek, Middle and tribs	Suffolk	Great South Bay, West
Onondaga	Onondaga Creek, Upp, and minor tribs	Suffolk	Mill and Seven Ponds
Onondaga	Harbor Brook, Lower, and tribs	Suffolk	Moriches Bay, East
Onondaga	Ninemile Creek, Lower, and tribs	Suffolk	Moriches Bay, West
Onondaga	Minor tribs to Onondaga Lake	Suffolk	Quantuck Bay
Onondaga	Onondaga Creek, Lower, and tribs	Suffolk	Shinnecock Bay (and Inlet)
Ontario	Honeoye Lake	Sullivan	Bodine, Montgomery Lakes
Ontario	Hemlock Lake Outlet and minor tribs	Sullivan	Davies Lake
Ontario	Great Brook and minor tribs	Sullivan	Pleasure Lake
Orange	Monhagen Brook and tribs	Sullivan	Swan Lake
Orange	Orange Lake	Tompkins	Cayuga Lake, Southern End
Orleans	Lake Ontario Shoreline, Western	Tompkins	Owasco Inlet, Upper, and tribs
Oswego	Pleasant Lake	Ulster	Ashokan Reservoir
Oswego	Lake Neatahwanta	Ulster	Esopus Creek, Upper, and minor tribs
Putnam	Oscawana Lake	Ulster	Esopus Creek, Lower, Main Stem
Putnam	Palmer Lake	Ulster	Esopus Creek, Middle, and minor tribs
Putnam	Lake Carmel	Warren	Lake George
Queens	Jamaica Bay, Eastern, and tribs (Queens)	Warren	Tribs to L.George, Village of L George
Queens	Bergen Basin	Warren	Huddle/Finkle Brooks and tribs
Queens	Shellbank Basin	Warren	Indian Brook and tribs
Rensselaer	Nassau Lake	Warren	Hague Brook and tribs
Rensselaer	Snyders Lake	Washington	Tribs to L.George, East Shr Lk George
Richmond	Grasmere, Arbutus and Wolfes Lakes	Washington	Cossayuna Lake
Rockland	Congers Lake, Swartout Lake	Washington	Wood Cr/Champlain Canal, minor tribs
Rockland	Rockland Lake	Wayne	Port Bay
Saratoga	Ballston Lake	Wayne	Marbletown Creek and tribs
Saratoga	Round Lake	Westchester	Lake Katonah
Saratoga	Dwaas Kill and tribs	Westchester	Lake Mohegan
Saratoga	Tribs to Lake Lonely	Westchester	Lake Shenorock
Saratoga	Lake Lonely	Westchester	Reservoir No.1 (Lake Isle)
Schenectady	Collins Lake	Westchester	Saw Mill River, Middle, and tribs
Schenectady	Duane Lake	Westchester	Silver Lake
Schenectady	Mariaville Lake	Westchester	Teatown Lake
Schoharie	Engleville Pond	Westchester	Truesdale Lake
Schoharie	Summit Lake	Westchester	Wallace Pond
Schuyler	Cayuta Lake	Westchester	Peach Lake
St. Lawrence	Fish Creek and minor tribs	Westchester	Mamaroneck River, Lower
St. Lawrence	Black Lake Outlet/Black Lake	Westchester	Mamaroneck River, Upp, and tribs
Steuben	Lake Salubria	Westchester	Sheldrake River and tribs
Steuben	Smith Pond	Westchester	Blind Brook, Lower
Suffolk	Millers Pond	Westchester	Blind Brook, Upper, and tribs
Suffolk	Mattituck (Marratooka) Pond	Westchester	Lake Lincolndale
Suffolk	Tidal tribs to West Moriches Bay	Westchester	Lake Meahaugh
Suffolk	Canaan Lake	Wyoming	Java Lake
Suffolk	Lake Ronkonkoma	Wyoming	Silver Lake
Suffolk	Beaverdam Creek and tribs		
Suffolk	Big/Little Fresh Ponds		
Suffolk	Fresh Pond		
Suffolk	Great South Bay, East		
Suffolk	Great South Bay, Middle		

Note: The list above identifies those waters from the final New York State "2014 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy", dated January 2015, that are impaired by silt, sediment or nutrients.

## APPENDIX F

### LIST OF NYS DEC REGIONAL OFFICES

<u>Region</u>	<u>COVERING THE FOLLOWING COUNTIES:</u>	<u>DIVISION OF ENVIRONMENTAL PERMITS (DEP) PERMIT ADMINISTRATORS</u>	<u>DIVISION OF WATER (DOW)  WATER (SPDES) PROGRAM</u>
<b>1</b>	NASSAU AND SUFFOLK	50 CIRCLE ROAD STONY BROOK, NY 11790 TEL. (631) 444-0365	50 CIRCLE ROAD STONY BROOK, NY 11790-3409 TEL. (631) 444-0405
<b>2</b>	BRONX, KINGS, NEW YORK, QUEENS AND RICHMOND	1 HUNTERS POINT PLAZA, 47-40 21ST ST. LONG ISLAND CITY, NY 11101-5407 TEL. (718) 482-4997	1 HUNTERS POINT PLAZA, 47-40 21ST ST. LONG ISLAND CITY, NY 11101-5407 TEL. (718) 482-4933
<b>3</b>	DUTCHESS, ORANGE, PUTNAM, ROCKLAND, SULLIVAN, ULSTER AND WESTCHESTER	21 SOUTH PUTT CORNERS ROAD NEW PALTZ, NY 12561-1696 TEL. (845) 256-3059	100 HILLSIDE AVENUE, SUITE 1W WHITE PLAINS, NY 10603 TEL. (914) 428 - 2505
<b>4</b>	ALBANY, COLUMBIA, DELAWARE, GREENE, MONTGOMERY, OTSEGO, RENSSELAER, SCHENECTADY AND SCHOHARIE	1150 NORTH WESTCOTT ROAD SCHENECTADY, NY 12306-2014 TEL. (518) 357-2069	1130 NORTH WESTCOTT ROAD SCHENECTADY, NY 12306-2014 TEL. (518) 357-2045
<b>5</b>	CLINTON, ESSEX, FRANKLIN, FULTON, HAMILTON, SARATOGA, WARREN AND WASHINGTON	1115 STATE ROUTE 86, Po Box 296 RAY BROOK, NY 12977-0296 TEL. (518) 897-1234	232 GOLF COURSE ROAD WARRENSBURG, NY 12885-1172 TEL. (518) 623-1200
<b>6</b>	HERKIMER, JEFFERSON, LEWIS, ONEIDA AND ST. LAWRENCE	STATE OFFICE BUILDING 317 WASHINGTON STREET WATERTOWN, NY 13601-3787 TEL. (315) 785-2245	STATE OFFICE BUILDING 207 GENESEE STREET UTICA, NY 13501-2885 TEL. (315) 793-2554
<b>7</b>	BROOME, CAYUGA, CHENANGO, CORTLAND, MADISON, ONONDAGA, OSWEGO, TIOGA AND TOMPKINS	615 ERIE BLVD. WEST SYRACUSE, NY 13204-2400 TEL. (315) 426-7438	615 ERIE BLVD. WEST SYRACUSE, NY 13204-2400 TEL. (315) 426-7500
<b>8</b>	CHEMUNG, GENESEE, LIVINGSTON, MONROE, ONTARIO, ORLEANS, SCHUYLER, SENECA, STEUBEN, WAYNE AND YATES	6274 EAST AVON-LIMA ROAD AVON, NY 14414-9519 TEL. (585) 226-2466	6274 EAST AVON-LIMA RD. AVON, NY 14414-9519 TEL. (585) 226-2466
<b>9</b>	ALLEGANY, CATTARAUGUS, CHAUTAUQUA, ERIE, NIAGARA AND WYOMING	270 MICHIGAN AVENUE BUFFALO, NY 14203-2999 TEL. (716) 851-7165	270 MICHIGAN AVE. BUFFALO, NY 14203-2999 TEL. (716) 851-7070

**APPENDIX B**

**NOTICE OF INTENT**

# NOI for coverage under Stormwater General Permit for Construction Activity

version 1.18


(Submission #: 3AA-VT4K-JCG4, version 2)

PRINTED ON 5/14/2019

## Summary

<b>Submission #:</b>	3AA-VT4K-JCG4	<b>Date Submitted:</b>	5/14/2019 12:32 PM
<b>Form:</b>	NOI for coverage under Stormwater General Permit for Construction Activity	<b>Status:</b>	Submitted
<b>Applicant:</b>	Elena Gutierrez	<b>Active Steps:</b>	Deemed Complete
<b>Reference #:</b>			
<b>Description:</b>	NOI for coverage under Stormwater General Permit for Construction Activity		

## Notes

 PUBLICLY ACCESSIBLE Processing Note on **05/14/2019** (*Applicant Action Required*)  
1. Question 2 indicates "redevelopment with an increase..."; however, in Question 4, the existing impervious is 1.2 & future is 0.8. Should the future be 2.0? 2. Questions 36 & 37 need to be answered.

## Details

### Owner/Operator Information

**Owner/Operator Name (Company/Private Owner/Municipality/Agency/Institution, etc.)**

NYC Department of Design and Construction

**Owner/Operator Contact Person Last Name (NOT CONSULTANT)**

Wong

**Owner/Operator Contact Person First Name**

Lucy

**Owner/Operator Mailing Address**

30-30 Thomson Avenue

**City**

Long Island City

**State**

New York

**Zip**

11101

**Phone**

718-391-1162

**Email**

WongLu2@ddc.nyc.gov

**Federal Tax ID**

NONE PROVIDED

### Project Location

**Project/Site Name**

NYPD 116th Precinct Station House

**Street Address (Not P.O. Box)**

244-04 North Conduit Avenue

**Side of Street**

South

**City/Town/Village (THAT ISSUES BUILDING PERMIT)**

Queens

**State**

New York

**Zip**

11422

**County**

QUEENS

**DEC Region**

2

**Name of Nearest Cross Street**

244th Street

**Distance to Nearest Cross Street (Feet)**

0

**Project In Relation to Cross Street**

South

**Tax Map Numbers Section-Block-Parcel**

Block 13265 / Lot 30

**Tax Map Numbers**

NONE PROVIDED

**1. Coordinates**

---

Provide the Geographic Coordinates for the project site. The two methods are: - Navigate to the project location on the map (below) and click to place a marker and obtain the XY coordinates. - The "Find Me" button will provide the lat/long for the person filling out this form. Then pan the map to the correct location and click the map to place a marker and obtain the XY coordinates.

**Navigate to your location and click on the map to get the X,Y coordinates**

40.666393, -73.734040

**Project Details**

**2. What is the nature of this project?**

Redevelopment with increase in impervious area

**3. Select the predominant land use for both pre and post development conditions.**

**Pre-Development Existing Landuse**

Parking Lot

**Post-Development Future Land Use**

Municipal

**3a. If Single Family Subdivision was selected in question 3, enter the number of subdivision lots.**

NONE PROVIDED

---

**4. In accordance with the larger common plan of development or sale, enter the total project site acreage, the acreage to be disturbed and the future impervious area (acreage) within the disturbed area. \*\*\* ROUND TO THE NEAREST TENTH OF AN ACRE. \*\*\***

**Total Site Area (acres)**

2.9

**Total Area to be Disturbed (acres)**

1.7

Existing Impervious Area to be Disturbed (acres)

1.2

Future Impervious Area Within Disturbed Area (acres)

1.6

5. Do you plan to disturb more than 5 acres of soil at any one time?

No

---

6. Indicate the percentage (%) of each Hydrologic Soil Group(HSG) at the site.

A (%)

0

B (%)

100

C (%)

0

D (%)

0

7. Is this a phased project?

No

8. Enter the planned start and end dates of the disturbance activities.

Start Date

12/01/2019

End Date

12/31/2021

9. Identify the nearest surface waterbody(ies) to which construction site runoff will discharge.

Jamaca Bay

9a. Type of waterbody identified in question 9?

Other Type Off Site (enter description below)

Other Waterbody Type Off Site Description

Bay/Ocean

9b. If "wetland" was selected in 9A, how was the wetland identified?

NONE PROVIDED

10. Has the surface waterbody(ies in question 9 been identified as a 303(d) segment in Appendix E of GP-0-15-002?

Yes

11. Is this project located in one of the Watersheds identified in Appendix C of GP-0-15-002?

No

12. Is the project located in one of the watershed areas associated with AA and AA-S classified waters?

No

If No, skip question 13.

13. Does this construction activity disturb land with no existing impervious cover and where the Soil Slope Phase is identified as an E or F on the USDA Soil Survey?



If Yes, what is the acreage to be disturbed?

NONE PROVIDED

14. Will the project disturb soils within a State regulated wetland or the protected 100 foot adjacent area?

No

15. Does the site runoff enter a separate storm sewer system (including roadside drains, swales, ditches, culverts, etc)?

No

16. What is the name of the municipality/entity that owns the separate storm sewer system?

NONE PROVIDED

17. Does any runoff from the site enter a sewer classified as a Combined Sewer?

No

18. Will future use of this site be an agricultural property as defined by the NYS Agriculture and Markets Law?

No

19. Is this property owned by a state authority, state agency, federal government or local government?

Yes

20. Is this a remediation project being done under a Department approved work plan? (i.e. CERCLA, RCRA, Voluntary Cleanup Agreement, etc.)

No

### Required SWPPP Components

21. Has the required Erosion and Sediment Control component of the SWPPP been developed in conformance with the current NYS Standards and Specifications for Erosion and Sediment Control (aka Blue Book)?

Yes

22. Does this construction activity require the development of a SWPPP that includes the post-construction stormwater management practice component (i.e. Runoff Reduction, Water Quality and Quantity Control practices/techniques)?

Yes

If you answered No in question 22, skip question 23 and the Post-construction Criteria and Post-construction SMP Identification sections.

23. Has the post-construction stormwater management practice component of the SWPPP been developed in conformance with the current NYS Stormwater Management Design Manual?

Yes

24. The Stormwater Pollution Prevention Plan (SWPPP) was prepared by:

Professional Engineer (P.E.)

### SWPPP Preparer

Langan Eng, Env, Surv, L.A. & Geo, DPC

Contact Name (Last, Space, First)

Vitolano, Christopher

Mailing Address

360 West 31st Street, 8th Floor

City

New York

State

NY

Zip

10001

Phone

212-479-5400

**Email**

cvitolano@langan.com

**Download SWPPP Preparer Certification Form**

Please take the following steps to prepare and upload your preparer certification form: 1) Click on the link below to download a blank certification form 2) The certified SWPPP preparer should sign this form 3) Scan the signed form 4) Upload the scanned document

[Download SWPPP Preparer Certification Form](#)

**Please upload the SWPPP Preparer Certification - Attachment**

[SWPPP Preparer Certification Form.pdf](#)

Comment: NONE PROVIDED

**Erosion & Sediment Control Criteria****25. Has a construction sequence schedule for the planned management practices been prepared?**

Yes

**26. Select all of the erosion and sediment control practices that will be employed on the project site:****Temporary Structural**

Dust Control

Silt Fence

Stabilized Construction Entrance

Storm Drain Inlet Protection

Straw/Hay Bale Dike

**Biotechnical**

None

**Vegetative Measures**

None

**Permanent Structural**

None

**Other**

NONE PROVIDED

**Post-Construction Criteria**

\* IMPORTANT: Completion of Questions 27-39 is not required if response to Question 22 is No.

**27. Identify all site planning practices that were used to prepare the final site plan/layout for the project.**

Reduction of Clearing and Grading

**27a. Indicate which of the following soil restoration criteria was used to address the requirements in Section 5.1.6("Soil Restoration") of the Design Manual (2010 version).**

All disturbed areas will be restored in accordance with the Soil Restoration requirements in Table 5.3 of the Design Manual (see page 5-22).

**28. Provide the total Water Quality Volume (WQv) required for this project (based on final site plan/layout). (Acre-feet)**

0.205

**29. Post-construction SMP Identification**

Use the Post-construction SMP Identification section to identify the RR techniques (Area Reduction), RR techniques(Volume Reduction) and Standard SMPs with RRv Capacity that were used to reduce the Total WQv Required (#28). Identify the SMPs to be used by providing the total impervious area that contributes runoff to each technique/practice selected. For the Area Reduction Techniques, provide the total contributing area (includes pervious area) and, if applicable, the total impervious area that contributes runoff to the technique/practice. Note: Redevelopment projects shall use the Post-Construction SMP Identification section to identify the SMPs used to treat and/or reduce the WQv required. If runoff reduction techniques will not be used to reduce the required WQv, skip to question 33a after identifying the SMPs.

30. Indicate the Total RRv provided by the RR techniques (Area/Volume Reduction) and Standard SMPs with RRv capacity identified in question 29. (acre-feet)

0.381

31. Is the Total RRv provided (#30) greater than or equal to the total WQv required (#28)?

Yes

If Yes, go to question 36. If No, go to question 32.

32. Provide the Minimum RRv required based on HSG. [Minimum RRv Required = (P) (0.95) (Ai) / 12, Ai=(s) (Aic)] (acre-feet)

NONE PROVIDED

32a. Is the Total RRv provided (#30) greater than or equal to the Minimum RRv Required (#32)?

If Yes, go to question 33.

Note: Use the space provided in question #39 to summarize the specific site limitations and justification for not reducing 100% of WQv required (#28). A detailed evaluation of the specific site limitations and justification for not reducing 100% of the WQv required (#28) must also be included in the SWPPP. If No, sizing criteria has not been met; therefore, NOI can not be processed. SWPPP preparer must modify design to meet sizing criteria.

### 33. SMPs

Use the Post-construction SMP Identification section to identify the Standard SMPs and, if applicable, the Alternative SMPs to be used to treat the remaining total WQv (=Total WQv Required in #28 - Total RRv Provided in #30). Also, provide the total impervious area that contributes runoff to each practice selected.

NOTE: Use the Post-construction SMP Identification section to identify the SMPs used on Redevelopment projects.

33a. Indicate the Total WQv provided (i.e. WQv treated) by the SMPs identified in question #33 and Standard SMPs with RRv Capacity identified in question #29. (acre-feet)

NONE PROVIDED

Note: For the standard SMPs with RRv capacity, the WQv provided by each practice = the WQv calculated using the contributing drainage area to the practice - provided by the practice. (See Table 3.5 in Design Manual)

34. Provide the sum of the Total RRv provided (#30) and the WQv provided (#33a).

NONE PROVIDED

35. Is the sum of the RRv provided (#30) and the WQv provided (#33a) greater than or equal to the total WQv required (#28)?

If Yes, go to question 36. If No, sizing criteria has not been met; therefore, NOI can not be processed. SWPPP preparer must modify design to meet sizing criteria.

36. Provide the total Channel Protection Storage Volume (CPv required and provided or select waiver (#36a), if applicable.

CPv Required (acre-feet)

NONE PROVIDED

CPv Provided (acre-feet)

NONE PROVIDED

36a. The need to provide channel protection has been waived because:

Site discharges directly to tidal waters or a fifth order or larger stream.

37. Provide the Overbank Flood (Qp) and Extreme Flood (Qf) control criteria or select waiver (#37a), if applicable.

Overbank Flood Control Criteria (Qp)

Pre-Development (CFS)

NONE PROVIDED

Post-Development (CFS)

NONE PROVIDED

Total Extreme Flood Control Criteria (Qf)

Pre-Development (CFS)

NONE PROVIDED

Post-Development (CFS)

NONE PROVIDED

37a. The need to meet the Qp and Qf criteria has been waived because:

Site discharges directly to tidal waters or a fifth order or larger stream.

38. Has a long term Operation and Maintenance Plan for the post-construction stormwater management practice(s) been developed?

Yes

If Yes, Identify the entity responsible for the long term Operation and Maintenance

NYC Department of Design and Construction

39. Use this space to summarize the specific site limitations and justification for not reducing 100% of WQv required (#28). (See question #32a)

This space can also be used for other pertinent project information.

The 2.89 acre project site consists of both new development and redevelopment activities. There is an existing NYPD Precinct that is to remain, and a new NYPD Precinct to be constructed. The water quality volume was determined by calculating the summation of the new development and redevelopment WQv. RRv (0.019 acre-ft) for the new development areas and WQv (0.047 acre-ft) of the site are satisfied with the onsite stormwater infiltration system of 0.381 acre-ft. The onsite infiltration system consists of Contech ChamberMaxx chambers with 6" of stone above and below the chambers. Pretreatment for the system is provided by deep sump catch basins with hoods.

The proposed stormwater retention system has been designed to comply with NYCDEP quantity regulations. For storms exceeding the NYC DEP design storm, all flows that exceed the capacity of the retention chambers will pass through an overflow pipe that connects to the NYCDEP storm sewer.

**Post-Construction SMP Identification**

Runoff Reduction (RR) Techniques, Standard Stormwater Management Practices (SMPs) and Alternative SMPs

Identify the Post-construction SMPs to be used by providing the total impervious area that contributes runoff to each technique/practice selected. For the Area Reduction Techniques, provide the total contributing area (includes pervious area) and, if applicable, the total impervious area that contributes runoff to the technique/practice.

RR Techniques (Area Reduction)

Round to the nearest tenth

Total Contributing Acres for Conservation of Natural Area (RR-1)

NONE PROVIDED

Total Contributing Impervious Acres for Conservation of Natural Area (RR-1)

NONE PROVIDED

Total Contributing Acres for Sheetflow to Riparian Buffers/Filter Strips (RR-2)

NONE PROVIDED

Total Contributing Impervious Acres for Sheetflow to Riparian Buffers/Filter Strips (RR-2)

NONE PROVIDED

Total Contributing Acres for Tree Planting/Tree Pit (RR-3)

NONE PROVIDED

Total Contributing Impervious Acres for Tree Planting/Tree Pit (RR-3)

NONE PROVIDED

Total Contributing Acres for Disconnection of Rooftop Runoff (RR-4)

NONE PROVIDED

RR Techniques (Volume Reduction)

Total Contributing Impervious Acres for Disconnection of Rooftop Runoff (RR-4)  
NONE PROVIDED

Total Contributing Impervious Acres for Vegetated Swale (RR-5)  
NONE PROVIDED

Total Contributing Impervious Acres for Rain Garden (RR-6)  
NONE PROVIDED

Total Contributing Impervious Acres for Stormwater Planter (RR-7)  
NONE PROVIDED

Total Contributing Impervious Acres for Rain Barrel/Cistern (RR-8)  
NONE PROVIDED

Total Contributing Impervious Acres for Porous Pavement (RR-9)  
NONE PROVIDED

Total Contributing Impervious Acres for Green Roof (RR-10)  
NONE PROVIDED

Standard SMPs with RRV Capacity

---

Total Contributing Impervious Acres for Infiltration Trench (I-1)  
NONE PROVIDED

Total Contributing Impervious Acres for Infiltration Basin (I-2)  
NONE PROVIDED

Total Contributing Impervious Acres for Dry Well (I-3)  
NONE PROVIDED

Total Contributing Impervious Acres for Underground Infiltration System (I-4)  
2.13

Total Contributing Impervious Acres for Bioretention (F-5)  
NONE PROVIDED

Total Contributing Impervious Acres for Dry Swale (O-1)  
NONE PROVIDED

Standard SMPs

---

Total Contributing Impervious Acres for Micropool Extended Detention (P-1)  
NONE PROVIDED

Total Contributing Impervious Acres for Wet Pond (P-2)  
NONE PROVIDED

Total Contributing Impervious Acres for Wet Extended Detention (P-3)  
NONE PROVIDED

Total Contributing Impervious Acres for Multiple Pond System (P-4)  
NONE PROVIDED

Total Contributing Impervious Acres for Pocket Pond (P-5)  
NONE PROVIDED

Total Contributing Impervious Acres for Surface Sand Filter (F-1)  
NONE PROVIDED

Total Contributing Impervious Acres for Underground Sand Filter (F-2)  
NONE PROVIDED

Total Contributing Impervious Acres for Perimeter Sand Filter (F-3)  
NONE PROVIDED

Total Contributing Impervious Acres for Organic Filter (F-4)

NONE PROVIDED

Total Contributing Impervious Acres for Shallow Wetland (W-1)

NONE PROVIDED

Total Contributing Impervious Acres for Extended Detention Wetland (W-2)

NONE PROVIDED

Total Contributing Impervious Acres for Pond/Wetland System (W-3)

NONE PROVIDED

Total Contributing Impervious Acres for Pocket Wetland (W-4)

NONE PROVIDED

Total Contributing Impervious Acres for Wet Swale (O-2)

NONE PROVIDED

Alternative SMPs (DO NOT INCLUDE PRACTICES BEING USED FOR PRETREATMENT ONLY)

---

Total Contributing Impervious Area for Hydrodynamic

NONE PROVIDED

Total Contributing Impervious Area for Wet Vault

NONE PROVIDED

Total Contributing Impervious Area for Media Filter

NONE PROVIDED

"Other" Alternative SMP?

NONE PROVIDED

Total Contributing Impervious Area for "Other"

NONE PROVIDED

Provide the name and manufacturer of the alternative SMPs (i.e. proprietary practice(s)) being used for WQv treatment.

Note: Redevelopment projects which do not use RR techniques, shall use questions 28, 29, 33 and 33a to provide SMPs used, total WQv required and total WQv provided for the project.

Manufacturer of Alternative SMP

NONE PROVIDED

Name of Alternative SMP

NONE PROVIDED

## Other Permits

40. Identify other DEC permits, existing and new, that are required for this project/facility.

None

If SPDES Multi-Sector GP, then give permit ID

NONE PROVIDED

If Other, then identify

NONE PROVIDED

41. Does this project require a US Army Corps of Engineers Wetland Permit?

No

If "Yes," then indicate Size of Impact, in acres, to the nearest tenth

NONE PROVIDED

42. If this NOI is being submitted for the purpose of continuing or transferring coverage under a general permit for stormwater runoff from construction activities, please indicate the former SPDES number assigned.

NONE PROVIDED

### MS4 SWPPP Acceptance

43. Is this project subject to the requirements of a regulated, traditional land use control MS4?

No

If No, skip question 44

44. Has the "MS4 SWPPP Acceptance" form been signed by the principal executive officer or ranking elected official and submitted along with this NOI?

#### MS4 SWPPP Acceptance Form Download

Download form from the link below. Complete, sign, and upload.

[MS4 SWPPP Acceptance Form](#)

#### MS4 Acceptance Form Upload - Attachment

NONE PROVIDED

Comment: NONE PROVIDED

### Owner/Operator Certification

#### Owner/Operator Certification Form Download

Download the certification form by clicking the link below. Complete, sign, scan, and upload the form.



[Owner/Operator Certification Form \(PDF, 45KB\)](#)

#### Upload Owner/Operator Certification Form \* - Attachment

[Owner-Operator Certification Form.pdf](#)

Comment: NONE PROVIDED

#### Attachments

Date	Attachment Name	Context	
05/14/2019 12:26 PM	SWPPP Preparer Certification Form.pdf	v2 - Required SWPPP Components	
05/14/2019 12:26 PM	Owner-Operator Certification Form.pdf	v2 - Owner/Operator Certification	

#### Status History

Date	User	Processing Status
5/14/2019	Elena Gutierrez	Draft
5/14/2019	Elena Gutierrez	Submitted

#### Processing Steps

Step Name	Assigned To/Completed By	Date Completed
Form Submitted	Elena Gutierrez	05/14/2019 12:32 PM
Deemed Complete	Toni Cioffi	

**APPENDIX C**

**WATER QUALITY**



**Watershed:** **Proposed Site Area**

**Purpose:** To calculate the first flush runoff volume WQv and convert it to a flow in accordance with the New York State Stormwater Design Manual.

**Procedure:** 1. Compute WQv in watershed inches using the following equation:

$$WQv = (P * Rv * A) / 12$$

where: WQv = water quality volume (acre-feet)  
P = 90% Rainfall Event Number per figure 4.1 in NYS SWDM  
R = volumetric runoff coefficient = 0.05 + 0.009(I)  
I = percent impervious cover, %

Storm Connection 1	A (acres)	Percent Imp. (%)	R (calculated)	P (inches)	WQv (acre-feet)	WQv (cubic feet) (75% for Redevelopment)
New Development	0.02	50.00	0.500	1.50	0.00	54
Redevelopment	0.25	68.00	0.662	1.50	0.02	676
Total	0.27					730

Storm Connection 2	A (acres)	Percent Imp. (%)	R (calculated)	P (inches)	WQv (acre-feet)	WQv (cubic feet) (75% for Redevelopment)
New Development	0.14	85.71	0.821	1.50	0.01	626
Redevelopment	0.20	30.00	0.320	1.50	0.01	261
Total	0.34					888

Storm Connection 3	A (acres)	Percent Imp. (%)	R (calculated)	P (inches)	WQv (acre-feet)	WQv (cubic feet) (75% for Redevelopment)
New Development	0.17	88.24	0.844	1.50	0.02	781
Redevelopment	1.01	78.22	0.754	1.50	0.10	3,110
Total	1.18					3,891

Storm Connection 5	A (acres)	Percent Imp. (%)	R (calculated)	P (inches)	WQv (acre-feet)	WQv (cubic feet) (75% for Redevelopment)
New Development	0.11	100.00	0.950	1.50	0.01	569
Redevelopment	0.99	72.73	0.705	1.50	0.09	2,848
Total	1.10					3,417

Total Site WQv 8,926

**Project:** RRv for 244-04 North Conduit Ave - For New Development Portion of the Site

**Purpose:** To calculate the first flush runoff flow rate WQv in accordance with the New York State Stormwater Design Manual.

**Procedure:** 1. Compute required WQV in watershed inches using the following equation:

$$WQv = (P * Rv * A) / 12$$

where: WQv = water quality volume (ac-ft)  
P = 90% Rainfall Event Number per figure 4.1 in NYS SWDM  
R = volumetric runoff coefficient = 0.05 + 0.009(I)  
I = percent impervious cover, %  
A = Contributing area, acres

A (acres)	Percent Proposed Imp. (%)	R (calculated)	P (in)	WQv (ac-ft)	WQv (cf)
0.440	88.64	0.848	1.50	0.05	2,031

2. Summary of provided WQv:

Technique	WQv (cf)
Infiltration Chambers	16,597

3. Comparison between WQv required to be treated and WQv actually treated:

WQv Required to Be Treated (cf)	WQv Actually Treated (cf)
2,031	16,597

WQv OK

4. Summary of provided RRv for Infiltration:

where: The storage volume in cf is calculated for the retention systems by the space within the ChamberMaxx chamber itself and the void space of the stone backfill. The stone backfill is 0.5-ft below and above the chamber assumes a 40% stone void ratio.

Provided RRv for Standard SMPs (cf)
16,597

5. Compute minimum required RRv:

$$RRv = (P * (Rv *) * Ai) / 12$$

where: RRv = runoff reduction volume (ac-ft)  
P = 90% Rainfall Event Number per figure 4.1 in NYS SWDM  
Rv\* = 0.05+0.009(I) where I is 100% impervious  
Ai = impervious coverage targeted for runoff reduction = (S)(Aic)  
Aic = total area of new impervious cover  
S = hydrological soil group (HSG) specified reduction factor

P (in)	Rv* (calculated)	Aic (ac-ft)	S (for soil group B)	Ai (ac-ft)	RRv (ac-ft)	RRv (cf)
1.50	0.950	0.390	0.4	0.16	0.019	807

6. Comparison between RRv required to be treated and RRv actually treated:

RRv Required to Be Treated (cf)	RRv Actually Treated (cf)
807	16,597

RRv OK

**APPENDIX D**

**SITE CONNECTION PROPOSAL**



May 7, 2019

Langan Engineering  
Attn: Christopher Vitolano, P.E.  
21 Penn Plaza, 360 West 31<sup>st</sup> Street  
New York, NY 11422

Vincent Sapienza, P.E.  
Commissioner

Re: **SCP-10954-2**; Site connection proposal for 244-04 North Conduit Avenue  
NYPD Police Precinct; Block: 13265; Lot: 30;  
Borough of Queens.

Dear Mr. Vitolano:

This office has completed its review of the referenced site connection proposal application submitted with your letter received on April 9, 2019 and has certified it. Copies of the certified forms for the owner and the applicant have been sent to the Borough of Queens Local Records Office of the Department of Environmental Protection (DEP). A copy of the same has been sent to the Site Connection Inspection Unit of the DEP as well.

Anastasios Georgelis, P.E.  
Deputy Commissioner  
Bureau of Water &  
Sewer Operations

59-17 Junction Bl,  
Flushing, NY 11373

Connections@dep.nyc.gov

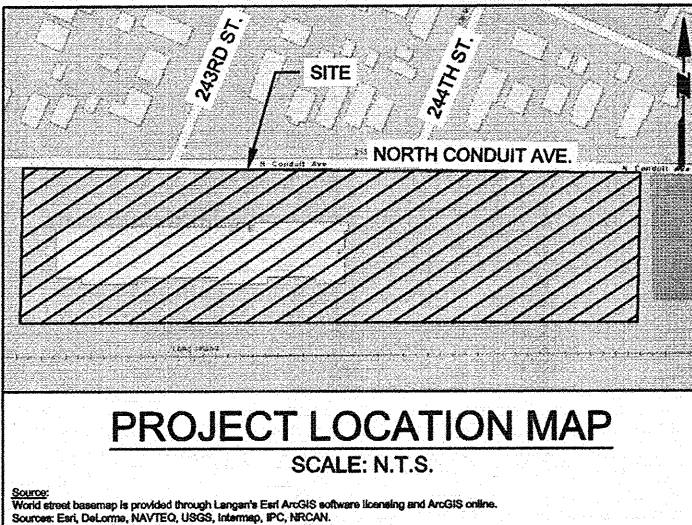
Very truly yours,

A handwritten signature in black ink, appearing to read "A. Yakoub".

Adel Yakoub, P.E.,  
Engineer - In - Charge  
Site Connection Review Unit

Cc: Mark Safari, P.E., Director, Connections & Permitting  
Ketki Patel, P.E. Deputy Chief, Site Connection & Application Review  
Ramses Sidhom, Engineer-In-Charge, Queens Local Office  
File/GP





DEPARTMENT OF ENVIRONMENTAL PROTECTION  
BUREAU OF WATER AND SEWER OPERATIONS  
SITE PLAN - SITE CONNECTION PROPOSAL  
APPLICATION NO: SCP-10954      DOB No. 420665211

PROJECT INFORMATION

BOROUGH: QUEENS  
ADDRESS: 244-04 NORTH CONDUIT AVENUE  
BLOCK: 13265  
PRESENT LOTS: 30  
TENTATIVE LOT: N/A  
EXISTING ZONING: R3-2 / C1-3  
PROPOSED ZONING: N/A  
DEVELOPMENT TYPE: NYPD POLICE PRECINCT  
OWNERSHIP TYPE: FEE SIMPLE  
STORM FLOW DETENTION NOTES:  
DEVELOPED STORM FLOW OF 12.09 CFS WILL BE  
RETAINED ON SITE BY MEANS OF RETENTION  
FACILITIES.  
SANITARY FLOW: 0.023 CFS  
NAME OF CITY TREATMENT PLANT: JAMAICA  
DATUM: ELEVATIONS SHOWN ARE REFERENCE TO THE NORTH  
AMERICAN VERTICAL DATUM OF 1988 AS ESTABLISHED  
BY THE U.S. COAST AND GEODETIC SURVEY.  
OWNER'S NAME AND ADDRESS:  
THE NEW YORK POLICE DEPARTMENT  
1 POLICE PLAZA PATH  
NEW YORK, NY 10007

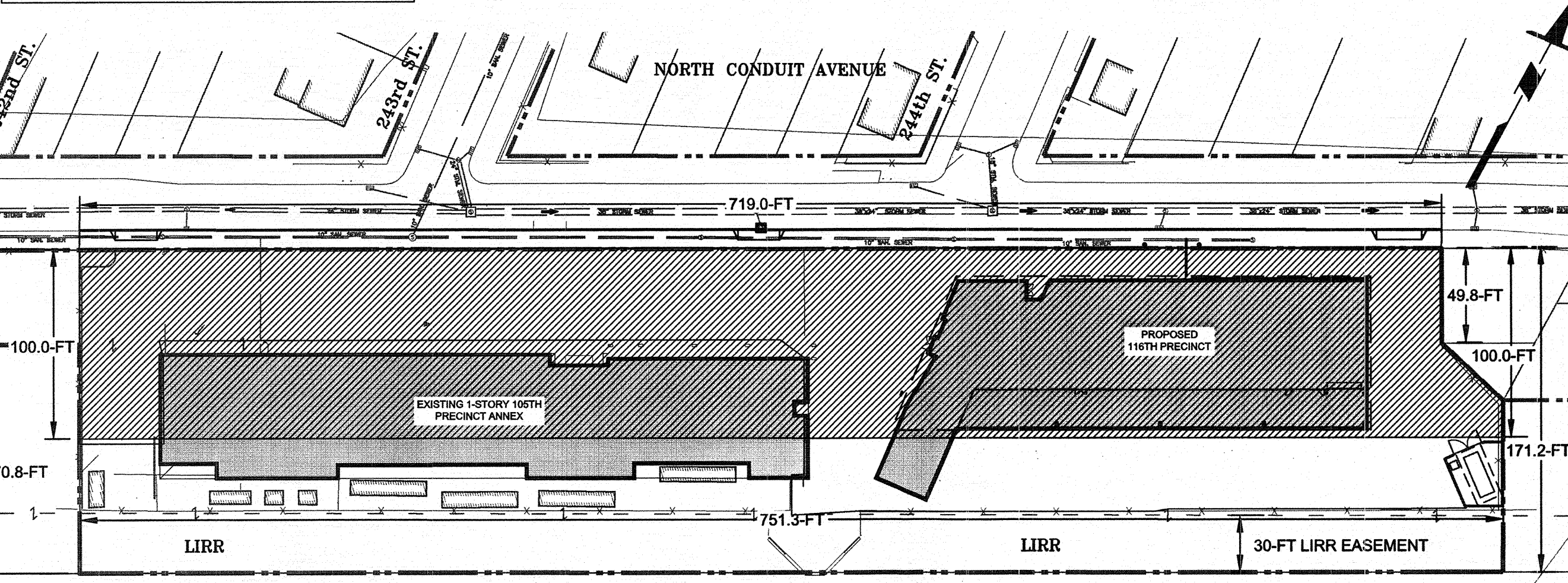
APPLICANT INFORMATION

NAME: CHRISTOPHER VITOLANO, P.E.  
FIRM/ORGANIZATION: LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING,  
LANDSCAPE ARCHITECTURE, AND GEOLOGY, D.P.C.  
ADDRESS: 21 PENN PLAZA  
360 WEST 31ST STREET, 8TH FLOOR  
NEW YORK, NY 10001  
TELEPHONE: 212-479-5400

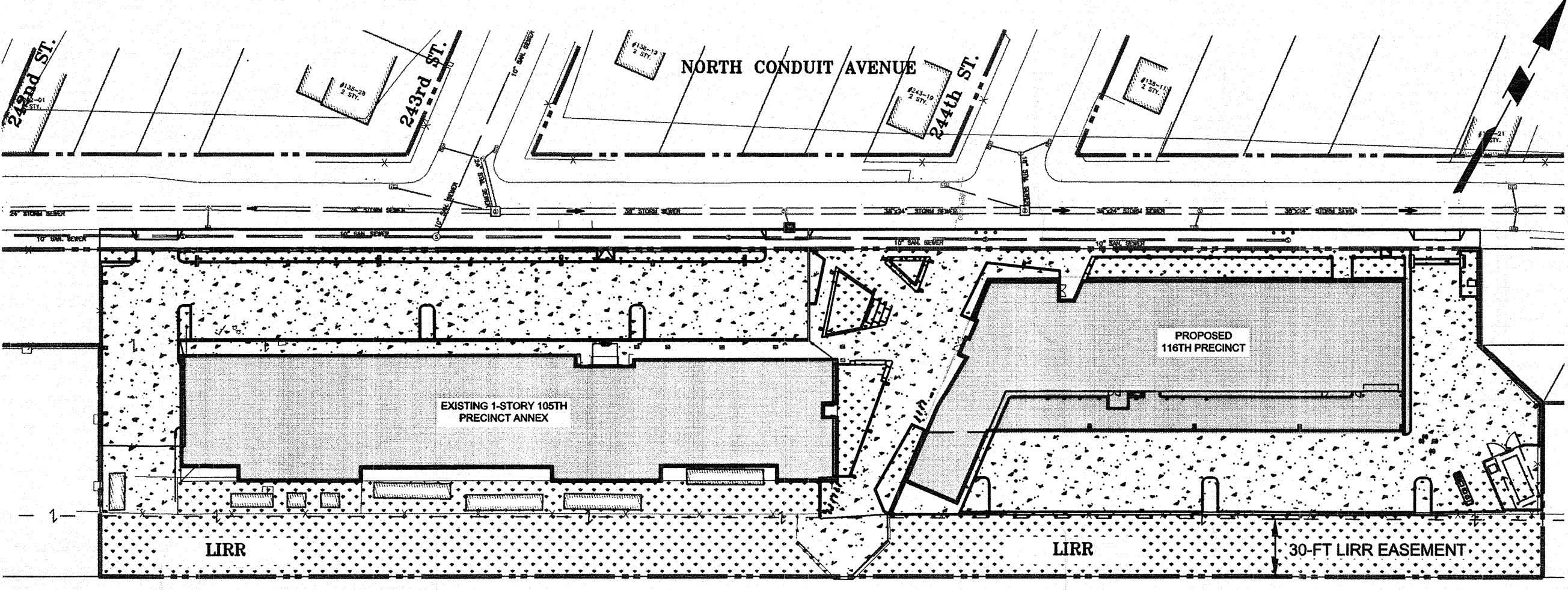
REVISIONS

6TH SUBMISSION:  
5TH SUBMISSION:  
4TH SUBMISSION:  
3RD SUBMISSION:  
2ND SUBMISSION: FEBRUARY 26, 2019  
1ST SUBMISSION: NOVEMBER 14, 2018

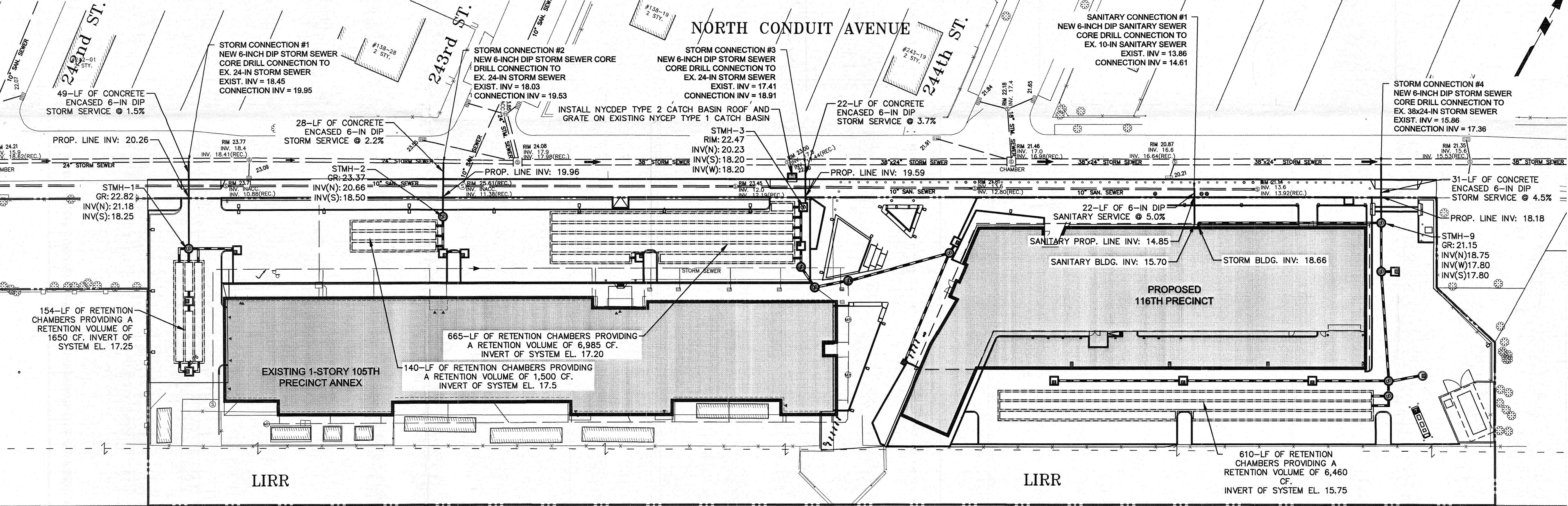
CERTIFICATION BOX  
(DEP USE ONLY)



ALLOWABLE AREA PLAN  
SCALE: 1" = 60'



DEVELOPED AREA PLAN  
SCALE: 1" = 60'



SITE PLAN  
SCALE: 1" = 30'

I, CHRISTOPHER VITOLANO, A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF NEW YORK (NUMBER 081589), DO HEREBY CERTIFY THAT THE OFFICE WORK REQUIRED IN AND SHOWN ON THIS PLAN WAS DONE BY ME OR UNDER MY DIRECT SUPERVISION AND NO PART OF SAID WORK WAS DONE BY ANY EMPLOYEE OF THE CITY OF NEW YORK.



NYS LICENSED PROFESSIONAL ENGINEER NAME:  
CHRISTOPHER VITOLANO  
ADDRESS:  
LANGAN ENGINEERING, ENVIRONMENTAL,  
SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C.  
21 PENN PLAZA 360 W. 31ST STREET, 8TH FLOOR  
NEW YORK, NY 10001  
TELEPHONE NUMBER:  
212-479-5400

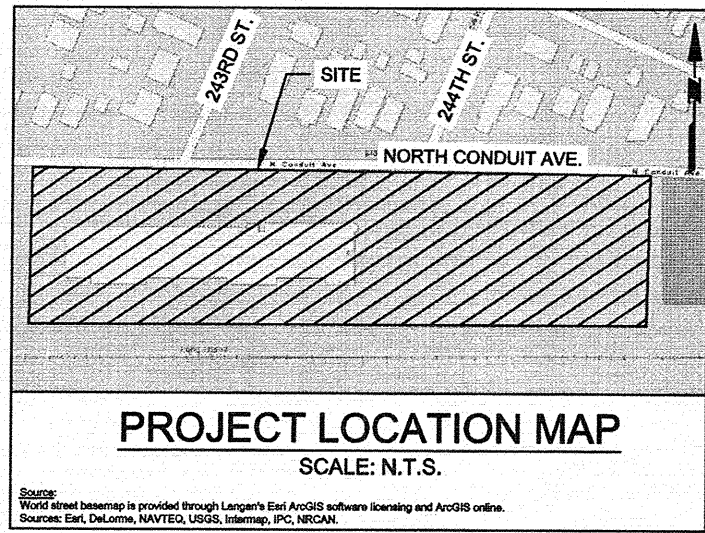
GENERAL NOTES

- BACKGROUND SURVEY INFORMATION TAKEN FROM TOPOGRAPHICAL AND PROPERTY LINE MAP SURVEY FOR "244-04 NORTH CONDUIT AVENUE" PREPARED BY NYC DDC, LAST DATED 08/25/17.
- ELEVATIONS SHOWN ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
- SEWER SERVICE CONNECTION TO NYCDEP SEWERS SHALL BE DUCTILE IRON PIPE. NO SUBSTITUTIONS ALLOWED.
- ALL SEWER WORK SHOWN ON THIS PLAN SHALL BE IN CONFORMANCE WITH THE LATEST NYCDEP STANDARDS AND SPECIFICATIONS.

LEGEND (N.T.S.)

	BUILDING		LANDSCAPE	C = 0.20
	PROPOSED STORM DRAINAGE PIPE		BUILDING ROOF	C = 0.95
	PROPOSED AREA DRAIN		PAVEMENT	C = 0.85
	PROPOSED RETENTION PIPING			





**DESIGN CALCULATIONS**  
DOB # XXXXXXXX  
QUEENS BLOCK 13265, LOT 30  
ZONE: R3-2  
TOTAL SITE AREA = 125,909 SF = 2.89 AC

**STORM DESIGN CALCULATIONS:**  
**ALLOWABLE STORM FLOW**  
ALLOWABLE SITE AREA AS SHOWN ON SHEET 1  
 $A_{ALL} = 73,029 \text{ SF} = 1.68 \text{ AC}$

**ALLOWABLE STORM FLOW (QUEENS)**  
FROM DRAINAGE PLAN:  
 $Q_{ALL} = (A_{ALL} / 18,200)$   
 $Q_{ALL} = (73,029 / 18,200)$   
 $Q_{ALL} = 4.01 \text{ CFS}$

**TOTAL DEVELOPED STORM FLOW**  
ROOF AREA: 1.02 AC (C = 0.95)  
PAVEMENT AREA: 1.06 AC (C = 0.85)  
LANDSCAPE AREA: 0.81 AC (C = 0.20)  
TOTAL: 2.89 AC  $C_W = 0.70$

$Q_{DEV-1} = C_W * I * A$   
 $Q_{DEV-1} = (0.70 * 5.95 * 2.89 \text{ AC})$   
 $Q_{DEV-1} = 12.09 \text{ CFS}$

TOTAL DEVELOPED FLOW FOR THE SITE IS  
12.09 CFS. ALL STORM FLOW SHALL BE RETAINED ON  
SITE AND OVERFLOW TO THE EXISTING STORM SEWER  
IN NORTH CONDUIT AVENUE.

NOTE: ALL ON-SITE RETENTION MUST BE IN  
COMPLIANCE WITH NYCDOB RULES AND REGULATIONS.

**STORM CONNECTION #1**  
**DEVELOPED STORM WATER FLOW**  
**TO CONNECTION #1 IN NORTH CONDUIT AVENUE**  
CONCRETE AREA: 0.01 AC (C = 0.95)  
PAVEMENT AREA: 0.17 AC (C = 0.85)  
LANDSCAPE AREA: 0.09 AC (C = 0.20)  
TOTAL: 0.27 AC  $C_W = 0.64$

$Q_{DEV-1} = C_W * I * A$   
 $Q_{DEV-1} = (0.64 * 5.95 * 0.27 \text{ AC})$   
 $Q_{DEV-1} = 1.02 \text{ CFS}$

TOTAL DEVELOPED FLOW FOR DRAINAGE AREA #1 OF  
1.02 CFS SHALL BE RETAINED ON SITE AND OVERFLOW  
TO THE EXISTING STORM SEWER IN NORTH CONDUIT  
AVENUE.

**REQUIRED STORAGE VOLUME**  
TRIBUTARY AREA IN ACRES  
 $A = 0.27$   
WEIGHTED RUNOFF COEFFICIENT  
 $C = 0.64$   
FOOTPRINT/SURFACE AREA OF SYSTEM IN SF  
 $FA = 660$   
SOIL INFILTRATION RATE IN IN/HR  
 $I = 0.50$

OUTFLOW RATE DUE TO INFILTRATION IN CFS  
 $Q_{INF} = (FA * I) / 43,200 = (660 * 0.50) / 43,200$   
 $= 0.0076$   
RESTRICTED FLOW RATE IN CFS/AC OF IMPERVIOUS  
 $Q_0 = Q_{INF} / (A * C) = 0.0076 / (0.27 * 0.64)$   
 $= 0.044$   
DURATION OF STORM IN MINUTES  
 $T = ((12,600 / Q_0)^{0.5} / 2) - 15 = ((12,600 / 0.044)^{0.5} / 2) - 15$   
 $= 252.62$

MINIMUM REQUIRED DETENTION VOLUME  
 $V_{REQ} = (8,400 * T / (T + 15) - 40 * T * Q_0) * A * C$   
 $= (8,400 * 252.62 / (252.62 + 15) - 40 * 252.62 * 0.044) * 0.27 * 0.64$   
 $= 1,293.3 \text{ CF}$

**STORAGE VOLUME PROVIDED**  
RETENTION SYSTEM SURFACE AREA = 660 SF  
STONE POROSITY = 40%  
OVERALL LENGTH OF CHAMBER = 154 FT  
NUMBER OF UNITS = 22  
LENGTH OF CONTECH CHAMBER MAX UNIT = 7.116667 FT  
VOLUME PER UNIT = 75.1 CF

NUMBER OF UNITS \* VOLUME PER UNIT  
 $22 * 75.1 \text{ CF}$   
TOTAL  
 $= 1,652.2 \text{ CF}$

$V_{PROVIDED} > V_{REQ}$   
 $1,652.2 \text{ CF} > 1,293.3 \text{ CF}$

**STORM CONNECTION #2**  
**DEVELOPED STORM WATER FLOW**  
**TO CONNECTION #2 IN NORTH CONDUIT AVENUE**  
CONCRETE AREA: 0.02 AC (C = 0.95)  
PAVEMENT AREA: 0.15 AC (C = 0.85)  
LANDSCAPE AREA: 0.17 AC (C = 0.20)  
TOTAL: 0.34 AC  $C_W = 0.53$

$Q_{DEV-2} = C_W * I * A$   
 $Q_{DEV-2} = (0.53 * 5.95 * 0.34 \text{ AC})$   
 $Q_{DEV-2} = 1.07 \text{ CFS}$

TOTAL DEVELOPED FLOW FOR DRAINAGE AREA #2 OF  
1.07 CFS SHALL BE RETAINED ON SITE AND OVERFLOW  
TO THE EXISTING STORM SEWER IN NORTH CONDUIT  
AVENUE.

**REQUIRED STORAGE VOLUME**  
TRIBUTARY AREA IN ACRES  
 $A = 0.34$   
WEIGHTED RUNOFF COEFFICIENT  
 $C = 0.53$   
FOOTPRINT/SURFACE AREA OF SYSTEM IN SF  
 $FA = 600$   
SOIL INFILTRATION RATE IN IN/HR  
 $I = 0.50$

OUTFLOW RATE DUE TO INFILTRATION IN CFS  
 $Q_{INF} = (FA * I) / 43,200 = (600 * 0.50) / 43,200$   
 $= 0.0069$   
RESTRICTED FLOW RATE IN CFS/AC OF IMPERVIOUS  
 $Q_0 = Q_{INF} / (A * C) = 0.0069 / (0.34 * 0.53)$   
 $= 0.039$   
DURATION OF STORM IN MINUTES  
 $T = ((12,600 / Q_0)^{0.5} / 2) - 15 = ((12,600 / 0.039)^{0.5} / 2) - 15$   
 $= 270.90$

MINIMUM REQUIRED DETENTION VOLUME  
 $V_{REQ} = (8,400 * T / (T + 15) - 40 * T * Q_0) * A * C$   
 $= (8,400 * 270.90 / (270.90 + 15) - 40 * 270.90 * 0.039) * 0.34 * 0.53$   
 $= 1,358.1 \text{ CF}$

**STORAGE VOLUME PROVIDED**  
RETENTION SYSTEM SURFACE AREA = 600 SF  
STONE POROSITY = 40%  
OVERALL LENGTH OF CHAMBER = 140 FT  
NUMBER OF UNITS = 20  
LENGTH OF CONTECH CHAMBER MAX UNIT = 7.116667 FT  
VOLUME PER UNIT = 75.1 CF

NUMBER OF UNITS \* VOLUME PER UNIT  
 $= 1,502 \text{ CF}$   
TOTAL  
 $= 1,502 \text{ CF}$

$V_{PROVIDED} > V_{REQ}$   
 $1,502 \text{ CF} > 1,358.1 \text{ CF}$

**STORM CONNECTION #3**  
**DEVELOPED STORM WATER FLOW**  
**TO CONNECTION #3 IN NORTH CONDUIT AVENUE**  
ROOF/CONCRETE AREA: 0.53 AC (C = 0.95)  
PAVEMENT AREA: 0.37 AC (C = 0.85)  
LANDSCAPE AREA: 0.28 AC (C = 0.20)  
TOTAL: 1.18 AC  $C_W = 0.74$

$Q_{DEV-3} = C_W * I * A$   
 $Q_{DEV-3} = (0.74 * 5.95 * 1.18 \text{ AC})$   
 $Q_{DEV-3} = 5.20 \text{ CFS}$

TOTAL DEVELOPED FLOW FOR DRAINAGE AREA #3 OF  
5.20 CFS SHALL BE RETAINED ON SITE AND OVERFLOW  
TO THE EXISTING STORM SEWER IN NORTH CONDUIT  
AVENUE.

**REQUIRED STORAGE VOLUME**  
TRIBUTARY AREA IN ACRES  
 $A = 1.18$   
WEIGHTED RUNOFF COEFFICIENT  
 $C = 0.74$   
FOOTPRINT/SURFACE AREA OF SYSTEM IN SF  
 $FA = 2850$   
SOIL INFILTRATION RATE IN IN/HR  
 $I = 0.50$

OUTFLOW RATE DUE TO INFILTRATION IN CFS  
 $Q_{INF} = (FA * I) / 43,200 = (2850 * 0.50) / 43,200$   
 $= 0.033$   
RESTRICTED FLOW RATE IN CFS/AC OF IMPERVIOUS  
 $Q_0 = Q_{INF} / (A * C) = 0.033 / (1.18 * 0.74)$   
 $= 0.038$   
DURATION OF STORM IN MINUTES  
 $T = ((12,600 / Q_0)^{0.5} / 2) - 15 = ((12,600 / 0.038)^{0.5} / 2) - 15$   
 $= 272.91$

MAXIMUM REQUIRED DETENTION VOLUME  
 $V_{REQ} = (8,400 * T / (T + 15) - 40 * T * Q_0) * A * C$   
 $= (8,400 * 272.91 / (272.91 + 15) - 40 * 272.91 * 0.038) * 1.18 * 0.74$   
 $= 6,591 \text{ CF}$

**STORAGE VOLUME PROVIDED**  
RETENTION SYSTEM SURFACE AREA = 2850 SF  
STONE POROSITY = 40%  
OVERALL LENGTH OF CHAMBER = 665 FT  
NUMBER OF UNITS = 93  
LENGTH OF CONTECH CHAMBER MAX UNIT = 7.116667 FT  
VOLUME PER UNIT = 75.1 CF

NUMBER OF UNITS \* VOLUME PER UNIT  
 $93 * 75.1 \text{ CF}$   
TOTAL  
 $= 6,984 \text{ CF}$

$V_{PROVIDED} > V_{REQ}$   
 $6,984 \text{ CF} > 6,591 \text{ CF}$

**STORM CONNECTION #4**  
**DEVELOPED STORM WATER FLOW**  
**TO CONNECTION #4 IN NORTH CONDUIT AVENUE**  
ROOF = 20,116 SF = 0.46 AC (C = 0.95)  
PAVEMENT AREA: 0.37 AC (C = 0.85)  
LANDSCAPE AREA: 0.27 AC (C = 0.20)  
TOTAL: 1.10 AC  $C_W = 0.67$

$Q_{DEV-4} = C_W * I * A$   
 $Q_{DEV-4} = (0.67 * 5.95 * 1.10 \text{ AC})$   
 $Q_{DEV-4} = 4.41 \text{ CFS}$

TOTAL DEVELOPED FLOW FOR DRAINAGE AREA #4 OF  
4.41 CFS SHALL BE RETAINED ON SITE AND OVERFLOW  
TO THE EXISTING STORM SEWER IN NORTH CONDUIT  
AVENUE.

**REQUIRED STORAGE VOLUME**  
TRIBUTARY AREA IN ACRES  
 $A = 1.10$   
WEIGHTED RUNOFF COEFFICIENT  
 $C = 0.67$   
FOOTPRINT/SURFACE AREA OF SYSTEM IN SF  
 $FA = 3,490$   
SOIL INFILTRATION RATE IN IN/HR  
 $I = 0.50$

OUTFLOW RATE DUE TO INFILTRATION IN CFS  
 $Q_{INF} = (FA * I) / 43,200 = (3,490 * 0.50) / 43,200$   
 $= 0.0404$   
RESTRICTED FLOW RATE IN CFS/AC OF IMPERVIOUS  
 $Q_0 = Q_{INF} / (A * C) = 0.0404 / (1.10 * 0.67)$   
 $= 0.05$   
DURATION OF STORM IN MINUTES  
 $T = ((12,600 / Q_0)^{0.5} / 2) - 15 = ((12,600 / 0.05)^{0.5} / 2) - 15$   
 $= 225.75$

MAXIMUM REQUIRED DETENTION VOLUME  
 $V_{REQ} = (8,400 * T / (T + 15) - 40 * T * Q_0) * A * C$   
 $= (8,400 * 225.75 / (225.75 + 15) - 40 * 225.75 * 0.05) * 1.10$   
 $= 5,472.3 \text{ CF}$

**STORAGE VOLUME PROVIDED**  
RETENTION SYSTEM SURFACE AREA = 3,490 SF  
STONE POROSITY = 40%  
OVERALL LENGTH OF CHAMBER = 610 FT  
NUMBER OF UNITS = 96  
LENGTH OF CONTECH CHAMBER MAX UNIT = 7.116667 FT  
VOLUME PER UNIT = 75.1 CF

NUMBER OF UNITS \* VOLUME PER UNIT  
 $96 * 75.1 \text{ CF}$   
TOTAL  
 $= 6,984 \text{ CF}$

$V_{PROVIDED} > V_{REQ}$   
 $6,458.6 \text{ CF} > 5,472.3 \text{ CF}$

**SANITARY CONNECTION #1**  
**SANITARY FLOW CALCULATIONS**  
**TO SANITARY CONNECTION #1 IN NORTH CONDUIT AVENUE**

ZONING = R3-2  
R3-2 POPULATION DENSITY = 50 PERSONS/ACRE  
DEMAND = 150 GALLONS/PERSON/DAY (GPD)

$Q_{SAN} = (50 \text{ PERSONS/ACRE} * 0.49 \text{ ACRES} * 150 \text{ GPD}) / (7.48 * 86,400)$   
 $Q_{SAN} = 0.006 \text{ CFS}$

PEAK  $Q_{SAN} = Q_{SAN} * 4.0$   
PEAK  $Q_{SAN} = 0.006 * 4.0$   
PEAK  $Q_{SAN} = 0.023 \text{ CFS}$

**TOTAL SANITARY FLOW OF 0.023 CFS SHALL DISCHARGE**  
**TO EXISTING SANITARY SEWER IN NORTH CONDUIT AVENUE VIA SANITARY CONNECTION #1**

## PROJECT INFORMATION

BOROUGH:  
QUEENS  
ADDRESS:  
244-04 NORTH CONDUIT AVENUE  
BLOCK:  
13265  
PRESENT LOTS:  
30  
TENTATIVE LOT:  
N/A  
EXISTING ZONING:  
R3-2 / C1-3  
PROPOSED ZONING:  
N/A  
DEVELOPMENT TYPE:  
NYPD POLICE PRECINCT  
OWNERSHIP TYPE:  
FEE SIMPLE  
STORM FLOW DETENTION NOTES:  
DEVELOPED STORM FLOW OF 12.09 CFS WILL BE  
RETAINED ON SITE BY MEANS OF RETENTION  
FACILITIES.

SANITARY FLOW:  
0.023 CFS  
NAME OF CITY TREATMENT PLANT:  
JAMAICA  
DATUM:  
ELEVATIONS SHOWN ARE REFERENCE TO THE NORTH  
AMERICAN VERTICAL DATUM OF 1988 AS ESTABLISHED  
BY THE U.S. COAST AND GEODETIC SURVEY.  
OWNER'S NAME AND ADDRESS:  
THE NEW YORK POLICE DEPARTMENT  
1 POLICE PLAZA PATH  
NEW YORK, NY 10007

## APPLICANT INFORMATION

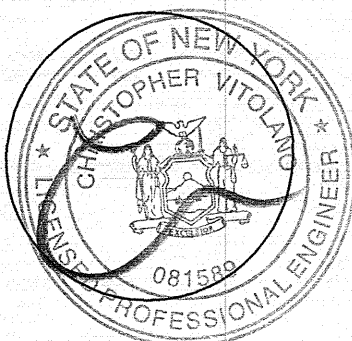
NAME:  
CHRISTOPHER VITOLANO, P.E.  
FIRM/ORGANIZATION:  
LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING,  
LANDSCAPE ARCHITECTURE, AND GEOLOGY, D.P.C.  
ADDRESS:  
21 PENN PLAZA  
360 WEST 31ST STREET, 8TH FLOOR  
NEW YORK, NY 10001  
TELEPHONE:  
212-479-5400

## REVISIONS

6TH SUBMISSION:  
5TH SUBMISSION:  
4TH SUBMISSION:  
3RD SUBMISSION:  
2ND SUBMISSION:  
FEBRUARY 26, 2019  
1ST SUBMISSION:  
NOVEMBER 14, 2018

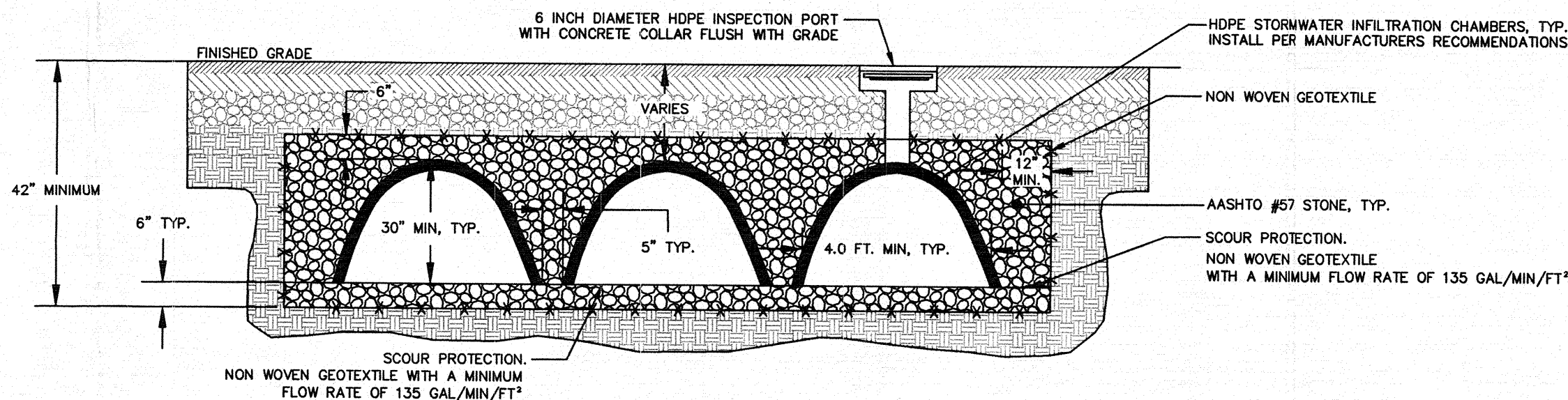
## CERTIFICATION BOX (DEP USE ONLY)

I, CHRISTOPHER VITOLANO, A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF NEW YORK (NUMBER 081589), DO HEREBY CERTIFY THAT THE OFFICE WORK REQUIRED IN AND SHOWN ON THIS PLAN WAS DONE BY ME OR UNDER MY DIRECT SUPERVISION AND NO PART OF SAID WORK WAS DONE BY ANY EMPLOYEE OF THE CITY OF NEW YORK.

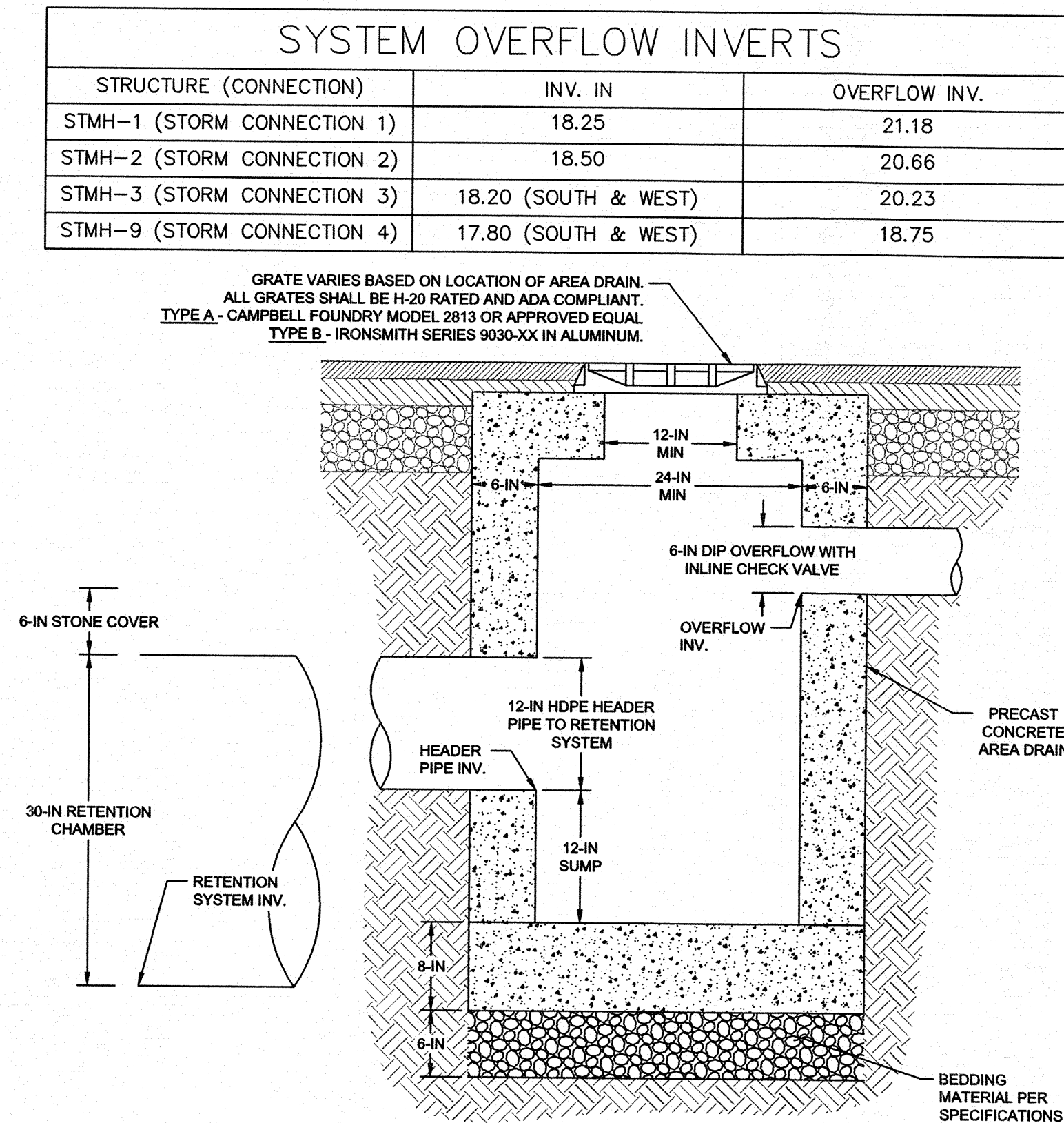


NYS LICENSED PROFESSIONAL ENGINEER NAME:  
CHRISTOPHER VITOLANO  
ADDRESS:  
LANGAN ENGINEERING, ENVIRONMENTAL,  
SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C.  
21 PENN PLAZA 360 W. 31ST STREET, 8TH FLOOR  
NEW YORK, NY 10001  
TELEPHONE NUMBER:  
212-479-5400

## STORM WATER RETENTION SYSTEM N.T.S.



## AREA/YARD DRAIN N.T.S.





**APPENDIX E**

**CONSTRUCTION INSPECTION LOG AND REPORTS**

<p style="text-align: center;"><b>APPENDIX F</b> <b>CONSTRUCTION SITE INSPECTION</b> <b>AND MAINTENANCE LOG BOOK</b></p>
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**STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM FOR CONSTRUCTION  
ACTIVITIES**

**SAMPLE CONSTRUCTION SITE LOG BOOK**

Table of Contents

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- I. Pre-Construction Meeting Documents
  - a. Preamble to Site Assessment and Inspections
  - b. Pre-Construction Site Assessment Checklist
  
- II. Construction Duration Inspections
  - a. Directions
  - b. Modification to the SWPPP



## I. PRE-CONSTRUCTION MEETING DOCUMENTS

**Project Name** \_\_\_\_\_  
**Permit No.** \_\_\_\_\_ **Date of Authorization** \_\_\_\_\_  
**Name of Operator** \_\_\_\_\_  
**Prime Contractor** \_\_\_\_\_

### a. Preamble to Site Assessment and Inspections

The Following Information To Be Read By All Person's Involved in The Construction of Stormwater Related Activities:

The Operator agrees to have a qualified inspector<sup>1</sup> conduct an assessment of the site prior to the commencement of construction<sup>2</sup> and certify in this inspection report that the appropriate erosion and sediment controls described in the SWPPP have been adequately installed or implemented to ensure overall preparedness of the site for the commencement of construction.

Prior to the commencement of construction, the Operator shall certify in this site logbook that the SWPPP has been prepared in accordance with the State's standards and meets all Federal, State and local erosion and sediment control requirements. A preconstruction meeting should be held to review all of the SWPPP requirements with construction personnel.

When construction starts, site inspections shall be conducted by the qualified inspector at least every 7 calendar days. The Operator shall maintain a record of all inspection reports in this site logbook. The site logbook shall be maintained on site and be made available to the permitting authorities upon request.

Prior to filing the Notice of Termination or the end of permit term, the Operator shall have a qualified inspector perform a final site inspection. The qualified inspector shall certify that the site has undergone final stabilization<sup>3</sup> using either vegetative or structural stabilization methods and that all temporary erosion and sediment controls (such as silt fencing) not needed for long-term erosion control have been removed. In addition, the Operator must identify and certify that all permanent structures described in the SWPPP have been constructed and provide the owner(s) with an operation and maintenance plan that ensures the structure(s) continuously functions as designed.

1 Refer to "Qualified Inspector" inspection requirements in the current SPDES General Permit for Stormwater Discharges from Construction Activity for complete list of inspection requirements.

2 "Commencement of construction" means the initial removal of vegetation and disturbance of soils associated with clearing, grading or excavating activities or other construction activities.

3 "Final stabilization" means that all soil-disturbing activities at the site have been completed and a uniform, perennial vegetative cover with a density of eighty (80) percent has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

## **b. Pre-construction Site Assessment Checklist**

**(NOTE: Provide comments below as necessary)**

### **1. Notice of Intent, SWPPP, and Contractors Certification:**

**Yes No NA**

- ☐ ☐ ☐ Has a Notice of Intent been filed with the NYS Department of Conservation?
- ☐ ☐ ☐ Is the SWPPP on-site? Where? \_\_\_\_\_
- ☐ ☐ ☐ Is the Plan current? What is the latest revision date? \_\_\_\_\_
- ☐ ☐ ☐ Is a copy of the NOI (with brief description) onsite? Where? \_\_\_\_\_
- ☐ ☐ ☐ Have all contractors involved with stormwater related activities signed a contractor's certification?

### **2. Resource Protection**

**Yes No NA**

- ☐ ☐ ☐ Are construction limits clearly flagged or fenced?
- ☐ ☐ ☐ Important trees and associated rooting zones, on-site septic system absorption fields, existing vegetated areas suitable for filter strips, especially in perimeter areas, have been flagged for protection.
- ☐ ☐ ☐ Creek crossings installed prior to land-disturbing activity, including clearing and blasting.

### **3. Surface Water Protection**

**Yes No NA**

- ☐ ☐ ☐ Clean stormwater runoff has been diverted from areas to be disturbed.
- ☐ ☐ ☐ Bodies of water located either on site or in the vicinity of the site have been identified and protected.
- ☐ ☐ ☐ Appropriate practices to protect on-site or downstream surface water are installed.
- ☐ ☐ ☐ Are clearing and grading operations divided into areas <5 acres?

### **4. Stabilized Construction Access**

**Yes No NA**

- ☐ ☐ ☐ A temporary construction entrance to capture mud and debris from construction vehicles before they enter the public highway has been installed.
- ☐ ☐ ☐ Other access areas (entrances, construction routes, equipment parking areas) are stabilized immediately as work takes place with gravel or other cover.
- ☐ ☐ ☐ Sediment tracked onto public streets is removed or cleaned on a regular basis.

### **5. Sediment Controls**

**Yes No NA**

- ☐ ☐ ☐ Silt fence material and installation comply with the standard drawing and specifications.
- ☐ ☐ ☐ Silt fences are installed at appropriate spacing intervals
- ☐ ☐ ☐ Sediment/detention basin was installed as first land disturbing activity.
- ☐ ☐ ☐ Sediment traps and barriers are installed.

### **6. Pollution Prevention for Waste and Hazardous Materials**

**Yes No NA**

- ☐ ☐ ☐ The Operator or designated representative has been assigned to implement the spill prevention avoidance and response plan.
- ☐ ☐ ☐ The plan is contained in the SWPPP on page \_\_\_\_\_
- ☐ ☐ ☐ Appropriate materials to control spills are onsite. Where? \_\_\_\_\_

## II. CONSTRUCTION DURATION INSPECTIONS

### a. Directions:

**Inspection Forms will be filled out during the entire construction phase of the project.**

Required Elements:

- 1) On a site map, indicate the extent of all disturbed site areas and drainage pathways. Indicate site areas that are expected to undergo initial disturbance or significant site work within the next 14-day period;
- 2) Indicate on a site map all areas of the site that have undergone temporary or permanent stabilization;
- 3) Indicate all disturbed site areas that have not undergone active site work during the previous 14-day period;
- 4) Inspect all sediment control practices and record the approximate degree of sediment accumulation as a percentage of sediment storage volume (for example, 10 percent, 20 percent, 50 percent);
- 5) Inspect all erosion and sediment control practices and record all maintenance requirements such as verifying the integrity of barrier or diversion systems (earthen berms or silt fencing) and containment systems (sediment basins and sediment traps). Identify any evidence of rill or gully erosion occurring on slopes and any loss of stabilizing vegetation or seeding/mulching. Document any excessive deposition of sediment or ponding water along barrier or diversion systems. Record the depth of sediment within containment structures, any erosion near outlet and overflow structures, and verify the ability of rock filters around perforated riser pipes to pass water; and
- 6) Immediately report to the Operator any deficiencies that are identified with the implementation of the SWPPP.

**SITE PLAN/SKETCH**

\_\_\_\_\_  
**Inspector (print name)**

\_\_\_\_\_  
**Date of Inspection**

\_\_\_\_\_  
**Qualified Inspector (print name)**

\_\_\_\_\_  
**Qualified Inspector Signature**

The above signed acknowledges that, to the best of his/her knowledge, all information provided on the forms is accurate and complete.

**Maintaining Water Quality****Yes No NA**

- ☐ ☐ ☐ Is there an increase in turbidity causing a substantial visible contrast to natural conditions at the outfalls?
- ☐ ☐ ☐ Is there residue from oil and floating substances, visible oil film, or globules or grease at the outfalls?
- ☐ ☐ ☐ All disturbance is within the limits of the approved plans.
- ☐ ☐ ☐ Have receiving lake/bay, stream, and/or wetland been impacted by silt from project?

**Housekeeping**

## 1. General Site Conditions

**Yes No NA**

- ☐ ☐ ☐ Is construction site litter, debris and spoils appropriately managed?
- ☐ ☐ ☐ Are facilities and equipment necessary for implementation of erosion and sediment control in working order and/or properly maintained?
- ☐ ☐ ☐ Is construction impacting the adjacent property?
- ☐ ☐ ☐ Is dust adequately controlled?

## 2. Temporary Stream Crossing

**Yes No NA**

- ☐ ☐ ☐ Maximum diameter pipes necessary to span creek without dredging are installed.
- ☐ ☐ ☐ Installed non-woven geotextile fabric beneath approaches.
- ☐ ☐ ☐ Is fill composed of aggregate (no earth or soil)?
- ☐ ☐ ☐ Rock on approaches is clean enough to remove mud from vehicles & prevent sediment from entering stream during high flow.

## 3. Stabilized Construction Access

**Yes No NA**

- ☐ ☐ ☐ Stone is clean enough to effectively remove mud from vehicles.
- ☐ ☐ ☐ Installed per standards and specifications?
- ☐ ☐ ☐ Does all traffic use the stabilized entrance to enter and leave site?
- ☐ ☐ ☐ Is adequate drainage provided to prevent ponding at entrance?

**Runoff Control Practices**

## 1. Excavation Dewatering

**Yes No NA**

- ☐ ☐ ☐ Upstream and downstream berms (sandbags, inflatable dams, etc.) are installed per plan.
- ☐ ☐ ☐ Clean water from upstream pool is being pumped to the downstream pool.
- ☐ ☐ ☐ Sediment laden water from work area is being discharged to a silt-trapping device.
- ☐ ☐ ☐ Constructed upstream berm with one-foot minimum freeboard.

**Runoff Control Practices (continued)**

## 2. Flow Spreader

**Yes No NA**

- ☐ ☐ ☐ Installed per plan.
- ☐ ☐ ☐ Constructed on undisturbed soil, not on fill, receiving only clear, non-sediment laden flow.
- ☐ ☐ ☐ Flow sheets out of level spreader without erosion on downstream edge.

## 3. Interceptor Dikes and Swales

**Yes No NA**

- ☐ ☐ ☐ Installed per plan with minimum side slopes 2H:1V or flatter.
- ☐ ☐ ☐ Stabilized by geotextile fabric, seed, or mulch with no erosion occurring.
- ☐ ☐ ☐ Sediment-laden runoff directed to sediment trapping structure

## 4. Stone Check Dam

**Yes No NA**

- ☐ ☐ ☐ Is channel stable? (flow is not eroding soil underneath or around the structure).
- ☐ ☐ ☐ Check is in good condition (rocks in place and no permanent pools behind the structure).
- ☐ ☐ ☐ Has accumulated sediment been removed?.

## 5. Rock Outlet Protection

**Yes No NA**

- ☐ ☐ ☐ Installed per plan.
- ☐ ☐ ☐ Installed concurrently with pipe installation.

**Soil Stabilization**

## 1. Topsoil and Spoil Stockpiles

**Yes No NA**

- ☐ ☐ ☐ Stockpiles are stabilized with vegetation and/or mulch.
- ☐ ☐ ☐ Sediment control is installed at the toe of the slope.

## 2. Revegetation

**Yes No NA**

- ☐ ☐ ☐ Temporary seedings and mulch have been applied to idle areas.
- ☐ ☐ ☐ 4 inches minimum of topsoil has been applied under permanent seedings

**Sediment Control Practices**

## 1. Silt Fence and Linear Barriers

**Yes No NA**

- ☐ ☐ ☐ Installed on Contour, 10 feet from toe of slope (not across conveyance channels).
- ☐ ☐ ☐ Joints constructed by wrapping the two ends together for continuous support.
- ☐ ☐ ☐ Fabric buried 6 inches minimum.
- ☐ ☐ ☐ Posts are stable, fabric is tight and without rips or frayed areas.

Sediment accumulation is \_\_\_\_% of design capacity.

**Sediment Control Practices (continued)**

2. Storm Drain Inlet Protection (Use for Stone & Block; Filter Fabric; Curb; or, Excavated; Filter Sock or Manufactured practices)

**Yes No NA**

- ☐ ☐ ☐ Installed concrete blocks lengthwise so open ends face outward, not upward.
- ☐ ☐ ☐ Placed wire screen between No. 3 crushed stone and concrete blocks.
- ☐ ☐ ☐ Drainage area is 1 acre or less.
- ☐ ☐ ☐ Excavated area is 900 cubic feet.
- ☐ ☐ ☐ Excavated side slopes should be 2:1.
- ☐ ☐ ☐ 2" x 4" frame is constructed and structurally sound.
- ☐ ☐ ☐ Posts 3-foot maximum spacing between posts.
- ☐ ☐ ☐ Fabric is embedded 1 to 1.5 feet below ground and secured to frame/posts with staples at max 8-inch spacing.
- ☐ ☐ ☐ Posts are stable, fabric is tight and without rips or frayed areas.
- ☐ ☐ ☐ Manufactured insert fabric is free of tears and punctures.
- ☐ ☐ ☐ Filter Sock is not torn or flattened and fill material is contained within the mesh sock.
- Sediment accumulation \_\_\_\_% of design capacity.

3. Temporary Sediment Trap

**Yes No NA**

- ☐ ☐ ☐ Outlet structure is constructed per the approved plan or drawing.
- ☐ ☐ ☐ Geotextile fabric has been placed beneath rock fill.
- ☐ ☐ ☐ Sediment trap slopes and disturbed areas are stabilized.
- Sediment accumulation is \_\_\_\_% of design capacity.

4. Temporary Sediment Basin

**Yes No NA**

- ☐ ☐ ☐ Basin and outlet structure constructed per the approved plan.
- ☐ ☐ ☐ Basin side slopes are stabilized with seed/mulch.
- ☐ ☐ ☐ Drainage structure flushed and basin surface restored upon removal of sediment basin facility.
- ☐ ☐ ☐ Sediment basin dewatering pool is dewatering at appropriate rate.
- Sediment accumulation is \_\_\_\_% of design capacity.

**Note:** Not all erosion and sediment control practices are included in this listing. Add additional pages to this list as required by site specific design. All practices shall be maintained in accordance with their respective standards.

Construction inspection checklists for post-development stormwater management practices can be found in Appendix F of the New York Stormwater Management Design Manual.

## CONSTRUCTION DURATION INSPECTIONS

**b. Modifications to the SWPPP (To be completed as described below)**

The Operator shall amend the SWPPP whenever:

1. There is a significant change in design, construction, operation, or maintenance which may have a significant effect on the potential for the discharge of pollutants to the waters of the United States and which has not otherwise been addressed in the SWPPP; or
2. The SWPPP proves to be ineffective in:
  - a. Eliminating or significantly minimizing pollutants from sources identified in the SWPPP and as required by this permit; or
  - b. Achieving the general objectives of controlling pollutants in stormwater discharges from permitted construction activity; and
3. Additionally, the SWPPP shall be amended to identify any new contractor or subcontractor that will implement any measure of the SWPPP.

**Modification & Reason:**This image shows a full page of blank white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings present.



**APPENDIX F**

**PERMANENT STORMWATER MAINTENANCE  
INSPECTION LOGS**



## ChamberMaxx<sup>®</sup> Inspection and Maintenance Guide



CHAMBERMaxx<sup>®</sup>

## Safety

Before entering into any storm sewer or underground retention/detention system check to make sure all OSHA and local safety regulations and guidelines are observed during the maintenance process. Hard hats, safety glasses, steel-toed boots and any other appropriate personal protective equipment shall be worn at all times.

## Inspection Frequency

Inspections are recommended at a minimum annually. The first year of operation may require more frequent inspections. Frequency of inspections will vary significantly on the local site conditions. An individual inspection schedule should be established for each site.

## Inspections

Inspection is the key to effective maintenance and is easily performed. Inspections may need to be performed more often in the winter months in climates where sanding operations may lead to rapid sediment accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

The entire treatment train should be inspected and maintained. The treatment train may consist of an upstream sump manhole, manifold system or pre-treatment HDS device. Inspections should start at the upstream device and continue downstream to the discharge orifice if incorporated into the chamber system.

### Pre-Treatment Device Inspection

Inspection and maintenance procedures provided by the manufacturer should be followed for pre-treatment systems such as a CDS®, Vortechs®, VortSentry® or VortSentry® HS. Expected pollutants will be floatable trash, sediment and oil and grease. Pre-treatment devices are recommended for all detention/retention devices regardless of type.

### Containment Row™ Inspection

The optional Containment Row consists of a diversion concrete manhole with a weir and a drain down orifice, and a row of chambers placed on woven geotextile. The diversion weir directs the first flush flows into the Containment Row of chambers. The majority of sediment will be captured in the Containment Row due to the extended detention time which allows the particles to settle out. Higher flows overtop (bypass) the weir into the manifold system.

The Containment Row will typically be located in the first row of chambers connected to the diversion manhole. Inspection can be done through accessing the diversion manhole and visually inspecting the Containment Row through the inlet pipe. Inspection ports throughout the system can be used for visual observation and measurement of sediment accumulation using a stadia rod. When the depth of sediment accumulates over 4-inch (102 mm), cleanout is recommended.

### Manifold System Inspection

The main manifold pipe can be inspected from the diversion manhole upstream. When a quarter of the pipe volume has been filled with sediment the header system should be maintained.

### Visual Inspection

Maintenance or further investigation may be required if any of the following conditions exist:

- Evidence of an unusual amount of silt and soil build-up on the surface.
- Clogged outlet drainpipe.
- System does not drain to the elevation of the lowest pipe in dry conditions.
- Evidence of potholes or sinkholes

## Maintenance

Underground stormwater retention/detention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities rather than the size or configuration of the system. If accumulated silt is interfering with the operation of the detention system (i.e.: blocking outlet pipes or deposits significantly reduce the storage capacity of the system) it should be removed.

It is easiest to maintain a system when there is no flow entering. For this reason, cleanout should be scheduled during dry weather.

A vacuum truck or other similar devices can be used to remove sediment from the treatment train. Starting upstream, maintain manholes with sumps and any pre-treatment devices (following manufacturer recommended procedures). Once maintenance is complete, replace all caps, lids and covers. It is important to document maintenance events on the Inspection and Maintenance Log.

### Header System Maintenance:

If maintenance is required, use a high pressure nozzle with rear facing jets to wash the sediments and debris into the diversion manhole. Use the vacuum hose stinger nozzle to remove the washed sediments from the sump of the diversion manhole. It is important to not flush sediments into the chamber system during the maintenance process.

**Containment Row™ Maintenance**

If maintenance is required, a JetVac truck utilizing a high pressure nozzle (sledge dredging tool) with rear facing jets will be required. Insert the nozzle from the diversion manhole into the Containment Row through the inlet pipe. Turn the water feed hose on and feed the supply hose until the nozzle has reached the end of the Containment Row. Withdraw the nozzle slowly.



Figure 1— Containment Row shown with high pressure cleaning nozzle

The tool will backflush the Containment Row forcing debris into the diversion manhole sump. Use the stringer vacuum hose to remove the sediments and debris from the sump of the diversion manhole. Multiple passes may be required to fully cleanout the Containment Row. Vacuum out the diversion manhole and remove all debris. See Figure 1.

**Inspection & Maintenance Log Sample Template**

ChamberMaxx			Location:	
Date	Depth of Sediment	Accumulated Trash	Name of Inspector	Maintenance Performed/Notes

---

CHAMBERMaxx®

SUPPORT

- Drawings and specifications are available at [www.ContechES.com](http://www.ContechES.com).
- Site-specific support is available from our engineers.



800.338.1122

[www.ContechES.com](http://www.ContechES.com)

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

## MAINTENANCE LOG FOR STORMWATER CONVEYANCE SYSTEMS

### INSTRUCTIONS:

THIS LOG SHALL BE UPDATED TO INCLUDE ALL MAINTENANCE  
PERFORMED AT A SPECIFIC STORMWATER MEASURE.

DATE	PERSON CONDUCTING MAINTENANCE	AREA OF MAINTENANCE	PROBLEM(S) FOUND	ACTION(S) TAKEN

## MAINTENANCE LOG FOR STORMWATER DETENTION FACILITY

### INSTRUCTIONS:

THIS LOG SHALL BE UPDATED TO INCLUDE ALL MAINTENANCE  
PERFORMED AT A SPECIFIC STORMWATER MEASURE.

DATE	PERSON CONDUCTING MAINTENANCE	AREA OF MAINTENANCE	PROBLEM(S) FOUND	ACTION(S) TAKEN

## **APPENDIX G**

### **NYS OPRHP CULTURAL RESOURCE INFORMATION SYSTEM RESPONSE LETTER**





## Parks, Recreation, and Historic Preservation

ANDREW M. CUOMO  
Governor

ERIK KULLESEID  
Commissioner

May 01, 2019

Mr. Brian Conway  
Project Engineer  
Langan  
360 West 31st Street  
8th Floor  
New York, NY 10001

Re: DEC  
NYPD 116th Precinct  
244-04 North Conduit Avenue, Queens, NY 11422  
19PR02600

Dear Mr. Conway:

Thank you for requesting the comments of the Office of Parks, Recreation and Historic Preservation (OPRHP). We have reviewed the project in accordance with the New York State Historic Preservation Act of 1980 (Section 14.09 of the New York Parks, Recreation and Historic Preservation Law). These comments are those of the OPRHP and relate only to Historic/Cultural resources. They do not include potential environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the State Environmental Quality Review Act (New York Environmental Conservation Law Article 8) and its implementing regulations (6 NYCRR Part 617).

Based upon this review, it is the New York State Office of Parks, Recreation and Historic Preservation's opinion that your project will have no impact on archaeological and/or historic resources listed in or eligible for the New York State and National Registers of Historic Places.

If further correspondence is required regarding this project, please be sure to refer to the OPRHP Project Review (PR) number noted above.

Sincerely,

Michael F. Lynch, P.E., AIA  
Director, Division for Historic Preservation

**APPENDIX H**

**CONTRACTOR'S CERTIFICATION STATEMENT**

**CONTRACTOR CERTIFICATION STATEMENT**  
**NYPD 116 Precinct Station House**  
**244-04 North Conduit Avenue**  
**Queens, NY 11422**

The following certification shall be signed by both contractor(s) and subcontractor(s) having responsibility for installing, constructing, repairing, replacing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) having responsibility for the construction of all post-construction stormwater management practices included in the SWPPP.

*“I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the qualified inspector during a site inspection. I also understand that the Owner or Operator must comply with the terms and conditions of the most current version of the New York State Pollutant Discharge Elimination System (“SPDES”) general permit for stormwater discharges from construction activities and that it is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for knowing violations.”*

Certification Signature:

---

Name

---

Title

---

Company

---

Address

---

Phone Number

---

Date

**APPENDIX I**

**OWNER'S CERTIFICATION STATEMENT**



Department of  
Environmental  
Conservation

## Owner/Operator Certification Form

### SPDES General Permit For Stormwater Discharges From Construction Activity (GP-0-15-002)

Project/Site Name: NYPD 116th Precinct

eNOI Submission Number: 3AA-VT4K-JCG4

eNOI Submitted by: ☐ Owner/Operator ☒ SWPPP Preparer ☐ Other

#### Certification Statement - Owner/Operator

I have read or been advised of the permit conditions and believe that I understand them. I also understand that, under the terms of the permit, there may be reporting requirements. I hereby certify that this document and the corresponding documents were prepared under my direction or supervision. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further understand that coverage under the general permit will be identified in the acknowledgment that I will receive as a result of submitting this NOI and can be as long as sixty (60) business days as provided for in the general permit. I also understand that, by submitting this NOI, I am acknowledging that the SWPPP has been developed and will be implemented as the first element of construction, and agreeing to comply with all the terms and conditions of the general permit for which this NOI is being submitted.

Owner/Operator First Name M.I. Last Name  
NYC Department of Design and Construction  
Lucy Wong

Signature

*for NYC DDC*

Date

05/10/19

**Owner/Operator Certification**


I have read or been advised of the permit conditions and believe that I understand them. I also understand that, under the terms of the permit, there may be reporting requirements. I hereby certify that this document and the corresponding documents were prepared under my direction or supervision. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further understand that coverage under the general permit will be identified in the acknowledgment that I will receive as a result of submitting this NOI and can be as long as sixty (60) business days as provided for in the general permit. I also understand that, by submitting this NOI, I am acknowledging that the SWPPP has been developed and will be implemented as the first element of construction, and agreeing to comply with all the terms and conditions of the general permit for which this NOI is being submitted.

**Print First Name**

LUCY

**MI****Print Last Name**

WONG

**Owner/Operator Signature** for NYC DDC**Date**

05 / 10 / 2019



Department of  
Environmental  
Conservation

# SWPPP Preparer Certification Form

*SPDES General Permit for Stormwater Discharges  
From Construction Activity (GP-0-15-002)*

## Project Site Information

### Project/Site Name

NYPD 116th Precinct Station House

## Owner/Operator Information

### Owner/Operator (Company Name/Private Owner/Municipality Name)

NYC Department of Design and Construction

## Certification Statement – SWPPP Preparer

I hereby certify that the Stormwater Pollution Prevention Plan (SWPPP) for this project has been prepared in accordance with the terms and conditions of the GP-0-15-002. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of this permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Christopher

First name

MI

Vitolano

Last Name

Signature

A handwritten signature in black ink, appearing to read "Christopher Vitolano".

5.13.19

Date

**APPENDIX J**

**NOTICE OF TERMINATION (BLANK)**



**New York State Department of Environmental Conservation  
Division of Water  
625 Broadway, 4th Floor  
Albany, New York 12233-3505**

\*(NOTE: Submit completed form to address above)\*

**NOTICE OF TERMINATION** for Storm Water Discharges Authorized  
under the SPDES General Permit for Construction Activity

**Please indicate your permit identification number:** NYR \_\_\_\_ \_

**I. Owner or Operator Information**

1. Owner/Operator Name:

2. Street Address:

3. City/State/Zip:

4. Contact Person:

4a. Telephone:

4b. Contact Person E-Mail:

**II. Project Site Information**

5. Project/Site Name:

6. Street Address:

7. City/Zip:

8. County:

**III. Reason for Termination**

9a. ☐ All disturbed areas have achieved final stabilization in accordance with the general permit and SWPPP. \***Date final stabilization completed** (month/year): \_\_\_\_\_

9b. ☐ Permit coverage has been transferred to new owner/operator. Indicate new owner/operator's permit identification number: NYR \_\_\_\_ \_  
(Note: Permit coverage can not be terminated by owner identified in I.1. above until new owner/operator obtains coverage under the general permit)

9c. ☐ Other (Explain on Page 2)

**IV. Final Site Information:**

10a. Did this construction activity require the development of a SWPPP that includes post-construction stormwater management practices? ☐ yes ☐ no (If no, go to question 10f.)

10b. Have all post-construction stormwater management practices included in the final SWPPP been constructed? ☐ yes ☐ no (If no, explain on Page 2)

10c. Identify the entity responsible for long-term operation and maintenance of practice(s)?

\_\_\_\_\_

**NOTICE OF TERMINATION for Storm Water Discharges Authorized under the  
SPDES General Permit for Construction Activity - continued**

10d. Has the entity responsible for long-term operation and maintenance been given a copy of the operation and maintenance plan required by the general permit?    ☐ yes    ☐ no

10e. Indicate the method used to ensure long-term operation and maintenance of the post-construction stormwater management practice(s):

- ☐ Post-construction stormwater management practice(s) and any right-of-way(s) needed to maintain practice(s) have been deeded to the municipality.
- ☐ Executed maintenance agreement is in place with the municipality that will maintain the post-construction stormwater management practice(s).
- ☐ For post-construction stormwater management practices that are privately owned, a mechanism is in place that requires operation and maintenance of the practice(s) in accordance with the operation and maintenance plan, such as a deed covenant in the owner or operator's deed of record.
- ☐ For post-construction stormwater management practices that are owned by a public or private institution (e.g. school, university or hospital), government agency or authority, or public utility; policy and procedures are in place that ensures operation and maintenance of the practice(s) in accordance with the operation and maintenance plan.

10f. Provide the total area of impervious surface (i.e. roof, pavement, concrete, gravel, etc.) constructed within the disturbance area? \_\_\_\_\_  
(acres)

11. Is this project subject to the requirements of a regulated, traditional land use control MS4?    ☐ yes  
☐ no  
(If Yes, complete section VI - "MS4 Acceptance" statement)

**V. Additional Information/Explanation:**  
(Use this section to answer questions 9c. and 10b., if applicable)

**VI. MS4 Acceptance - MS4 Official (principal executive officer or ranking elected official) or Duly Authorized Representative** (Note: Not required when 9b. is checked -transfer of coverage)

I have determined that it is acceptable for the owner or operator of the construction project identified in question 5 to submit the Notice of Termination at this time.

Printed Name:

Title/Position:

Signature:

Date:

**NOTICE OF TERMINATION** for Storm Water Discharges Authorized under the  
SPDES General Permit for Construction Activity - continued

**VII. Qualified Inspector Certification - Final Stabilization:**

I hereby certify that all disturbed areas have achieved final stabilization as defined in the current version of the general permit, and that all temporary, structural erosion and sediment control measures have been removed. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:

Title/Position:

Signature:

Date:

**VIII. Qualified Inspector Certification - Post-construction Stormwater Management Practice(s):**

I hereby certify that all post-construction stormwater management practices have been constructed in conformance with the SWPPP. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:

Title/Position:

Signature:

Date:

**IX. Owner or Operator Certification**

I hereby certify that this document was prepared by me or under my direction or supervision. My determination, based upon my inquiry of the person(s) who managed the construction activity, or those persons directly responsible for gathering the information, is that the information provided in this document is true, accurate and complete. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:

Title/Position:

Signature:

Date:

(NYS DEC Notice of Termination - January 2015)

FMS ID: PO002-116



Department of  
Design and  
Construction

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**THE CITY OF NEW YORK  
DEPARTMENT OF DESIGN AND CONSTRUCTION  
DIVISION OF PUBLIC BUILDINGS**

30-30 THOMSON AVENUE      LONG ISLAND CITY, NEW YORK 11101-3045  
TELEPHONE (718) 391-1000      WEBSITE [www.nyc.gov/buildnyc](http://www.nyc.gov/buildnyc)

---

**Contract for Furnishing all Labor and Material Necessary and Required for:**

**CONTRACT NO. 1      GENERAL CONSTRUCTION WORK**

## **New 116th Precinct Station House Rebid**

**LOCATION:**                      244-04 North Conduit Avenue  
**BOROUGH:**                  Queens, NY 11422  
**CITY OF NEW YORK**

---

\_\_\_\_\_  
Contractor

Dated \_\_\_\_\_, 20\_\_\_\_

---

Entered in the Comptroller's Office

\_\_\_\_\_  
First Assistant Bookkeeper

Dated \_\_\_\_\_, 20\_\_\_\_

